SUBTERRANEAN ORGANS

The subterranean organs (the underground organs) of the plant comprises two types. They are either of stem origin such as rhizomes, corms, bulbs and tubers or of root origin such as roots and root tubers. Subterranean organs are generally collected from peremnial plants where they perform as storage organs, full of reserve food materials mean of perennation. It is impracticable to classify the drugs of this class separate roots and rhizomes, as in many herbaceous plants the rhizome passes gradually into the root e.g. Dandelion.

Many drugs of this class consist of portions of both stem and root origins, in some both roots and rhizomes are collected together (Valerian and Hydrastis). Some drugs which are comonly spoken of as roots consist partly or wholly of rhizome e.g. Gentian and Rhubarb respectively, in many cases the transion from stem to root makes an accurate differentiation of the two parts impossible. The general characters of roots and rhizomes may therefore be usefully discussed together.

The Root

The root is the portion of the plant axis derived from the radice and grows towards the soil and water.

They are characterised by :

a) It never develops leaves.

b) It shows no nodes and internodes.

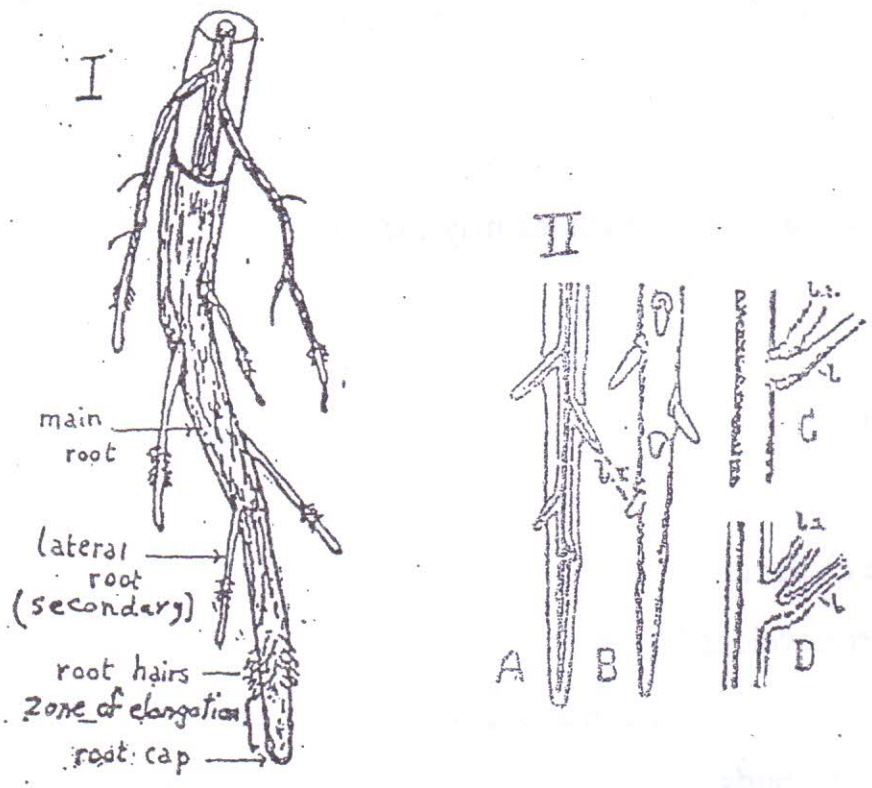
c) It bears no buds.

d) Its growing point is covered by special tissue called root-cap or Calyptra.

e) Unlike the stem, it show no chlorophyll and have one kind of lateral appendages which are similar in structure to the parent root but differ in direction.

The Root System :

It develops as a result of the growth of the radicle into the soil producing primary root, which in most of Dicotyledons persists and develops tap-root system. In many Monocotyledons, the primary root stops growing early and numerous roots arise from the stem producing fibrous-root system.



I, Normal tap root (semidiagrammatic) and its composition; II, types of branching of roots (A&B, endogenous) and of stem (C&D, exogenous).

Composition of the root :

The root is generally formed of 4 zones :

a) Growing point : It is covered by the root cap which is usually darker. The outer cells are constantly worn away and replaced by cells formed by the apical meristem.

b) Zone of elongation : It lies directly behind the growing point and is responsible of the increase of length of the root.

c) Zone of root hairs : It is completely covered by root hairs which are the principal absorping parts of the root.

d) Zone of lateral branches : This zone comprises most of the root.

Functions of the root :

Abosrption of water, soluble minerals and organic compounds form the soil and transportation of them to the stem.

It Anchors the plant to the ground.

As storage organ and for propagation.

Braching of the root :

The tap root grows vertically towards the soil giving lateral roots which are thinner, less stronger and spreading obliquely in all directions. These lateral roots arise deeply from the pericycle and so called endogenously. They arise either opposite to the protoxylem or to the conducting parenchyma present between the xylem and phloem groups. Therefore, lateral roots occur in rows of the same number of xylem group or twice this.

Types of roots :

1- Primary roots : Developing into tap-root e.g. senega.

2- Secondary roots : Lateral branches of tap-root e.g. kremeria.

3- Adventitious roots : Arise from the stem e.g. Ipecacuanha, Calumba and Jalap.

4- Prop roots : Adventitious roots but arise from the stem, above the soil and extending diagenally into the soil e.g. Maize.

5- Fibrous roots : Very slender as in grasses.

6- Aerial roots : Adventitious roots hanging in the air or growing down to anchor in the ground e.g. Ficus Bengalensis.

7-Respiratory roots : Growing from the soil into air for respiration e.g. some plants growing in water-logged soil.

8- Storage roots : Roots swollened with reserve food material. It may be primary e.g. Belladonna, secondary e.g. Umbelliferous roots, adventitious e.g. Calumba or it may be very swollen roots and called root tubers.

CONDITION :

Drugs of roots occur usually in dry conditions, rarely fresh. They are :

a) Entire of rarely so e.g. Senega.

b) Sliced longitudinally e.g. Althea or transversely e.g. Calumba.

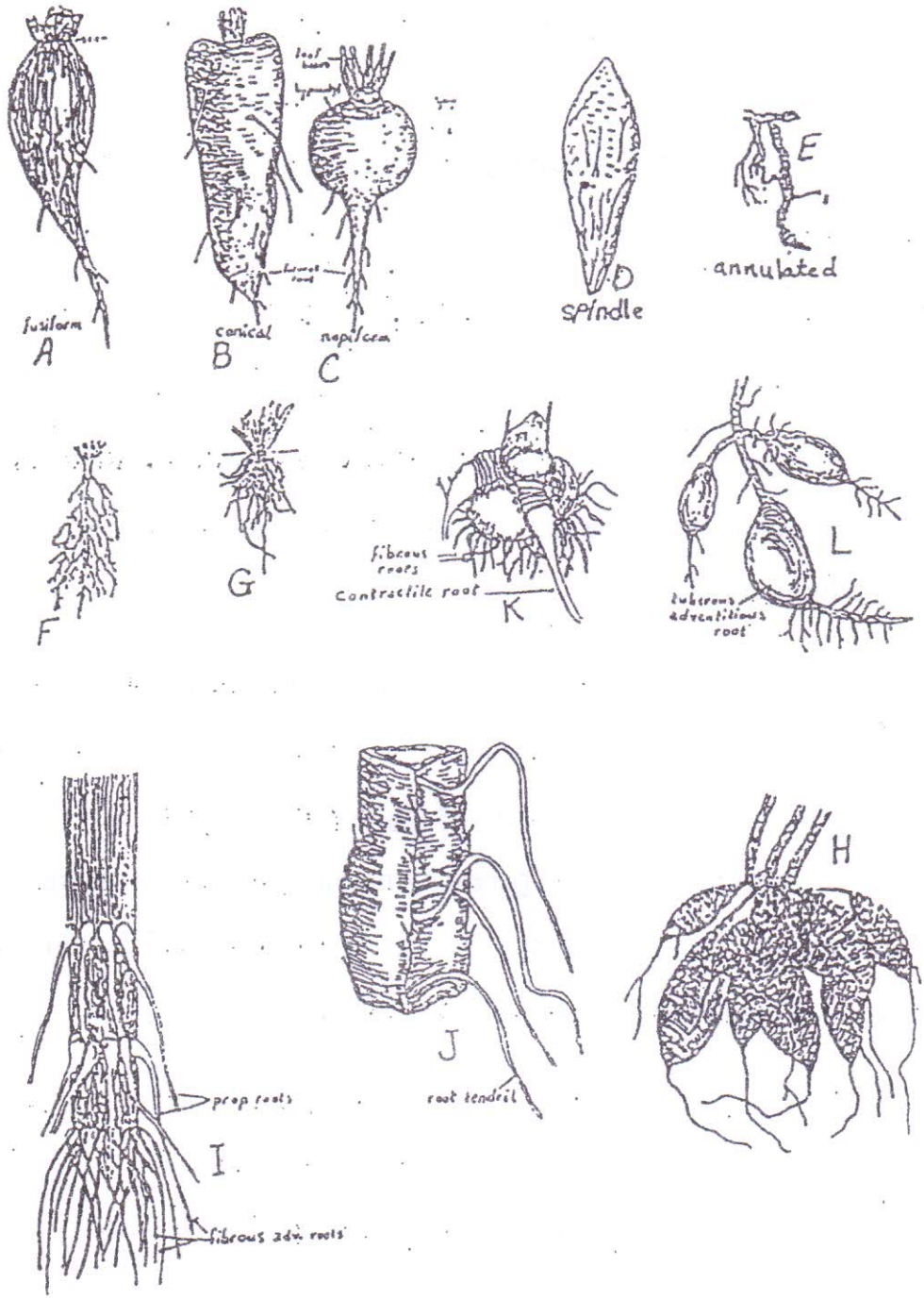
c) Peeled e.g. Althea or liquorice.

Shape :

1- Cylindrical e.g. sarsaparilla.

2- Subcyindrical e.g. Rauwolfia.

3- Teret : when tapering gradually.



Types and forms of roots: A, fusiform tap root of raddish; B, conical root of carrot; C, napiform of turnip; D, spindle of Jalap; E, annulated of Ipecac; F, normal tap-root system; G, fibrous root of grass; H, tuberous of Dahlia; I, prop of maize; J, root tendrils of Cereus; K, contractile roots of Crocus; L, tuberous adventituous roots of Asparagus.

4- Twisted e.g. Scammony.

5- Obconical e.g. Aconite and carrot.

6- Fusiform e.g. Jalap.

7- Napiform globular and becoming suddenly slender e.g. Turnip.

Structure of Root :

Structure of Young Root : The transverse section of young root shows the following tissues.

1- Piliferous layer : It is formed of a single row of thin walled cells showing no stomata, no cuticle and no intercellular spaces. The cells bear and produces root hairs.

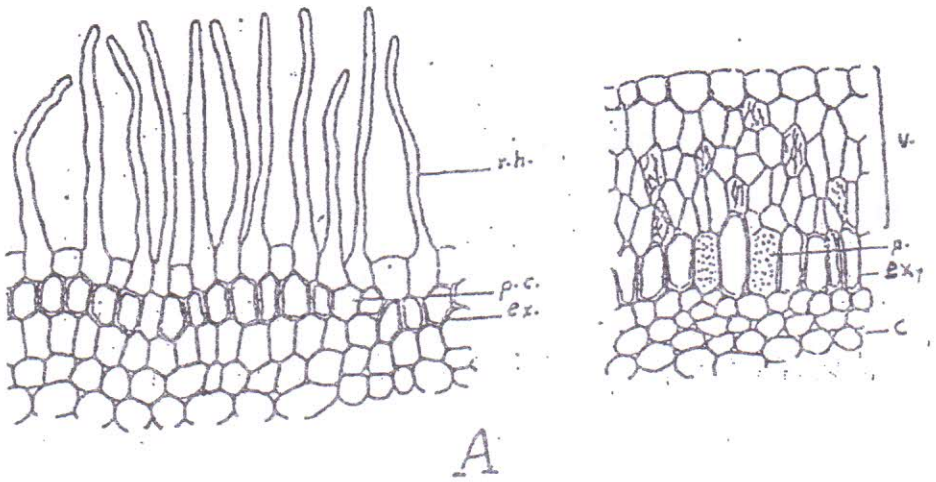
2- Cortex : The cortex is usually wide and parenchymatous. It is formed of an outer layer called exodermis, the cells of which are small and brownish with thickened suberised or lignified walls. The rest of the cortex is formed of larger parenchymatous cells with wide intercellular spaces. The cells usually contain starch, rarely fixed oil globules, e.g. Gentian and calcium oxalate crystals

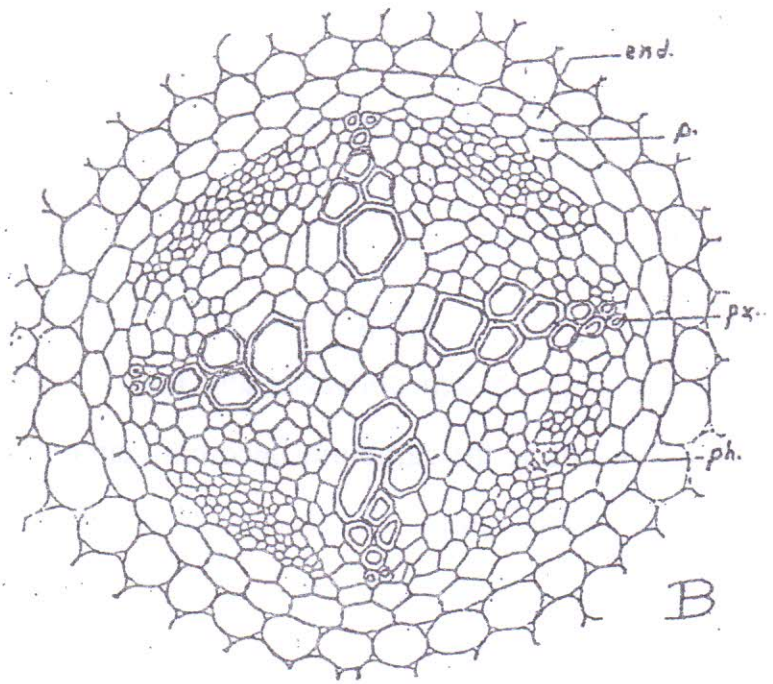
3- Endodermis : The endodermis is distinct as a single row of smaller cells. They have either thin outer tangential walls and other thickened ones or lingnified or cuticularised casparian strip.

4- Stele : The stele is central and formed of a single or many layered pericycle enclosing the vascular bundles. The vascular bundles are radial, formed of alternating groups of phloem and xylem separated with conducting parenchyma. It shows no combium or central pith. The xylem occur in radial groups or archs with the

Part IV

SUBTERRANEAN ORGANS





Histology of roots. A, T.S. of outer part of root; B, T.S. of stele. c, cortex; end, endodermis; ex, exodermis; p, pericycle; p.c. passage cell; ph, phloem; px, protoxylem; r.h, root hari; v, velamen.

protoxylum directed outwards that is called exarch (c.f. the stem which is endarch).

The number of archs varies from 2 to 7 rarely more e.g. Veratrum and accordingly the root is described as diarch e.g. Senega, triarch e.g. Ipecacuanha, tetrarch e.g. Liquorice, pentarch e.g. Vicia and Polyarch e.g. Veratrum As a rule, archs are few in ferns. Gymnosperma and Dicotyledons and numerous in Monocotyledons varying from 6 to 100 archs.

Structure of old Root :

Secondary thickening takes place in Dicotyledons and Gymnosperms only. The cambium is originated in the parenchyma below the phloem, in the conducting parenchyma and in the pericycle outside the protoxylem archs forming a stellate ring. This cambium divides to give secondary phloem outwards and much xylary tissue, secondary xylem, inwards so the cambium becoming circular in form. Opposite each protoxylem group the cambium forms a primary medullary ray. At the same time phellogen is formed in the pericycle dividing to give outer cork and inner wide pheloderm, thus cutting off the piliferous layer, primary cortex and endodermis.

As a result of secondary thickening, the old dicotyledonous root is formed of the following tissues.

a) Cork.

b) Phelloderm.

c) Collapsed primary phloem.

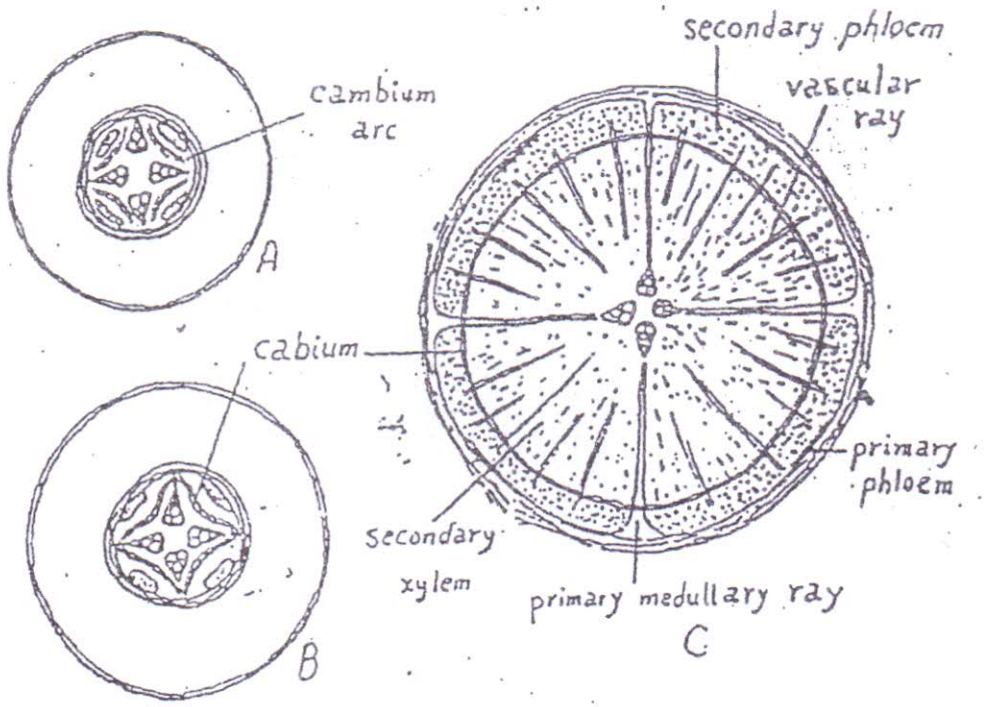
d) Secondary phloem.

e) Cambium.

f) Secondary xylem.

g) Primary xylem groups in the center.

h) The pith is usually absent except in Aconite.

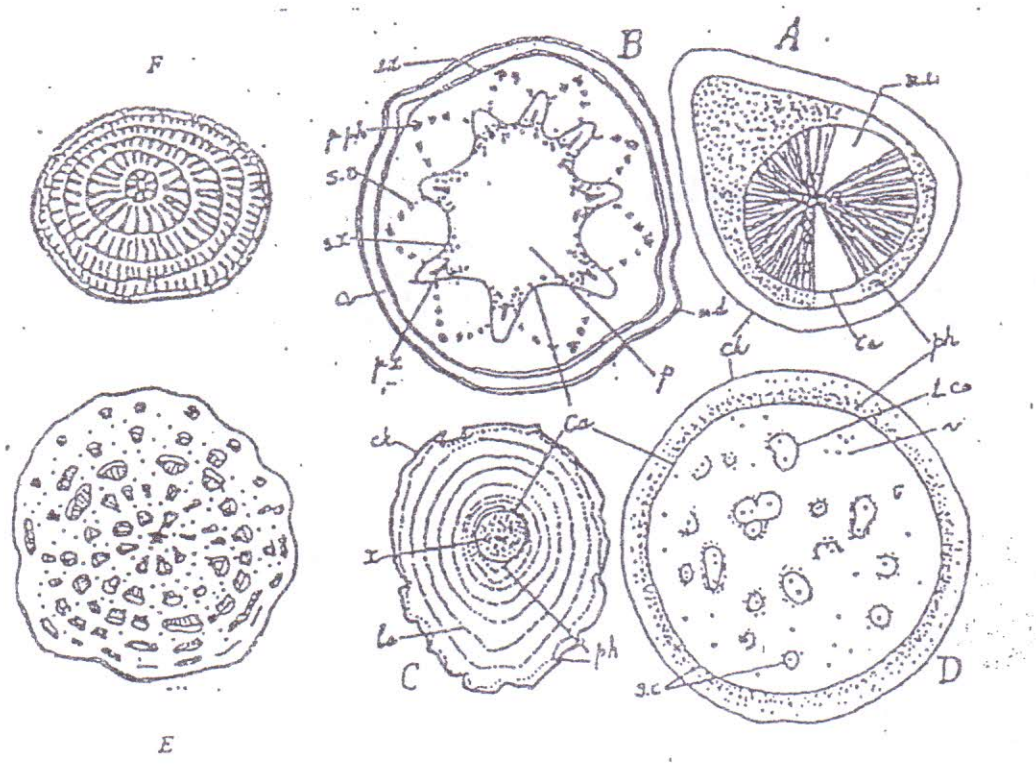


Digrams showing the sucessive stages of the secondary thickening of a dicotyledenous root.

Anomalous Secondary Thickening :

Some medicinal roots show abnormal types of secondary thickening which are described as amonalous. The following are examples of this type of thickening :

1- Ipecacuanha : The vascular cambium yields a small and dense xylem to the inside and very narrow ring of phloem outwards with short wedges of sieve tissues. The phellogen produces a very wide starchy parenchymatous phelloderm.



Anomalous root structure. A, Polygala; B, Aconite; C, Dandalion; D, Jalap; E, Orizaba Jalap, showing successive rings of vascular bundles; F, Pareira root, showing alternate rings of parenchyma and vsular tissues; Ca, cambium; ck, cork; co, cortex; en, endodermis; la; laticiferous vessels; m.d., metaderm; medullary ray; p., pith; p.ph., primary phloem; p.x., primary xylem; s.c., secretion cell; s.t. sieve tissues; s.x., secondary xylem; t.ca., tertiary cambium; x, xylem; v, vessels.

2- Senega : The xylem is wedged by the formation of wide, V-shaped, one or more parenchymatous medullary rays. Furthermore, excessive secondary phloem is abnormally developed at small place

producing on external ridge termed the keel.

3- Aconite : The cambium retains its stellate form and develops little secondary xylem and wide parenchymatous phloem with little amount of sieve tissue. The root shows wide medullary rays and parenchymatous pith. The tegumentary tissue in aconite is the metaderm which is formed of irrigularly arranged suberised dcells erived from the outer layers of the cortex.

4- Jalap: Circles curves or concentric rings of tertiary cambia arise in the wide parenchymatous secondary xylem and produce parenchymatous tertiary elements on both sides.

5- Orizaba Jalap : Successive tertiary cambia of limited period of activity are developed in the pericyle producing concentric rings of tertiary vascular bundles.

6- Gentian and Belladonna: Secondary xylem is wide and parenchymatous showing scattered vessels and islands of abnormally developed interxyllary phloem.

7- Dandelion: Secondary xylem is small and dense while the phloem is very wide showing concentric rings of sieve tissue and laticiferous vessels alternating with phloem parenchyma.

SUBTERRANEAN STEMS

In distinction from aerial stem, the subterranean stem differs in the following aspects :

a) It bears scale and not foliage leaves.

b) It bears adventitious roots arising generally from the nodes.

c) It has growing point protected by scale and not by compactly arranged rudimentary leaves.

Moreover, it differs from the root as follows :

a) It generally, has nodes and internodes.

b) It bears scale leaves with axillary buds.

c) Numerous adventitious roots are generally arising from the nodes.

d) It has growing point protected by scale leaves and not by root-cap.

e) Histologically, it shows a central pith and numerous collateral not radial vascular bundles.

Functions of Subterraneana Stem :

They function as a mean of perennation.

They serve as storageorgans for reserve food materials e.g. starch, inulin, sugars etc.

Direction of Growth :

Growth of subterranean stem may be

Horizontally : It is the usual type in this case, it shows scars of the aerial shoots or buds with encircling scale leaves on the upper side and roots or their scars on the lower side e.g. podophyllum and Ginger.

Vertically : In this type, the subterranean stem shows roots and scale leaves all over the surface with a large bud at the apex. Also, it shows annulated surface due to the presence of the encircling leaf scars e.g. Veratrum and Valerian.

3- Obliquely : It is occasional type in which, the aerial parts leave

the suberranean stem with angles equal to that between the subterranean stem and the ground level e.g. Filix mas.

Mode of Branching :

Monopodial : In which the main axis continues growing and produces the successive yearly portions of the axis e.g. Filix mas

2- Sympodial : In which the main axis stop growing as a result of destructing of the apical bud. The main axis continues its growth by the development of axillary buds in the axil of scale leaves e.g. Ginger.

3- In some cases, the rhizome starts its growth monopodially but, later on, continues sympodially e.g. Iris.

CONDITION :

Subterranean stems are usually present in dry conditions, rarely fresh e.g. Colchicum corm. They are :

a) Entire or nealy so e.g. Veratrum.

b) In brocken pieces e.g. Ginger.

c) In longitudinal slices e.g. Valerian or in transverse slices e.g. Colchicum.

d) Peeled or decorticated e.g. Ginger and Rhubarb.

Types of Subterranean Stems :

1) Rhizome : It shows nodes and short or long internodes, terminal bud and serial shoots. Rhizome is usually thick, perennial and occasionally branched e.g. Iris and Rhubarb.

2) Sobole : It is a rhizome with long slender internodes e.g. Couch Grass.

Root Stock : It is regarded as vertical rhizome which is composed

of the lower modified subterranean portion of aerial stem attached to the root. It bears buds e.g. Senega.

4) Sucker : It is a branch growing under the ground and arising either from a stem e.g. Mentha or from the top of the root e.g. Rose.

5) Stem-tuber : It is a stem or part of stem which is subterranean and swollen with reserve food material. It usually shows small scales, buds as well as a terminal bud on he free end e.g. potato.

6) Corm : It is a shortened swollen erect under ground base of the stem, covered with scale leaves and usually have a large apical bud small axillary ones. It usually produces a daughter corm either above the parent corm e.g. Colocasia or at its side e.g.

7) Bulb : It is formed of reduced flattened discoid underground stem crowned with crowded fleshy scale leaves or their bases and having adventitious roots. It bears a terminal bud in the axil of one of the inner most scales and axillary buds in the axil of other scales. There are two kinds of bulbs:

a) Scaly bulb : The fleshy scales overlap at their margins e.g. Scilla indica.

b) Tunicated bulb : The outer scales are larger and completely encircling the inner ones e.g. onion and Squill.

Structure of Subtarranean Stems :

Subarranean stems generally resemble in structure the aerial stems. They are almost devoid of sclerenchymatous tissue as they are not in need of supporting themeselves. They are formed of the following

layers :

1- The Tegumentary layer : It formed the outer protective layer and may be :

a) Epidermis : Which is persistent in som cases as in couch Grass.

b) Cork: Which is formed of few rows of regular layers of suberised or lignified cells with no intercellular spaces e.g. Liquorice and Rauwolfia.

c) Metaderm : Which consists of few rows of irrigularly arranged suberised cells derived from the outer layers of the cortex, so may show intercellular spaces.

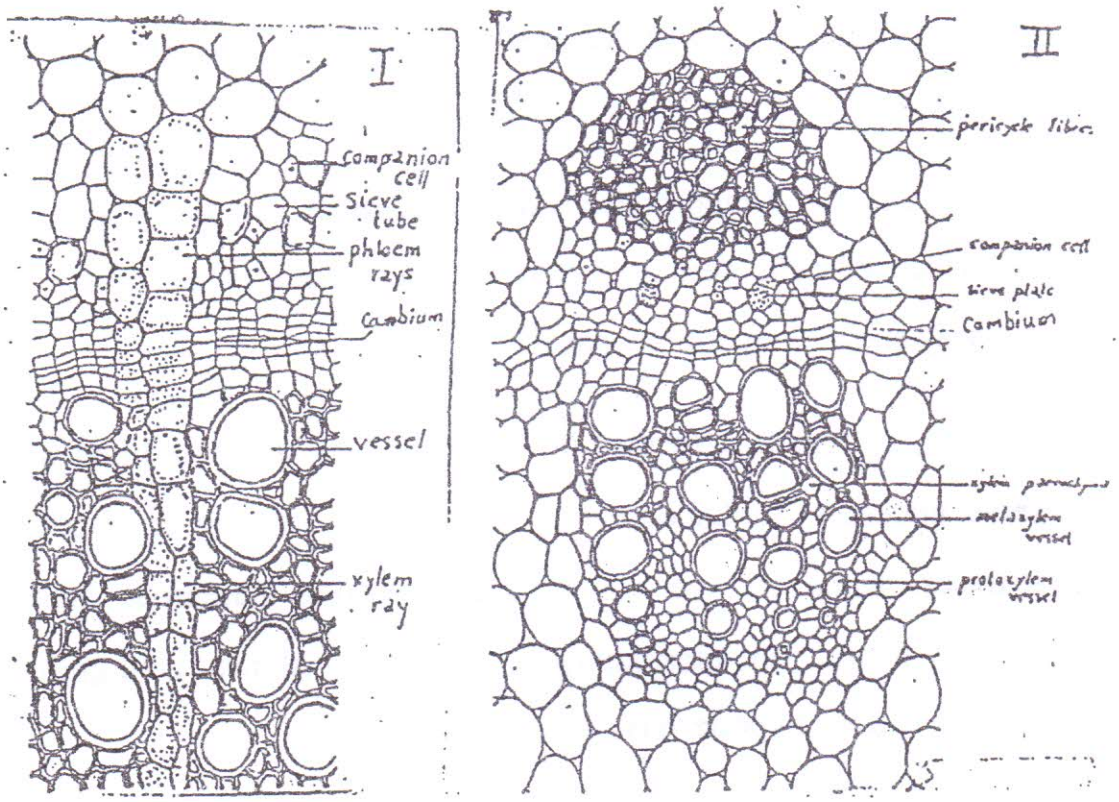
2- The Cortex: It is formed of thin-walled parenchyma filled with reserve materials. In Dicotyledons, it is wide showing few root-or leaf-traces, while in Monocotyledons, it shows numerous closed vascular bundles. In pteridophyta, the cortex shows nonlignified sclerenchymatous hypodermis.

3- The Endodermis : It is usually indistinguishable in Dicotyledons, though it may be clear as in Valerian. In Monocotyledons it is distinct.

4- The Vascular Bundles : They occur in the following forms.

a) Open, i.e. showing cambium, widely separated by medullaey rays forming a single ring around the pith e.g. Podophllum or the secondary tissues are greately developed formed continuous ring around the pith e.g. Dicotyledons like Liquorice and Rauwolfia.

Closed numerous and scattered in both the cortex and the stele being smaller and more numerous near the endodermis e.g. Ginger and Monocotyledons. Sometimes, they are restricted to a single layer within the endodeermis surrounding a central pith e.g. Couch grass.



Vascular tissue. I, of old stem; II, of young stem. The same for subterranean stem.

c) Dictyostele of separate meristeles, each is formed of a concentric vascular strands surrounded by distinct endodermis e.g. pteridopthyta.

Anomalous structures in subterranean stems may be present e.g. In Rhubarb, abnormal bundles are developed in the pith as radiating stellate structure called star spot. It is formed by abnormally developed

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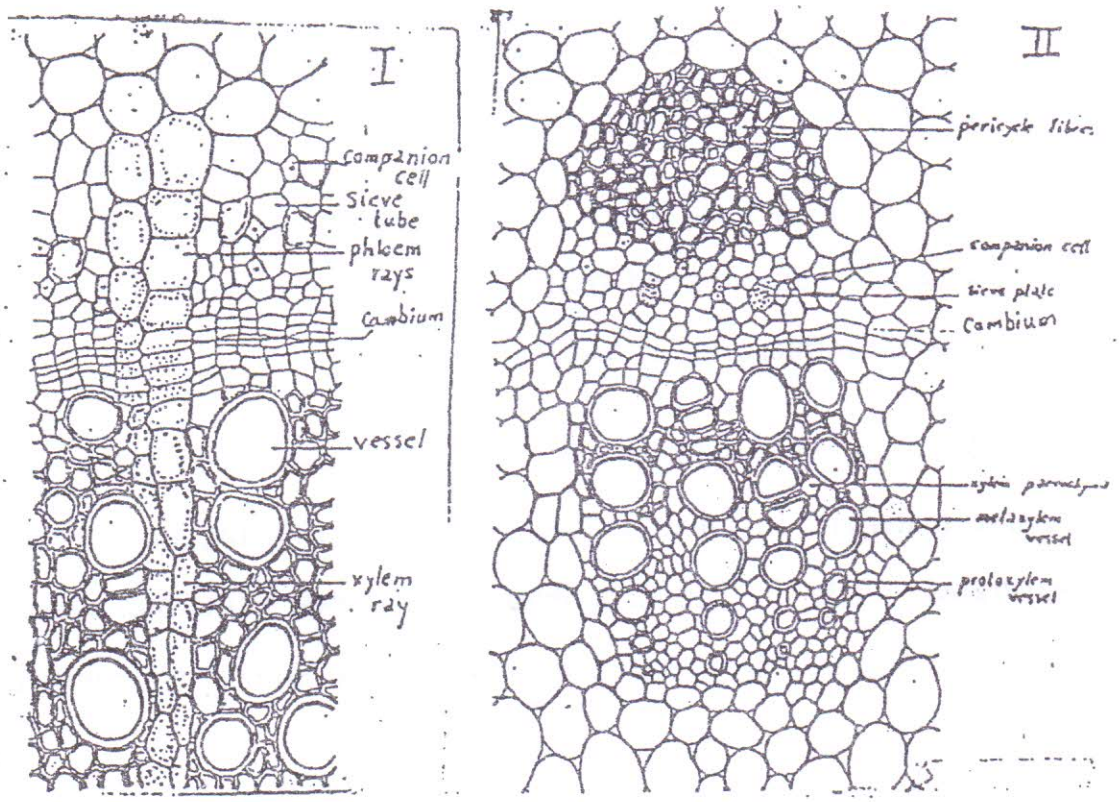

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cambium which results from activation of parenchyma cells around the collapsed perimedullary phloem. This cambium gives phloem to the inside and xylem to the outside with radiating slightly curved medullary rays filled with dark browm contents.

RADIX GLYCYRRHIZAE

Liquorice = Jithrul sous:

Liquorice, Reglisse, Radice di Liquirizia, Sussholz.

Syn.: Glycyrrhiza, Liquiritae Radix, Sweet Wood, Boid Doux, Riglisse, Oudel Sous, Erqusous.

Liquorice is the dried peeled or unpeeled root and rhizome of *Glycrrhiza glabra Linne var. Typica* Regel et Herder, known as Spanish Liquorice or *Glycyrrhiza glabra var. Glandulifera* (Wald et Kit) Regel et Herder, known as Russian Liquorice or of other varieties of *Glycyrrhiza glabra* Linne, Fam. Leguminosae-Papilionoideae.

Glycyrrhiza glabra Linne is cultivated in England, Spain and grown in Asia minor and North Africa, Germany, France and U.S.A. Var. glanduliferae grows in Russia, chiefly in the basin of Volga.

CULTIVATION AND COLLECTION:

Spanish liquorice is cultivated by replanting pieces of the stolons, each having 2-3 buds of aerial shoots. The underground organs are developed at sufficient extent by the end of 3-4 years, when they are dug-up, washed and cut into short pieces. Root-lets and buds are removed and the drug is dried rapidly in the sun and finally in a heated chamber.

DESCRIPTION:

Macroscopical Characters:

1. Spanish Liquorice:

Consists chiefly of stolons with few pieces of roots. The pieces are unbranched, mostly cylindrical, 14-20 cm long and 5-20 mm in diameter. The unpeeled drug is dark-brown or reddish-brown in colour, longitudinally wrinkled externally and the stolons bear occasional small buds, scaly leaves and scars of slender side-roots. The peeled drug has a yellow slightly fibrous exterior, which often shows longitudinal flattish areas (resulting from the use of knife for peeling). Fracture is fibrous in the bark and splintery in the wood. Odour is faint and characterstic and the taste is very sweet, almost free from bitterness and acridity.

2. Russian Liquorice:

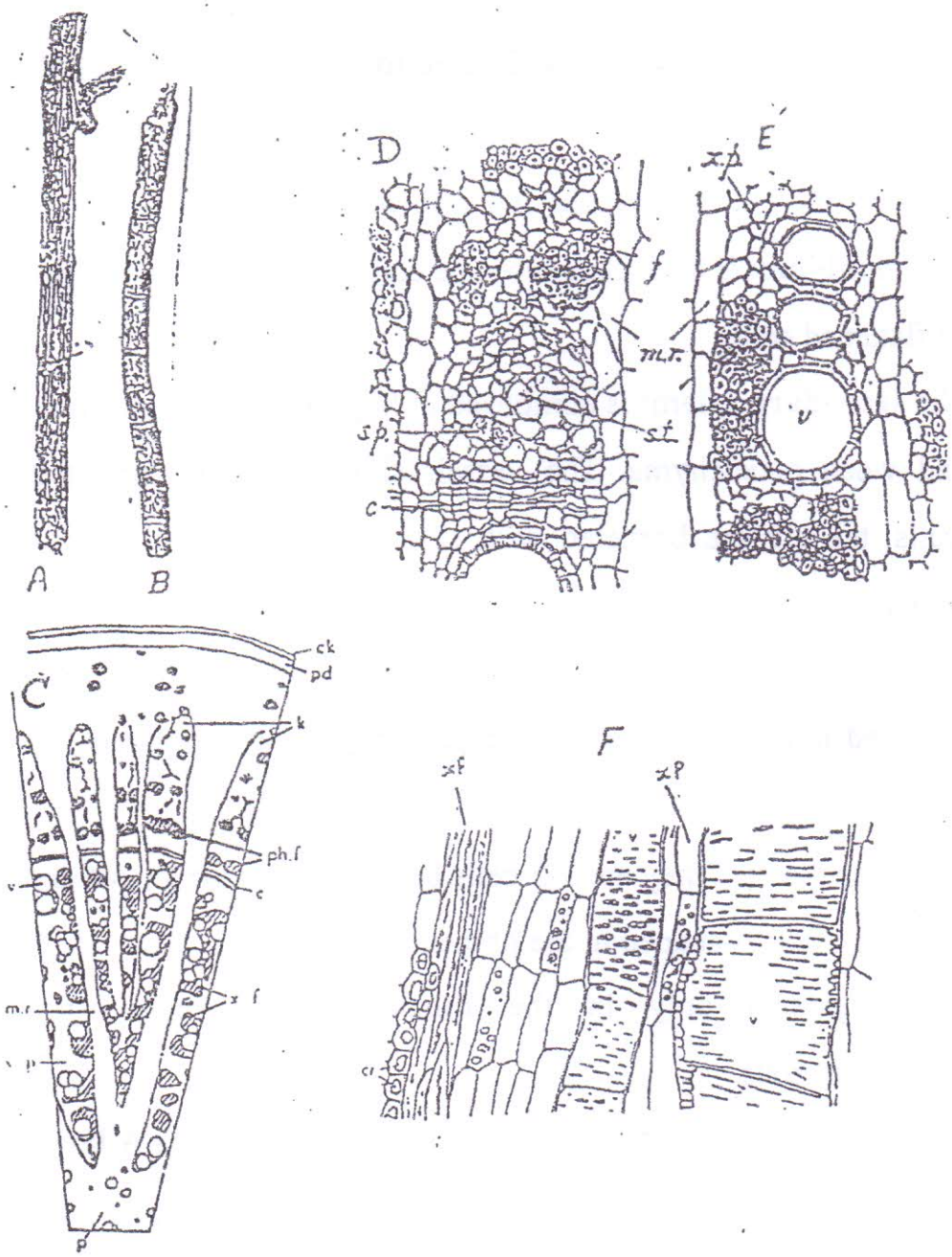
The unpeeled drug occurs in somewhat tapering pieces up to 30 cm

in length and 1-5 cm in diameter, it consists mainly of roots together with root-stock. The surface is covered with a somewhat scaly, purplish cork. The pieces of root-stock often bear buds and have a pith, but the roots may be distinguished from the stolons of the Spanish drug by the absence of buds. Fracture is very fibrous, the strands of fibres tending to separate from one another. This variety is sometimes peeled. The taste is sweet but usually not entirely free from bitterness and acridity.

Microscopical Characters:

Rhizomes and roots of liquorice have typical structure except the absence of pith in the root and presence of the tetrach primary xylem in the center of the root. A transverse section shows the following layers.

1. Cork: thick, brown or purplish-brown, formed of several layers of flattened polygonal, thin-walled cells.
2. Cortex: of phelloderm in root, somewhat narrow, yellow, formed of parenchyma cells containing isolated prisms of calcium oxalate and simple starch granules, about 10 u.
3. Pericycle: it is parenchymatous with small groups of fibres at intervals.
3. The pholem: it is wide, yellow and composed of alternating zones of hard and soft bast traversed by numerous wavy funnel-shaped medullary rays 1-8 cells wide. The hard bast, is composed of groups of fibres, being yellowish and slightly lignified, each group is surrounded by a sheath of



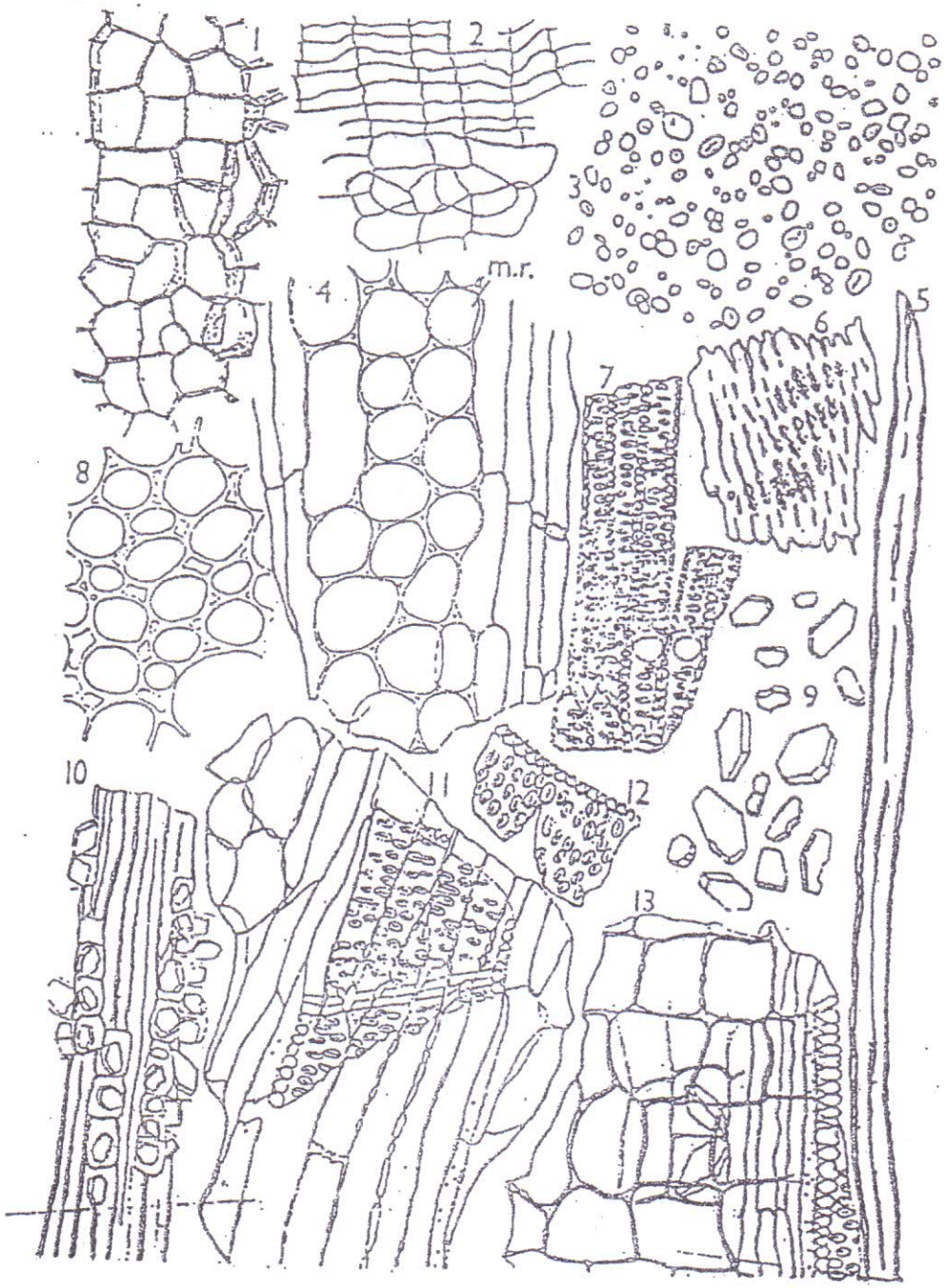
Liquorice. A, stolon; B, a root; C, diagram of T.S. stolon; D, T.S. of phloem; E, T.S. of xylem; F, L.S. of xylem; b, bud; c, cambium; ck, cork; cr, calcium oxalate; k, ceratenchyma; m.r, medullary ray; p, pith; pd, phelloderm; ph. f, phloem fibres; v, vessel; x. f, xylem fibres; x. p, xylem parencyma.

parenchymatous cells, each usually contains a prism of Ca. Ox forming a crystal-sheath. The soft bast, consists of sieve tissue which in the outer part was collapsed to form ceratenchyma, the sieve tissue adjacent to the cambium being the only part which shows clearly the sieve tubes and phloem parenchyma.

5. **The cambium:** is an incomplete line composed of about 3 layers of flattened cells.
6. **The secondary xylem:** is composed of large vessels, wood fibres and wood parenchyma. The vessels show reticulate or pitted walls, the pits are bordered with slit-like opening. They occur singly or in small groups and alternate with bundles of woodfibres resembling the phloem fibres in form and in being enclosed in a crystal sheath. The parenchyma of the xylem has lignified pitted walls.
7. **Meduallary rays:** they are 3-5 cells being wide in the xylem and becoming funnel-shaped in the phloem.
8- **Pith:** present only in the rhizome, dark yellow and parenchymatous.

Root, with 4 arch primary xylem, but no pith and shows 4 broad primary meduallary rays, radiating from the center at right angle to one an other.

In the peeled liquorice the cork, cortex and sometimes part of phloem are absent.



Powdered Liquorice. 1,2, cork; 3, starch; 4, m.r. with sieve tissue; 5 fibre; 6, pitted vessel; 7, same; 8, cortex cells; 9, prisms of calcium oxalate; 10, fibres with crystal sheath; 11, wood; 13, m.r. crossed wood parenchyma.

POWDER:

Powder liquorice is light brown in the peeled or brownish-yellow or purplish-brown in the unpeeled. It has a faint characteristic odour and very sweetish taste, almost free from bitterness and acridity. Microscopically, it is characterised by the following fragments:

1- Numerous fragments of fibres accampanied by crystal sheath.

2- Dark-yellow fragments of vessels 80-200 u in diameter.

3- Prismatic crystals of Ca ox, free or in cells.

4- Numerous starch granules, free or in parenchyma cells, mostly simple, oval, rounded or fusiform, with no striations but occasionally showing hilum, 2-20 u in diameter.

Cork may be present.

CONSTITUENTS:

1- A sweet principle Glycyrrhizin, the potassium and calcium salts of glycyrrhizinic acid the diglucopyrano-siduronic acid of glycyrrhetic acid. Also, the C_20 epimer of glycyrrhetic acid, liquiritic acid is present.

2- Flavonoid compounds, liquiritin, isoliquirtin rhamnoliquirtin which on drying is converted into liquiritin, liquiritigenin and isoliquiritigenin.

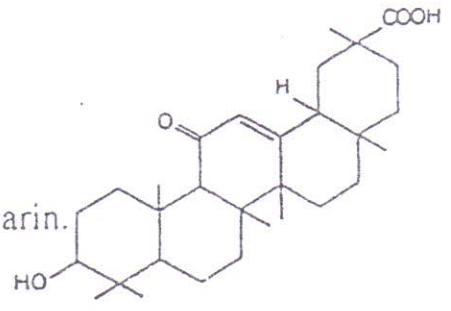
3- A coumarin compound, liqcoumarin.

4- About 5-15% of sugars, starch, protein,

B sitosterol and a bitter principle glycyramarin.

5- Asparagin, amide of aspartic acid.

6- 0.04 - 0.06% of volatile substances.



Glycyrrhetinic acid

USES:

1. Demulcent and mild expectorant.
2. In cough mixtures as expectorant and to mask the taste of nauseous medicaments.
3. For gastric and duodenal ulcers.
4. In treatment of rheumatoid arthritis and various inflammatory conditions due to its deoxycorticosterone effect.
5. As gentle laxative.
6. Mouth wash for mouth ulcers.

N.B.: Contraindicated in pregnancy and hypertension.

Tests for Identitiy:

1. Mix a little of powdered liquoric with 1-2 drops of sulphuric acid (66% v/v), an orange-red colour is produced.

2- Shake the aqueous decoction of liquore, a voluminous froth is produced.

Adulteration:

Powdered liquorice is subjected to the following adultrants.

a) Curcuma powder: It can be detected by presence of gelatinized starch and yellow masses.

b) Olive stone: Its presence is verified by presence of stone cells.

RHIZOMA RHEI

(Rhubarb = Ryzomatul Rawînd)

Rhubarb, Rhubarabe, Rabarbaro, Rhabarber.

Syn.: Rheum, Chinese Rhubarb.

Rhubarb is the dried rhizome and big roots of *Rheum palmatum* Linne, *R. officinale* Baillon or of other species or hybrieds of *Rheum* excepting *Rheum rhaponticum*, Fam. Polygonaceae, grown in China and Tibet and deprived of most of its bark.

Rhubarb contains not more than 2% of foreign organic matter.

The plant grows on the high plateaux of Asia, in Tibet and China. The drug is known in commerce as Shense and Canton rhubarb.

Cultivation, Collection And Preparation:

Rhubarb is propagated by seeds, usually cultivated in September, in sandy and clay loamy soils the rhizomes are grown at a high altitute (3000-4000m) dug up in autumn when about 6-10 years old deprived of its cork an dried. Pieces often show holes indicating that they were threaded into cords for drying in the shade. The drug may be also artificially dried, e.g. on heated stone tables.

DESCRIPTION:

Macroscopical Characters:

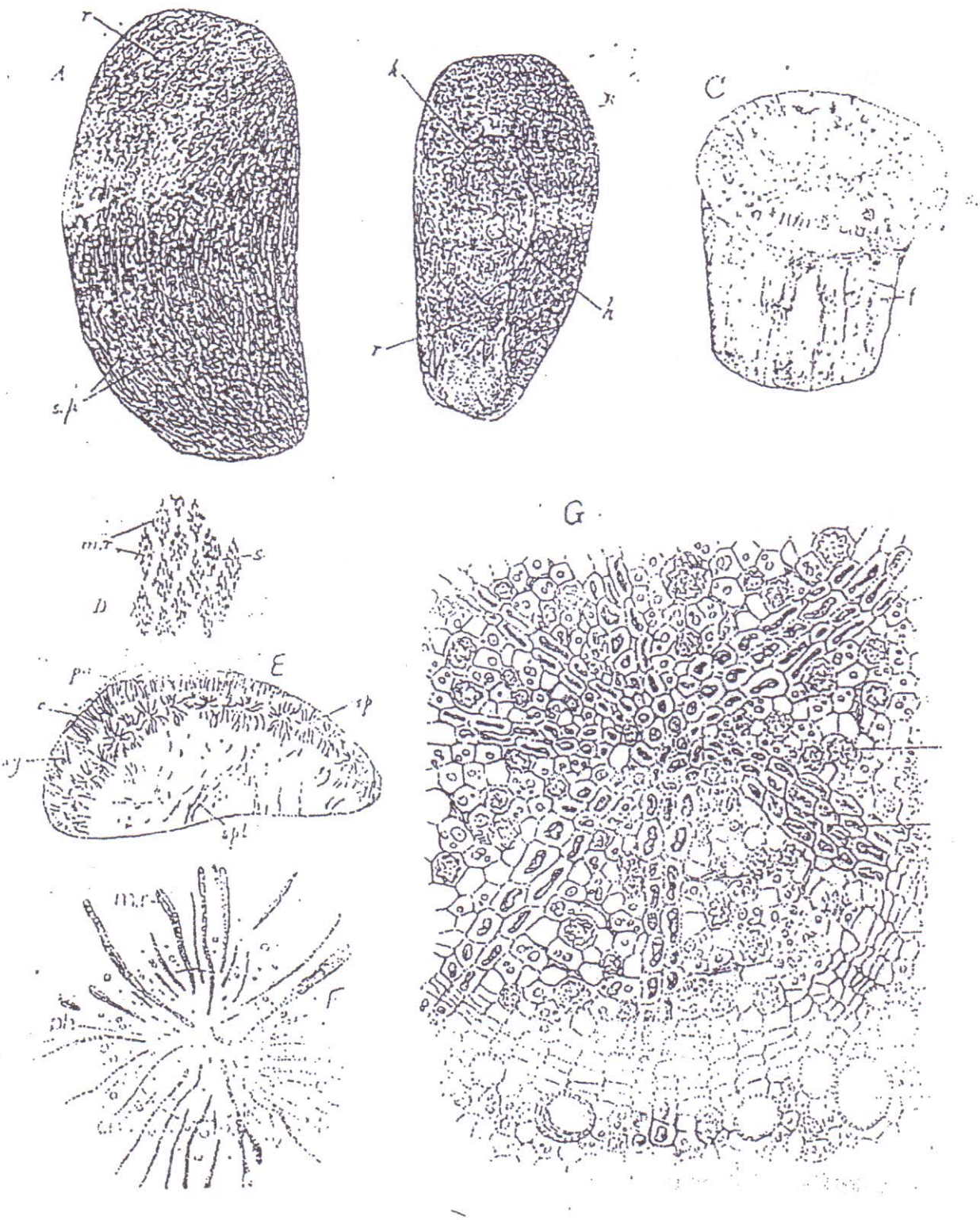
Rhubarb occurs in subcylindrical, barrel-shaped, conical, plano-convex or rectangular pieces, each occasionally showing a perforation which was pierced for drying. It measures 5 to 17 cm long

and 4 to 10cm wide. Externally, the drug is usually dusted with a fine, bright, brownish-yellow powder and showing longitudinal reddish-brown lines and dots embedded in a greyish-white ground tissue frequently forming a network of whitish lines, in the meshes of which are alternating white, phloem parenchyma, and orange or brownish red lines, meduallary rays, in addition to small patches of cork. If the trimming has been severe there may be seen upon the surface numerous groups of radiating dark, reddish-orange lines known as (Star spots), which result from sections of abnormal vascular strands occuring in the pith. Rhubarb is compact, firm, hard and heavy with granular and uneven fracture. Internally, the drug is pinkish-brown to greyish, not discoloured or lacunous, showing numerous reddish-brown lines embedded in a greyish-white matrix. The smoothed transverse surface usually showing near the periphery an occasional dark cambium line, followed by a radiating narrow xylem, numerous star spots scattered, or in a more or less diffuse ring, in the periphery of a large, greyish-white pith. Rhubarb has characteristic aromatic odour and bitter and astringent taste, when chewed, it is very gritty between the teeth and colours the saliva yellow.

Microscopical Characters:

T.S. in Rhubarb shows the following layers:

1- **The cortex:** If present, is very narrow consisting of polygonal, parenchymatous cells, containing simple or compound starch granules and large clusters of CaOx.



Rhubarb. A Shensi flat; B. Shersi round; C. conron round. D. dctcils of reticuations; E. T.C. surface of a flan E.T.S. of a star spor; G. detailed T.S. through a star spot. c. cambium; cr. crystals; f. facets produced by pceling; h. hole; k, knife maih; m.r, medullary; ay, ph. phlocm, reticulatons; s. starchy parenchma; sp. star spot. spl. star spot cut longitudinally; v. vessel : x.p. wood par. : xy, xylem.

2- The phloem: If present, is parenchymatous, the sieve tissue is in scattered groups, mostly obliterated and collapsed, it is traversed by reddish-brown medullary rays, 2-5 cells wide with reddish-brown contents and showing numerous large clusters of CeOx., the phloem parenchyma contains starch granules.

3- The xylem: It is formed of a narrow ring within the cambium and traversed by parenchymatous medullary rays, of 2-3 cells wide with brown amorphous contents, the vessels are non-lignified, isolated or in small groups, mostly reticulate, may show spiral or annular thickening.

4- The pith: It consists mostly of parenchyma and irrigularly traversed by star-shaped, amphivasal, abnormal vascular bundles called star spots.

The star-spots: arise as a result of the development in the pith of supernumerary concentric bundles having phloem towards the center and xylem externally. In the center of a star-spot there is a small amount of collapsed phloem, this is surrounded by a phloem developed from the cambium, which arise around the original strand of phloem, externally the cambium forms xylem with large vessels, the radiating orange arms of the star are the medullary rays being slightly curved.

There are no sclerenchymatous fibres or cells and the commercial rhubarb has no cork.

POWDER:

Powdered rhubarb is reddish-brown to yellowish-brown in colour with characteristic aromatic odour and bitter astringent taste. It is characterised microscopically by the following fragments:

1- Abundant fragments of thin-walled parenchyma containing numerous starch granules.

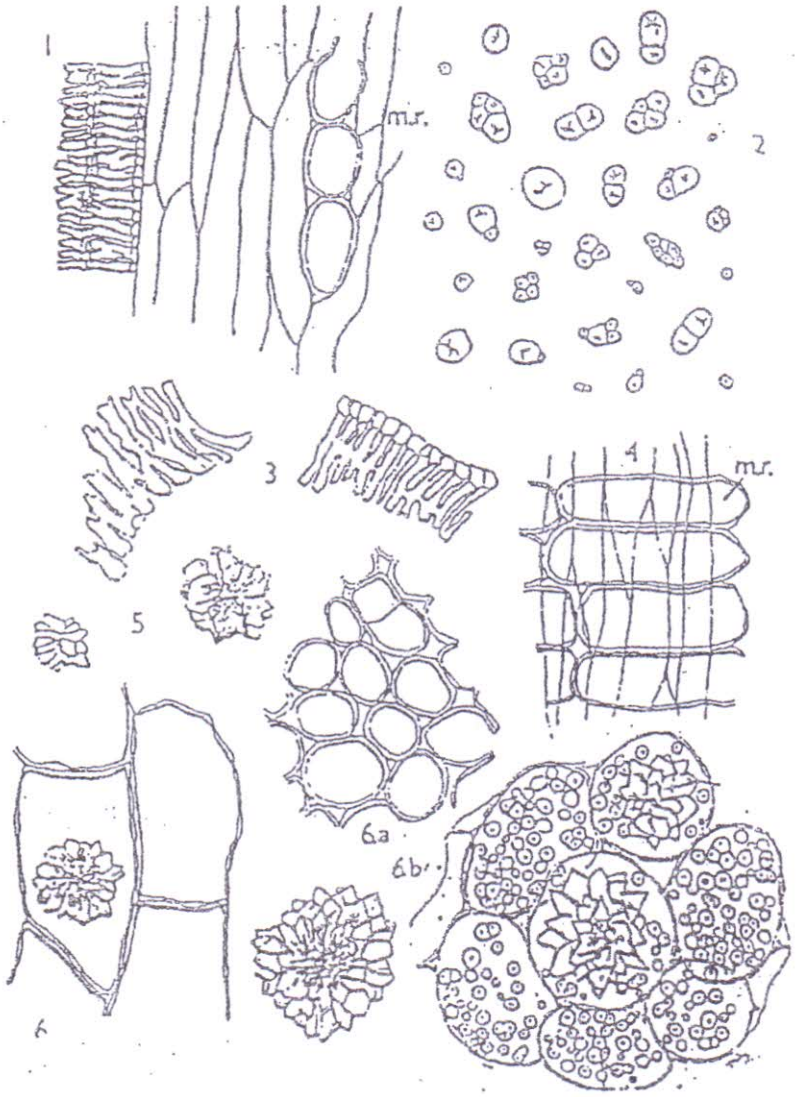
2- Fragments of medullary ray cells with brownish contents, giving a reddish-pink colour with solution of caustic alkalies (these contents are insoluble in alcohol, soluble in water and chloral-hydrate).

3- Fragments of non-lignified, reticulate spiral or annular vessels.

4- Numerous large cluster crystals of Ca ox. 20-200 mostly 60-120u in dimater, sometimes broken.

5- Numerous starch granules, simple, 4-25 mostly 20u in diameter or compound of 2-4 components, with a central cleft or radiate hilum. Single granules are rounded, components of compound granules are often muller-shaped.

6- Fibres and sclereids are absent.



Powdered Rhubarb.1, frag. of xylem; 2, starch; 3, vessels; 4, m.r. with parenchyma; 5, calcium oxalate clusters; 6, parenchyma containing starch and calcium oxalate.

CONSTITUENTS:

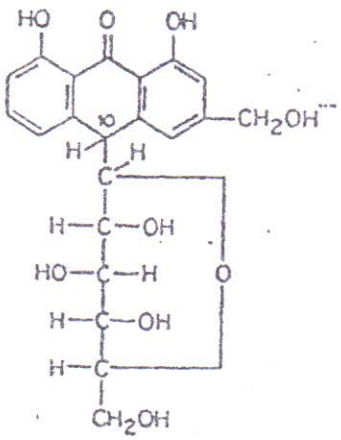
I- Anthraquinones derivatives (2-4.5%) of the following types:

1- Anthraquinones without a carboxyl group e.g. chrysophanol, aloe-emodin, emodin and physcion and their glycosides e.g. glucoaloeemodin and chrysophanein.

2- Anthraquinones with a carboxyl group e.g. rhein and glucorhein.

3- Anthrones or dianthrones of chrysophanol or emodin or aloe-emodin or physcion e.g. sennosides A & B and the oxalates of these, sennosides E and F.

4- Heterodianthrones e.g. palmidin A, palmidin B and palmidin C. Also sennidin C and sennoside C, reidin B and C.



Barbaloin

II- Astringent compounds: glucogallin, free gallic acid, epicatechin gallate and catechin.

III- Starch and calcium oxalate.

USES:

1- In small doses rhubarb is used as a bitter stomachic and in large doses it is used in the treatment of diarrhaea (purgation being followed by an astringent effect), due to the tannins present.

2- In cases of indigestion with diarrhaea.

3- As a mild laxative.

4- It has been used in jaundice, sores and cancer.

TESTS FOR IDENTITY:

1- On microsublimation:

powdered rhubarb gives a yellow needle-shaped sublimate, which dissolves in potassium hydroxide T.S. giving a reddish colouration.

2- Test for anthraquinone derivatives:

Boil 0.1 g powdered rhubarb with 5 ml of 10% sulphuric acid for two minutes to hydrolyse any glycosides. Filter while hot, cool the filtrate and shake with benzene. To the clear benzene solution add half its volume of 10% ammonia, shake and allow to separate when the ammonical layer will have aquired a rose-pink colour.

TESTS FOR PURITY:

1- When the powder is examined under Ultra Violet light no chinhy blue violet spots or particles (Rhapontic Rhubarb).

2- Place on a slide 2-3 drops of 10% freshly prepared solution of furfural in alcohol and 3 drops of sulphuric acid, then sprinkle little of the powder and examine immediately under the microscope: a bluish-violet colour should not be produced (Rhapontic Rhubarb)

SUBSTITUTES AND ADULTERANTS:

1- English Rhubarb:

Two species of Rheum are cultivated in England, *R. officinale* and *R. rhaponticum*:

a) The rhizomes of *Rheum officinale* resemble the Chinese drug, but being more spongy, shrink and wrinkle as they dry, and are softer to cut, the white reticulations are commonly absent, the star-spots are fewer and more scattered. The constituents are similar to the chinese drug.

b) The rhizomes of *R. rhaponticum* (indigenous to South Siberia) much shrunken and usually pinkish in colour, they can be readily distinguished by the transverse section which shows a diffused circle of isolated star-spots. It contains traces of emodin, aloe-emodin or rhein, its most characteristic constituent is a crystalline glycoside, rhaponticin, which fluoresces blue in Ultra-Violet light.

2- Chinese Rhapontic Rhubarb:

It closely resembles English rhapontic, but is usually darker, often hollow in the center. Internally, it is yellow, rather than pink. It fluorescence test for rhaponticin, a mixture of both when examined in Ultra-Violet light shows bright blue specks (rhapontic rhubarb) in a velvety-brown ground colour (official Chinese Rhubarb).

3- Indian Rhubarb: (*Rheum emodi*):

It is shrunken, and easily cut. In Ultra-Violet light, it fluorecences deep-violet with certain amount of velvety-brown patches. It does not contain rhaponticin and gives positive test for anthraquinone derivatives.

4- Many species of Rumex root:

e.g. *Rumex. alpinus* and *R. obtusifolius* have been used as substitutes for Rhubarb. They contain anthraquinone derivatives.

Rhizoma Zingiberis

(Ginger = Ryzomatula Zanjabeel)

Ginger, Gingembre, Zenzero, Ingwer.

Syn.: Zingiber, Zanjabeel.

Ginger is the fresh or dried rhizome of *Zingiber officinale* roscoe Fam. ingiberaceae, deprived of the dark outer tissues and known as unbleached Jamaica Ginger.

Ginger yields not less than 1%. of volatile oil.

The plant is native of South-eastern Asia. It is cultivated in India, Nigeria, West Africa and Jamaica.

Cultivation, Collection and Preparation:

Ginger grows well in well-drained rich loamy soil at subtropical temperature and by the presence of abundant rain-fall. The plants are propagated from cuttings of the rhizomes, called fingers, each bearing a bud. The rhizomes are collected in December or January, cleaned by removal of soil, buds, roots, and saked overnight in water. After soaking, the rhizomes are carefully peeled, (removing the cork and some of the underlying parenchyma) washed and then dried in the sun for 5 to 6 days. The product is known as "Unbleached Jamaica Ginger".

Coated or Unscraped Ginger where little or no cork is removed from Ginger, these are sometimes whitened by dusting with lime or calcium carbonate (Limed Ginger). They are less susceptible to insect attacks.

Description:

Macroscopical Characters:

Unbleached Jamaica ginger occurs in branched pieces known as "hands" or races, 7-15 cm long and up to 6.5 cm high. Each piece consists of a horizontal rhizome from which branches about 3-6cm long and known as (fingers) arise vertically, and terminating with depressed scar or in undeveloped bud. The branching system is sympodial and the whole piece is laterally compressed 1-2 cm thick, Externally, ginger is pale yellowish-buff; and longitudinally striated or fibrous. The scraping has removed all traces of root-scars. The fracture is short with projecting fibres and is mealy or hard and somewhat

The smoothen transvers surface is elliptical with a well marked endodermis separating the cortex, which may occupy up to the radius, from the central stele. The vascular bundles are scattered throughout both cortex and stele, being smaller and more numerous near the endodermis, minute yellow oil cells are irregularly distibuted in the ground tissue.

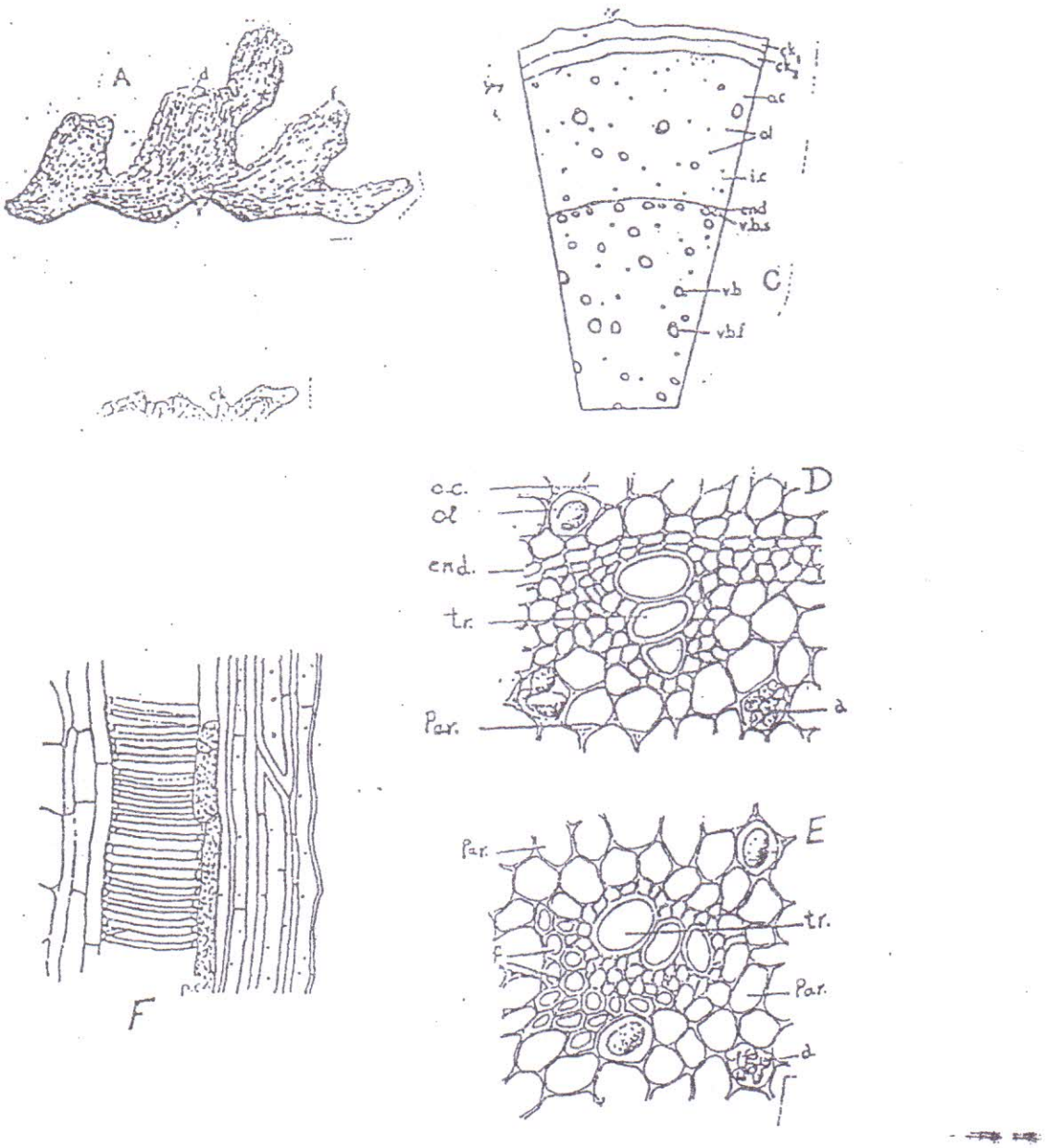
Ginger has agreeable aromatic odour and pleasntly pungent aromatic tatste.

Microscopical Characters:

T.S. of unpeeled rhizomes shows the following layers:

a) Cork: several layers of thin-walled polygonal tabular cells.

b) Cotex: cmposed of thin-walled parenchyma cells, the majority of which contain starch grains which are entirely simpe, ovoid or sack-shaped with an eccentric hilum and transverse striations



Ginger. A, peeled Jamaica rhizome; B, partially peeled African ginger; C, diagrammatic T.S. of unpeeled rhizome; D & E, detailed T.S., F, L.S. of a vascular bundle. a, starch; ck, outer cork; d, depressed scar; end, endodermis; f, fibres; i.c, inner cortex; ol, oleoresin cell; o.c, outer cortex; par. parenchyma; r, ridges; s, septum; s.s, scraped surface; tr, vessel; v.b, vascular bundle; v.b.f, fibrous vascular bundle; v.b.s, ring of small v.b.

(scitaminaceous starch grains). Scattered in the cortex are numerous oil cells with suberised walls and containing yellowish-brown oleo-resin.

c) Endodermis: a single layer free from starch.

d) Pericycle: the outermost layer of the stelel composed of a single layer of cells. Cells of endodermis and pericycle contain no strach.

e) Stele: the ground mass is formed of parenchyma cells cotaining strach grains and shows numerous oil cells.

f) The vascular bundles: are numerous, scattered all over the cortex and the stele. The are collateral and closed and with the exception of those neighbouring the endodermis, each is associated with arc-schaped group of fibres. Each vascular bundle is formed of:

i- Phloem, formed of well marked sieve tubes.

ii- Xylem, composed of annular spiral or reticulate non-lignified vessels as well as axillv elongated parenchyma or secretion cells containing reddish brown contents viz pigment cells.

iii- Fibrs occurring in arc-shaped group rarlv surrounding the vascular bundle. The fibres are thin-walled and unligbnified except the middle lamella and oftenly they have delicate pectosic transverse septa so they are termed sepate fibres.

N.B.: Calcium oxalate and sclereids are totally absent.

Powder:

Powdered ginger is yellowish-white, with characteristic aromatic odour and a pungent aromatic taste. Microscopically it is characterised

Powdered Ginger. 1,3,9,10 & 11, parenchyma showing oleo resin cells)o.r), starch grains and showing collapsed tissue; 2, starch granules; 5,6 & 7, fragments of septate fibres; 4 & 8, fragment of reticulate vessel associated with pigment cell (pg).

by the following fragments:

1- Numerous fragments of thin-walled parenchyma containing starch granules (Scitaminaceous).

2- Fragments of thin-walled septate fibres, with slit-like pits, only the middle lamella is lignified.

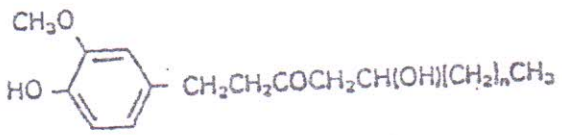
3- Fragments of unlignified vessels (annular, reticulate, scalariform and spiral, sometimes accompanied by narrow dark-brown pigment cells.

4- Yellowish-brown oleo-resin masses, free or in the cells.

5- numerous starch grains, simple; flate or oval-oblong with eccentric hilum and transverse striations.

6- Absence of stone cells, lignified elements, Ca ox and cork cells.

Constituents:



Gingerol (where n = 3, 4 or 5)

1- Ginger contains from 0.25-3% of a volatile oil which is responsible for the aroma, Consisting of monoterpenes (phellandrene, camphene, cineole, citral and borneol) and sesquiterpenes (zingiberene and bisabolene).

2- A yellowish oily body, called gingerol and shogaols, which is odourelss but with an intensely pungent taste (phenolic compound). This pungency is destroyed by boiling with 2% potassium hydroxide solution.

3- Resin and starch (56%).

USES:

1- Travel and motion sickness (the phenolic compounds responsible for relaxing the muscles of the stomach), the study indicated that the powdered ginger may be a more effective antiemetic than dimenhydrinate (Dramamine).

2- Indigestion and nausea; sickness in pregnancy.

3- Sluggish circulation, especially where hands and feet are cold by improving the circulation, ginger helps high blood pressure, it also increases sweating and helps reduce body temperature and fever.

4- Ginger is warming and soothing for coughs, cold, fluand other respiratory problems.

5- High cholesterol levels.

VARIETIES:

1- Cochin ginger: hands are usually smaller than those of jamaica.

a) The branches are shorter and thicker.

b) The aroma less agreeable.

c) It occurs in both the scraped or coated varieties.

2- African ginger: occurs in hte coated variety.

a) The dorsal and ventral sides bear patches of wrinkled cork of an earthy brown colour.

b) It is typically smaller and darker than the cochin variety.

c) It lacks the fine aroma of the jamaican drug but is more pungent.

3- Indian inger : resembles the african and is very pungent.

Adultration:

1- Japanese ginger:

a) It occurs in small flattened, unscraped pieces, obtained from

Zingiber mio-.

b) Many of the starch grains are compound.

c) The volatile oil differs from the official drug in physical properties.

d) The taste is less pungent.

2- Exhausted ginger: Generally in the form of powder it can be detected by:

a) Determination of the amount of extractives i.e. matter extracted by solvents such as water or alcohol (decreased).

b) Presence of gelatinised starch.

Exhausted ginger may have its pungency increased by the addition of capsicum or grain of paradise, which can be detected by heating in a after both the liquid extract with caustic alkali. The liquid is then evaporated, the residue acidified with HCL, and shaken with ether. Some of the ethereal solution ovaporated on a watch-glass. The residue left should not be pungent to taste.

3- Foreign starches, and saw dust, easily detected microscopically.

Rhizoma Curcumae:

Curcuma rhizome Turmeric:

Turmeric is the dried prepared rhizomes of *Curcuma demestica*, (*C. longa*) family Zingiberaceae.

The plant is indigenous to Southern Asia, and is cultivated in India, China and Malaya.

The rhizomes are dug up, steamed or boiled and dried.

Constituents:

(1) 4-5% of an ornage-yellow volatile oil, that composed mainly of turmerone (60%) and zingiberene (25%).

(2) 0.3- 5.4% of a yellow crystalline substance (curcumi).

(3) Starch (30-50%).

(4) Resin.

(5) SUgars.

USES:

1- As a condiment, Colouring agent, Stimulant and carminative. As a reagent for the detection of boric acid.

2- Anti-inflammatory, Turmeric is a powerful anti-inflammatory, it has an even stronger action than hydrocortisone.

3- Anti oxidant, Curcumin is more strongly antioxidant than vitamin E (choleretic strong antihepatoxic action).

4- Treatment of jaundice and hepatitis.

5- CUrcumin when applied to the skin and exposed to sunlight, it is strongly antibacterial and is useful in treating a number of conditions including psoriasis and fungal infections.

RADIX IPECACUANHA

Ipecace, Racine d'Ipeca, Radice di Ipecacuana, Brechwurzel, Syn.: Ipecacuanha root, Ipecacuanha Annellee, Racine Braziliene, Ruhrwurzel, Erquel Thahab.

Ipecacuanha is the dried root or the root and rhizome of *Cephaelis ipecacuanha* (Brot) A. Rich (-Uragoga ipecauanha Baillon, Psychotria *ipecacuanha* Stokes), known as Rio or Brazilian Ipecacuanha, or of Cephaelis acuminata karsten(Uragoga granstensis Baillon) known as Cartagena, Nicaragua or Panama Ipecacuanha, Fam. Rubiaceae.

Ipecacuanha contains not more than 2% of foreign organic matter, and yields not less than 2% of total alkaloids calculated as emetine, of which not less than 60% consists of non-phenolic alkaloids, calculated as emetine.

The plant is a shrub produces a slender rhizome bearing fibrous adventituous roots, many of which become thickened and form the commercial source of the drug. C. Ipecacuanha is indigenous to Brazil, but now is cultivated in Malay and India. On the other hand, C. acuminata is indigenous to the northern region of Colombia, Panama. and Nicragua and is exported from Cartagena.

CONSTITUENTS:

1) 2-3% of the isoquinoline alkaloids emetine, cephaeline psychotrine, psychotrine methyl ether and emetamine.

Rhizoma Curcumae:

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Constituents:

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(2) 0.3- 5.4% of a yellow crystalline substance (curcumi).

(3) Starch (30-50%).

(4) Resin.

(5) SUgars.

USES:

1- As a condiment, Colouring agent, Stimulant and carminative. As a reagent for the detection of boric acid.

2- Anti-inflammatory, Turmeric is a powerful anti-inflammatory, it has an even stronger action than hydrocortisone.

3- Anti oxidant, Curcumin is more strongly antioxidant than vitamin E (choleretic strong antihepatoxic action).

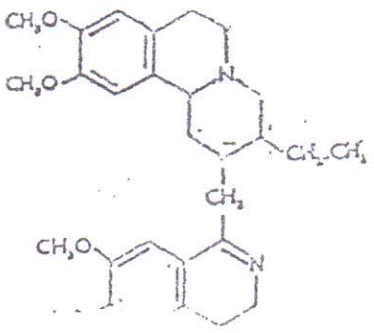
4- Treatment of jaundice and hepatitis.

5- CUrcumin when applied to the skin and exposed to sunlight, it is strongly antibacterial and is useful in treating a number of conditions including psoriasis and fungal infections.

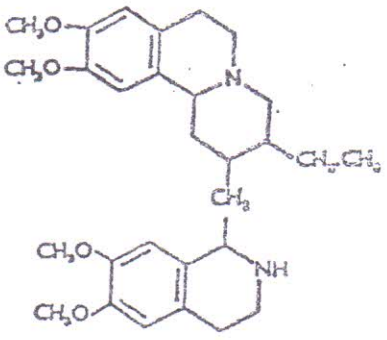
3) Iridoid glycosides sweroside and 7-dehydrologainin.

4. Acid saponin and ipecacuanhic acid.

5) Starch and calcium oxalate.



Psychotrine



Emetine

USES:

1- Expectorant and emetic.

2- Possesses diaphoretic and cholagogue properties.

3- Its most important use is as a remedy for amoebic dysentry if given in large doses.

4- In the treatment of amoebic dysentry emetine hydrochloride is given by injection.

5- Emetine has antitumour activity.

6- Psychotrine and O-methyl ether are selective inhibitors of human immunodeficiency virus.

RADIX RAUWOLFIA

(Rauwolfia, Indian Snake root, Chootchand)

Rauwolfia is the dried rhizome and roots of *Rauwolfia serpentina* Benth, Fam. Apocynaceae.

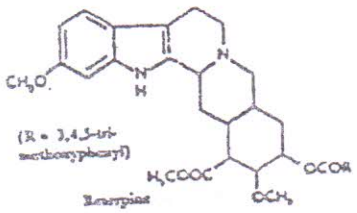
The plant is a large shrub indigenous to India, Burma, Pakistan, Siam and Jave.

The roots and rhizomes are dug in autumn from plants 3 to 6 years old.

CONSTITUENTS:

1- Alkaloids (up to 1.4%) the important of which are:

Ajmaline, ajmalinine, ajmalicine, serpintine serpintinine, resperpine and rescinnamine, the chief therapeutically important alkaloids are reserpine and rescinnamine.



2- Phytosterols, fatty acids, unsaturated alcohols dextrose and fumaric acid.

USES:

1- Rauwolfia and reserpine are used in hypertension, and in certain neuropsychiatric disorders.

2- In treatment of insomnia.

Rhizoma Podophylli

Podophyllium rhizome, · May-apple root, · American Mandrake American podophyllum is the dried rhizomes of *Podophyllus peltatum*, Fam. Berberidaceae.

The plant is a perennial herb, indigenous to moist shady places of Eastern U.S.A. and Canda. The drug is collected from wild plants in autumn.

CONSTITUENTS:

1. 3-8% of resins which is the purgative principle of podophyllum and known as podophyllin. The major constituents of the resin are:

a) Podophyllotoxin (20%).

b) α-peltatin (5%) free or as glucoside.

c) β-peltatin (10%) free or as glucoside.

CHEMICAL TESTS:

1- Extract the powder with alcohol, filter and devide the filtrate into two portions.

a) To the first portion add few drops of 5% copper acetate solution, a bright green colour is developed, but no brown precipitate (c.f. Indian podophyllum).

b) To the second portion add water and few drops of 5% potassium hydroxide solution, no gelatinisation occurs (c.f. Indian podophyllum)

USES:

1- The resin is used as a drastic purgative with cholagouge action.

2- A paint of podophyllum is used in the tratment of warts.

3- Large doses produce fetal inflammation of the stomach and intestine.

Indian podophyllum

Indian podophyllum is the dried rhizomes of *Podophyllum emodi*, Fam. Berberidaceae.

The plant is a perennial herb grows widly on the high latitudes of Tibet and Afghanistan and slopes of the Himalaya of Pakistan and India.

CONSTITUENTS:

6. 2% resins which contains:

a) 40% podophyllotoxin.

b) No peltatin.

USES:

Indian podophyllum is twice as active as American podophyllum. It is also used as drastic purgative and for warts.

Unorganised drugs

Unorganised drugs are crude drugs of animals or plant origin having no cellular or definite structure. They are either mixture of chemical substances or decomposition products substances originally present in the biological source of the drug. They are produced either normally or pathologically due to injuries or incisions.

Classification:

Group I: Resins and resin combinations.

Group II: Gums.

Group III: Latices.

Group IV : Juices

Group V : Extracts.

Group VI : Lipids.

Group VII : Proteins

Group VIII : Volatile Oils.

Group IX : Waxes.

Group X : Saccharine Substances.

Group I: Resins and resin combinations.

1. Resins

Resins are hard, solid or semisolid amorphous organic substances of complex nature. They are insoluble in water but dissolve in alcohol, chloroform and ether and on evaporation deposit the resins. They also dissolve in other organic solvents as fixed, volatile oils and in chloroform.

a. Resina Terebintinae: قلفونية

Colophony

Colophonium resina Colophonium Gallicum; Rosin.

It is the residue left after distilling the volatile oil from the oleoresin obtained from Pinus palustris Fam. Pinaceae.

Preparation:

Oleoresin produced by the tree ducts located just beneath the cambium and is greatly increased by injury

Characters

Translucent glossy masses of a pale yellow or amber colour, frequently covered with a yellow powder. It is brittle and easy pulverisable. It is insoluble in water but soluble in alcohol, chloroform, ether, benzene ..etc

Test of identity

1- 10ml of 1% solution. in acetic anhydride + one drop sulphuric acid where a bright purplish red colour which rapidly change in to violet is produced.

2- Shake about 0.05 g of freshly powdered colophony with petrolium benzene for few minutes, filter. Shake the filterate with an equal volume of dil. Copper acetate the benzene–petrolium layer assume a bright bluish - green colour

Constituents:

94% of total resin acids in which abietic acids is the major constituents

5-6% resene, 0.5% volatile oil and trace of a bitter substance.

Uses

Stimulant and a diuretic properties as ingradient of ointments and plasters, of some varnishes, paint dryers, printing inks and floor covering .It asses growth of lactic acid and butyric acid bacteria. It is used in manufacture of of ester gums used in laquers and varnishes.

Turpentine oil

It consists mainly of α- pinene (64%) and β- pinene (33%) it has mild antiseptic effect used as insecticide solvents for waxes, production of synthetic camphor and furniture polishes.

Purified turpentine oil:

By distillation of it from aquous sol. In NaOH.

Uses

Stimulant to the mucous membrane, diuiretic and expectorant.

راتنج خشب الانبياء

b. Guaiacum Resin

Resina Guaiaci; Rating Khashabel Anbeya

Guaiacum resin is the resin obtained from the heartwood of Guaicum officinale fam. Zygophyllaceae.

Constituents :

α-and β- guaiaconic acids (70%), guairetic acids (11%), small amount of guaiacic acids , guaiac β-resin, guaiaic yellow, vanillin and guaiac saponin.

Test for Identity

With oxidizing agents: Ferric chloride (one drop) 1cc of 1% sol. Of guaiacum Resin in alcohol where a deep blue colour is produced.

Uses

Local stimulant, irritant, as lozenges locally , given in acute gout , rheumatism, as tincture to detect oxidases.

c. Resina Jalapae

Jalap resin راتنج الجلبة

Mixture of resins by precipitating with water the alcoholic extracts of the dried tuber of Ipomea purga Hayne (Fam Convolvulaceae).

Test for identity:

1- Shake one gram of the powder for 1 hour in a dried flask with 20cc ether, filter, wash the residue and flask with 3 successive portions , each of 5cc of ether. Evaporate the ethereal extract and wash, dry at 100, and weight; not more than 0.15 gm of residue left (not more than 15% is soluble in ether ; Scammony Resin Orizaba Resin, Colophony and other resins.

2- disolve the ethereal residue in few ml. of alcohol , dip in the solution a piece of filter paper, remove and dry. Add to the dry paper drop of ferric chloride :no blue colour is formed c.f. Guaiacum Resin.

3- Triturate 1 gm of powdered Jalap Resin with 10 cc. of petrolium-benzene R., and filter. Shake the filtrate with 3ml of dilute copper acetate T.S. the petrolium- benzene layer is not coloured green c.f.with colophony.

...ts:

...resin is glycosidal and yields on hydrolysis glucose and rhamnose together with convolvulinolic acids and ipurganol which are crystalline substances as well as butyric isovaleric tiglic and exogenic acids.

Uses:

Cathartic, possessing hydragogue activity

d. Resina Podophylli

Podophylum resin; podophyllin.

Amixture of resins prepared from dried rhizomes and roots of Podophyllum peltatum known a American podophyllum resin and podophyllum hexandrum known as Indian Podophyllum resin. Fam : Berberidaceae