the usual reactions for an alkaloid. The alcoholic extract was very sweet and contained a large quantity of a body readily reducing Fehling's solution; the extract also contained an organic acid and ammonia, an alkaloid, and a soluble chloride in the portion soluble in water. The resinous part of this extract insoluble in water formed a gelatinous magma with that menstruum, and instantly dissolved, without deepening of colour, with the aid of an alkali. The aqueous extract was sweet and had the peculiar odour of liquorice. It contained sugar and an organic acid similar to that found in the spirit extract; it gave a precipitate without colour with ferric chloride, mixed clear with gelatine, and precipitated with the mineral acids as a jelly-like substance. The ash amounted to 15·2 per cent., and consisted mainly of alkaline salts. The alkaloid contained in these leaves is not bitter.

CORNACEÆ

ALANGIUM LAMARCKII, *Thwaites.*

Fig.—*Wight Ic., t.* 194; *Ill., t.* 96; *Rheede Hort. Mal. iv., tt.* 17, 26.

Hab.—Throughout India. The roots, bark, seeds, and leaves.

Vernacular.—Dhera, Akola, Ankul (*Hind.*), Ankul (*Guz.*), Ankoli (*Mar.*), Ankalige (*Can.*), Bagh-ankura, Dhalákura (*Beng.*), Azhinji-maram, Alangi (*Tam.*), Uduga-chettu, Ankolam-chettu (*Tel.*).

History, Uses, &c.—This tree, in Sanskrit Ankota, Nikochaka, and Gupta-sneha, "the oil of which is hidden," is described in the Nighantas as bitter, mucilaginous, pungent, light and aperient; it expels worms, wind, phlegm and poison. The fruit is cold and sweet, and begets phlegm, it is strengthening and aperient, and cures wind, bile, inflammations, phthisis and skin diseases. Rheede says:—"Cæterum arbor hæc varias ob causas emblema Regiæ majestatis Malabarensibus

habetur, quarum præcipua est, quod flores diadematí Imperiali haud absimiles, rigidis inhereant spinis. Insuper succus ex arboris radice expressus, et exhibitus vermes necat, nec non biliosos ac pituitosos humores per alvum expurgat, et aquas hydropicorum ducit."

Mr. Moodín Sheriff has drawn attention to the emetic properties of the bark in the *Pharmacopœia of India*. He says:—"It has proved itself an efficient and safe emetic in doses of fifty grains; in smaller doses it is nauseant and febrifuge. The bark is very bitter, and its repute in skin diseases is not without foundation. If it is continued for a sufficient period its influence over them is greater than that of *Calotropis gigantea*." Mr. Moodín Sheriff, in a further report upon this drug (1883), states:—"It is a good substitute for Ipecacuanha, and proves useful in all diseases in which the latter is indicated, except dysentery. As a diaphoretic and antipyretic it has been found useful in relieving pyrexia. Dose as a nauseant, diuretic and febrifuge, 6 to 10 grains of the root bark; as an alterative, 2 to 5 grains; it is given in leprosy and syphilis; the natives consider it to be alexiteric, especially in cases of bites from rabid animals."

Dr. S. Arjun (*Bomb. Drugs*, p. 70,) states that the leaves are used as a poultice to relieve rheumatic pains.

The reports of several medical officers are quoted by Dr. Watt in his Dictionary of the Economic Products of India, but none of them, except Mr. Moodín Sheriff, appear to speak from personal experience.

Description.—Root heavy, wood close-grained, yellow, having an oily appearance; it and the bark turn of a dirty-green colour on being touched with a solution of perchloride of iron. The bark is of a cinnamon-brown colour, the external surface separating in thin corky flakes, which are studded with small circular warts. The inner layers are compact and of the same colour. Taste bitter, odour rather nauseous. The fruit is astringent and acid, $\frac{5}{8}$ by $\frac{5}{8}$ of an inch,

black, closely pubescent or finally glabrous; endocarp bony. The leaves are 3—6 by 1—2 inches, oblong or elliptic, acute or subobtuse, base unequal, above nearly glabrous with pubescent nerves, beneath hairy and often with tufts of hair or hollow glands in the axils of the primary nerves.

Chemical composition.—The most interesting principle present in the roots, is a very bitter non-crystallizable alkaloid which we have provisionally called *Alangine*. It is soluble in alcohol, ether, chloroform, and acetic ether, and practically insoluble in water. With the mineral acids, and with acetic, tartaric, and oxalic acids we failed in obtaining crystallizable salts. From an alcoholic solution, on spontaneous evaporation, it occurs as a yellowish, varnish-like deposit wholly destitute of any crystalline structure. From an acid solution it is precipitated in white flocks by the addition of alkalies, and with the ordinary alkaloidal re-agents it affords marked precipitates. With concentrated sulphuric acid, alone or with the addition of potassium bichromate, no special colour reactions were observed. Fröhde's re-agent gave an indigo-blue coloration in the cold, and on gently heating and then cooling a very light brilliant blue resulted. With nitric acid a reddish brown solution was yielded, and on gently warming it nitrous fumes were evolved and the liquid became lighter in colour. A platinum salt was prepared which contained 20·703 per cent. of platinum on the salt dried at 100° C.

CAPRIFOLIACEÆ.

VIBURNUM FŒTIDUM, *Wall.*

Fig.—*Wall. Pl. As. Rar., Vol. i., t.* 61.

Hab.—Burma. Cultivated in India. The leaves.

Vernacular.—Narvel (*Mar.*), Naruval (*Can.*).

History, Uses, &c.—Though a native of Burma this shrub is found in cultivation throughout Western India.

It appears to be confounded with, and to be used for the same purposes as *Premna coriacea*, Clarke, and other strong-smelling Premnas which bear the Sanskrit names of Sriparna and Jaya. How and when *V. fœtidum* was introduced into India is unknown; it seldom flowers and fruits here. It is customary for Hindu women who have been confined to hang a branch over the door of the room in which they lie, as a protection against evil spirits and post-partum hæmorrhage. Another superstition is, that if seven pieces of the stem of this plant are knotted into a thread made from cotton picked by a virgin, the necklace thus formed will cure scrofulous glands. A cake made from the flour of eighteen different kinds of grain with Narvel juice, is scraped while hot on one side, well moistened with the juice and applied to the head in headache. A wineglassful of the juice of the leaves is administered internally in menorrhagia daily, also in post-partum hæmorrhage. It is remarkable that *V. prunifolium*, an American plant, is also said to be useful in all uterine diseases characterised by loss of blood and in threatened abortion. (Cf. *Les Nouveaux Remèdes. Sept.* 8, 1888; *Etude sur l'emploi thérapeutique du Viburnum prunifolium, par le Dr. Debierre.*)

Two of the Viburnums are common garden shrubs in Europe, *V. Opulus* and *V. tinus*, the former is probably the θραυπαλος of Theophrastus; the fruit is edible. The cultivated variety of this plant is the Gueldres Rose, in which the flowers form a white ball. The latter is the well known Laurestine. *V. Opulus* is said to have the same medicinal properties as *V. prunifolium*. (*Purdy, On the use of V. Opulus in dysmenorrhœa and uterine pain. New York Med. Journ., Nov.* 1882.)

Description.—A shrub, leaves variable, usually ovate-lanceolate, serrated, length 1½ to 2 inches, flowers small, greenish white, berries small, ovoid, and of a vivid red colour. All parts of the plant have a powerful unpleasant odour like that of *Premna integrifolia*.

Chemical composition.—The *viburnic acid* of Krämer (1844) obtained from the bark of *V. Opulus* was proved by Monro

(1845) to be identical with valerianic acid. The *viburnin* of Krämer is a light yellowish substance or whitish powder of a neutral reaction, and of a purely bitter taste; it is slightly soluble in water and more freely so in alcohol. Enz (1863) found in the fruit of *V. Lantana*, a hygroscopic neutral bitter principle readily soluble in water, also valerianic, acetic, tartaric and tannic acids.

The odorous principle of the leaves of *V. fœtidum* is removed by distillation in the form of fetid volatile oil, separating from the distillate in white greasy flakes neutral in reaction. The decoction remaining in the retort had a nauseous animal-like odour, and when filtered, showed the presence of much mucilage by giving gelatinous precipitates with ferric chloride, lead acetate and alcohol. Ether removed the fetid principle together with chlorophyll, some resinous matter, and a trace of alkaloid from the dried and powdered leaves. The alcoholic extract was sweet, with a peculiar sharpness on the palate, and was acid in reaction. The aqueous solution of this extract gave abundant precipitates with potassio-mercuric iodide, iodine solution, tannin and ferrocyanide of potassium, indicating the presence of an alkaloid, which was subsequently confirmed by separating it from this solution by the cautious addition of ammonia or caustic soda. Ammonia added to its solution caused a precipitate of cross-shaped crystals; soda threw down the alkaloid as a whitish powder, which agglutinated into a brown mass soluble in excess of the alkali The alkaloid had a peculiar sharp taste, was soluble in ethylic and amylic alcohol and chloroform, and slightly in water and ether. It formed a crystalline sulphate, hydrochlorate and nitrate. It gave no peculiar colour reactions with the strong mineral acids, but dissolved in nitric acid, and the solution when evaporated left a mass of crystals which had a fragrant odour when mixed with water. The alkaloid fused into a reddish mass when heated, and gave off alkaline fumes. The leaves left 12·25 per cent. of white ash when completely ignited.

RUBIACEÆ.

ANTHOCEPHALUS CADAMBA, *Miq.*

Fig.—*Bedd. Fl. Sylv.* 127, *t.* 35; *Korth. Verh. Nat. Gesch. Bot.* 154, *t.* 48. Wild Cinchona (*Eng.*).

Hab.—Himalaya to Ceylon, wild or cultivated. The fruit and bark.

Vernacular.—Kadamb (*Hind., Beng.*), Kalamb, Nhyu (*Mar.*), Vella-kadamba (*Tam.*), Kadambe (*Tel.*), Kadavála-mara (*Can.*).

History, Uses, &c.—This tree is sacred to Kâli or Parvati, the consort of Siva; it is the *Arbor Generationis* of the Maratha Kunbis, and a branch of it is brought into the house at the time of their marriage ceremonies. The tree is planted near villages and temples, and is held to be sacred. In Sanskrit it is called Kadamba or Kalamba, and has also many synonyms, such as *Sisu-pála*, 'protecting children'; *Hali-priya*, 'dear to agriculturists,' &c. The Kadamba blossoms at the end of the hot season, and its night-scented flowers form a large, globular, lemon-coloured head, from which the white clubbed stigmas project. They are compared by the Indian poets to the cheek of a maiden mantling with pleasure at the approach of her lover, and are supposed to have the power of irresistably attracting lovers to one another. This idea is expressed in the following couplet of the Saptasatika of Hála:—"Sweet-heart, how I am bewitched by the Kadamba blossoms, all the other flowers together have not such a power. Verily Kama wields now-a-days a bow armed with the honey balls of the Kadamba." The flowers are fabled to impregnate with honey the water which collects in holes in the trunk of the tree. Beal, in his *Catena of Buddhist scriptures from the Chinese*, informs us that according to the Dirghagama Sutra, to the east of mount *Sume* rises a great king of trees called Kadamba; in girth seven yoganas, height a hundred yoganas, and in spread fifty yoganas. M. Sénart (*Essai sur la légende*

du Buddha) says :—"L'arbre de Bouddha sort spontanément d'un noyau de Kadamba déposé dans le sol ; en un moment, la terre se fend, une pousse paraît, et le géant se dresse ombrageant une circonférance de trois cents coudées. Les fruits qu'il porte troublent l'esprit des adversaires du Buddha contre lesquels les Dévas déchaînent toutes les fureurs de la tempête." (*De Gubernatis.*) The fruit, which is about the size of a small orange, is eaten by the natives and is considered to be cooling and a destroyer of phlegm and impurities of the blood. The bark is considered to be tonic and febrifuge, and its fresh juice is applied to the heads of infants when the fontanelle sinks; at the same time a small quantity mixed with cumin and sugar is given internally. In inflammation of the eyes the bark-juice with equal quantities of lime-juice, opium and alum is applied round the orbit.

Description.—The bark taken from the larger branches occurs in thick flat pieces, the external surface is grey and studded irregularly with small, prominent corky lenticels; it shows numerous and extensive light brown scars caused by the separation of portions of bark due to the development of corky layers in its substance. The inner surface and substance of the bark is red and fibrous. Taste bitter and astringent.

Chemical composition.—The bark gave 9·8 per cent. of ash and 18 per cent. of alcoholic extract. The former contained calcium carbonate from the reduction of the oxalate present in the bark, and the latter contained an astringent principle. The extract soluble in water was red in colour, and gave a green precipitate with ferric chloride, a bulky flesh-coloured precipitate with gelatine, and a brick-red deposit with iodine solution. Treated with caustic alkali, a yellowish brown liquor was obtained, which gradually assumed a deep red and gave off the odour of cinchona bark solutions when treated under the same conditions. Boiled with dilute sulphuric acid for one hour a red deposit occurred in the decoction. The extract insoluble in water was for the most part soluble in diluted alkali with a rich red colour and a slight blue fluorescence. The solution

precipitated with an acid, and the red magma separated and treated with lime water, afforded to the solvent no principle insoluble when acidified. The astringency of the bark is due to an acid similer to cinchotannic acid, and the drug contains a ready formed oxidation product of the nature of cinchona red. No alkaloidal principle is present.

ADINA CORDIFOLIA, *Hook. f.*

Fig.—*Brand. For. Fl., t.* 33; *Roxb. Cor. Pl. I., t.* 53.

Hab.—Throughout the hilly parts of India. The bark.

Vernacular—Haldu, Hardu, Karam (*Hind.*), Bangka, Kelikadam (*Beng.*), Manja-kadambe (*Tam.*), Paspu-kadambe, Dudagu (*Tel.*), Hedde, Yettega (*Can.*), Hedu (*Mar.*).

History, Uses, &c.—This tree is regarded by the Hindus as a species of Kadamba, and is the Dhárá-kadamba or Kalambaka of Sanskrit writers. It is well known in all parts of India for its bitter medicinal bark, and valuable yellow wood, which is used for many industrial purposes. The bark is a popular febrifuge amongst the agricultural classes, and ground into a paste with water it is much used as a local application to the sores and galls to which draught cattle are subject. It is considered to be antiseptic and to prevent the generation of worms in sores.

Description.—The bark occurs in thick curved pieces, externally light grey or dirty white, darkly shaded from the growth of a small Hepatica on its surface. Its inner surface and substance is reddish-brown and fibrous. Taste bitter and astringent.

Chemical composition.—The bark contains the same constituents as that of *Anthocephalus Cadamba*. The red-coloured tincture gave 32 per cent. of dried extract, calculated on the powdered bark. This extract contained an astringent acid like cinchotannic acid, a red oxidized product, a fluorescent bitter principle, but no alkaloid. Starch and calcium oxalate were present in the inner layers of the bark, and calcium

carbonate constituted the greater portion of the 10·4 per cent. of ash obtained on combustion.

UNCARIA GAMBIER, *Roxb.*

Fig.—*Hunter in Trans. Linn. Soc. ix.*, 218, *t.* 22; *Korth. Verh. Nat. Gesch. Bot.*, *t.* 34; *Bentl. and Trim.*, 139. The extract, Gambier, Pale catechu (*Eng.*), Gambir cubique (*Fr.*).

Hab.—Malacca, Penang, Singapore. The extract of the leaves, and young shoots.

Vernacular.—Chini-Katha or Kath, &c. (*Ind.*) In the Indian languages it bears the same name as Acacia Catechu, with the addition of the adjective Chinese.

History, Uses, &c.—We meet with no account of this substance in Hindu or Mahometan works on Materia Medica. Anslie mentions the drug, but he appears to have been very imperfectly acquainted with it, as in his first volume he describes the different kinds of catechu found in Southern India without noticing Gambier. (*Materia Indica, II., p.* 105.) Flückiger and Hanbury in their *Pharmacographia* remark that:—"If we may credit Rumphius, it would seem that the important manufacture of Gambier had no existence at the commencement of the last century. As to 'Gutta Gambier,' his statements are scarcely in accord with those of more recent writers. We may, however, remark that that name is very like the Tamil Katta Kambu, signifying catechu, which drug is sometimes made into little round cakes, and was certainly a large export from India to Malacca and China as early as the 16th century. That Gambier was unknown to Europeans long after the time of Rumphius, is evident from other facts. Stevens, a merchant of Bombay, in his *Compleat Guide to the Eastern India Trade*, published in 1766, quotes the prices of goods at Malacca, but makes no allusion to Gambier. Nor is there any reference to it in Savary's *Dictionnaire de Commerce* (Edn. of 1750), in which Malacca is mentioned as the great *entrepôt* of the trade of India with that of China and

Japan. The first account of Gambier known to us, was communicated to the Batavian Society of Arts and Sciences in 1780, by a Dutch trader named Couperus. This person narrates how the plant was introduced into Malacca from Pontjan in 1758, and how Gambier is made from its leaves; and names several sorts of the drug and their prices. In 1807 a description of 'the drug called Gutta Gambier,' and of the tree from which it is made, was presented to the Linnean Society of London by William Hunter.' A good description of the manufacture of Gambier will be found in the *Pharmacographia*. The process consists in boiling the leaves and young shoots and evaporating the liquor until it crystallizes.

Description.—Gambier is an earthy-looking substance of light brown hue, consisting of cubes about an inch each side, more or less agglutinated, or it is in the form of entirely compact masses. The cubes are externally dark reddish brown and compact, internally of a pale cinnamon hue, dry, porous, friable, devoid of odour, but with a bitterish astringent taste, becoming subsequently sweetish.

Under the microscope the cubes of Gambier are seen to consist of very small acicular crystals. (*Pharmacographia.*) Gambier is also imported into India in the form of small lozenges.

Chemical composition.—In chemical composition Gambier agrees with Kutch. (*See Acacia Catechu.*) Gambier from Singapore has lately been exported in a damp condition causing great inconvenience in the trade. Mr. W. N. Evans has analysed some authentic field and trade samples with the following results:—

	Gambier from field.	Trade Gambier.
Tannin	11·48	14·68
Organic matter	30·11	42·26
Water	53·39	31·39
Ash	4·46	6·34
Loss	0·56	4·88
	100·00	100·00

A substance named *Than*, used to adulterate kutch in Burma, was investigated by Dr. Romanis in 1888. Than is a red-coloured gum or mixture of gums, insoluble in spirit, and having no action on polarized light. Under some circumstances it ferments and evolves gases. It contains no leather forming property, but is thrown down by gelatine and alum; if, however, this precipitate is boiled in water, the than is dissolved. (*Chem. Examiner's Report*, 1888.)

Commerce.—Gambier is imported into India from Singapore in large baskets. The exports of Kutch and Gambier from India are more than 300,000 cwts. annually.

Value, Rs. 4 to Rs. 6 per Surat maund of 37½ lbs.

CINCHONA SUCCIRUBRA, *Pavon.*

Fig.—*Howard's Illustrations, Neuva Quinologia. p.* 7. Red bark.

Hab.—Slopes of Chimborazo, S. America. Cultivated in Southern India, Sikkim and Ceylon.

CINCHONA OFFICINALIS, *Hooker.*

Fig.—*Bot. Mag.* 5364. The Loxa, Crown, Condaminea or pale bark of commerce.

Hab.—Ecuador and Peru. Cultivated on the Nilgiri Hills.

C. CALISAYA (*Wedd.*) and var. LEDGERIANA.

Fig.—*Howard's Quinology, pp.* 4, 5, 6. The Calisaya, Ledger, or yellow bark of commerce.

Hab.—Bolivia and Southern Peru. Cultivated in Sikkim and Southern India.

History, Uses, &c.—Cinchona bark was introduced into Europe in the 17th century, when it was brought over by Jesuit missionaries from America. The Countess of Chinchon, the wife of a Viceroy of the Spanish colony of Peru,

had been cured of an attack of fever by its use, hence the early names of the medicine were *Peruvian or Jesuit's bark* and *Countess's powder*. The trees yielding this bark were not discovered until a century later, when La Condamine and Jussieu, members of a French exploring party, obtained some plants. Linnæus established the botanical genus Cinchona in 1742. Peruvian bark was acknowledged as a most valuable medicine soon after its introduction into Europe, and the consumption rapidly increased, but no care was spent over the preservation of the natural forests in South America. It would appear that the Jesuits in Peru about 1650 began to distribute the bark to those of their fraternity stationed in other parts of the world, as was their usual practice upon the discovery of any new article of economic value. In this manner it probably reached India not long after its discovery in America.

After its admission in 1677 to the London *Pharmacopœia*, it was necessarily sent out to the physicians of the English East India Company. Its use must have spread rapidly, as in 1770 we find a description of it under the English name of bark (بارک) in the *Makhzan-el-Adwiya* of Mir Muhammad Husain, showing that it was already well known to the native physicians. He describes it as a bark resembling Cassia bark but of a darker colour, and remarks that its medicinal properties are said to have been discovered in Peru by a sect of Christians called Jesuits, who first brought it to Europe, and for this reason it bears the name of Jesuit's bark. It is also called Kina Kina. He correctly describes its use as an anti-periodic, and pronounces it to be hot and dry in the second degree. Quinine appears to have been first used in India in 1826; the records of the Government Medical Store Department show that the Government of Bombay purchased for trial in that year a small quantity of the new medicine at the rate of £28-10-8 per lb. from Mr. Sprague, a chemist and druggist, who had recently opened a shop in Bombay.

The demands for Cinchona and Quinine from India soon became so large that Dr. Royle, botanist to the Indian

Government, fearing that the supply might cease, or be obtainable at a price beyond the reach of the community, recommended to Government in 1839, and again in 1852, that the cultivation of Cinchona should be tried in the country. No steps were taken in the matter until Mr. C. R. Markham in 1860 was selected to organize an expedition to the forests of the Andes for the purpose of collecting seeds and plants. Mr. Markham, accompanied by Mr. Weir, a practical gardener, undertook to collect seeds of the Calisaya or yellow bark tree in the forests of Bolivia and Southern Peru. Mr. Pritchett was to explore the Grey bark region of Huanuco and Humalies in Central Peru, and Messrs. Spruce and R. Cross were to collect the seeds of the Red bark trees in the mountains of Ecuador. Mr. Markham succeeded in collecting several hundred plants of Calisaya, but these were lost owing to the treatment they received *en route* to India. The other collectors were successful in their undertakings, not however without some hardships and disappointments, and the first seed of the Grey barks arrived in India in January 1861, and those of the Red barks a few months later. Mr. Cross was subsequently commissioned to procure seeds of the *C. officinalis* in the forests near Loxa, and this commission he executed with so much success that the seeds were brought to India in 1862. The seeds and young plants on their arrival were committed to the care of Mr. W. G. McIvor, Superintendent of the Botanic Gardens, Ootacamund, and it was to his patience and skill that the cultivation of Cinchona in India became an accomplished fact. Cinchona cultivation was introduced about the same time in the Bengal Presidency under the direction of Dr. T. Anderson. The first seeds sent to the Sikkim Plantations were from Kew; these were soon followed by plants of Pahudiana, Calisaya and Lancifolia from Java, and some Succirubras from Ootacamund. The Cinchona was introduced in Ceylon in 1861 by Dr. Thwaites, and was subsequently taken up with much vigour by the planters of that island. Plantations were opened up afterwards in Wynaad, Mysore, Coorg, Travancore and Tinnevelly entirely as private specula-

tions. For further information the reader is referred to "*Peruvian Bark*," by C. R. Markham; "*Cinchona Barks Pharmacognostically considered*," by F. A. Flückiger; Blue Books. *Copy of Correspondence relating to the Introduction of the Cinchona Plant into India, &c., with Maps.* 1852 to 1875, 5 volumes; *The Annual Reports on the Government Cinchona Plantations, Bengal and Madras*, up to 1889.

Small doses of cinchona preparations and quinine augment the force of the heart's constriction, increase the appetite, and act as a general tonic, but if too frequently repeated, the contractile power of the heart is diminished, although the rate of its movements progressively increases; the latter effect is also produced by large single doses. Poisonous doses annihilate the heart's contractility, producing rapid death; yet if the operation is not promptly fatal, the respiratory movements cease before those of the heart. Theoretically, in moderate doses, quinine stimulates the trophic centres, and quickens tissue change, but in large doses it has the opposite effect. The reduction of the pulse rate and force by quinine is attended by a reduction in temperature. Observations of the effect of quinine upon the blood corpuscles have led to no very satisfactory conclusions. When 5 or 6 grains of sulphate of quinine are taken by an adult man at a single dose, or two or three times that quantity in the course of 12 hours, there is apt to be some heaviness and confusion of thought, headache, buzzing in the ears, vertigo, and unsteadiness of gait. Larger doses occasion, in addition, a sense of fulness, tension, and pulsation in the head; the face becomes suffused and animated; the eyes are bright; epistaxis sometimes occurs; the patient is restless and agitated, and complains of muscular twitching in the limbs. After several hours these phenomena are followed by some degree of exhaustion and a disposition to sleep, with slight torpor and muscular debility. If as much as 30 grains are given daily for several days, in divided doses, there may be observed great depression, apathy, somnolence, unsteadiness of gait, impaired sight and hearing, and dilatation of the pupils; the general

sensibility is obtuse and the limbs tremulous. If, finally, the dose has been excessive, complete loss of consciousness may occur, the sight and hearing fail, the skin loses its sensibility, and the limbs their power of motion.

The usual and most probable interpretation of these phenomena is that quinine in moderate doses primarily stimulates the nervous centres and increases the amount of blood circulating in them; that in excessive doses it diminishes the supply of blood to the same parts; and that this diminution results mainly from the depressed power of the heart. The most important fact in support of this view is that the giddiness, confusion of sight, and faintness caused by quinine subside as soon as the patient lies down.

On the *respiratory organs* the primary action of quinine is stimulant, slightly increasing the rate of breathing. Poisonous doses occasion dyspnœa and noisy respiration, which is also jerking, interrupted, retarded, and finally arrested, death taking place with symptoms of asphyxia. In some cases the sputa have been bloody. Doubtless the latter phenomena are due to a paralyzing influence exerted by quinine upon the respiratory nervous centres, coupled with an analogous action of the drug upon the cardiac nerves and ganglia. According to certain experiments upon rabbits (*Strassburg*), quinine does not diminish the exhalation of carbonic acid, even while it lowers the temperature.

On the *digestive organs* small doses of quinine, as of all pure bitters, stimulate the appetite and digestion, but in large and continued doses it irritates the stomach and confines the bowels at first, although it may afterward cause diarrhœa.

The fact that when quinine cures intermittent fever it also contracts the *spleen*, if that organ is enlarged, is a familiar one. It is also known that when quinine is largely administered to animals for various experimental purposes the spleen is found pale and hard and its capsule wrinkled. These effects occur even when all the nervous trunks supplying the organ are divided. Hence, it is concluded that quinine must act upon the

internal nervous system of the spleen. (*Binz.*) The function of the organ, it is added, being to form the white corpuscles of the blood and to prepare various oxidized substances, and especially uric acid, for excretion, and quinine having the power of restraining both of these operations, necessarily the organ appropriated to them must contract in proportion to the restriction of its functions.

Quinine, being excreted with the *urine* to the extent of at least one-half, sometimes occasions irritation of the urinary passages, causing in different cases micturition, retention of urine, and even hæmaturia. (*Stillé and Maisch.*)

But the most important property of quinine is its destructive action upon the low animal organisms (hæmatozoa), whose presence in the blood has been shown by Laveran (*Archives de Médecine Expèrimentale*, I., p. 789; ii., p. 1,) to be the exciting cause of malarial fevers. Previous to Laveran's great discovery, the power possessed by the cinchona alkaloids of preventing as well as curing these fevers had long been a well recognised fact, and it was known that a person under the influence of a dose of quinine (2 to 5 grains given once or twice a day) might be exposed to malarial contagion without danger. The antiseptic properties of quinine had also been sufficiently established, a dilute solution having been found to preserve fluids containing animal matter from putrefaction for a length of time, although it had not the same destructive action upon the lower forms of algæ as it had upon the lower forms of animal life. Laveran's observations, which have now been amply confirmed, show that the hæmatozoa of malaria are present in the blood in the greatest number immediately before the febrile paroxysm, which is an effort of nature for their destruction, and that the administration of the cinchona alkaloids, and more especially of quinine, has a marked effect in reducing the number of these parasites, and inasmuch as they remove the cause of the irritation, they also prevent the recurrence of the febrile paroxysms. (*Op. cit.* 1889—90; *Laveran, Traité des fièvres palustres, Paris,* 1884.)

Quinine has no power to originate uterine contractions in the pregnant female, but when once parturition has commenced, the flagging pains are greatly stimulated and increased by a dose of ten grains of the drug, and when abortion is threatened through malarial influence, no hesitation should be felt in using it. Quinine should always be given in some easily soluble form, as any salt of the alkaloid which escapes absorption in he stomach must be precipitated by the alkaline juices of the bowels, and be absorbed very slowly or not at all. Dr. G. Kerner has found it in the fæces partly in an amorphous form and partly as a crystalline bitter fluorescent substance, named *dihydroxyl-quinine*; the alkaloid has also been found in the tears, sweat, milk, urine and saliva.

In malarial fevers quinine should be administered in such a way that the last dose should be ingested about 2 hours before the expected return of the paroxysm, and the first dose 4 or 5 hours previous to the last. When there is sufficient time, its influence is almost always very sensibly aided by the exhibition, 12 or more hours before, of a mercurial or other purge. In typhus and typhoid fever, scarlatina, severe erysipelas, rheumatic hyperexia, &c., after the use of the cold bath, 20 grains are often very efficacious in preventing a rapid return of the excessive fever. (*U. S. Dispensatory*, 1889.)

In the year 1866, the Madras Government appointed a Medical Commission to test the respective efficacy in the treatment of fever of quinine, quinidine, cinchonine and cinchonidine. From the Report it appears that the number of cases of paroxysmal malarious fevers treated was 2,472,—namely, 846 with quinine, 664 with quinidine, 559 with cinchonine and 403 with cinchonidine. Of these 2,472 cases, 2,445 were cured and 27 failed. The difference in remedial value of the four alkaloids as deduced from these experiments may be thus stated :—

Quinidine—ratio of failure per 1000	.....			6
Quinine	„	„	„	 7
Cinchonidine	„	„	„	 10
Cinchonine	„	„	„	 23

In 1880 a further report was made on some trials of cinchona febrifuge in quotidian, tertian, quartan and febricula. Out of 5,081 cases, 92·2 per cent. were cured. The administration of febrifuge is often attended with nausea, which was supposed to be due to the amorphous alkaloid present, which is more readily absorbed in the system than the crystalline alkaloids. Purified amorphous alkaloid in small doses of two grains is very active, and has been found in Holland and in Madras to have distinct antiperiodic properties.

The Cinchona Plantations and Harvesting the Bark.—There are three Government Cinchona estates on the Nilgiris, situated at Ootacamund, Naduvatam, and Pykara. Each estate consists of one or more plantations; Naduvatam comprises Denison, Kilgraston and Napier; Pykara is composed of Hooker and Wood; and Dodabetta represents the whole of the minor plantations known under that name. The site occupied by Dodabetta is the ravine behind the Botanic Gardens, situated at an elevation of from 6,500 to 8,000 feet above sea-level, and with a mean temperature in the shade of 60° and a maximum of 70°. During the months of December, January and February the frosts are often severe, and considerable damage is done to the trees lying in the lower parts of the estate. This estate is named after the mountain, about two miles off, called Dodabetta, from Dodda (great) and Betta (hill), which is 8,642 feet above the sea, consequently the highest point on the Nilgiris, and one of the highest in Southern India. The Naduvatam estate is situated about 22 miles from Ootacamund, at the top of the Gudalur ghaut, and on the verge of the steep descent to the Wynaad plateau. The elevation varies from 5,000 to 6,000 feet, with a mean temperature of 60° in the shade, and maximum of 80° and a minimum of 54°, and an average rainfall of 105 inches. The trees grown here are Succirubras and hybrids, and several experimental plots of Calisayas, Carthagena, Santa Fé and Remijias. The Pykara estates are made up of Hooker and Wood plantations separated by the Pykara river. The elevation ranges from 5,000 to 6,200. It is estimated that the area

covered by all these estates is 1,779 acres, the greater portion of which is under cultivation. The total number of trees in 1889 were reckoned at 1,709,656, and included the following varieties:—

Officinalis	981,919
Hybrids	655,856
Succirubras	70,693
Calisayas	278
Other kinds	915
	1,709,656

In 1879, ten years previously, the number of plants on the estates was computed at 569,031, and was composed of the following:—

Officinalis	305,432
Succirubras	260,837
Grey	1,874
Calisayas	552
Other species	336
	569,031

The *Cinchona officinalis*, yielding the Crown bark of commerce, is the chief species cultivated on the Nilgiris, and is one of the most desirable kinds for the manufacture of quinine. The Calisaya bark is the best quinine yielder of all the cinchonas, but unfortunately will not grow on the elevated sites of the Government plantations. *Cinchona succirubra* affords a bark, official in the British *Pharmacopœia*, and which obtains but little favour now in commerce. The statistics of 1879 compared with 1889 show how the red and grey bark plants have given way in the plantations to species of much greater value, such as the officinalis and the officinalis hybrid.

The outturn of bark from these estates is calculated at 100,000 pounds per annum, the whole of which has until recently been sold in London, or by public auction in the country, but within the last two years the manufacture of sulphate of quinine and other alkaloids has commenced, and

to such an extent as to consume all the bark likely to be produced on these plantations in the future.

Besides those of Government, there are several private estates on the Nilgiris, among which might be mentioned Ossington, Devashola, Liddellsdale, and other estates at Coonoor and Kotagiri. Cinchona is largely planted in Wynaad, where an estimate of 5,000,000 plants has been reported. The species mostly cultivated are *Cinchona Ledgeriana* and *C. succirubra*, and a hybrid between these two kinds, which gives a very valuable bark containing as much as 8 per cent. of sulphate of quinine. Travancore afforded suitable sites for cinchona, and extensive tracts were planted up with Red and Crown bark varieties in the Peermaad hills and mountain districts about Devakolam, but the small remuneration accruing to the planter has caused cinchona to be neglected, and tea, as a more promising plant, is being reared in its stead.

The Darjeeling plantations of the Bengal Government are situated some 17 miles from the station of that name in the valley of the Ryang, and at Sittong in the valley of the Teesta, British Sikkim. They were commenced in the year 1862 at Rungbee, and the head-quarter buildings and factories are at Mongpoo. Some land has been opened out at Runjung in British Bhutan, but the plants have not shown so much promise as those at Sikkim, on account of the heavy rainfall in that district. The Sikkim plantations are at an elevation of from 1,400 to 5,000 feet, and occupy a tract of about 20,000 acres, only a part of which is cultivated. The Ledger cinchonas are here reared to a very large extent. Succirubra and its hybrid also grow well, and the Morada and Verde types of Calisaya have within the past few years been put out with very encouraging results. Ledgers thrive best at this latitude between 2,000 to 3,500 feet, while the Moradas and Verdes prefer a somewhat lower elevation. It has been noticed that Ledgers like a sunny aspect and Succirubras a northerly or shaded one. The plantations never reach an old age, for when the trees are 6 or 8 years old, they are cut down and uprooted, and the whole of the bark is scraped off. The plot of land is then left for a

few years, after which it will be ready for planting up again. These plantations, therefore, possess almost unlimited tracts of the richest soil in which to extend the cultivation. The bark harvested in Sikkim differs from that of the Nilgiris in being all of one kind—namely, natural, and it is estimated that as much as 300,000 pounds can be harvested each year. In 1862 there were 311 plants. In 1875 there were 2,000 acres planted up with 3,000,000 trees from 4 to 30 feet high. At the end of the financial year 1882, there were 4,731,608 plants of the following kinds:—

Succirubras	3,873,285
Calisayas	566,695
Hybrids	291,628
	4,731,608

At this time the Darjeeling plantations were using the Succirubra bark for the manufacture of febrifuge. Recently a method has been discovered for making sulphate of quinine, hence the plantations have been adapted for the production of a larger yield of richer bark, and the statistics of the number of trees in 1889 show how this object has been attained:—

Succirubras	1,882,000
Calisayas	1,768,060
Hybrids	1,145,170
Other species	15,001
	4,810,231

The number of Succirubras has been reduced by one-half, the Calisayas have been trebled, and the hybrids quadrupled, and in this manner the alkaloid-yielding plants are being gradually replaced by those affording pure quinine.

The area of private plantations is—

Bengal	1,355 acres
Madras	6,444 ,,
Coorg and Mysore	2,000 ,,

There are four methods of collecting or harvesting the bark:—

1. By taking it in longitudinal strips from the standing tree,

and leaving the bark to renew over the exposed wood; 2, by scraping and shaving off the bark; 3, by coppicing; and 4, by uprooting. The first is that most in use in, and peculiar to the Nilgiris, having been discovered by Mr. McIvor. The trees are barked preferably in the rainy season, when the bark "lifts," or is more easily removed from the wood. The coolie inserts the point of a knife in the tree as far as he can reach and draws it down, making an incision in the bark straight to the ground; he then makes another cut parallel to the first, about an inch and a half apart, and loosening the bark with the back part of the knife, the strip or ribbon is taken off. If the operation is performed carefully, and the cambium cells are not broken, a new layer of bark will be formed in the place of that which is taken away. Other strips are taken at intervals around the stem, and the tree is then covered by moss, grass or leaves of *Phormium tenax*, and bound on by coir string or fibre. The stem is covered after the operation of stripping in order to foster the growth of the new bark (renewed bark) from the cambium, and to thicken the untouched layers of natural bark, which are now termed mossed bark. The moss which was first used to cover the partly decorticated stem is not now used on account of its scarcity, and grass, straw, leaves, tin and newspapers have been found to answer the purpose. After about two years, the trees are again visited, and if recuperation has gone on satisfactorily, the mossed bark is harvested in strips, leaving the renewed bark to thicken, and to allow a further supply of renewed bark to take the place of the mossed. The renewed bark is always of greater value than the mossed and the mossed than the natural, so long as the trees are under 20 years old, for it has been found that after that time the bark ceases to thicken, and the alkaloids remain stationary or even decrease. The bark being collected in wet weather artificial heat has to be used in drying it. Both at Naduvatam and Dodabetta there are abandoned jails where the bark is dried; fires are lighted beneath, and flues conduct the heat through the building where the bark is laid on a series of shelves. Sun heat is used at lower elevations, where other kinds of Cinchona

are grown, and where the expense of artificial heat could not be met. The shaving process was first practised in Java, and consists in shaving off the superficial layers of bark from the whole surface of the stem, taking care that no point of the wood is laid bare. Coppicing Cinchona is to cut the tree down to a foot above ground, and to allow one or more shoots to spring up from the stool. Uprooting is adopted in the Bengal plantations, where the trees are uprooted and the whole of the bark is collected from the root, trunk and branches.

Description.—Cinchona bark is usually exported in packages, which are subjected to hydraulic pressure and arrive in the market more or less in a comminuted condition. Crown bark occurs in single quills with a blackish surface, often covered with various lichens (*Usnea*, *&c.*); it breaks with a fibrous fracture, and the powder of the bark is light brown. Succirubra bark is rough and warty on the outer surface, with fewer cryptogamic plants, and thicker than other kinds. It has a fibrous and splintery fracture, a reddish inner surface, and yields a reddish brown powder. Ledger bark is generally uncoated yellowish brown or whitish with black markings; the epiphlœum often falls off in flakes; the inner substance of the bark is yellowish brown, which is the colour of the powder. Root bark from all kinds of Cinchona is in the form of short recurved or twisted pieces, thicker and lighter in colour than the stem bark. Shavings consist of the outer or cellular portion of the bark, and are consequently thin and brittle, and are easily crushed in packing. Mossed bark has a dark surface, is usually free from lichen, and occurs in thick, half or single quills. Renewed bark is light in colour, easily fractured on account of the absence of much liber, and is known by the peculiar uniform smoothness of its external surface. The characters of Cinchona bark can best be studied in carefully prepared and exported samples of what is known in the market as "Druggist's bark." The character of the drug supplied to the manufacturers is of less importance than a knowledge of the amount of quinine it contains which is determined solely by chemical analysis. Indian Cinchona bark has never been

known to be adulterated with any of the bitter indigenous drugs of the country.

Chemical composition.—The constituents of Cinchona bark of most importance are the bitter alkaloids or bases, to the first in the following list of those principles, the value of the drug almost exclusively depends.

Quinine, $C^{20}H^{24}N^2O^2$, is a light-coloured, amorphous, brittle substance in an anhydrous state, but may be obtained in a crystalline condition with $3H^2O$. It is soluble in ether, alcohol, chloroform, and very slightly in water. Aqueous solutions of the salts made with the oxygenated acids possess a blue fluorescence, and when treated with chlorine water and ammonia, a beautiful green solution is produced, known as the thalleioquin test. The solutions deviate the plane of polarization to the left. The quinine salt mostly used in medicine is the sulphate $(C^{20}H^{24}N^2O^2)^2$, $H^2SO^4,7H^2O$, the theoretical centesimal composition of which is—

Quinine	74·31
Sulphuric acid	11·23
Water of crystallization	14·45

Cinchonidine, $C^{19}H^{22}N^2O$, forms colourless anhydrous crystals. The sulphate is more soluble in water than quinine, and the tartrate is very insoluble. The solutions show the same optical behaviour as quinine but to a less extent.

Quinidine possesses the same formula as quinine, and the solutions of its salts are fluorescent and afford the thalleioquin reaction; it differs, however, in deviating the plane of polarization to the right. It is separated from the other alkaloids as an insoluble hydriodate.

Cinchonine is not very soluble in ether and alcohol. The formula is the same as that of cinchonidine, but has exactly the opposite action upon polarized light.

Amorphous alkaloids, called also *Quinoidine* or *Chinioidin*, occur in all Cinchona barks and leaves. It is the name given to the preparation obtained in quinine factories, and in analysis by precipitating the mother liquors with alkali. It is a dark

brown brittle mass softening below 100° and alkaline in reaction.

Quinamine, an unimportant alkaloid, was discovered in 1872 by Hesse in Succirubra bark cultivated at Darjeeling. Other Cinchona bases have been found and described, but as they do not occur in Indian grown barks, they need only be mentioned by name. *Paricine* in *Buena hexandra*; *Aricine and Cusconine* in false Cinchona of undetermined origin. *Pitoyine* in China bicolorata Tecamez; *Paytine* in white bark; and *Homoquinine* discovered by D. Howard and others in Cuprea bark from *Remijia* species in 1882.

The above bases are combined with Kinic and Cincho-tannic acids. *Kinic acid*, $C^7H^{12}O^6$, occurs in monoclinic prisms soluble in water and alcohol, but hardly in ether. The solutions are levorotatory. By heating it with peroxide of manganese and sulphuric acid, yellow crystals of quinone ($C^6H^4O^2$) are produced.

Cincho-tannic acid, the astringent principle of the Cinchonas, is soluble in water and spirit, and is precipitated by acids, acetate of lead and gelatine. It strikes a green colour with ferric chloride, and affords pyrocatechin by destructive distillation. Its solution in the presence of an alkali, or by boiling with dilute sulphuric acid, decomposes into an oxidized product, *Cinchona-red*, and a sugar. *Cinchona-red* occurs naturally in red bark as an amorphous substance soluble in alkaline solutions and alcohol, but neither in water nor in ether.

Quinovic acid crystallizes in scales, which are sparingly soluble in cold alcohol, more readily in hot alcohol, but insoluble in water, ether, or chloroform.

Quinovin, an amorphous bitter substance present in nearly every part of the plant, is resolvable into quinovic acid and *mannitan*. It is removed from the bark by diluted soda, from which it is precipitated with cinchona-red by an acid, from this, milk of lime dissolves out quinovin and quinovic acid, which are again precipitated by an acid, and separated by chloroform, in which the former is very soluble.

The wax-like principle of barks has been designated by Kerner *cinchocerotin*. Hesse has found two substances of this nature; *cupreol*, $C^{20}H^{34}O$, melting at 140°C, and *cinchol* melting at 139°; they both crystallize in laminæ, but differ in optical properties.

Cultivated barks yield over 8 per cent. of mineral matter; the average of three hundred estimations was 3·42 per cent. Renewed and old natural barks are poor in ash, but scarcely, if ever, fall below 2 per cent., while young and branch barks give 4 per cent. or more. Crown bark is richer in ash than that of the red, and the red than that of the yellow. From a complete analysis of the ash of Officinalis bark, it appears that lime forms one-third and potash one-sixth of the whole, and in that of Succirubra bark, lime forms one-third and potash one-eighth of the whole. A full grown Succirubra tree has been analysed and found to contain nearly half a pound of pure lime (CaO).

Effects of Cultivation on the Alkaloids.—The alkaloids first appearing in young plants and in leaves and twigs are in an amorphous state, but as growth proceeds they become crystalline, hence it is probable that the latter are produced from the former. In diseased and dead bark and in that killed by frost, the alkaloids revert to an amorphous condition, and gradually disappear.

Trees of the same species and height, and growing under exactly similar conditions of aspect and soil, are not necessarily of the same alkaloidal value. They vary in amount of total alkaloids, but the proportion of quinine in the total alkaloids remains fairly constant for each species. This proportion averages 70 to 80 per cent. in Ledgers, 60 to 70 per cent. in Officinalis, and 20 per cent. in Succirubras. Hybridization between these plants materially affects these proportions according to the parents of the hybrid. Succirubra has influenced the Officinalis of the Nilgiris and the Ledgers of the Wynaad, forming characteristic hybrids, with their alkaloids to a very large extent taking up a mean between those of the parents. Several analysis of the Officinalis hybrid show that

the alkaloids contain 41 per cent. of quinine in the total alkaloids, and the Ledger hybrid 58 per cent.

Ledgers and Succirubras do not much increase in alkaloidal value after 6 years of age, and therefore should not be barked when young. The Officinalis, being of slower growth, does not mature or yield the full amount of alkaloid, until the trees are at least 7 years old. The faster-growing trees appear to begin to degenerate after 15 years, and the Officinalis after 20 years.

The north or shaded side of a tree has a richer bark than that on the south side—a fact which explains the success of the mossing-system, where the bark is entirely protected from the light and heat of the sun's rays, and a larger yield of alkaloids thereby encouraged. The renewal of most barks under moss, or a similar covering, has a tendency to increase the amount of quinine at the expense of the cinchonidine, except in the case of Calisaya bark, where there is very little cinchonidine naturally existing. In the renewal of grey barks (*C. micrantha*, &c.), where no quinine or cinchonidine are found in natural bark, cinchonidine is formed at the expense of the cinchonine, which is always present in these barks in large quantity.

A large number of experiments have been made in manuring Cinchonas, and all the more important trees have been operated upon at different ages and during short and long periods. In every case the manures have increased the amount of alkaloids in the bark, and, as a rule, the increase has been in the most valuable alkaloid quinine. Manure affects the bark of young trees more quickly than that of older ones; but, on the other hand, old trees of twelve years and upwards are greatly improved by manure when it is allowed a longer time to work, about two years or more.

Some analyses of frost-bitten barks show that there is very little diminution in alkaloids when compared with natural bark analysed before the frost. It was formerly supposed that frost-bitten barks were worthless.

The object in the Indian plantations has been to propagate those species known by analysis to contain much quinine, or if these will not grow, to raise robust trees which will yield more quinine by cultivation. Hybrids are on the increase in many estates, and by careful selection from these, the value of the future cultivation will largely depend.

The following table gives a list of the most important barks grown on the Government plantations at the present time, with a full analysis of each :—

	Quinine.	Cinchonidine.	Quinidine.	Cinchonine.	Amorphous Alkaloids.	Total.	Sulphate of Quinine.
C. officinalis, natural	2·93	1·40	·08	·42	·42	5·25	3·94
,, mossed	3·40	1·50	·20	·45	·62	6·17	4·57
,, renewed	4·21	·85	·22	·65	·70	6·63	5·66
C. succirubra, branch	1·38	2·28	...	1·59	1·16	6·41	1·85
,, natural	1·40	2·25	...	1·92	·68	6·25	1·88
,, mossed	1·69	2·03	...	1·68	·98	6·38	2·27
,, renewed	1·84	1·48	...	1·25	·71	5·28	2·47
,, ,, shavings.	2·30	1·16	...	2·06	1·45	6·97	3·09
C. angustifolia, natural	3·97	1·32	·12	·12	·87	6·40	5·34
,, mossed	5·60	1·41	·33	·04	·97	8·35	7·53
,, renewed	4·91	·89	·38	·19	1·14	7·51	6·60
C. hybrid, branch	1·64	2·71	...	1·17	·50	6·02	2·20
,, natural	3·19	2·87	...	·67	·55	7·28	4·29
,, mossed	1·92	3·16	...	·77	·35	6·20	2·58
,, renewed	4·40	2·54	...	·51	1·65	9·10	5·92
C. micrantha, branch	...	...	...	1·60	·45	2·05	...
,, natural	...	...	...	1·92	·40	2·32	...
,, renewed	tr.	2·45	...	1·12	1·02	4·59	tr.
C. pitayensis, natural	2·34	·56	1·10	1·93	·39	6·32	3·14
,, mossed	3·81	·95	·63	1·91	·37	7·67	5·12
,, renewed	2·50	·52	·78	2·33	·55	6·68	3·36
C. Calisaya, natural	1·21	2·32	...	2·13	·29	5·95	1·62
,, branch	·59	·73	...	1·93	·48	3·73	·79
C. Anglica, natural	·81	·88	·29	1·49	·44	3·91	1·09
,, branch	tr.	tr.	·25	2·04	·36	2·65	tr.
C. Javanica, natural	...	...	1·32	2·64	·48	4·44	...
,, branch	...	...	1·43	1·49	·45	3·37	...
C. Ledgeriana, natural	5·49	1·33	...	·82	88	8·52	7·38
,, branch	2·21	·49	...	1·07	·50	4·27	2·97
C. Humboldtiana	2·24	1·55	tr.	·49	·90	5·18	3·01
C. nitida	1·42	2·45	...	1·45	·67	5·99	1·91
C. Pahudiana	·04	·10	...	·39	·43	·96	·05
C. Carthagena	...	·40	...	1·64	1·51	3·55	...
C. Santa Fé	1·71	·83	...	·60	·66	3·80	2·30
C. Succirubra, Sikkim	·66	1·12	...	1·93	·77	4·48	·88
C. Ledgeriana ,,	2·92	·38	·11	·14	·21	3·66	3·93
C. hybrid ,,	2·24	2·13	...	·69	·54	5·60	3·01

Manufacture of Alkaloids and Quinine.—The authorities in charge of the Cinchona plantations have for many years seen the desirability of extracting in the country the alkaloids so valuable in fevers and in a form that could readily be taken.

At the suggestion of Dr J. E. de Vrij, the manufacture of a light-coloured powder, consisting of the alkaloids of red bark, was started in 1874. This powder was called "quinetum" or "febrifuge," or, with reference to the locality of its production, Sikkim or Darjeeling febrifuge. Febrifuge is made by exhausting the powdered red bark with water acidulated with hydrochloric acid, precipitating the liquor with caustic soda, and drying the crude deposit. This is again dissolved in sufficient acid, reprecipitated by soda in a pure condition, filtered, dried and powdered. It has a tolerably uniform composition of Quinine 15·5; Cinchonidine 29·0; Cinchonine 33·5; Amorphous alkaloids 17·0; and colouring matter, &c., 5·0 per cent.

About three years ago, Mr. J. A. Gammie, the resident Superintendent, with the co-operation of Mr. C. H. Wood, formerly Quinologist to the Bengal Government, elaborated a method of extracting quinine from yellow bark, called the "oil process." It is called the oil process, because a mixture of fusel and kerosene oils is employed in the manufacture. The finely-powdered bark is mixed with water containing caustic soda in solution, the oils are added, and the whole is intimately agitated for a few hours and then allowed to rest. The alkaloids are then contained in the oil, which is decanted, and stirred up with water acidulated with sulphuric acid. The acid liquor now containing the alkaloids is transferred to pans and heated by steam; while still hot, the liquor is neutralized with soda and filtered, and on cooling, the solution yields the crystals of sulphate of quinine. The crude crystals are purified by dissolving them in a certain amount of hot water, filtering and cooling, and the crystals which form are collected and dried in a warm air-chamber.

Commerce.—Indian Cinchona bark began to be exported in 1867; the first three bales realized Rs. 287, and sold in London for 2 shillings per lb. From 1871 to 1886, when the export ceased,

the Madras Government plantations sent bark to England to the extent of 31 lakhs. Red barks first sold for 2*s.* per pound and Crown barks for 3*s.* The total export from India from October 1 to September 31 was:—

1886–87.....	1,286,900	lbs.
1887–88.....	1,449,315	,,
1888–89.....	3,074,098	,,

Cinchona bark is sold by the unit of sulphate of quinine. The unit is the price in pence per pound of bark containing one per cent. of sulphate of quinine. In 1885 the price of bark reached 7*d.* per unit; at the present time, 1890, it is not more than 2*d.* In 1885, a bark containing 3 per cent. of sulphate would have been worth 1*s.* 9*d.* per pound; at the present time the same bark would not sell for more than 6*d.* The fall in the price of bark has had the effect of lowering the price of the alkaloids; sulphate of quinine, for instance, last year sold for 1*s.* per ounce. The price had been gradually declining from 1877, when it was valued at 16*s.* 6*d.* per ounce in bulk.

HYMENODICTYON EXCELSUM, *Wall.*

Fig.—*Wight Ic., t.* 79.

Hab.—W. Himalaya, Deccan, Central India, Tenasserim, Chittagong. The bark.

Vernacular.—Bhaulan, Barthoa (*Hind.*), Bandárú (*Tel.*), Sagapu (*Tam.*), Kála-kadva, Bhoursál (*Mar.*).

History, Uses, &c.—Roxburgh states that the inner coat of the bark possesses the bitterness and astringency of Peruvian bark. *H. excelsum* is his *Cinchona excelsa.* Ainslie quotes Roxburgh, and tells us that the bark is used by tanners, and also as a medicine by the Hindus in cases requiring astringents. The tree yields a bitter bark in common use among the natives as a tonic and febrifuge, which was tried in the Calcutta Medical College Hospital by O'Shaughnessy, and

found to be most valuable. In 1870, Broughton examined the fresh bark of one of the Hymenodictyons, and found that the bitter taste was due to the existence of *æsculin*, and that the bark when dry was almost tasteless owing to the transformation of that substance into *æsculetin*, the decomposition having been induced by contact with decaying organic matter. The fact here mentioned that the bark when dry lost its bitterness leads us to suppose that it was not that of *H. excelsum* but of *H. obovatum*, the dry bark of the former tree being extremely bitter.

Description.—The bark of *H. excelsum* is very bitter, and may be distinguished from that of *H. obovatum* by its red colour and bitterness. The minute structure resembles that of the Cinchonas, but the bundles of stone cells are larger, the spiral and laticiferous vessels also are more numerous, the latter being very large, and exuding when cut a waxy latex. Many of the cells are filled with a red-colouring matter as in Cinchona bark; and there is a continuous ring of stone cells near the junction of the bark with the wood. The bark examined was from branches about one inch in diameter.

Chemical composition.—From an examination of the bark made by W. A. H. Naylor in 1883, it appears that the bitter principle is not the glucoside æsculin, or its decomposition product, æsculetin, but an alkaloidal substance allied to quinoidine, berberine and paricine. From quinoidine it differs in being optically inactive, and from its double compound containing relatively less platinum. From berberine it differs in that it contains a higher percentage of carbon, while its double compound also yields a relatively larger amount of platinum. From paricine it differs only in the percentage of hydrogen it gives. Mr. Naylor considers it to be a new alkaloid having a composition corresponding to the empirical formula $C^{24}H^{40}N^{2}$, and therefore an addition to the small class of bases devoid of oxygen. Besides *Hymenodictyonine*, which is the name given to the new alkaloid, Mr. Naylor has separated a bitter neutral principle, represented by the formula $C^{22}H^{45}O^{10}$,

which he thinks may possibly be a decomposition product of a glucoside.

In a paper read before the Pharmaceutical Society in 1886, Mr. Naylor gave the following account of further experiments made with the alkaloid hymenodictyonine:—

"On gradually adding a weak solution of iodine in ether to an ethereal solution of the alkaloid, the iodine became decolorized and a deep orange-red precipitate was formed, which quickly agglutinated and presented the appearance of a black resinous mass. By continuing the addition of iodine until it ceased to be decolorized an excess could readily be recognised. The resultant varnish-like mass was washed freely with ether, in which it was but little soluble, and then treated with hot alcohol. It was soluble to a considerable extent in cold alcohol, but its solubility increased with increase of temperature. It was hoped that by the use of a limited quantity of this solvent, acting on the compound at a suitable temperature to be ascertained by experiment, followed by a gradual process of cooling, a crystalline derivative would separate. The expectation was not realized, for the substance that separated under these conditions was always amorphous.

"The experiment was next tried of adding iodine in large excess to a solution of the alkaloid in much ether. This had the effect of producing a more flocculent precipitate at the moment of its formation, but toward the end of the reaction the several particles began to coalesce. This viscid mass was treated precisely as the previous one, and refused to be coaxed into crystallizing.

"A third attempt was made by precipitating a weak solution of the alkaloid in ether, with rather less iodine than would be required to produce complete precipitation. The precipitate was subjected to the same treatment as the previous ones, and resembled them in the granular appearances of their separations from alcohol, notwithstanding the inducement to assume some definite form offered by the varying temperatures to which they were subjected.

"Although, after much labour and thought, I have failed to obtain an iodo-derivative in a crystalline form, I do not regard it as one of those organic principles to which the faculty of crystallization has been denied, but believe that a more perfect knowledge of the conditions of its formation in a state of purity would lead to its production. This belief is encouraged by a close correspondence to a possible formula which may be assigned to the iodo-compound prepared by the method last described. That portion of the viscid mass which dissolved in a limited quantity of hot alcohol and separated out on cooling, gave, in a series of iodine determinations by combustion with quick lime, the equivalent of 47·52 per cent. The formula $(C^{23}H^{10}N^2)^2I^52HI$ would require 47·92 per cent of iodine. Throughout these combustions it was observed that a fatty looking substance distilled over, having the characteristic odour of naphthaline. From solution in alcohol it crystallized in white scales.

Several attempts were made to produce a crystalline bromo-derivative, but without success. The flocculent precipitate which resulted from the reaction of ethereal solutions of bromine and alkaloid, after treatment with hot alcohol, gave on cooling a granular looking body, which was chiefly remarkable for the facility with which it parted with a portion of its bromine. A stable and definite compound was not obtained.

"The action of oxidizing agents on the alkaloid next claimed attention. The alkaloid was converted into sulphate, and to its aqueous solution was gradually added a one per cent. aqueous solution of potassium permanganate, until the liquid became permanently coloured. It was then concentrated by distillation to a small bulk and filtered. The filtrate was neutralized with sulphuric acid and evaporated to dryness. The residue was exhausted with hot alcohol, which on cooling gave a deposit and when quite cold was filtered. The filtrate was evaporated, taken up with water and converted into a silver salt, which was decomposed by sulphuretted hydrogen. Filtration, evaporation, and subsequent purification of the

residue with alcohol and water, left a feebly coloured acid having the following properties:—

"It was markedly acid to litmus, and had a bitter after-taste. It dissolved readily in alcohol and water, and was but little soluble in ether. It united both with bases and acids. Its hydrochloride in aqueous solution when evaporated over sulphuric acid assumed an arborescent crystallization; the platino-chloride under the same conditions crystallized in plates or prisms. The acid was not precipitated with sulphate of copper, but gave with nitrate of silver a white gelatinous precipitate, which in the moist state became rapidly reduced on exposure. Lead acetate gave a white granular precipitate. Two determinations of the platinum in the platino-chloride dried at 115° C. gave 29·50 per cent. of platinum. The formula $(C^6 H^5 NO^2 HCl)^2 Pt Cl^4$ requires 29·72 per cent. of platinum, and this is the platino-chloride of a pyridine-monocarboxylic acid, *viz.*, $C^5 H^4 N. COOH$. Further, the acid, or one of its salts, when distilled with lime, yielded as a product of decomposition a volatile base which possessed the peculiar odour and general properties of pyridine. This property of the acid, coupled with its behaviour towards reagents, and the percentage of platinum in its platino-chloride, may be accepted as trustworthy evidence of its being a carboxylic derivative of pyridine. If nitric acid be used in place of potassium permanganate the same acid is obtained.

It would therefore appear that in common with the rest of the non-oxygenated alkaloids hymenodictyonine is constitutionally related to pyridine.

OLDENLANDIA CORYMBOSA, *Linn.*

Fig.—*Rheede Hort. Mal. x., t.* 35.

Hab.—Throughout India. The herb.

Vernacular.—Daman-pápra, Bakra, Pit-pápra (*Hind.*), Khet-pápara, Pit-pápara (*Beng.*), Khet-pápada, Pitpápada, Paripát (*Mar.*), Parpadagam (*Tam.*), Kallasabatra-sige (*Can.*), Verinella-vemu (*Tel.*), Khet-pápra (*Guz.*).

History, Uses, &c.—This plant, called in Sanskrit Kshetraparpata, or field *Parpata*, from its frequent occurrence in cultivated fields about the end of the rainy season, is the *Oldenlandia biflora* of Roxburgh and the *O. herbacea* of De Candolle. It is frequently mentioned in Sanskrit medicinal works, and is considered a cooling medicine of importance in the treatment of fevers supposed to be caused by deranged air and bile, that is, remittent fever with gastric irritability and nervous depression. The entire plant is prescribed in decoction, and is combined with aromatics as in the *Panchabhadra*, which is a decoction of Parpata, Mustaka, Gulancha, Chireta and ginger, of all equal parts, two tolas (360 grains) being given for a day's consumption.

Rheede, who calls it *Parpadagam*, notices its use in decoction with aromatics, for spasmodic fever, and also its application as an apozem with sandalwood and honey in the same disease. It must not be confounded with the Pitpápra of the Mahometans, which is Fumitory, and is distinguished in Sanskrit as *Yavana-parpata*, or Greek *Parpata*, or with the various substitutes for that drug which are in use in India under the name of Pittapapara.

Description.—An annual, slender herb, glabrous, rarely scaberulous, leaves linear or narrowly elliptic-lanceolate, margins often recurved, nerveless; peduncles solitary, 1 to 4 flowered, pedicel long, capillary, calyx-teeth subulate, rather shorter than the corolla-tube, crown of capsule low. It is a very variable plant, not always distinguishable from *O. diffusa* and *O. Heynii*. It varies from a diminutive straggling herb, with branches 1—2 in., to an erect one a foot and more high. Leaves from ½ to 2 by $\frac{1}{16}$ to ⅛ in., erect, spreading, or recurved, sometimes as broad as in narrow leaved forms of *O. crystallina*; stipules small, membranous, irregularly-cut, with a long and several shorter teeth or bristles. Capsule usually broad didymous, sometimes hemispheric or narrowed below the calyx-teeth, base acute or rounded, crown usually not rising above the base of the calyx-teeth, at others hemispheric and approaching that of *O. Heynii*. (*Fl. Br. India.*)

Chemical composition.—A watery extract of this plant gave coloured precipitates with alkalies, a green reaction with ferric chloride, none with gelatine or acids, an abundant cream-coloured precipitate with lead acetate, and afforded indications of an alkaloid. A watery solution of an alcoholic extract had similar properties; it was mawkish and saline to the taste, and when evaporated to dryness it formed a mass of cubical, deliquescent crystals. A portion of this extract ignited left a saline residue consisting of potassium, sodium, and a small quantity of calcium, mostly existing as chlorides. No ammonia was detected in the herb, and the alkaloid was shaken out of an alkaline solution with ether, but had no very characteristic reactions. The value of the plant as a cooling medicine no doubt is due to the inorganic salts present. The dried herb left an unusually large incombustible residue, amounting to 22·2 per cent., very soluble in water.

Oldenlandia umbellata, *Linn., Roxb. Cor. Pl. t.* 3. Chayroot or Indian Madder.

Ainslie says:—"The small narrow, pale green leaves of this low growing plant the native doctors consider as expectorant, and prescribe them accordingly; of the virtues of the root in poisonous bites, colds and cutaneous disorders, as mentioned by Miller in his Dictionary, I know nothing. When dried and powdered the leaves are sometimes mixed with flour and made into cakes, which are eaten by such as suffer from consumptive or asthmatic affections. The dose of the decoction of the leaves is about an ounce twice daily." The root is long and slender, with a few lateral fibres, and of an orange colour. It is best known as a dyeing material. An account of its use for this purpose in India will be found in *Drury's Useful Plants of India*, 1873, pp. 240 and 470.

OPHIORRHIZA MUNGOS, *Linn.*

Fig.—*Gärt. Fruct. i., t.* 55.

Hab.—Mountains of Assam, Western Peninsula and Ceylon. The root and plant.

Vernacular.—Kiri-purandán (*Tam.*), Sarpáshi-chettu (*Tel.*), Rásna, Nákuli (*Hind.*), Nanjáre, Rashme (*Can.*), Rásna, Mungusvel (*Mar.*), Mungusvel, Nákuli (*Guz.*).

History, Uses, &c.—This plant is described in Sanskrit in the following terms:—

Nákuli, Surásá, Rásná, Sugandhá, Gandhanákuli,
Nákuleshtá, Bhujangákshi, Chhatrica, Suvaha, Nava.

The fifth and sixth synonyms signify that its odour is agreeable to the Nákula, and the seventh that it is offensive to snakes.

It was first brought to the notice of Europeans by Garcia. Kæmpfer, who calls the root *Radix Mungo* (*Amœn.* 573 and 577), says of it:—"Radix est, plantæ Malaicé *Hampaddu Tanab*, id est, *Fel terræ* dicta, á sapore amarissimo omnium feré partium, præsertim radicis, quæ intensam bilis amaritiem exhibit, Lusitanis ibidem *Raiz* seu radix *Mungo* appellata, á mustela quadam seu viverra, Indis *Mungutia*, Lusitanis ibidem *Mungo*, Batavis *Muncus*. Garciæ ab Hort, (*Ar. Hist. L. i., c.* 44.) *Quil* et *Quirpele* appellata, quæ radicem monstrasse, et usum ejus pro alexipharmico prima mortalibus prodidisse creditur. Est mustelæ huic is genius, ut serpentem naturali odio prosequatur; et velut glirem catus invadat. Tradunt igitur, si contingat morderi muncum, serpentis astutia roboreve victum, relicto hoste, pro alexipharmaco hanc radicem quærere, et esu ejus illico restitutum, certamen redintegrare. Sit fides rei penes indigenas. Hoc tantum de mustela hac exploratum habeo, morsam á vipera, vel luctu fatigatum, dimisso victore, ex palæstra in campum excurrere et obvias depascere herbarum radiculas, mox pastu, ut opinor refectam, rursus comparere ad certamen, cum hoste, si adsit, redauspicandum." Kæmpfer also says that the plant to his knowledge grows in Java, Ceylon, and Sumatra, is a foot or more in height, and not unlike the lesser Centaury. It has a single root, a span in length and as thick as the finger, much contorted, with a rough, brown, closely-adhering corky bark, and a hard, white fragile woody column; it has a bitter taste like Gentian but

more delicate and agreeable. (*Op. cit., p.* 577.) The supposed alexipharmic properties of this plant have long since been disproved, but it appears to be an agreeable bitter tonic.

Description.—A small shrubby plant, 1 to 1½ foot; stems hard and woody, bark light brown and corky; leaves opposite, elliptic-lanceolate, acuminated at both ends, glabrous, very thin, unequal in size, 2—5 by 1—2½ in., calyx-tube turbinate, limb 5-cleft; corolla-tube infundibuliform, short, hairy within, limb 5-lobed; stamens enclosed; capsule compressed, crowned with the calycine segments, 2-celled, 2-valved; seeds numerous, somewhat hexagonal; cymes peduncled, terminal, branched; flowers nearly sessile, white. The root consists of several hard, woody, contorted branches, about six inches in length, covered with a thin brown bark. The lower portions of the stem are generally collected along with the root, and to these Kæmpfer's description appears more particularly to apply, as the root-bark can hardly be described as corky. Taste moderately bitter.

Chemical composition.—A decoction of the root contained starch but no astringent matter. An alcoholic extract evaporated to dryness was a mixture of some green fatty oil containing chlorophyll, and a light brown resin which remained as yellowish red flakes when water was added. The resin was tasteless, and gave a blood-red colour with caustic soda and red with sulphuric acid; it dissolved in chloroform and other volatile solvents, but showed no disposition to crystallize on gentle evaporation of these solutions. The filtrate from the resin was sweet and demulcent and afterward bitter, shaken up with ether it yielded a resinous substance to that solvent. The liquid treated with ammonia and then shaken with ether, yielded up no alkaloidal body, but a white granular scum remained on the stratum between the two liquids; benzol added and agitated with the alkaline liquid separated the bitter alkaloid in an amorphous condition, the quantity however was too small to admit of anything approaching a complete analysis.

MUSSÆNDA FRONDOSA, *Linn.*

Fig.—*Wight Ill. t.* 124; *Rheede Hort. Mal. ii., t.* 18.

Hab.—Tropical Himalaya, Western Peninsula. Leaves, fruit, flowers and root.

Vernacular.—Bebina, Sribar (*Hind.*), Srivadi (*Mal.*), Vella-ellay (*Tam.*), Srivar, Srivardoli, Bhútkes, Lavasat (*Mar.*), Asari (*Nipal*).

History, Uses, &c.—This is a well-known scandent shrub, and easily recognised by its orange-coloured flowers, which contrast prettily with the white calycine leaf, making it a very remarkable object. All the flowers do not produce this leaf-like sepal, but two or three in each corymb, and occasionally two sepals are thus developed. *M. frondosa* is called Srivati in Sanskrit, and is a favourite of the goddess of fortune, from its bearing the white mark of Vishnu or Krishna; another name for it is Nagavalli. Among the Tamil people it is called the "white-rag plant." The flowers are used in country places to make the garland which is tied over the doorway on festive occasions. The root in 80-grain doses is given with cow's urine as a remedy for jaundice (pandu-roga), or two tolas (360 grains) of the white leaves may be given in milk. The juice of the leaves and fruit, which is very mucilaginous, is used as an eye-wash. Rheede says:—The root in decoction expels phlegm, externally applied it is cooling, boiled in oil it cures aphthæ. According to Loureiro, the flowers are attenuant and diuretic, and are used in cough, asthma, ague, and flatulence; externally applied they clean foul ulcers, and cure skin eruptions. In Mauritius a species of Mussænda is called "wild cinchona" and is used as a tonic.

Chemical composition.—A bitter principle, having the peculiarities of a glucoside, pervades all parts of this plant. It was soluble in water and rectified spirit, afforded a reddish brown colour with sulphuric acid, passing from a fine red to a purple, and was not precipitated by alkaloidal reagents or by tannin. Evaporated with an excess of hydrochloric

acid, the purple colour was developed, and boiled with the acid, the bitterness of the solution was reduced, a brown decomposition product separated, and the filtrate readily reduced Fehling's solution. The taste was very bitter and acrid, and the glucoside was not obtained in crystals. The aqueous solution of the ether extracts of the various parts of the plant contained a yellow colouring matter related to the quercitrin group, and a colouring matter of the nature of an organic acid was present in the alcoholic extracts, precipitated by acids, and redissolving with the formation of an orange colour in alkalies.

A proximate analysis was made of the white calycine leaves, the fruits, the green leaves, and the mixed stem and root barks. On comparing these results, there is seen to be a correspondence on the one hand between the composition of the calycine leaves and fruits, and on the other hand between that of the green leaves and bark,—results which might naturally be expected, seeing that the calycine leaf is merely an expansion of the ovary-coat, and the leaves act the part of elaborating principles to be stored up in the bark and root.

	Calycine leaves.	Fruit.	Leaves.	Bark.
Ether extract	4·3	8·8	5·0	15·7
Alcoholic „	28·7	27·3	15·1	17·3
Aqueous „	11·5	13·4	13·8	9·4
Crude fibre	32·4	33·2	38·3	39·3
Albumen, &c. by difference	15·1	8·5	16·4	7·0
Ash.....	8·0	8·8	11·4	11·3
	100·0	100·0	100·0	100·0

The bark contained the largest quantity of ether-soluble resin, which was yellow, opaque, tasteless and very tenacious. In the leaves the resin was associated with a fat, and in the calycine leaves with a wax. The fruits and calycine leaves contained larger quantities of sugar than other parts of the plant, as seen in the figures for the alcoholic extracts. The aqueous extracts contained mucilage and colouring matter, the former predominating in the leaves and fruits. The

albuminous matter was most abundant in the expanded parts of the plant.

The fruits were specially examined for alkaloids, but with negative results; they were much more bitter and acrid than the leaves, and would not be acceptable as an article of diet. Notice has recently been taken of an article called "Mussænda coffee" found in the isle of Réunion; but an investigation of the subject proved that the fruits and seeds were those of *Gærtnera vaginata*, a loganiaceous plant, and that chemically they were destitute of an alkaloid. (*Kew Bulletin*, December 1889).

RANDIA DUMETORUM, *Lam.*

Fig.—*Lam. Ill. t.* 156, *f.* 4; *Wight Ic. t.* 580; *Roxb. Cor. Pl. t.* 136.

Hab.— Throughout India. The fruit.

Vernacular.— Mainphal, Mindhla, Pinda (*Hind.*), Mindhal (*Guz.*), Gela, Gelaphal, Peralu (*Mar.*), Menphal (*Beng.*), Maruk-kallán-kai (*Tam.*), Mangáre-bongáre (*Can.*).

History, Uses, &c.—Mainphal is described by Sanskrit writers under the name of Madana as pungent and dry, and beneficial in leprosy and phlegmatic swellings, the best or safest of emetics; one ripe fruit is said to be a sufficient dose; emesis is generally promoted by a drink containing bitters and aromatics. It is indispensable at the marriage ceremonies of the Vaisya caste, being tied upon the wrists of both bride and bridegroom along with the fruit of *Helicteres Isora*. The Mahometan physicians of India have adopted it as a substitute for the Jouz-el-kai of the Arabs; they describe it as an emetic which expels bile and phlegm, at the same time acting as an aperient; it should be administered in combination with aromatics and honey. Ainslie says:—"The Vytians consider it amongst their best emetics, and prescribe it in the quantity of about one pagoda weight. It is given commonly in the form of powder, the whole nut, seeds included, being powdered." An infusion of the bark of the root is administered to nauseate in

bowel complaints. Roxburgh in his Coromandel Plants observes that the nut bruised and thrown into pools where there are fish intoxicates them, in the same way that *Cocculus Indicus* does. This practice may be observed in the Concan, where the fruit is well-known as a fish-poison, and is also mixed with corn to preserve it from insects. Mr. Moidín Sheriff, in his *Supplement to the Pharmacopœia of India*, says:—"It is certainly not a good emetic if used as is generally done by powdering the whole nut. The thick shell and the numerous hard seeds are not emetic at all; indeed, if anything they are slightly irritant; only the dry pulp or mucus, which is the least part of the nut, possesses emetic and nauseant properties. The contents of two to three nuts are generally a sufficient dose; they should be bruised, macerated for ten or fifteen minutes in three to four ounces of water, rubbed and strained through cloth. The draught is now ready for use, and produces nausea and vomiting in about ten minutes; emesis should be promoted by the administration of warm water. The ejected matter contains a large quantity of frothy mucus." Mr. Sheriff has found the drug a good substitute for Ipecacuanha in dysentery. He recommends the powdered pulp as the most convenient form for administration. Dose, 40 grains as an emetic; 15 to 30 grains in dysentery, according to the severity of the disease. In colic the fruit is rubbed to a paste with rice water and applied over the navel.

Description.—The dried fruit is about the size of a crab apple, globular or oval, reddish brown, crowned with the rim of the calyx, and in a fresh state has a strong odour of recently tanned leather. It consists of a pericarp and shell, which contains the seeds embedded in pulp. The shell is hard and thick, 2-celled, the dividing septum being thin and membranous. The pulp is grey, and has a nauseous taste and smell. The seeds are small and oblong, about 1½ lines in length, slightly flattened, very hard and of a brown colour, and 100 on an average are contained in each fruit. The average weight of the fruit is about 60 grains, of the pulp separated from the seeds 15 grains.

Microscopic structure.—The greyish pulp surrounding the seeds is composed of large oval cells containing a little granular matter. The pulp of the pericarp is remarkable for numerous large reddish-brown stony cells. The epidermis is formed of tessalated cells of irregular size and shape. The albumen of the seeds is horny and translucent.

Chemical composition.—The active principle of the fruits is saponin, which forms a large proportion of the pulp surrounding the seeds. The fresh pulp was mixed with water and the juice expressed; the filtered liquor had the following properties:—It was acid in reaction and very frothy, it gave opaque white precipitates with diluted mineral acids, a greenish colour and transparent jelly with ferric chloride, a yellow colour with caustic soda, no reaction with iodine, and no precipitate with two volumes of rectified spirit. Acetate of lead caused such a thick mixture as to allow the vessel to be inverted without the contents flowing out. A measured quantity of the solution, representing a weighed quantity of the dried pulp, was boiled for one hour with dilute HCl, after which the insoluble sapogenin was weighed and the increase of glucose was determined in the filtrate. Calculations from these results showed that the pulp contained about one-third its weight of saponin, and that on an average about four grains of this principle existed in each fruit.

An extract was also obtained by exhausting the pulp with hot spirit and evaporating the united liquors to dryness. This extract was soluble in water, except a little waxy matter, and the solution was acid and frothy. It gave a green coloration with ferric chloride, turning red with ammonia, yellow precipitates with barium hydrate and the acetates of lead, a red colour with caustic soda, and negative reactions with gelatine and iodine solutions and alkaloidal tests. This solution gave a precipitate when boiled with dilute acid, and showed an increase in glucose corresponding with that obtained in the decomposition of saponin. Evaporated portions of the solution produced a purple colour in contact with strong sulphuric acid.

The pericarp contained some of the principles peculiar to the pulp, such as saponin, wax, resin and colouring matter, and in addition a volatile odorous body of the nature of a soluble fatty acid, which was obtained by distillation and formed soluble salts with silver and barium. A portion of the distillate was neutralized with caustic soda, and carefully evaporated to dryness. The residue was crystalline, deliquescent, soluble in rectified spirit, and sweetish to the taste; treated with sulphuric acid the odour of valeric acid was liberated, and this acid no doubt existed in the pericarps of the fresh fruits in a free state.

The unripe fruits of **Randia uliginosa**, *DC., Wight Ic. t.* 397, are astringent; roasted in hot ashes they are used as a domestic remedy for diarrhœa and dysentery. When ripe they are cooked and eaten as a vegetable. They are of a yellow colour, and have the appearance of a small pear. The structure of the fruit is similar to that of *R. dumetorum*. It is called Pindálu or Pedalu in Hindi, Pinglu in Guzarathi, Chuvadialu or Piralu in Bengali, Pendhári Pendhru or Péndhar in Marathi, Nalaika in Telugu, Wagata in Tamil, Karé in Canarese, and Pindálu or Pindáluka in Sanskrit; and is described as sweet, cooling, and diuretic.

GARDENIA GUMMIFERA, *Linn. f.*

Fig.—*Thunb. diss. Gard., t.* 2, *f.* 3.

Hab.—Western Peninsula, Chittagong, Burma. The resinous exudation.

Vernacular.—Dikamáli (*Hind., Guz.*), Dikémáli (*Mar., Can.*), Kumbai, Dikamali (*Tam.*), Tella-manga, Chiaka-ringuva (*Tel.*).

History, Uses, &c.—This remarkable substance is supposed to be the Nadi-hingu, Hingu-nádika or Pindahva of Sanskrit writers, and is used by the Hindus in fever, dyspepsia, flatulence, and chronic skin diseases. In veterinary practice, it is much used to keep flies from sores, and some European physicians have used it to expel round worms with success.

G. lucida yields a similar exudation, and Roxburgh states that the fruit of *G. campanulata* is used as a cathartic and anthelmintic, and to remove stains from silk. In the Concan, the root of *G. florida*, rubbed into a paste with water, is applied to the top of the head as a remedy for headache during pregnancy, and is also given internally in hysteria, alone, or combined with *Bharangi* (*Clerodendron serratum*).

Description.—Commercial Dikamali occurs in the form of irregular flat cakes, of a dull olive green colour, more or less mixed with bark, sticks, and the leaf-buds of the plant. The odour is peculiar and offensive, like that of cat's urine. The resinous exudation, if carefully collected from the leaf-buds, is transparent and of a bright golden yellow; it dissolves rapidly in rectified spirit, forming a solution of the colour of pale sherry, which, when poured into water, forms a delicate primrose-coloured emulsion. This after standing for 24 hours deposits a portion of the resin in an opaque condition, and of the colour of precipitated sulphur, but not in sufficient quantity to visibly affect the colour or opacity of the emulsion.

Chemical composition.—Dikamáli contains two resins, one soft and of a greenish colour, the other crystalline and of a golden yellow. The latter was discovered by Stenhouse (*Phil. Trans.* 1856, *CXLVI.*, 155, and *Ann. Chem. Pharm. XCVIII.*, 316), but the amount of *gardenin* obtained at that time was insufficient for a satisfactory analysis. Stenhouse and Groves operating with a larger quantity of the resin found that the best method of obtaining the crude gardenin was to boil the resin with alcohol, filter the solution to separate the insoluble residue, consisting chiefly of small fragments of bark and wood, and allow it to cool. It then deposited almost the whole of the gardenin in slender pale yellow needles, which were collected and washed with cold spirit, to free them from the amorphous greenish yellow resin, which forms by far the larger portion of Dikamáli gum. These needles, however, even after several crystallizations from alcohol, were found to be still impure, being contaminated with a colourless substance

of low-melting point, somewhat resembling a fat in appearance. After repeated trials in various ways, it was found that this impurity might be removed by means of light petroleum. A boiling saturated solution of the gardenin in alcohol was allowed to cool, and the almost pasty mass of crystals was agitated with light petroleum at a temperature of about 30°, the clear liquid poured off, and the residue again agitated with petroleum, repeating the operation several times. The gardenin was finally purified by alternate crystallization from hot benzine in which it is readily soluble, and from alcohol.

When pure, gardenin forms brilliant deep yellow crystals, which melt at 163° to 164°. Dried at 100°, and burnt in a current of oxygen, it gave the following results:—

I. 0·249 gram. of substance gave 0·567 gram. carbonic anhydride, and 0·119 gram. of water.

II. 0·202 gram. of substance gave 0·457 gram. carbonic anhydride, and 0·102 gram. of water.

		Theory	I.	II.	Mean.	Flückiger.
C5	60	61·86	62·12	61·70	61·91	59·47
H5	5	5·16	5·31	5·60	5·45	6·71
O2	32	32·98	.....	.....	.....	.....
	97	100·00				

Flückiger's numbers do not agree with these, but as the specimen he analysed had merely been purified by repeated crystallization from spirit, it is not impossible that it was contaminated with traces of the colourless fatty substance mentioned above. This is rendered very probable by the much lower melting point (155°) which he obtained. It was stated in the earlier paper (Stenhouse *loc. cit.*), that when gardenin is digested with concentrated nitric acid, it is rapidly decomposed, picric acid, but no oxalic acid, being produced. On repeating the experiment, however, this statement was found to be incorrect; gardenin when boiled with nitric acid, dissolves with evolution of nitrous fumes, forming a yellow solution, which on evaporation leaves a yellowish residue; this, however, on careful examination, proved to be quite free from

trinitrophenol. It was noticed in making this experiment, that at the moment the gardenin came in contact with the nitric acid, it assumed a brilliant crimson colour before dissolving. The attempts made to isolate the red substance thus formed were ultimately successful; one part of gardenin was dissolved in about thirty times its weight of boiling glacial acetic acid, and after being rapidly cooled two parts of nitric acid of sp. gr. 1·45 were added to the clear solution. In a few seconds hair-like crimson needles began to form, very different in appearance from gardenin. At the expiration of five minutes, the mixture, which was kept cold, had solidified to a pulp of needles. It was then mixed with about 150 parts of cold water, and the gelatinous precipitate collected after it had stood a few minutes. The pasty red mass, after being well washed, was pressed into a cake and dried. Gardenin yields nearly 90 per cent. of its weight of this substance, which is insoluble in water and dilute acids, but readily soluble in alkaline solutions, and reprecipitated on the addition of an acid. It has been provisionally named *gardenic acid*. It is free from nitrogen, and after being purified by boiling with spirit, in which it is but very slightly soluble, and crystallization from glacial acetic acid, it was found to melt at about 236°. (*Phar. Jour. and Trans., July 21st*, 1877.)

Commerce.—Dikamáli is collected by hand, the leaf bud with the drop of resin attached to it being broken off. It is sometimes made into circular cakes of about a pound weight; at other times it occurs in large irregular masses, often very impure. Value, Rs. 3-12 per maund of 37½ lbs.

Canthium parviflorum, *Lam.*, a small thorny shrub of the Western Peninsula and Ceylon, called *Kirni* in Marathi and *Karai-cheddi* in Tamil, is noticed by Ainslie as having medicinal properties. He says:—"A decoction of the edible leaves, as well as root of this plant, is prescribed in certain stages of flux, and the last is supposed to have anthelmintic qualities, though neither have much sensible taste or smell." (*Mat. Ind. ii.*, 63.) This shrub is best known for its edible

fruit, which is an obovate compressed drupe of a reddish-brown colour about the size of a horse bean; it is sweet, and contains two seeds.

Canthium didymum, *Roxb. Mallea, Varsangi* (*Mar. Naum-pápala* (*Tel.*), has leaves which smell like coriander. The pounded bark is applied by the natives to fractures.

These plants have really little, if any, medicinal qualities.

Vangueria spinosa, *Roxb.*, is the *Pinda* and *Pinditaka* of Sanskrit writers, who consider the fruit to be medicinal, and describe it as strengthening, cooling, and an expellant of phlegm and bile. It is a small tree or large bush, common in many parts of India, from Northern Bengal to Canara, which bears cymes of greenish flowers; the fruit is a drupe, the size of a cherry, of a yellow colour when ripe, subglobose or turbinate, smooth and fleshy, pyrenes 4 to 5, woody, smooth.

The vernacular names are Pundrika, Pinditak (*Hind.*), Mayna (*Beng.*), Pedda-manga (*Tam.*), Vadanike, Chega-gadda (*Tel.*), Chircholi, Madanvriksh (*Mar.*), Maggare-gida (*Can.*).

PAVETTA INDICA, *Linn.*

Fig.— *Rheede Hort. Mal. v., t.* 10; *Wight Ic., t.* 148.

Hab.— Throughout India. The root and leaves.

Vernacular.—Kukura-chura (*Beng.*), Pápari, Kankra (*Hind.*), Pavuttay-vayr (*Tam.*), Páputta-vayroo (*Tel.*), Pápadi (*Mar.*), Pappadi (*Can.*).

History, Uses, &c.—This shrub, which is common on hilly ground, is called Pápata and Tiryakphala in Sanskrit. It is the Malleamothe of Rheede, who says that the leaves are used as manure, and a decoction of them as a fomentation, and that the root with ginger is given in dropsy. Ainslie says:— "This is a bitter but not unpleasant tasted root, possessing at the same time aperient qualities, and is one of those medicines commonly prescribed by the native doctors in visceral obstruc-

tion; given in powder to children, the dose is about a drachm or more.

Description.—The root is crooked, from 1 inch to ¼ inch in diameter. The bark is grey, with a light brown papery epidermis, and seems to be the most active part. It has a sweetish aromatic taste followed by a bitterness. A section placed under the miscroscope shows large laticiferous vessels, containing a greenish latex, and a parenchymatous structure containing many small starch granules. It is not an article of commerce.

Chemical composition.—The powder gave off a pleasant odour when boiled with water, and a greenish resinous scum separated on the surface of the liquid. The decoction showed the presence of starch, the absence of tannin, and contained a coloured organic acid. Alcohol removed the active bitter principle of the root, and after separating the resin by precipitation with water, the solution when evaporated was perfectly crystalline. The residue was insoluble in ether, but boiling chloroform formed with it a solution from which the bitter principle separated on cooling in white transparent needle-shaped crystals. These crystals were very soluble in water and alcohol, and reduced Fehling's reagent. With sulphuric acid they turned reddish brown, changing to violet; with Fröhde's reagent crimson, changing to green. Warmed with diluted sulphuric acid and potassium bichromate they gave off the odour of salicylol. They melted at 120° C. to an amber-coloured liquid, at a higher temperature to a rich red-brown colour, further heating carbonized them, and inflammable smoky vapours were given off leaving no ash. This bitter glucoside is closely related to salicin, but differs from that substance in its optical inactivity and its greater solubility in water.

IXORA COCCINEA, *Linn.*

Fig.—*Wight Ic., t.* 153; *Bot. Reg.* 513 *and* 154, Jungle Geranium (*Eng.*).

Hab.—Western Peninsula. Cultivated elsewhere.

Vernacular.—Rangan, Rajana (*Beng., Hind.*), Bakura, Pentgul (*Mar.*), Vitchie (*Tam.*).

History, Uses, &c.—The shrub is sacred to Shiva, and Don is probably correct in stating that the generic name is derived from that of a Malabar idol. The Sanskrit word Ishvara, which signifies god, and especially Shiva, would be written Ixora in Portuguese, and nothing can be more probable than that the first explorers of the Malabar Coast, on learning that the plant was sacred to Ishvara, should name it after that god. In Southern and Western India the Hindus use the bright red flowers, probably in accordance with the doctrine of signatures, as a remedy for dysentery. In the Concan they are fried in melted butter, rubbed down with a little cumin and nágkesar (cinnamon buds), and made into a bolus with butter and sugar-candy. In Southern India they are given with tyre or goat's milk. Rheede notices the use of the root in fever and gonorrhœa, also its external application in headache, and to boils, with or without cocoanut milk. The root was brought to the notice of the profession a few years ago as a remedy for dysentery by a medical man in Bengal, but Dr. F. Willis reports:—"I tried it in many cases, but only in a small number did I find it of any benefit, one case only was cured without other drugs; it is, however, a very good stomachic tonic, useful in cases of debility of that organ, and that I think is its proper place in therapeutics."

Description.—Root branched, ¼ inch or more in diameter; bark thick, smooth, brown, marked with small warty prominences, it exudes a yellow juice when cut; wood hard, yellowish; odour rancid and disagreeable. Commencing from the exterior the bark, when viewed under the microscope, presents several rows of brick-shaped cork cells of a brown colour; the parenchyma is loaded with starch cells, and permeated towards the inner part by yellow laticiferous vessels, just without these is an interrupted zone of yellow stone cells. The wood is porous with strongly marked medullary rays.

Chemical composition.—The root had no peculiar taste, but a slight odour of volatile fatty acids developed on boiling the powdered root with water. Ether separated a yellow oily

liquid, the aqueous solution of which was very acid and had an odour of butyric acid. A tincture of the root was red in colour, astringent to the taste, and very acid in reaction. Evaporated to dryness and heated with water, the solution gave evidence of a tannin by giving a green precipitate with ferric chloride, pinkish with gelatine and bulky brown with iodine. The insoluble portion yielded to petroleum spirit one or more fatty acids, liquid at 20° C., and the red precipitate insoluble in this medium was soluble in spirit and soda solution, and consisted of oxidized tannin. A white crystalline substance was associated with the tannin in the aqueous solution of the alcoholic extract, and gradually formed in small quantity when the evaporated solution was set aside for a few days. The flowers have the delicate odour of cinchona flowers, and contain a colouring and astringent principle of the nature of an organic acid. The red colour is imparted to water more readily than to alcohol, but the latter separates it in a purer condition. The aqueous solution is blackened by ferric chloride, precipitated by gelatine, destroyed in brilliancy by fixed alkalies and restored by acids. Ammonia renders the solution dichromatic, and lead acetate throws down the colouring matter as a greenish blue precipitate, containing 32·9 per cent. of oxide. Ether removes a wax and a yellow colouring matter related to quercitrin. Alcohol and water respectively remove from the drug the same amount of extract, namely, 30 per cent., consisting largely of saccharine matter. The astringent colouring matter occurred to the extent of 5·7 per cent., and the papers used in filtering the solutions retained a small quantity of the colour, which changed to blue by exposure to the air, and this paper acted as litmus in turning red with the least trace of acid. The ash was 6·4 per cent.

The flowers of **Ixora parviflora**, *Vahl.*, the Torch tree, pounded in milk, are given for whooping cough, and at the same time a necklace of the flowers is worn. This evergreen shrub or small tree is common in many parts of India, and the Dâk (Post office) runners make torches of it. The vernacular names are Kotha-gandhal (*Hind.*), Rangan (*Beng.*), Raikura

Mákadi (*Mar.*), Gorabikattige (*Can.*), Shulundu-kora (*Tam.*), Kachipadel (*Tel.*).

COFFEA ARABICA, *Linn.*

Fig.—*Bot. Mag., t.* 1303; *Bentl. and Trim.* 144. Coffee bush (*Eng.*), Cafeier (*Fr.*).

Hab.—Africa. Cultivated elsewhere. The seeds.

Vernacular.—Kahvah (*Arab., Ind. Bazars*). Corruptions of the English name are now in general use among the natives.

History, Uses, &c.—The plant is a native of tropical Africa; it grows gregariously in woods at an elevation of 1,000 to 2,000 feet or more. It is common in Abyssinia, whence it was introduced into Arabia by the Arabs, and through them the seeds became known to the Persians and Turks. The date of the introduction of coffee into Arabia is uncertain, the first Arabian writer who mentions *bunn* (coffee berries) is Firuzabadi in the Kámus, which work was, according to the original copy, written by himself, completed A.H. 768 (A.D. 1366). He describes *bunn* as a certain thing which is taken like the condiments termed بزر (murriye). Ibn-es-Simani says, "It is a thing reckoned among what are termed بزر قمح (kawámikh) which signifies the same as Murriye. The physician Dawood, says: "It is the produce of a certain tree in El Yemen, which grows to the height of about three cubits, on a stem of the thickness of the thumb, and has a white flower, which is succeeded by a berry, like the hazel nut; sometimes it is cut like beans; and sometimes, when it is divested of its covering, it divides into two halves: it has been proved to be good for alleviating humidities and cough and phlegm and defluxions, and for opening obstructions, and causing a flow of the urine: when roasted (and pounded or ground) and well cooked (*i.e.*, boiled in water), it is now commonly known by the name of قهوة (kahvah)." (*Lane, in Madd-el-Kamus.*) Kahvah in Arabic signifies 'wine' or 'that which causes appetite,' and, before coffee was known to the Arabs, was applied to some other stimulating drink (probably kât), which they were in the habit of

using. Coffee is not mentioned by Haji Zein-el-Attár, who wrote in A.D. 1368; consequently, it cannot have been known in Persia at that date. Though coffee was known to the Arabs as a medicine in the 14th century, coffee-drinking does not appear to have been practised until the early part of the 15th century, when, according to some authorities, Jamal-ed-deen Abu Abdulla Muhammad bin Said-ed-Dabáni, Kadi of Aden, returning from Abyssinia, where the practice is said to have existed from a very early date, introduced it at Aden, whence its use gradually spread through Arabia to Persia and Turkey. Another account of its introduction as a drink in Arabia is that the disciples of Sheik Abul Hasan Shadali, who had a cloister on the mountains of Yémen, being much worn out by fasting and constant vigils, accidentally ate some of the berries of a coffee bush, and finding them very refreshing, told the Sheik of their discovery, upon which he ordered them to use a decoction of the fruit as a drink. When first introduced the practice of coffee-drinking met with much opposition both in Arabia and Persia, and its use was prohibited by some of the Mahometan law doctors. A Persian rhymster says of it:

آن سیر رو کہ نام او قہوہ است .·. مانع النوم و قاطع الشہوہ است

i.e.—That black-faced drink called coffee is the preventer of sleep and destroyer of manhood. On the other hand, its admirers were not silent, as will be seen from the following lines:—

راحیست قہوہ روح فزا و کسل کسل .·. آرام جان و قوت اعضا و قوت دل

تقریب اجتماع جوانان پارسا .·. تفریح بخش خاطر پیران مضمحل

Coffee is a wine which induces a feeling of well-being and ease;
It soothes the mind and strengthens the limbs and heart.
It ministers to the pleasures of the youth of Persia,
And alleviates the pangs of decrepid old age.

According to Indian tradition the Coffee plant was introduced into Mysore by a Bábu or wandering monk, named Abu-din, who about A.D. 1650 came and took up his abode on the uninhabited hills in the Nugger division, named after him, and where he established a college, which still exists, endowed by the Government. It is said that he brought seven

coffee berries from Mocha, which he planted near his hermitage, about which are now to be seen some very old coffee plants. (*Drury.*)

Coffee-drinking was introduced into India by the Persian invaders, but its use appears to have been confined for a long time to the entourage of the Moghal Court, as Linschoten, who was in India from 1576 to 1590, does not mention the berry among the articles of trade found in the Portuguese Settlements in the East. Rauwolff is the first European writer who notices it, having observed its use at Aleppo in 1573. In 1592, Prosper Alpinus published a figure and description of the plant from a cultivated specimen he saw in a garden in Egypt. For some time after this, Cahué, Coffa, or Kauhi as it is written in an Arabic and English pamphlet printed at Oxford in 1659, appears to have been known by name only to the learned in Europe, as Burton in his *Anatomy of Melancholy*, which was published in 1621, says, "The Turks have a drink called coffee (for they use no wine), so named of a berry as black as soot, and as bitter (like the black drink which was in use amongst the Lacedæmonians, and perhaps the same), which they sip still of, and sup as warm as they can suffer," &c.

Coffee-drinking began to be practised in Western Europe by Turkey merchants in 1650, and in 1652 it was introduced into London, when one Pasqua Rosee, the Greek servant of a Turkey merchant named Edwards, opened a house to sell it publicly in St. Michael's Alley, Cornhill. There appears to have been much prejudice for a long time against *the Turkish berry as black as soot and as bitter*, as in 1663 a poetical satire, entitled "*A Cup of Coffee or Coffee in its colours*," appeared, in which it is stigmatized as—

> "A loathsome potion, not yet understood,
> Syrop of soot, or essence of old shoes,
> Dasht with diurnals and the book of news."

And in the "Women's Petition against Coffee," 1674, they complained that "it made men as unfruitful as the desert whence that unhappy berry is said to be brought." As late as 1711, we find the following passage in a letter written by

Charlotte Elizabeth from Marly to her step-sister in Germany: "I am grieved to learn, dear Louise, that you have taken to coffee; nothing is so unhealthy, and I see many here who have had to give it up because of the diseases it has brought upon them. The princess of Hanan died of it in frightful sufferings. After her death they found the coffee in her stomach, where it had caused several ulcers. Let this then be a warning to you."

Coffee is cultivated by the Arabs in the lower valleys of the mountains of Yemen, the plant is watered regularly morning and evening, and takes three years to arrive at maturity, when it forms a shrub from 7 to 11 feet in height. A good bush of *Oudanee* coffee produces 28 lbs. yearly. The beans are brought in December and January to Sanaa, from the surrounding districts. They are divided into seven classes, as *sherjee*, the best; *oudanee*, the largest, &c. From Sanaa they are carried to Mocha and Hodeida. The people of Sanaa never use the coffee bean, but employ the husk, which they call "*Khishr*," and which is prepared in the same manner; they say that the bean is too heating, but that kishr is an infallible remedy for all disorders. (*C. J. Cruttenden, Trans. Bom. Geograph Soc. ii.*, 45, 1836.) Cruttenden notices the difficulty experienced by the merchants in forwarding their coffee to Mocha, owing to the Turks having taken possession of the Tehama, and shortly afterwards we find that the trade was to a great extent transferred to Aden.

The Dutch were the first European people to grow the plant at the end of the 17th century at Batavia from Arabian seeds. In 1690 one of these was sent to Witsen at Amsterdam, and the plant soon became known in European gardens. The Dutch also imported the plant into the New World, the first coffee being grown at Surinam in 1718, whence in 1725 it was secretly carried to Cayenne by the French. Its introduction into the West Indies appears to be due to a French naval officer, who in 1720 or 1723 brought the plant to Martinique.

At the present time coffee is cultivated in nearly all tropical and subtropical countries. The berries of some other species

are used, especially those of *C. liberica*, Hiern., from the West Coast of Africa. It is a larger and more robust plant, and flourishes at a lower elevation than *C. arabica*; its berries also are larger. Coffee leaves are preferred by the natives of Sumatra to the berries; with boiling water they afford a transparent, brown infusion, which when made sufficiently strong is by no means unpalatable. For full particulars, see *Hanbury Science Papers, p.* 84.

Coffee is prepared in the East from the freshly-roasted berries crushed in a mortar and boiled in water; as soon as the water boils the decoction is ready for use and is taken without sugar or milk in small cups (finján) about the size of a large egg cup, and a glass of cold sherbet is taken immediately after it. It contains therefore hardly any of the caffeine, and its virtues almost entirely depend upon the aromatic products produced during the process of roasting. Coffee prepared in this manner or by a rapid process of infusion produces mental exhilaration, physical activity, and wakefulness. Jomand says, "One hundred and twenty grams of powdered coffee and 3 litres of an infusion made with 200 grams of different kinds of coffee enabled me to live for five consecutive days without lessening my ordinary occupations, and to use more and more prolonged muscular exercise than I was accustomed to, without any other physical injury than a slight degree of fatigue and a little loss of flesh." It appears to us highly probable that all the effects which are stated to be produced by the use of Kola seeds would also be induced by the consumption of coffee berries. Comparative experiments are certainly worth trying.

It has been proved by experiment that under the influence of coffee the amount of blood circulating in the brain is reduced, but that it is brought to the nerve tissues under increased pressure, hence assimilation of nutritive material should be increased in rapidity if lessened in quantity. Prolonged mental labour produces cerebral congestion and drowsiness, it is this condition apparently which coffee corrects by contracting the blood-vessels and lessening the amount of blood in the brain. Coffee like other stimulants quickens gastric digestion, stimulates the

secretion of bile, and by augmenting the peristaltic action of the intestine, promotes defecation; but if taken in excess, it paralyzes the digestive function, and causes venous congestion of the liver, constipation and hæmorrhoids. Coffee is often a useful stimulant in asthma, narcotism, delirium tremens, and during convalescence. Experiments upon animals have shown that coffee and caffeine are direct physiological antidotes to morphia. Coffee and caffeine have been used as diuretics in dropsy. Dr. von Schrœder of Strasburg, from experiments which he has made, arrives at the conclusion that caffeine acts powerfully and energetically upon the renal secretion by direct stimulation of the secretory apparatus, but it may also so affect the vaso-motor centres as to diminish the urinary secretion. In order to eliminate the action of the vaso-motor centres upon the secretory apparatus, Schrœder paralysed these centres in animals by means of chloral hydrate. The result was a marked lowering of blood tension. A rabbit of two kilos weight was narcotised with chloral, and canulas introduced into the ureters. Within 70 minutes 50 centigrams of caffeine was injected by three separate operations into the veins. The quantity of urine secreted during this time was about eleven times greater than under normal conditions. Here the caffeine appeared to act directly upon the renal epithelium. To demonstrate this more clearly, Schrœder cut the nerves of one kidney, leaving those of the other intact. All vaso-motor influence over one kidney was thus prevented, while to preserve it intact over the other, the animal was narcotised with morphia before the experiment. When caffeine was now introduced into the blood of the rabbit, there was a much greater urinary secretion from the kidney, the nerves of which had been divided, than from the other.

The diuretic action of caffeine has hitherto been misunderstood owing to the double influence which it exerts, *viz.*, excitation of the nerve centres like strychnia, and stimulation of the secretory elements of the kidney, the latter being often completely neutralised by the former. Schrœder compares this double action of caffeine to that of pilocarpine. Small

quantities of these alkaloids are sufficient to cause a specific secretion. He considers that the action of caffeine demonstrates the glandular nature of the kidney and shows that it is not a simple filter. (*Nouveaux Remèdes, Mars* 24, 1887.)

To illustrate the toxical effects of coffee, the following examples may suffice: Fifty minutes after taking a drachm of citrate of caffeine a burning sensation in the throat was complained of, and giddiness with vomiting, purging, and abdominal pain. General paresis with tremor ensued, followed by collapse, but the mind remained clear (*Routh, Practitioner*, xxxi., 48). Fort took an infusion of eight ounces of coffee in a quart of water in the course of a day. The pulse rose to 114, sleep was impossible, muscular spasms occurred all over the body, and were very painful in the extremities, chest, and throat. The tongue was dry, there was nausea with frequent liquid stools, and the pulse ranged from 110 to 114, and was intermittent. The next day there was headache and anorexia. (*Bull. de Thérap., civ.* 350.) The experiments of Lüderitz upon cultivations of various bacteria (*Berl. Klin. Wchenschr.*, 1890,) show that tincture of coffee possesses marked antiseptic properties. These properties cannot be due to caffeine, which has little effect as a germicide, the tannin may exert some influence, but it is probably the products formed during roasting which are the most active agents. It is remarkable that a cup of coffee may be exposed to the air in a room for a week or two without the appearance of any micro-organisms in it.

Description.—The seeds are oval, longitudinally grooved upon the flat side, usually almost completely deprived of the parchment-like, finely-wrinkled testa, fragments of which remain in the groove and sometimes upon the back. The horny albumen is of the shape of the seed, according to the variety, of a yellowish, brownish, bluish, or greenish tint, and is folded, or rather rolled up, whereby the groove is produced. The embryo is situated under the convex side near one end, is slightly curved, and occupies about one-fourth the length of the seed. Raw coffee has a very faint odour and a sweetish,

slightly astringent, and bitterish taste. The commercial varieties vary considerably in flavour, in size, and in the shade of colour. On keeping, coffee loses during the first year about 8 per cent. in weight, principally moisture; during the second, 5 per cent., and during the third year 2 per cent., the flavour being at the same time greatly improved.

In Mocha coffee the seed is often quite ovoid, only a single grain being contained in each fruit.

Chemical composition.—The sweetish pulp of the pericarp contains several sugars, of which Boussingault (1881) found 2·37 per cent. cane-sugar, 8·73 per cent. invert-sugar, and 2·21 per cent. mannit. According to Payen's analysis (1849), coffee contains 13 per cent. of fat, 15·5 of glucose, dextrin, and an undetermined vegetable acid, 10 of vegetable casein, 5 of chlorogenate of caffeine and potassium, 3 of nitrogenized principle, 0·8 of caffeine, 0·001 of solid volatile oil, 0·002 of liquid aromatic principle soluble in water, 6·7 of ash, and 1 of moisture, the remainder being cellulose. The fat consists of palmitin and olein. The acids contained in coffee have been the subject of repeated investigations. These render it probable that, besides a little citric acid, the principal one is *caffeo-tannic acid*, which, according to Rochleder, is Payen's *chlorogenic acid*; its precipitate with gelatin is soluble in the tannin solution; tartar emetic does not precipitate it, but it yields with lead salts and baryta solution yellow precipitates. Vlaanderen and Mulder (1855) separated this principle under the name of *caffeic acid*, and regard the other acids of coffee (*caffeanic*, *cærulic*, and *caffeelic*) as products of oxidation; and they believe the various colours of raw coffee to be due to mixtures of these derivatives. They consider chlorogenic as a mixture of their caffeic and cœrulic acids; Rochleder's *viridinic acid* (1848) may be a similar mixture. The *caffeic acid* of Hlasiwetz (1867) is obtained by continued boiling of caffeo-tannin with excess of potassa solution and separation by sulphuric acid. When pure it has the composition $C^9H^8O^4$, is in straw-yellow crystals, forms mostly yellow-coloured salts, and, like the amorphous gum-like caffeo-tannin, yields with fusing potassa protocatechuic

acid, $C^7H^6O^4$. By dry distillation pyrocatechin is obtained. Zwenger and Siebert (1861) obtained from Java coffee 0·3 per cent. of kinic acid, which is most likely the coffeic acid of Stenhouse, obtained (1854) from coffee-leaves, and which readily yielded kinone when treated with manganic deutoxide and sulphuric acid. (*Stillé and Maisch.*) König and others have obtained the following results from the analysis of coffee from four various sources :—

	König.		Payen.	Smethan. Roasted average of seven varieties.
	Raw.	Roasted.	Raw.	
Substances soluble in water.	27·44	27·45	.....	
Nitrogen	1·87	2·31	.....	2·26
Nitrogenous matter	11·43	12·05	11· to 13	
Caffeine	1·18	1·38	·8	
Caffetannic acid	...	...	3·5 to 5·	
Fat	13·23	15·03	10· to 13·	10·99
Ethereal oil	...	...	·013	
Sugar	3·25	1·32	.....	
Sugar and dextrin	...	...	15·5	
Other nitrogenous matter ...	31·52	38·41	.....	
Cellulose	27·72	24 27	34·	29·28
Ash	3·48	3·75	0·7	4·19
Soluble ash	...	...	.....	3·37
Moisture	11·19	3·19	12·	2·87

For information regarding the composition of various coffee substitutes, the reader is referred to König's work already quoted and to Battershall's Food Adulteration.

The roasting of coffee, which is best accomplished at a temperature of about 250° C., renders the seeds pulverizable, and at the same time gives them a more agreeable taste and enables them to yield more of their constituents to water. The coffee thus acquires a chestnut-brown colour and loses about 18 per cent. of its weight. The generation of gaseous compounds ruptures the cells, and a peculiar and agreeable aroma is produced, probably through the decomposition of the fat and

tannin. But Payen's (as well as Rochleder's) investigations failed to point out the principle to which the changes are due. Very probably they depend upon the decomposition of several of the organic compounds and unquestionably upon the production of a pyrogenated volatile oil, to which the grateful aroma is due. Caffeine does not partake of these changes, except that it is slowly volatilized at the temperature stated; hence the roasting of coffee ought to be effected in closed vessels. Bernheimer (1880) found nearly one-half of the products of roasting to consist of palmitic acid, the remainder being acetic acid, carbonic acid, probably acetone, hydroquinone, pyrrol, methylamine, ·18 to ·21 per cent. caffeine, and ·04 or ·05 *coffeol*, $C^9H^{10}O^2$, to which the aroma of coffee is due; it is an oil boiling at 195° C. (383° F.), and is probably a methyl ether of saligenin. (*Stillé and Maisch.*)

The extract from roasted coffee, mean of eight analyses, had the following composition: 100 parts of coffee yielded to water 25·50 per cent. of extractive, containing ·5 per cent. nitrogen, 5·18 per cent. oil, 13·14 per cent. non-nitrogenous matter and 4·06 per cent. ash. (*König.*)

Mocha coffee yields as much as 7·84 per cent. of ash—consisting chiefly of carbonates and phosphates of potassium, sodium, magnesium, and calcium, the earthy salts amounting to one-seventh or one-sixth of the weight.

The percentage of caffeine contained in raw coffee has been variously stated by different chemists to range from 0·23 (Liebig) to 2·00 (Allen.) Paul and Cownley (*Pharm. Journ., Jan. and Feb.* 1887,) have, however, after examining fourteen different samples of raw coffee dried at 100° C., obtained the following very uniform results:—

Kind of Coffee.	Moisture, p. 100.	Caffeine, p. 100
Coorg	8·0	1·20
Guatemala	8·6	1·29
Travancore	10·0	1·29
Liberia (1)	8·0	1·30
„ (2)	8·0	1·39
Rio	9·1	1·20

Kind of Coffee.	Moisture, p. 100	Caffeine, p. 100.
Santos, Brazil	9·0	1·29
Manilla	6·6	1·20
Ceylon	6·2	1·24
Perak	7·3	1·22
Costa-Rica	7·2	1·24
Jamaica (pale)	8·7	1·21
Do. (2)	9·0	1·28
Mysore	8·0	1·28

The process for the extraction of the caffeine used by Paul and Cownley was the following:—The coffee in fine powder was mixed with moist lime and exhausted by alcohol in a Waitt's percolator. After removal of the alcohol the dry residue was mixed with a small quantity of water, acidulated by sulphuric acid to convert into sulphate the trace of lime present. After filtration the liquid was shaken with chloroform, and on the evaporation of the chloroform the caffeine was obtained in a crystalline state.

Commerce.—The coffee-cultivating region is Southern India; it supplies most of the coffee consumed in India, and before the coffee blight (which is caused by a fungus, *Hemileia vastatrix*, spreading over the leaves and destroying their functions) it exported large quantities to other countries, as the following figures will show:—

Official years.	Quantities in Cwts.	Value in Rupees.
1878–79	341,186	1,54,36,427
1879–80	359,313	1,62,67,465
1880–81	869,357	1,59,96,688
1881–82	346,364	1,44,74,650
1882–83	353,824	1,39,22,040

Mocha coffee is imported into Bombay, where it fetches nearly double the price of Indian coffee.

Diplospora sphærocarpa *Dalz. Hook. in Kew Journ. ii., p.* 257.

The berries of this tree, growing on the Western Ghauts, are known as "wild Coffee," and, when ripening, are eaten largely by birds and jackals, but they have not been known to be used

as a substitute for coffee either by the natives or European planters. The berries are from ½ to ¾ of an inch in diameter, and are crowned by the calycine areole. The seeds, numbering from 4 to 10, are arranged in a vertically imbricate manner in the sweetish pulp, they are round and flattened in shape, glossy on the surface, light-brown in colour and horny in consistence. The seeds turn dark brown when roasted, throwing off the parchment-like testa, and when powdered possess an aroma resembling that of coffee. The roasted and powdered seeds were submitted to Brig.-Gen. A. Kenney-Herbert, a great authority on Indian cookery, and he reported as follows.—"The percolated liquor had a remarkably pleasant taste, having a marked flavour of coffee. Indeed, the only difference I could detect was this:—The liquor was not so dark in tint as coffee, being more golden brown than dark brown, and the beverage brewed seemed not quite so strong as would have been produced by a similar quantity of coffee powder. There can be no doubt of the distinct coffee-like properties of this powder, and the absence of any twang or conflicting flavour to mar its pleasant taste.

The seeds contain an alkaloid, which can be separated in the same manner as caffeine, an astringent acid, an aromatic body, some fat, one or more sugars, and four per cent. of mineral matter. The dried extract obtained by boiling water is 16 per cent., or something less than that obtained from cultivated coffee berries.

MORINDA CITRIFOLIA, *Linn.*

Fig.—*Rheede Hort. Mal. i., t.* 52; *Wight Ill., t.* 126.

MORINDA TINCTORIA, *Roxb.*

Fig.—*Bedd. Fl. Sylv., t.* 220.

Hab.—Throughout India, wild or cultivated. The leaves and fruit.

Vernacular.—A'l, Atchi (*Hind.*), A'l, Baratondi, A'sa, Nagakuda (*Mar.*), Núna-maram (*Tam.*), Ach, Achhu (*Beng.*), Munja, Pavattari (*Tel.*), Maddi (*Can.*).

History, Uses, &c.—The roots of these plants, in Sanskrit Achchhuka, have long been in use as a red dye in India, and the leaves and fruit are used medicinally. A paste of the leaves combined with aromatics is given in diarrhœa and dysentery, and is also used as a tonic and febrifuge. The juice is used as an external application to relieve the pain of gout, and to promote the healing of sores. The fruit is considered to be deobstruent and emmenagogue, and when unripe is eaten as a vegetable in curries. Morinda is extensively cultivated in Malwa; it is sown broadcast or in drills, and the ground ploughed and harrowed. In from 15 to 20 days the seed comes up, the field is then weeded, and the ground stirred. This operation is repeated at intervals during the first year, and in the dry months (January to June) the ground is three or four times irrigated. After the first year no further care is required, and in the third year the plant begins to bear flowers and fruit. In the fourth year the plants are dug up in February and March; one beegah yields from 48 to 72 maunds of wet root, which is allowed to dry in the sun, and then separated into coarse, medium, and fine. A few plants are left for seed until six years old, when the fruit is gathered, placed in heaps, covered with straw and allowed to rot; the seed is then washed out. Wheat or other grain is cultivated between the trees. The root is exported to Guzerat and Hindustan. See *As. Research. iv. p* 40, where an account of the method of dyeing with the root will be found. The plant is also cultivated in Southern India.

Description.—*M. citrifolia* is a small tree with oval, oblong, smooth shining leaves, 10 to 12 inches long, and 4 to 5 inches broad, veins pale, and prominent on the under surface; flowers white, with a long infundibuliform corolla; fruit oblong, 3 inches or more in length, and composed of the succulent enlarged calyces, enclosing many cartilaginous 1-seeded pyrenes; it is of a pale yellowish green colour, and is marked with numerous circular scars; when quite ripe it has an extremely offensive odour like that of putrid cheese. The seeds are black and not unlike quince seeds. *M. tinctoria* is a larger tree, having leaves, flowers and fruit very similar to

M. citrifolia, but the fruit is smaller, and the leaves are pubescent and in one variety quite tomentose. Some botanists consider it to be the wild form of *M. citrifolia*. Morinda root has a reddish-brown nearly smooth bark, which has a nauseous slightly bitter flavour; the woody portion is hard and of an orange-yellow or reddish-yellow colour. The odour of the freshly dug root is acrid and disagreeable.

Chemical composition.—Anderson has obtained from the root-bark of *M. citrifolia* by exhausting it with alcohol a crystalline principle, *Morindin*, $C^{28}H^{30}O^{15}$, to the presence of which the dyeing properties of the plant are due; after repeated crystallizations from dilute alcohol morindin forms slender yellow needles of a satiny lustre, soluble in boiling water, which on cooling deposits it in gelatinous flakes. Alkalies form with morindin orange-red solutions. Heated in a closed vessel morindin melts, boils, and emits orange vapours, which on condensation form long orange-yellow needles of *Morindon* ($C^{15}H^{10}O^{5}$). Rochleder (*Jahresb. f.* 1851, *p.* 548,) considers morindin to be identical with the ruberithric acid which he has extracted from madder, and morindon to be identical with alizarin, but morindin differs from ruberithric acid in being insoluble in ether and in its behaviour with alkalies; like ruberithric acid it is a glucoside. (*Wurtz, Dict. de Chim., t. ii., p.* 454; *Edin. Phil. Trans., xvi., p.* 434.) Two papers on morindin and morindon will be found in the *Transactions of the Chemical Society* for 1887 and 1888 by Prof. T. E. Thorpe.

Commerce.—One sumai (bundle) of 450 seers or 270 lbs. is worth Rs. 15. The main root is 12 annas per maund, the small roots are more valuable and sell at Re. 1 to Re. 1-8 per maund.

PÆDERIA FŒTIDA, *Linn.*

Fig.—*Griff. Ic. Pl. As., t.* 479, *f.* 3; *Gärt. f. Fruct. iii. t.* 195.

Hab.—Central and Eastern Himalaya, Bengal, W. Peninsula. The plant.

Vernacular.—Gandhali (*Hind.*), Gandhabhâduli (*Beng.*), Hiranvel (*Mar.*), Gandhana (*Guz.*), Paedebiri (*Pahâriya*).

History, Uses, &c.—An article of the Hindu Materia Medica in repute as a remedy for rheumatism. The Sanskrit names are Prásárani, Apehi-vata, "expelling flatulence," and Gandha-bhádáliya. It is the *P. fœtida* of Willdenow (*Spec. I.*, 1219), the Somaráji of the *Asiatic Researches* (IV., 261), the *Convolvulus fœtidus* of Rumphius (*Amb. V.* 436, *t.* 160), and the *Apocynum fœtidum* of Burmannus (*Ind.*, p. 71). The plant is found in most parts of India and all through the Malayan Archipelago, extending from the Mauritius northward to China and Japan; in Assam it is called '*Bedoli Sutta*,' and in China '*Jung-gala*'; it has been lately brought to notice as a fibre-yielding plant; Roxburgh says that the Hindus use the root as an emetic. Rumphius describes it as emollient and carminative, and useful in colic, spasms, rheumatism and gout. Corre and Lejanne say that in Cochin-China it is used as an emetic under the name of *Toui dit.* As a specific in rheumatism, used both internally and externally, it is best known in Hindu medicine. Bháva Misra prescribes an electuary (Prasárani leha), which is made by boiling down a strong decoction of the plant with treacle to the consistence of a thick syrup, and then adding ginger, pepper and Plumbago root. In Chakradatta the method of preparing a liniment (Kubja prásárani taila) will be found. (*Dutt's Hindu Materia Medica, p.* 179.) In the Bombay Presidency the plant is found in the Southern Concan.

Description.—Stem ligneous, twining, young parts round, smooth; leaves opposite, long petioled, oblong-cordate, pretty smooth, entire; stipules broad-cordate; panicles axillary and terminal; flowers numerous, of a deep pink colour; bracts ovate; berry dry, compressed, smooth, with five lines on each side, one-celled, two-seeded; seed compressed, smooth, with a membranous ring all round. (*For fig. see Baillon's Nat. Hist., Vol. VII., p.* 274.) All parts of the plant give off a most offensive odour of bisulphide of carbon when bruised.

Chemical composition.—By distillation with water a volatile oil was obtained, which had the highly offensive odour of the

fresh drug. We also obtained evidence of the presence of at least two alkaloids; one was soluble in ether and was deposited in minute needles which assumed an arborescent form: the second alkaloidal principle was only slightly soluble in amylic alcohol, chloroform or benzene; we failed to obtain it in a crystalline form. No special colour reactions were obtained with either principle. We propose provisionally for these principles the names α and β *Pæderine*.

SPERMACOCE HISPIDA, *Linn.*

Fig.—*Rheede Hort. Mal. ix. t. 76; Burm. Thes. Zeylan. t. 20, f. 3.* Shaggy Button weed (*Eng.*).

Hab.—Throughout India. The roots.

Vernacular.—Madana-ghettu (*Tel.*), Nutti-churi (*Tam.*), Ghanti-chi-baji, Dhoti, Gondi (*Mar.*), Thardavel (*Mal.*), Madana-buntakadu (*Beng.*).

History, Uses, &c.—In Southern India the Sanskrit name of this plant is said to be Madanaghanta, and there is a Hindu myth that an oyster will open its shell if touched by the plant. The seeds are thought to be aphrodisiac, and the plant is prescribed to cure hæmorrhoids. Kirkpatrick says the seeds are cooling and demulcent, and are given in dysentery in doses of one pagoda. Rheede says of it: "Succus expressus cum butyro decoctus lienteriæ prodest." Ainslie states that it is used as an alterative and purifier of the blood like sarsaparilla, and is prescribed in decoction, the dose of which is four ounces or more daily. In the Concan it is eaten along with other herbs as a vegetable. According to Bélanger it is used as a tonic and stimulant in Martinique.

Description.—A procumbent, scabrous, or hirsute herb; root fibrous, annual or perennial; leaves obovate spathulate, oblong or elliptic, obtuse or acute, coriaceous, ½—1½ by ¼ to ¾ in.; flowers 4 to 6 in a whorl, blue or white; capsules hispid or pubescent; seeds oblong, granulate, opaque. In some forms of the plant the leaves have cartilaginous edges.

RUBIA TINCTORIUM, *Linn.*

Hab.—Cashmere, Sind, Afghanistan, Europe. The roots. Madder (*Eng.*), Garance (*Fr.*).

RUBIA CORDIFOLIA, *Linn.*

Fig.—*Wight Ic., t.* 187; *Dcne in Jacq. Voy. Bot.* 84, *t.* 92. Heart-leaved Madder (*Eng.*), Garance à feuilles cordiformes (*Fr.*).

Hab.—Throughout the hilly districts of India. The roots.

Vernacular.—Manjith, Majith (*Hind., Guz.*), Manjitti, Shevelli (*Tam.*), Manjishta, Tamra-valli (*Tel.*), Manjushta (*Can.*), Manjit (*Beng.*), Manjeshta (*Mar.*).

History, Uses, &c.—Madder is used in Hindu medicine as a colouring agent: medicated oils are boiled with madder to give them colour. It is also a useful external astringent, and is applied to inflamed parts, ulcers, fractures, &c. Chakradatta recommends madder rubbed with honey as an application to the brown spots of *pityriasis versicolor*. The Sanskrit name is Manjishtha. Under the names of Fuvvah and Rúnás, Arabic and Persian writers treat of madder, probably the produce of *R. tinctorium*.*

They do not, however, make any distinction between the species, but simply mention a wild and a cultivated variety. The Mahometans consider the drug to be deobstruent, and prescribe it in paralytic affections, jaundice, obstructions in the urinary passages and amenorrhœa.† They mention the fruit as useful in hepatic obstruction, and a paste made from the roots with honey, as a good application to freckles and other discolorations of the skin. The whole plant is reputed to be alexipharmic; it is also hung up in houses to

* The author of the Makhzan gives Rubia as the European, Dúzarlús as the Greek, and Albisam as the Latin name of madder. *Cf.* Pliny 19, 17; 24, 56, who calls it Rubia and Erythrodanus.

† Cf. Theophr. H. P. ix., 14.

avert the evil eye, and tied to the necks of animals with the same object.*

Ainslie observes that the hakíms are in the habit of prescribing an infusion of madder root as a grateful and deobstruent drink in cases of scanty lochial discharge after lying-in. (*Materia Indica II., p.* 182.) In another notice of the article (*Op. cit. I., p.* 202), he remarks that it would appear to be chiefly produced in Cachar, and the root is in great demand in the adjacent countries, for dyeing their coarse cloths and stuffs red; the Nepalese are in the habit of bartering it for rock salt and borax. Kinnier and Tavernier notice the abundance of madder in Persia and Makran. Dr. G. Playfair, in a note appended to his translation of the *Talíf-i-sharífí* (*p.* 150) states that if taken to the extent of about 3 drachms several times daily, it powerfully affects the nervous system, inducing temporary delirium, &c., with evident determination to the uterine system. *R. cordifolia* is common throughout the hilly districts of India, but the Bombay market draws its supplies chiefly from Khelat through Sind, where *R. tinctorium* is cultivated.

Description.—Madder root consists of a short stock, from which numerous cylindrical roots about the size of a quill diverge; these are covered by a thin brownish suber which peels off in flakes, disclosing a red-brown bark marked by longitudinal furrows. The taste is sweetish at first, afterwards acrid and bitter.

Chemical composition.—According to Bucholz, the constituents of madder are as follows:—Resinous red colouring matter 1·2, extractive ditto 39·0, reddish brown substance soluble in alcohol 1·9, pungent extractive 0·6, gummy matter 9·0, woody fibre 22·5, matter soluble in potash 4·6, salts of lime with colouring matter 1·8, water 12·0, loss 7·4. The colouring principles of *R. tinctorium* are *purpurin* and *alizarin*, while *R. cordifolia* yields purpurin and a yellow colouring

* Compare with Dioscorides iii., 151. περὶ ἐρυθροδάνου, and Pliny 19, 17; 24, 56.

principle called by Stenhouse *munjistin*: it is to this fact that the inferiority of the latter plant as a dye-stuff is due. According to Higgins, the roots of *R. cordifolia* yield from 50 to 55 per cent. of *garancin*, which has only half the dyeing power of garancin made from *R. tinctorium*. (*Calvert, Dyeing and Calico Printing.*)

The medical action of madder, if any, is probably due to the small quantity of acrid and resinous matter contained in it. For an account of the colouring materials, which are of great importance to the dyer, Ure's *Dictionary of Arts and Manufactures* and Watts' *Dictionary of Chemistry* may be consulted.

Commerce.—Madder from Sind fetches a higher price than that grown in India; it is shipped from Kárachí to the extent of about 1,500 tons annually, and is worth about Rs. 17 per cwt., nearly double the price of Persian madder. The imports of madder (chiefly Persian) into Bombay do not exceed 7,000 cwts. annually.

VALERIANEÆ.

NARDOSTACHYS JATAMANSI, *DC.*

Fig.—*DC. Mem. Valer.* 7, *t.* 1; *Royle Ill.* 242—244, *t.* 54.

Hab.—Alpine Himalaya. The rhizome.

Vernacular.—Chhar, Balchhar, Jatamasi (*Hind.*), Jatamansi (*Beng., Mar.*), Jatamashi (*Tam.*), Jatamamshi (*Tel.*), Jatamanshi (*Can.*), Bhutkés (*Paháriya*).

History, Uses, &c.—This plant, in Sanskrit Jatamánsi, Mansi, Bhutakesi ("demon's hair"), Pisitá, Tapasvini and Mishi, has from a very remote period been in use among the Hindus as a perfume and medicine. It is mentioned by Susruta in a prescription for epilepsy, and is prescribed by Hindu physicians as a nervine tonic and carminative, and

aromatic adjunct in the preparation of medicinal oils and ghritas (butters). In the Nighantas it is described as cold and a remedy for leprosy, morbid heat and erysipelas. It is the *Nardin* of Dioscorides, which that writer tells us was also called *Gangitis*, because the Ganges flowed from the foot of the mountains where the plant grew.

Arabic and Persian physicians describe Jatamánsi under the name of Sumbul-i-Hindi, "Indian Spike," to distinguish it from their Sumbul-i-Rumi or Ikliti (*Valeriana celtica*), the root of which is much used in Turkey and Egypt as a perfume. The author of the *Makhzan-el-Adwiya* compares Jatamánsi root to the tail of a sable. He describes it as deobstruent and stimulant, diuretic and emmenagogue, and recommends it in various disorders of the digestive and respiratory organs, and as a nervine tonic in hysteria. He also notices the popular opinion that it promotes the growth and blackness of the hair. The dose is about 45 grains as an expectorant.

Ainslie states that the Vytians in Lower India prepare a fragrant and cooling liniment for the head * from this drug, and also prescribe it internally as a purifier of the blood. Sir W. O'Shaughnessy states as the result of his experience with jatamánsi, that it is a perfect representative for valerian. (*Bengal Disp.*, p. 404.)

When taken habitually in moderate doses, valerian improves the appetite and digestion without confining the bowels. Two drachms at a single dose may occasion a sense of heat and weight in the abdomen, eructations, and even vomiting, colic, and diarrhœa; also some excitement of the pulse, general warmth, and either perspiration or diuresis. In somewhat smaller doses its operation is chiefly restricted to the nervous

* The hair-wash in common use among Indian women, and called Angalepan, Angodvartan, Sughandi-puri or Utnen, is composed of Gávala (seed of *Prunus Mahalib*), Kápúrkachri (*Kæmpferia Galanga*), Vála (*Andropogon muricatus*), Pách (*Pogostemon Patchouli*), Jatamansi (*Nardostachys Jatamansi*), Upalét (*Saussurea Lappa*), Nágarmoth (*Cyperus pertenuis*), Dauna (*Artemisia Sieversiana*), and Murwa (*Origanum*, several species). Other articles are sometimes added.

system; it renders the mind tranquil, disposes to good humour and activity, produces sometimes a lively formication in the hands and feet, and a sensation about the head and spine which has been compared to the *aura epileptica*. Sometimes, on the contrary, there is a sense of embarrassment in the head, with heaviness and pain. In states of morbid nervous excitement without fever, when through exhaustion the pulse has become small and frequent, valerian lessens its frequency and increases its force and volume.

Given to rabbits in doses of from 1 to 3 drachms, valerianic acid renders the heart's action more rapid, but feebler; the respiration is hurried at first and then slower; and death usually takes place in three or four hours, preceded by prostration and convulsions. If death occurs speedily, the gastric mucous membrane is pale, but if delayed it may be congested; the kidneys are apt to be congested and the urine bloody. Oil of valerian appears to lessen the excitability of the spinal cord, and even to paralyze it, since two Cgm ($\frac{1}{3}$ gr.), injected under the skin of frog, have been found capable of preventing tetanic spasms after a like injection of 5 Mgm. ($\frac{1}{12}$ gr.) of strychnine. Given alone to these animals hypodermically, it impair mobility and sensibility. Valerianic acid, applied to the human skin, produces a white spot, followed by irritation and redness, and upon the tongue it may cause the epithelium to exfoliate.

As a medicine valerian is not a cure for *hysteria*, but it is a most valuable palliative when employed to avert or mitigate hysterical paroxysms provoked by some accidental cause. Especially is this the case in females of weak constitution and excitable temperament, and who are exhausted by care and anxiety. It is still more efficient in preventing the development of those hysteroidal attacks which weak and morbidly sensitive girls and women are liable to, and which consist in an excessive susceptibility to impressions, and in the power of converting into real sensations the suggestions of a disordered fancy, whereby countless subjective perceptions and various disordered actions

of the lungs, heart, stomach, &c., arise. In mild cases of *mental derangement*, especially when caused by nervous shock or strain; in nervous *atony* simulating paralysis; in cases also of irregular distribution of the blood, accompanied, it may be, with indications of cerebral congestion, or, on the other hand, of cerebral anæmia, of which the chief symptoms are *vertigo*, a sense of rush of blood to the head, or fainting, confusion of sight and hearing, &c., which more than at any other time are apt to occur about the menopause,—valerian is the most promptly efficient of all the palliatives that have been used. In all those cases valerian exhibits the same potency as asafœtida, musk, and castor, and more decidedly. Oil of valerian dissolved in ether may be administered by inhalation in such attacks. Valerian is one of the best remedies for *nervous headache*, especially when it is associated with ammonia, as in the ammoniated tincture of valerian or the popular valerianate of ammonium. These preparations may be used advantageously, along with a carminative tincture, in cases of *flatulence* accompanied with palpitation of the heart. The same medicines are equally efficient in relieving *infantile colic*.

Valerian is one of the innumerable articles that from time to time have been vaunted as remedies for *epilepsy*, and, allowing for the common error of confounding epilepsy with epileptiform reflex convulsions, and even with hysteria, there can be no doubt that it has sometimes cured the disease in females and young children, and especially when it originated in fright or some analogous impression. Even in these cases it must be administered in large doses and be long continued, while other and especially hygienic measures are employed to give permanent strength to the nervous system.

Valerian is useful in the treatment of the milder forms of *delirium tremens*, especially when they follow surgical operations or injuries, and in the ataxic phenomena which belong to the *typhoid state* of fevers and inflammations. It has had some reputation as a *vermifuge* for children when associated

with purgatives, such as jalap, and by enema as a remedy for ascarides of the rectum. It has also been used successfully for the relief of *dysmenorrhœa* and in *polyuria* or *diabetes insipidus*. Bouchard, however, claims that when the urine contains an excess of urea (azoturia) or of sugar (glycosuria), valerian diminishes the amount of solids discharged and thus acts as a conservator of tissue and of force. (*Stillé and Maisch.*)

Description.—The drug consists of a short portion of rhizome about as thick as the little finger, of a dark grey colour, surmounted by a bundle of fine, reddish-brown fibres, the whole forming an object not unlike the tail of a sable or martin. The fibres are produced by an accumulation of the skeletons of the leaves, and are matted together, forming a kind of network; amongst them the remains of flower stalks may be found. The odour of the drug is heavy and peculiar, like a mixture of Valerian and Patchouli, the taste bitter and aromatic. When the central portion is removed and cut across, it is seen to consist of a thin cortical portion connected with the central woody column by four medullary bands, between which are situated large canals which contain the fibro-vascular bundles. The central woody column is of a red-brown colour, angular and jointed, having a certain amount of resemblance to the vertebræ in the tail of an animal.

Chemical composition.—Kemp (1884) obtained three fluid ounces of the oil from 56 lbs. of jatamánsi, and found it to have a molecular rotation of —19·5 in 100 mm., the specific gravity at 82° F. was 0·9748. One hundred pounds of the root submitted to distillation with water by Messrs. Kemp and Co. (1890), yielded fifteen ounces of a pale yellow oil of valerian-like odour, and a faintly acid distillate. A fine violet or bluish colour is produced, as with oil of valerian, by mixing a drop or two of the oil with about 20 drops of carbon bisulphide and a drop of strong nitric acid. With sulphuric acid the oil gives a reddish brown coloration. On boiling the oil acquires a darker hue and a greenish fluorescence. (*J. G. Prebble.*)

The most important constituent of valerian root is its volatile oil. Free valerianic acid does not exist in the fresh root, but is generated from the volatile oil on exposure. The latest investigation of the oil is by Bruylants (1878), who ascertained some new facts. The hydrocarbon, $C^{10}H^{16}$, was named *borneene* by Gerhardt (1841) and *valerene* by Pierlot (1859). The *valerol* of the latter differed from Gerhardt's valerol, $C^6H^{10}O$, which he believed to become oxidized in contact with air to *valerianic acid*, carbonic acid being given off at the same time. Bruylants explains the generation of valerianic acid in old oil of valerian from the decomposition of $C^{10}H^{17}C^5H^9O^2$, which is the valerianic ether of borneol; besides this one, it contains the corresponding ethers of formic and acetic acids, the alcohol *borneol*, $C^{10}H^{18}O$, and its ether, $C^{10}H^{17}O^2$. Gerhardt assumed the production of borneol from the hydration of borneene. For a comparison of the chemical constitution of the root of an Indian officinal valerian with that of the European drug, the reader is referred to the next article.

VALERIANA WALLICHII, *DC.*

Fig.—*Asiat. Research. ii., p.* 405.

Hab.—Temperate Himalaya. The rootstock.

Vernacular.—Tagar (*Hind., Beng., Mar.*), Tagar-ganthoda (*Guz.*), Naudibattal (*Can.*), Mushk-i wáli, Bala (*Punjab*), Pámpe (*Bhutan*).

History, Uses, &c.—A fragrant drug called Tagara is frequently mentioned by Sanskrit writers, other names for it are Nandyávarta, Nandini, Varhini, Nahushákhya, and Pinditagara. It is described in the Nighantas as sweet, emollient, pungent, hot and light; a remedy for suppresion of urine, poisons, epilepsy, swoons and headaches. Besides it medicinal uses it is an ingredient in perfumed powders, in the same manner as jatamansi. The drug appears to have attracted the

attention of the Mahometans physicians of India, as we find it described by them as an Indian kind of Asárun (Asarabacca). The author of the *Makhzan-el-Adwiya* describes several kinds of Asárun, and says that the kind known as Tagar in India is with rice spirit given to people attacked by small-pox to lessen the eruption of pustules. Stewart notices the export of this drug to the plains of India for medicinal use. Sir William Jones (*As. Research.* II., 405,) obtained the plant and supposed it to be the source of the jatamansi root of commerce.

It appears to be the Sumbul-jibali of the Arabs and the Kishai-wála of the Persians. Recent experience has shown that this drug like jatamansi is an excellent substitute for the root of our Pharmacopœias.

Description.—The rhizomes are crooked, about two inches long and from ¼ to ½ an inch in diameter, of a dull brown colour, marked with transverse ridges, and thickly studded with circular prominent tubercules, to a few of which thick rootlets still remain attached. The crown is marked by a number of bracts; the lower end is blunt. The rhizome is very hard and tough, and the fractured surface greenish brown. The odour is like Valerian, but much more powerful.

Microscopic structure.—Examined under the microscope the outer bark is seen to be composed of ten or twelve layers of compressed cells; within this is a starchy parenchyma, and next to it a cambium layer; within the cambium layer is a broken ring of vascular bundles, and lastly, a starchy parenchyma, thickly studded with conglomerate masses of large cells, having greenish-yellow contents of a resinous appearance.

Chemical composition.—An analysis of the rootstock supplied by one of us* has been made by J. Lindenberg, and the results compared with a fresh analysis of the roots of *Valeriana officinalis* made by the same chemist. (*Pharm. Zeitschr. für Russland*, 1886.)

* Erroneously supposed at the time to be the root of *V. Hardwickii*.

The following table shows the results—

	V. Wallich.	V. officin.
Moisture	10·46	11·57
Ash	4·04	4·31
Fat and resin, soluble in petroleum-benzine	0·56	0·36
Volatile oil and valeric acid, sol. in benzine	1·005	0·90
Volatile acid, soluble in ether	0·335	0·31
Resin and wax, soluble in ether	0·56	0·85
Resin soluble in alcohol	1·05	0·975
Tannin	3·13	1·64
Citric, tartaric and other acids	0·335	0·565
Glucose	6·03	5·32
Other substances sol. in water, insol. in alcohol	14·96	14·39
Mucilage and albumin, sol. in water	4·16	2·97
Albuminoids extracted by soda	9·72	7·83
Metarabic acid, phlobaphene and albuminoids	19·10	16·70
Starch	14·05	12·87
Cellulose	10·36	11·65
Lignin and other compounds	10·015	16·80

Commerce.—Tagar is chiefly used as a perfume in India, much as valerian was formerly in Europe. Value, Rs. 7 per Surat maund of 37½ lbs.

Valeriana Brunoniana, a variety of *V. Leschenaultii*, *DC.*, growing on the Nilgiris, affords a root which develops a strong odour of valeric acid when dry, and yields to distillation with water a considerable amount of volatile oil. Dr. G. Bidie has recommended it as a good substitute for European valerian.

The Indian form of **Valeriana officinalis** (*V. dubia*, Bunge), *Ledeb. Ic. Fl. Ross, t.* 350, occurs in North Cashmere, but is not known to be used medicinally by the natives.

Royle (*Antiquity of Hindu Med.*, p. 82,) mentions the use of V. Hardwickii, *Wall.*, for medicinal purposes in Nepal. Wallich (*Pl. As. Rar., p.* 40), speaking of the same plant, says : "Nomen omnium specierum in Napalia, *Chamaha.*"

COMPOSITÆ.

VERNONIA ANTHELMINTICA, *Willd.*

Fig.—*Burm. Thes.* 210, *t.* 95 ; *Rheede Hort. Mal. ii., t.* 24.

Hab.—Throughout India. The fruit.

Vernacular.—Káli-jiri, Somráj, Bakchi (*Hind.*), Somráj (*Beng.*), Kadvo-jiri (*Guz.*), Káttu-shiragam (*Tam.*), Káralyé (*Mar.*), Adavi-jilakara (*Tel.*), Kadu-jirage (*Can.*).

History, Uses, &c.—The Sanskrit names of this common Indian plant are Vákuchi, Somaraji or Somarajin and Avalguja. It has long been highly esteemed as one of the principal remedies for leucoderma and psoriasis, and is also used as an anthelmintic in combination with other remedies. For administration in skin diseases Chakradatta directs the drug to be powdered along with an equal quantity of black sesamum, and a drachm of the powder to be taken in the morning with tepid water, after perspiration has been induced by exercise or exposure to the sun. The diet should consist of milk and rice. In leucoderma, a decoction of emblic myrobalans and catechu is given in addition to the powdered Vákuchi. Externally the drug is applied in skin diseases in a variety of forms, such as paste, oil, &c. Vákuchi is described in the Nighantas as sweet, pungent, digestive, bitter, alterative, astringent, cold, cardiacal, dry, antiphlegmatic ; a remedy for cough, fever, and intestinal worms. The author of the *Makhzan-el-Adwiya* describes Káli-jiri, and states that it is given internally to remove phlegm and worms from the intestines, and that a poultice or plaster of it is used to disperse cold tumors. He concludes by saying that the drug is not often prescribed internally, as it is

thought to have injurious effects, but that it is much used as a cattle medicine. Indian Mahometan druggists sell this drug as a substitute for Átrilál (*Anthriscus Cerefolium*). Ainslie says: "The small dark-coloured and extremely bitter seeds of this annual plant are considered as powerfully anthelmintic, and are also an ingredient of a compound powder prescribed in snake-bites." Rheede states that an infusion of them is given on the Malabar Coast for coughs and against flatulency. The dose of the seed in powder, when administered in worm cases, is one pagoda weight twice daily. (*Materia Ind. II.*, *p.* 54). According to the *Pharmacopœia of India*, the ordinary dose of the bruised seed as an anthelmintic, administered in electuary with honey, is about 1½ drachm, given in two equal doses at the interval of a few hours, and followed by an aperient; the worms are generally expelled in a lifeless state. Dr Æ. Ross speaks favourably of an infusion of the powdered seeds (in doses of from 10 to 30 grains) as a good and certain anthelmintic for ascarides. In Travancore the bruised seeds, ground up in a paste with lime juice, are largely employed as a means of destroying pediculi. Dr. Gibson, as the result of personal experience, regards them as a valuable tonic and stomachic in doses of 20 to 25 grains; diuretic properties are also assigned to them. (*Pharmacopœia of India*, *p.* 126.) In the Concan the following formula is in vogue as an antiperiodic—Vernonia seeds, Chiretta, Picrorhiza root, Dikamálí, Rocksalt and Ginger, p. æq. Powder, and give 6 massas in cold water, in which a red hot tile has been quenched, every morning.

Description.—The achenes are about $\frac{5}{16}$ inch long, of a dark brown colour, covered with whitish scattered hairs, cylindrical, tapering towards the base, marked with about ten paler longitudinal ridges, and crowned with a circle of short brown scales. The taste is nauseous and bitter.

Chemical composition.—The seeds, as sold in the bazars, lost 9·38 per cent. when heated to 100° C. The ash amounted to 7·7 per cent., and was free from manganese. The powdered seeds were digested with 80 per cent. alcohol, most of the alcohol

distilled off, and the remainder allowed to evaporate by exposure to air. The alcoholic distillate contained no volatile principle. The alcoholic extract contained a large amount of an amber-coloured oil soluble in petroleum ether, as well as resins. By agitation of the alkaline alcoholic extract with ether, a somewhat bitter extract was obtained, which, besides containing resins, afforded evidence of the presence of an alkaloid, which gave reactions with the usual alkaloidal reagents, but which afforded no special colour reactions. We have provisionally called this principle *Vernonine*.

Commerce.—The plant is common in waste places throughout India. The country people collect the fruit and bring it for sale in the cold weather.

Value.—Rs. 3½ per Surat maund of 37½ lbs.

Vernonia cinerea, *Less.*, *Rheede Hort. Mal. x., t.* 64, a common weed throughout India in the rainy season, is considered to be the Sahadevi of Sanskrit medical writers in Northern, Southern, and Western India. In the Hindi and Marathi vernaculars it bears the Sanskrit name; in Guzerathi it is Sádeori, a modification of the same name; in Bengali Kúkseem; and in Tamil Sira-shengalunir. Under the latter name Ainslie (*Mat. Ind. II.*, 363) notices it as the Gheruttikamma of the Telingis, used in medicine by the Hindus, in decoction, to promote perspiration in febrile affections. In the Nighantas it is described as cold, sweet, strengthening, astringent, correcting all the humors. For the numerous synonyms, and for a description of this very variable plant, we must refer the reader to the *Flora of British India*. It has no very sensible properties, and the medicinal virtues ascribed to it by the Hindus appear to us to be imaginary.

Elephantopus scaber, *Linn.*, *Wight Ic.*, *t.* 1086; *Rheede Hort. Mal. x.*, *t.* 7, common in shady places throughout India, is the Go-jihva, "ox tongue," of Sanskrit writers, and is described in the Nighantas as cold, light, astringent, cardiacal, alterative and febrifuge; expelling bile and phlegm, and curing urethral discharges. Rheede tells us that a

decoction of the root and leaves, with cumin and butter milk, is given on the Malabar Coast in dysuria, and in diarrhœa and dysentery. Ainslie calls it *Prickly-leaved Elephant's Foot*, and remarks that Sloane and Browne, in speaking of this plant, say, it is accounted a good vulnerary, and grows in the woods of Jamaica very plentifully; the leaves are frequently employed instead of *Carduus benedictus* amongst the inhabitants of the French West India Islands. The plant has a fibrous root; the leaves are chiefly radical and spread flat upon the ground; they are oblong, wrinkled, crenulate and very hairy; the flower stalk is branched, about a foot high, bearing a few small leaves and heads of flowers with pale purple florets. The plant is mucilaginous and astringent. The vernacular names are Gobhi (*Hind.*), Gojialata (*Beng.*), Gojibha (*Mar.*), Ana-shovadi (*Tam.*), Hakkariké (*Can.*).

Lamprachænium microcephalum, *Benth.*, is a plant of Western India called Aja-dandi and Brahma-dandi in Sanskrit, and Brahmadandi in Marathi and Canarese. It has flowers which smell like chamomile, and a branched, scabrous pubescent stem; leaves petioled, elliptic-acuminate, gradually attenuated into the petiole, pubescent above, hoary and tomentose beneath; heads of flowers small, solitary at the apex of the branches; scales of the involucre squariose, hoary and tomentose beneath, exterior ones lanceolate acuminate, bristle-pointed, ciliated; seeds smooth, shining, without ribs. The plant is used medicinally as an aromatic bitter, but is of little importance as a medicine.

Ageratum conyzoides, *Linn.*, has a strong, aromatic, and rather disagreeable smell; it has a reputation among the Hindus as an external application in agues, and is also worn as a charm against ague when dug up on Sunday with the proper ceremonies. The juice is said to be a good remedy for prolapsus ani. It is freely applied and the gut replaced. Corre and Lejanne state that the plant is used as a sudorific in Réunion under the name of *Herbe à bouc*. *A. conyzoides* is sometimes confounded by the natives with *Vernonia cinerea*,

and supposed to be a kind of Sahadevi: it is the *Ageratum cordifolium* of Roxburgh, and is called Uchunti in Bengal and Osári in Western India. The plant is a common annual weed throughout India, appearing after the rains and flowering through the cold season; it is from 1 to 2 ft. in height, hispidly hairy, leaves petioled, ovate crenate, heads small, in dense terminal corymbs, bracts striate, acute, ray-florets many, pale blue or white, achenes black, pappus scales 5-awned, often serrate below. (*Fl. Br. Ind.*, *iii.*, 243.)

EUPATORIUM AYAPANA, *Vent.*

Fig.—*Vent. Hort. Malm. t.* 3.

Hab.—America. Cultivated in India. The herb.

Vernacular.—Ayapána (*Hind.*, *Mar.*, *Beng.*), Ayapáni (*Tam.*, *Tel.*), Allápa (*Guz.*).

History, Uses, &c.—Ventenat found this plant growing on the banks of the river of the Amazons; it is also a native of Cayenne; another species, *perfoliatum*, is considered as a febrifuge in America. The Ayapana has been cultivated in India for a considerable time. Ainslie says of it:—"This small shrub, which was originally brought to India from the Isle of France, is as yet but little known to the native practitioners, though, from its pleasant, sub-aromatic but peculiar smell, they believe it to possess medicinal qualities. At the Mauritius it is in great repute, and there considered as alterative and antiscorbutic; as an internal remedy it has certainly hitherto much disappointed the expectations of European physicians. An infusion of the leaves has an agreeable and somewhat spicy taste, and is a good diet drink; when fresh and bruised, they are one of the best applications I know for cleaning the face of a foul ulcer." (*Mat. Ind. II.*, *p.* 35.) Mr. Dyer informed Ainslie that the plant was cultivated in the Island of Bourbon for the purpose of being dried and sent to France, where it was used for making a kind of tea used as a substitute for the tea

of China. According to Guibourt it is now almost forgotten. (*Hist. Nat* 6me *Ed.* III., 68.) In the *Pharmacopœia of India*, there is the following notice of Ayapana:—"A South American plant, naturalized in various parts of India, Java, Ceylon, &c., and generally known by its Brazilian name, Aya-pana. The whole plant is aromatic, with a slightly bitter sub-astringent taste. The exaggerated ideas of its virtues formerly entertained are now exploded; but there is reason to believe that it is a good stimulant, tonic, and diaphoretic. According to the statements of Bouton (*Med. Plants of Mauritius*, p. 96), it appears to hold a high place amongst the medicinal plants of the Mauritius, being there in daily use in the form of infusion, in dyspepsia and other affections of the bowels and lungs. In the cholera epidemics in that island in 1854-56, it was extensively used for restoring the warmth of the surface, the languid circulation, &c. As an antidote to snake-bites it has been used, both internally and externally, with alleged success. (*Madras Quart. Med. Jour., IV.*, 7.) It is not uncommon in gardens, and though not generally known, is held in considerable esteem by those who are acquainted with it. Ayapana may be compared with chamomile in its effects; it is stimulant and tonic in small doses, and laxative when taken in quantity; the hot infusion is emetic and diaphoretic, and may be given with advantage in the cold stage of ague and in the state of depression which precedes acute inflammatory affections. The infusion may be made with 1 oz. of the herb to a pint of water, and be given in 2 oz. doses every three hours.

Description.—A small shrubby plant, 5 to 6 feet high; branches straight, reddish, with a few simple scattered hairs; young shoots have a somewhat mealy appearance, due to the presence of small particles of a white balsamic exudation; leaves opposite, in pairs, their bases uniting round the stem, about 4 inches long and ¾ inch broad, fleshy, smooth, lanceolate, attenuated at the base; midrib thick and reddish; flowers like those of the groundsel, purple. The odour of the plant is aromatic, somewhat like ivy, but more agreeable; taste bitter and aromatic, peculiar.

Chemical composition.—On distillation of the fresh plant with water, a colourless oil was obtained, lighter than water, and possessing in a marked degree the odour of the plant. We also obtained a neutral principle, soluble in ether and alcohol, and crystallizing in long needles. It easily sublimed at a temperature of 159°—160° and condensed in beautiful brilliant scales and rhombic prisms. In water it was practically insoluble; it gave no reaction when dissolved in alcohol with ferric salts. In concentrated sulphuric acid it dissolved at once, with only a very faint yellow coloration. In concentrated nitric acid it dissolved immediately with production of a light yellow coloration: among the products of its oxidation by nitric acid, picric and oxalic acid were detected. With Fröhde's reagent a similar tint to that produced by sulphuric acid was yielded. We propose for this principle the name *Ayapanin*.

Eupatorium cannabinum, *Linn., Eng. Bot. V.* 6, *t.* 428, is a native of the temperate Himalaya and Europe; it is the *Herba sanctæ Kunigundis* of Tragus (*Hist.* 491, f.,) the *Hemp Agrimony* of the English, *Water-hauf* of the Germans, and *Origan aquatique* of the French. Though very common in the Himalayas, it does not appear to be used medicinally by the Hindus. The root and leaves have diuretic, and in large doses emetic properties. Boerhaave calls the herb *Rusticorum panacea*, and states that the turf-diggers in Holland use it with great benefit in jaundice, scurvy, foul ulcers, and those swellings of the feet to which they are much exposed. An infusion of 1 oz. of the dried leaves in a pint of water may be used daily; if taken hot it is a good diaphoretic. According to Righini, the leaves and flowers contain a white bitter alkaloid soluble in ether, which forms a crystalline sulphate.

In America **E. perfoliatum**, *Linn.*, and other species are used medicinally under the name of Boneset and Herbe à fièvre.

Solidago Virga-aurea, *Linn., Eng. Bot.* 801, is a native of the temperate Himalaya, Europe, and America. It is the *Golden Rod* of the English, *Verge d'or* of the French,

and *Goldruthe* of the Germans. The generic name is a derivative of *solidare*, to unite, because of the vulnerary qualities of the plant, which were first brought to notice by Arnoldus de Villa Nova, who also highly extolled it as a remedy for stone in the bladder. Gerarde had a high opinion of it as an application to bleeding wounds and ulcers, and says: "I have known the dry herbe, which came from beyond the sea, sold in Bucklersbury for halfe a crowne an ounce. But since it was found in Hampstead wood, even as it were at our townes end, no man will give halfe a crowne for an hundredweight of it; which plainely setteth forth our inconstancie and sudden mutabilitie, esteeming no longer of anything how pretious soeuer it be, than whilest it is strange and rare." He further says, that "*Saracens Consound* is not inferiour to any of the wound herbes whatsoeuer, being inwardly ministred or outwardly applied in ointments or oyles."

The flowering herb has an aromatic odour and a bitterish and astringent taste; it contains a volatile oil.

In America **S. odora**, *Ait.*, is much used as a domestic remedy to produce diaphoresis, to allay colic, promote menstruation, and to cover the taste of nauseous medicines. An infusion may be prescribed, or a few drops of the essential oil.

Grangea maderaspatana, *Poir. Wight. Ic., t.*, 1097, is a common field weed throughout India, growing flat on the ground in the cold weather after the monsoon crops have been harvested. It has sinuately pinnatifid leaves, and solitary, subglobose, leaf-opposed heads of yellow flowers. The odour resembles that of worm-wood. Ainslie (*Mat. Ind. i.*, 481,) calls it *Madras Wormwood*, and says that the Tamil doctors consider it to be a valuable stomachic medicine, and also suppose it to have deobstruent and antispasmodic properties; they prescribe it in infusion and electuary in cases of obstructed menses and hysteria, and sometimes use it in preparing antiseptic and anodyne fomentations. When given internally, Grangea is usually combined with ginger, pepper, and sugar; as an antiseptic application to ulcers, the powdered leaves are used.