# IV. PHARMACOGNOSTIC STUDIES

## PHARMACOGNOSTIC STUDIES

### Introduction

The Rubiaceae are an economically and medicinally important family. Many plants of this family are used in Indian systems of medicine. In the Ayurvedic system of medicine as it is practised today, there is considerable variation in the identity of the source plants of the individual drugs selected for use. This variation is due to ignorance, similar sounding vernacular nomenclature, mistaken identity, common synonyms and also due to the general practices in vogue. Botanically different plants are used for the same Ayurvedic drug in different parts of the country. Sometimes even in the same locality, more easily and cheaply available plant is used instead of the genuine plant. This doubtful identity is because, one drug has various names and also different drugs are known under the same name due to regional differences. To avoid such problems it is necessary to correlate scientifically a particular Ayurvedic drug with its proper botanical source. This is possible only by making a full pharmacognostic account of each drug. Without such an account it is difficult to differentiate any spurious specimen from the genuine one. With this object in view the pharmacognostic study of some of the important medicinal plants of this family hitherto not worked out have been done. The botanical identity of the source plant in use is fixed. External morphology alongwith suitable sketches for the purpose of correct identification is given. The morphological and anatomical

details of the original part or parts have been studied in detail and described, and illustrative camera lucida drawings have been given. The descriptive account of each drug and their uses as given in Ayurvedic texts have also been taken into consideration in this work. Anatomical details which are of importance in identification and a distinguishing powder character also is given to identify it in formulations. The chemical constituents of the leaves are worked out which are already discussed in the first part pertaining to the chemotaxonomy of this family.

Plants taken for the detailed pharmacognostic study and the parts studied are as under:-

| Sr.No. | Name of plant | Parts studied |
|---|---|---|
| 1. | Adina cordifolia (Roxb.) Benth. & Hook.f. | bark |
| 2. | Anthocephalus cadamba Miq. | bark, leaf |
| 3. | Borreria hispida Schum. | root |
| 4. | Gardenia (Dikamali) | gum |
| 5. | Hymenodictyon excelsum Wall. | bark |
| 6. | Ixora coccinea Linn. | root |
| 7. | Ixora nigricans Br. | leaf |
| 8. | Ixora parvilfora Vahl, | bark |
| 9. | Meyna laxiflora Robyns | leaf |
| 10. | Morinda citrifolia Linn. | leaf |
| 11. | Morinda tinctoria Roxb. | root |

| | | |
|---|---|---|
| 12. | Oldenlandia corymbosa Linn. | whole plant |
| 13. | Ophiorrhiza mungos Linn. | root |
| 14. | Paederia foetida Linn. | leaf, root |
| 15. | Pavetta indica Linn. | root |
| 16. | Plectronia didymo Kurz. | bark |
| 17. | Randia dumetorum Lamk. | fruit |
| 18. | Rubia cordifolia Linn. | root |
| 19. | Stephegyne parvifloia Korth. | bark |
| 20. | Xeromphis uliginosa (Retz.) Maheshwari | root |

## MATERIALS AND METHODS

For pharmacognostic studies, the materials used were collected from the natural habitats of the plants. The material was identified, cleaned, washed and dried in shade or in oven at a temperature at 60°C. The physical characters of the dried material i.e. shape, size, scars, colour, fracture, etc., were noted. In some cases market materials also were studied and compared with the specimen collected. For histological studies, sections were cut by free hand using razor and sliding microtome was used for hard materials. Sections of different drug materials were examined under the microscope and anatomical details were sketched with the help of camera lucida. The powder study is done with a fine powder of plant material passing through a No.85 sieve (mesh size 180 µm). Physical characters of powdered drug also were studied. Standard methods of studying crude drugs (Wallis, 1960; Johansen, 1940) were followed. Phloroglucinol (1% W/V in 90% alcohol) and Con. HCl were used for staining lignified tissues. Starch grains were studied after staining in Iodine water (2% W/V). The materials were boiled for 2 minutes in chloral hydrate solution (50 gm. chloral hydrate in 20ml D.W.) for clearing the sections from unwanted colouring matter which mask the structures and also for studying the calcium oxalate crystals. Individual cells and tissues were studied by macerating the plant material in Schulze's maceration fluid (50% Nitric acid in conjunction with a few crystals of potassium chlorate). Epidermal peel was prepared after boiling

the leaf in chloral hydrate solution or in dil. potassium hydroxide solution (10% W/V). Glycerin was used as the mountant. The microscopic study was carried out by using Leitz ortholux microscope. Calcium oxalate crystals and starch grains were studied under polarised light microscopy. The microscopic measurements were carried out by using an ocular and stage micrometer. Drawings were made by using Abbe type camera lucida.

Abbreviations of vernacular names

Ass. - Assamese
Ben. - Bengali
Eng. - English
Guj. - Gujarati
Hin. - Hindi
Kan. - Kannada
Mal. - Malayalam
Mar. - Marathi
Pun. - Punjabi
San. - Sanskrit
Tam. - Tamil
Tel. - Telugu
Uri. - Oriya

1. Adina cordifolia (Roxb.) Benth. & Hook. f.

(Syn. Nauclea cordifolia willd.)

Vernacular names - Keli kadam (Ben.); Haldu (Hin.);
Manja kadamba (Mal, Tam.)
Dharakadambu (San.)

Description of the plant:

An erect tree branches horizontal with thick brownish grey bark, externally furrowed, pubescent in young parts; leaves 10 to 25 cm long and about as broad as long, orbicular, shortly acuminate, slightly pubescent above, densely pubescent beneath especially when young. Petioles 5 to 10 cm long, stipules oblong. Flowers numerous in globose heads 1.8 to 2.5 cm in diam. on axillary peduncles, each bearing 1 rarely 2 heads of yellow flowers. Fruit is a capsule up to 0.5 cm. long. Seeds about 6 in each cell.

Medicinal part: bark, buds, root, juice.

Medicinal uses:

The small buds, ground with pepper, are sniffed into the nose in severe headache. The juice of the bark is used to kill worms in sores (Nadkarni, 1954). The bark is regarded as a febrifuge and antiseptic (The Wealth of India, 1948).

Macroscopical characters of bark:

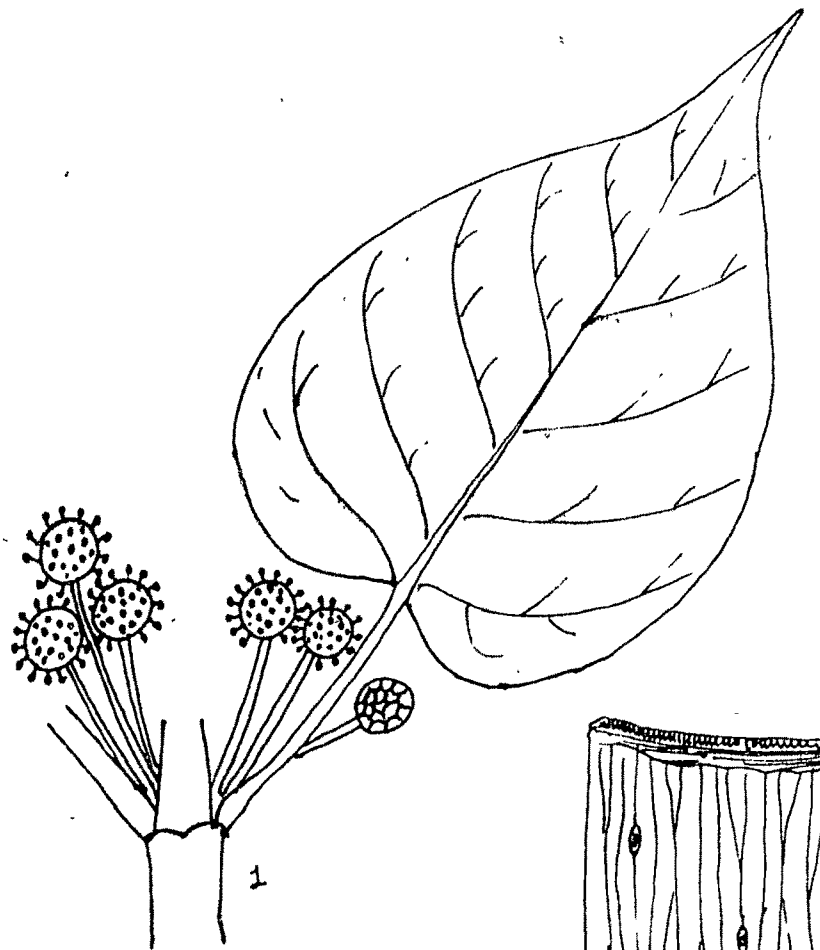
Bark is thick, variable in thickness, furrowed and brownish

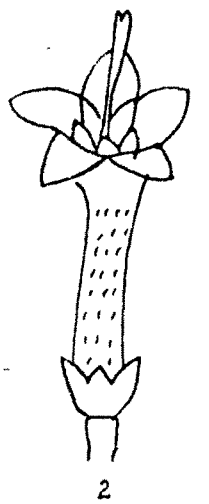
grey in colour externally, light yellowish in colour internally. The external surface exhibits lenticels. Internal surface shows longitudinal fibres. Fracture is short in the periphery and fibrous towards inner surface. Fractured surface is brownish towards periphery and light yellow towards inner surface.

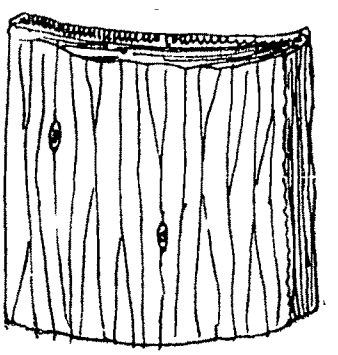
Microscopical characters of bark:

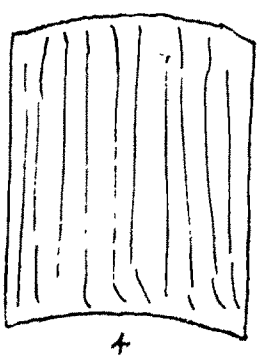
The bark in transverse section shows tabularly arranged suberised cork tissue with cells measuring T.* 25 $\mu$, R.** 20 $\mu$ towards the periphery. Cork tissue consists of upto 10 layers, and varies according to age of the tree. Within the cork tissue are 2 or 3 continuous bands of lignified tissues of sclereids, tangentially elongated measuring T. 20$\mu$, R. 10$\mu$. Each band of sclereids consists of a single layer of stone cells. Inner to the cork is the broad zone of parenchymatous cortex, consisting of about 35 layers of circular or irregularly compressed cells with intercellular spaces. These cortical cells measure T.60$\mu$, R.30$\mu$. Many cells of the cortex are filled with an orange coloured resinous amorphous substance. There are also schizogenous canals in the cortex filled with similar contents. Lignified isolated pericyclic fibres measuring T.40$\mu$, R.30$\mu$ are present in pericyclic region. The innermost tissue is phloem, which consists of phloem elements containing lignified bast fibres of 15$\mu$ in diam. and also schizogenous canals with dark coloured laticiferous substances. Crystals and starch are absent in the bark.

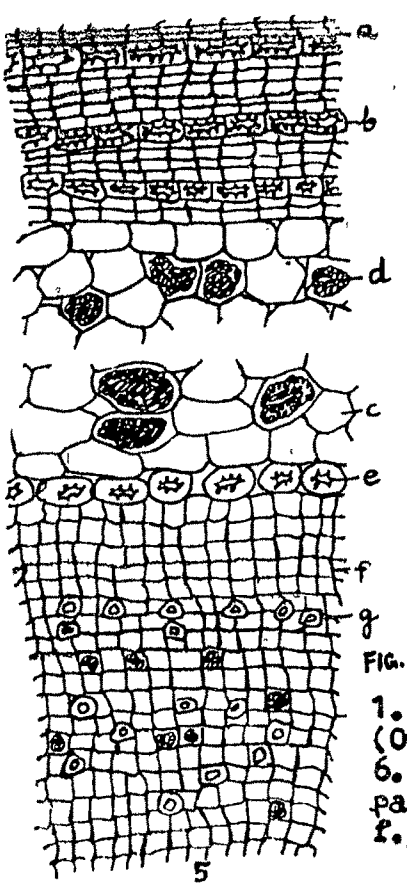
* T. = Tangential,
** R. = Radial



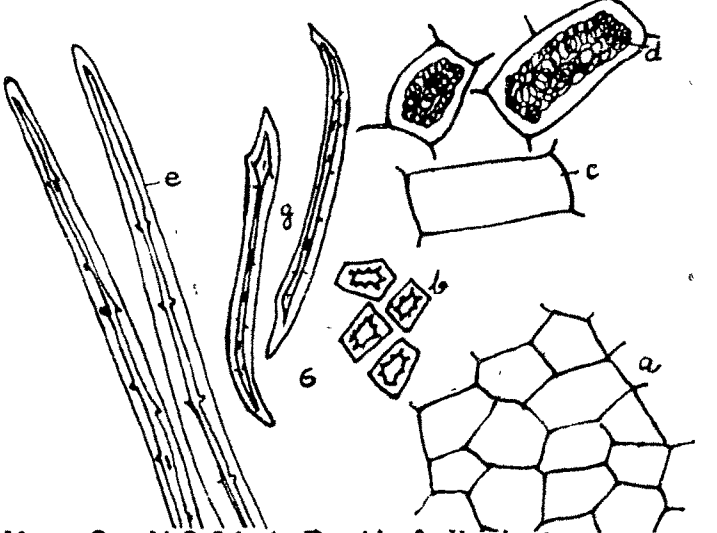




FIG.5 Adina Cordifolia (Roxb.) Benth. & Hook.f.

1.a branch with inflorescence 2.a flower 3.bark (Outer view) 4.bark(inner view) 5.t.s.of barkx200 6.bark(powder)x200. a.cork b.scleriods c.cortical parenchyma d.resinous substance e.pericyclic fibre f.phloem g.bast fibres.

Powder Microscopy of bark:-

The powder of the bark is light yellow in colour. Microscopical examination reveals the following diagnostic characteristics. Suberised cork tissues measuring 50$\mu$ x 40$\mu$, pericyclic fibres upto 80$\mu$ long and 20$\mu$ wide, pitted and with narrow lumen. The powder is dominated by cortical parenchyma measuring 100$\mu$ x 40$\mu$ . Some of the cortical parenchyma contain orange coloured resinous amorphous substance; lignified sclereids from cork region are slender measuring 37$\mu$ x 13$\mu$; bast fibres are 20$\mu$ wide and 350$\mu$ long pitted with broad lumen. Bast fibres are shorter and broader than pericyclic fibres, lumen also are wide in them. Other tissues present in the powder are of little diagnostic value.

2. Anthocephalus cadamba Miq.

(Syn. Anthocephalus indicus A. Rich.
Anthocephalus morindaefolius Korth .
Nauclea cadamba Roxb.,
Sarcocephalus cadamba Kurz.)

Vernacular names - Kadam (Ben) Wild cinchona(Eng.)
Kadamba (Hin. Mar. Guj.) Kadvala (Kan.)
Kadampu (Mal.) Kadamba (San.) Vella-Kadamba(Tam)
Rudrakshkamba (Tel.)

Description of the plant :

A tall large spreading tree attaining a height of 20 meters or more. Leaves fairly large, simple, ovate, or ovate-cordate, long stalked, stipulate. Inflorescence, large globular peduncled heads 2.5 to 5 cm in diameter of sessile fragrant lemon-or orange-coloured flowers with white protruding stigmas. Fruit, globose, many seeded somewhat fleshy, pyrenaceous capsules; seeds minute.

Medicinal part: leaf, bark, fruit.

Medicinal uses :

The fresh bark juice is used in inflamation of the eye and for gargle, (Sutaria, 1958). The bark is considered to be tonic and febrifuge. Decoction of the bark is given in fevers. Bark is used for dysentery with bleeding and leaves are used for healing wounds (Bapalal, 1965). Decoction of leaves is used as gargle (Chopra et al.,1958.) The fruit is considered to be cooling

and a destroyer of phlegm and impurities of the blood (Narayana Aiyer and Kolammal, 1962.)

Bark

Macroscopical characters of bark:

Thickness of the bark varies from 6 to 12 mm and goes upto 2.5 cm or more. It will be thicker on main stem than on branches. The bark is externally reddish to reddish brown in colour with longitudinal and transverse cracks and with distinct lamellations. The bark easily splits tangentially along the lamellations. The internal surface is smooth yellowish brown. The bark has a fibrous fracture and bitter astringent taste.

Microscopical characters of bark:

A transverse section of the bark shows a thin layer consisting of 3-4 rows of nearly rectangular thin walled cells of phellem as outer most layer. The cells of the outer most layer have brown contents. Inner to phellem is the phellogen composed of a single row of narrow tangentially elongated cells. Inner to this layer is the middle bark consists of 15 to 20 rows of cells which are rectangular or tangentially elongated, most of the cells are having highly thick cell walls. The rest of the cells are thin walled and contain cluster crystals of calcium oxalate measuring 30 to 36$\mu$. A few cells also contain tannins.

An aqueous extract of the bark when treated with ferric chloride solution produces a dark precipitate which indicate the presence of tannin.

The inner bark consists of 50 to 60 tangential bands of fibre groups alternating with thin walled phloem elements both are radially intercepted by many uni-to tri-seriate medullary rays. Some medullary ray cells contain sandy crystals of calcium oxalate. The fibre group within the inner bark are composed of two to fourteen cells. These fibres on maceration are found to be very long and thick walled with blunt or forked ends. The phloem tissue found in between the fibre groups consists of thin walled rounded to polygonal cells mixed with compressed cells. Thickwalled but nonsclerenchymatous cells are also present in this region. Inner to this tissue is cambium which separates the bark from the wood.

Powder microscopy of bark:

The predominance of sclerenchymatous groups, the presence of sandy crystals, and rosette crystals, absence of starch grains are the characteristic features of this bark and are useful powder characteristics for identification.

Leaf:

Macroscopical characters of leaf:

Leaves simple, opposite, spreading, petioled; petioles terete, smooth, 2.5 to 3.8 or 5 cm long, stipulate-stipules interfoliaceous, triangular-lanceolate to linear, 1.2 to 1.8 cm long and fall off early. Blade-ovate, ovate-cordate or elliptic-oblong, 18 to 36 cm long and proportionately

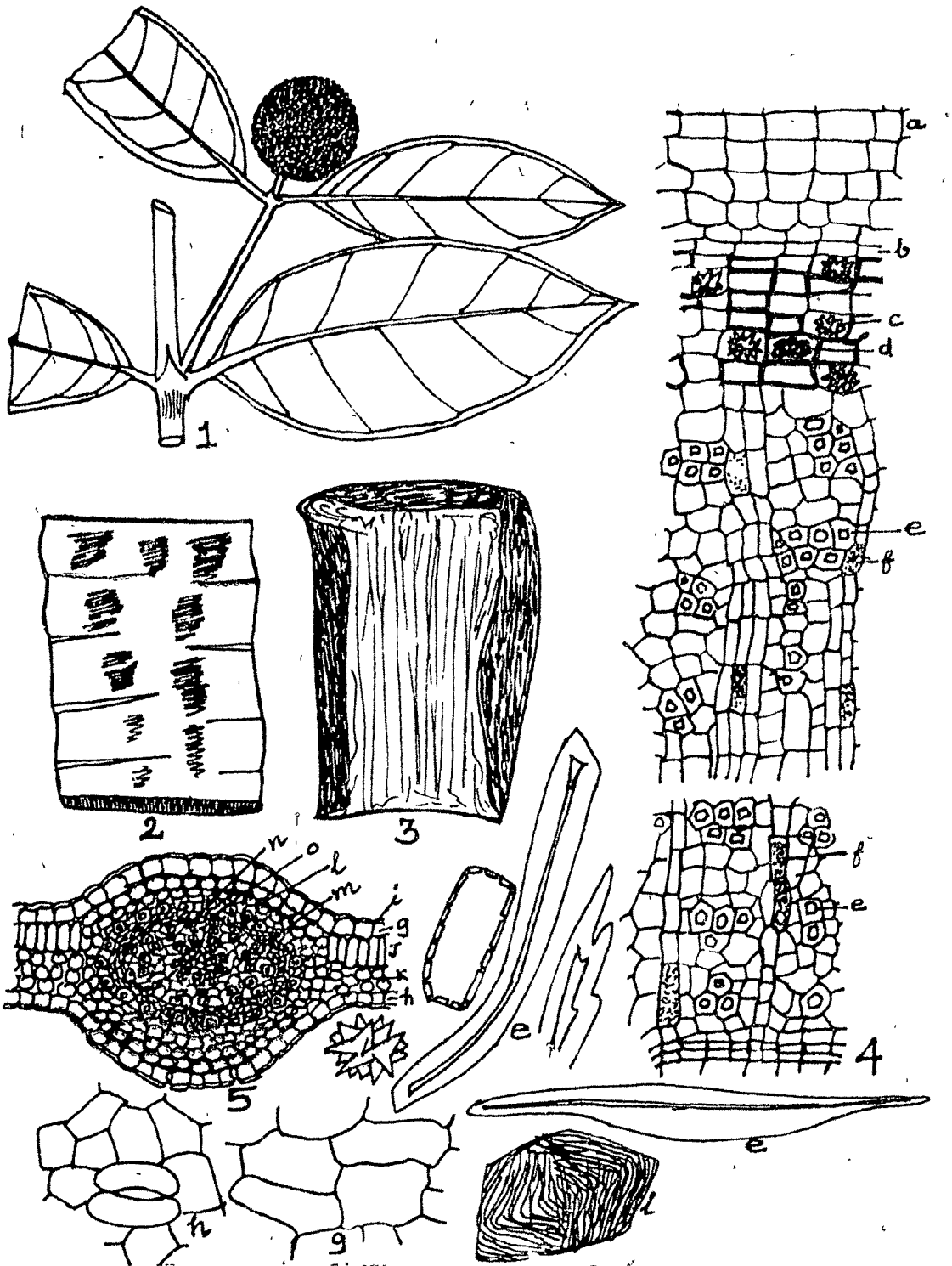



FIG-6. Anthocephalus cadamba Miq.
1. a flowering branch 2.outer surface of bark 3.inner surface of bark 4.t.s.of barkx200 5.t.s.of leaf(free hand) a.cork b.phellogen c.crystals d.coloured contents e.bast fibres f.sandy crystals g.upper epidermis h.lower epidermis i.cuticle j.palisade k.spongy parenchyma l.collenchyma m.fibres n.xylem o.phloem.

(7.5 cm or more) broad, entire, coriaceous; the base usually rounded or subcordate and abruptly cuneate or decurrent on the petiole, apex acute or shortly acuminate; surface dark green and shining above, paler beneath with 10-14 pairs of upwardly curved secondary nerves that are quite prominent on the lower side.

Microscopical characters of leaf:

A transverse section through the midrib shows a dorsiventral structure with a single layer of palisade below upper epidermis and spongy parenchyma below palisade. The upper and lower epidermis are covered with a thick layer of striated cuticle. Lower epidermis shows plenty of rubiaceous stomata. At the midrib region, inner to the upper and lower epidermis, there are 2-3 layers of collenchymatous tissue. Inner to the collenchyma is the parenchymatous tissue. Towards the centre is the circular vascular tissue with additional medullary bundles within the circle. Crystals of calcium oxalate are absent in the leaf.

3. Borreria hispida Schum.

(Syn. Spermacoce hispida Linn.)

Vernacular names - Madana - banta - kadu (Ben.); Shaggy button weed (Eng.); Madanaghanti (Hin.); Thartuvel (Mal); Ghanti-chi-bhaji (Mar.); Madanghanta (San.); Nutti-choorie (Tam.); Madana gheetu (Tel.)

Description of the plant:

A procumbent herb; stems quadrangular, hirsute, hispid, or subglabrous with long internodes. Leaves subsessile 1.2 to 5 cm by 8 mm to 2 cm., oblong, acute, pubescent, with scabrid or ciliate margins; stipules membranous. Flowers 4 to 6, in a whorl within the stipular cup; pedicel short, calyx hispid; tube narrowly campanulate; corolla pale-blue or white 5 mm long; lobes 2 mm long. Stigmas 2, capsule 5 mm long, ellipsoid. Seeds 4 mm long, ellipsoid, one end rounded, the other truncate, finely granulate rounded on the back with a deep groove on the flat face.

Medicinal part : Root, seed.

Medicinal uses:

The root possesses properties similar to Sarasaparilla. It is used as an alterative stimulant, and is generally prescribed in the form of decoction. The seeds have been recommended as a substitute for coffee (Kirtikar and Basu,1918.)

Seeds used as confection are cooling, demulcent and used in diarrhoea and dysentery (Nadkarni, 1954; The Wealth of India,1948).

Macroscopical characters of root:

Root is long slender, tortuous with hairy rootlets. Externally they are brownish in colour showing fine longitudinal ridges and striations, and internally creamy. Fracture short, fractured surface creamy.

Microscopical characters of root:

A transverse section of root is irregularly circular with a brown bark and a creamy central portion of xylem. A root of 1 m.m. diameter has a 100 $\mu$ bark, and rest is xylem. The xylem occupies the major portion of root. The centre of the root is occupied by the triarch primary xylem. Surrounding this is a dense wood composed of secondary xylem traversed by medullary rays, all the elements are lignified, external to the wood is a narrow band of secondary phloem and a narrow parenchymatous phelloderm, beyond which is the narrow layer of cork. The secondary xylem consists of narrow tracheidal vessels and tracheids both having simple pits, associated with xylem parenchyma and fibres. Fibres are pitted and with wide lumen. The segments of the tracheidal vessels usually have the communicating opening on the side walls near the ends; the tracheidal-vessels measure upto 400 $\mu$ long and 30 to 60 $\mu$ wide; xylem parenchyma measures 110 $\mu$ x 20 $\mu$ ; xylem fibres measure

500 μ long and 12 μ wide. The cells of xylem parenchyma have simple pits, in transverse section they appear as tangentially elongated and measures T.15 μ , R.10 μ . In transverse section the medullary ray are recognised by the slight radial elongation of their cells; they measure R.15 μ , T.10 μ . The pholem occurs as small groups of sieve tissue embedded in parenchyma. Some of the phloem parenchyma contain brownish amorphous substances. The narrow phelloderm consists of irregular shaped parenchyma. Some of them are filled with brownish amorphous substances and contain bundles of acicular raphides of calcium oxalate, the crystals are about 75 μ long. The raphides bundles appear as small group of microcrystals in transverse section of the root. Mechanical tissues are absent in bark. Starch also is absent from root.

Powder microscopy of root:

A powder of the root is cream-coloured. Microscopical examination shows the following diagnostic characteristics. Suberised cork cells measuring 60 μ x 30 μ ; parenchymatous phelloderm cells measuring 50 to 90 μ long and upto 40 μ wide some of which contain brownish amorphous substances; lignified xylem elements consisting of pitted vessels measuring 400 μ long and 30 μ wide; tracheids, pitted xylem parenchyma measuring 110 μ x 20 μ ; and xylem fibres measuring 500 μ long and 12 μ wide, pitted and with a wide lumen. Powder of the root shows broken bundles of raphides, and needle crystals are seen scattered singly in powder.

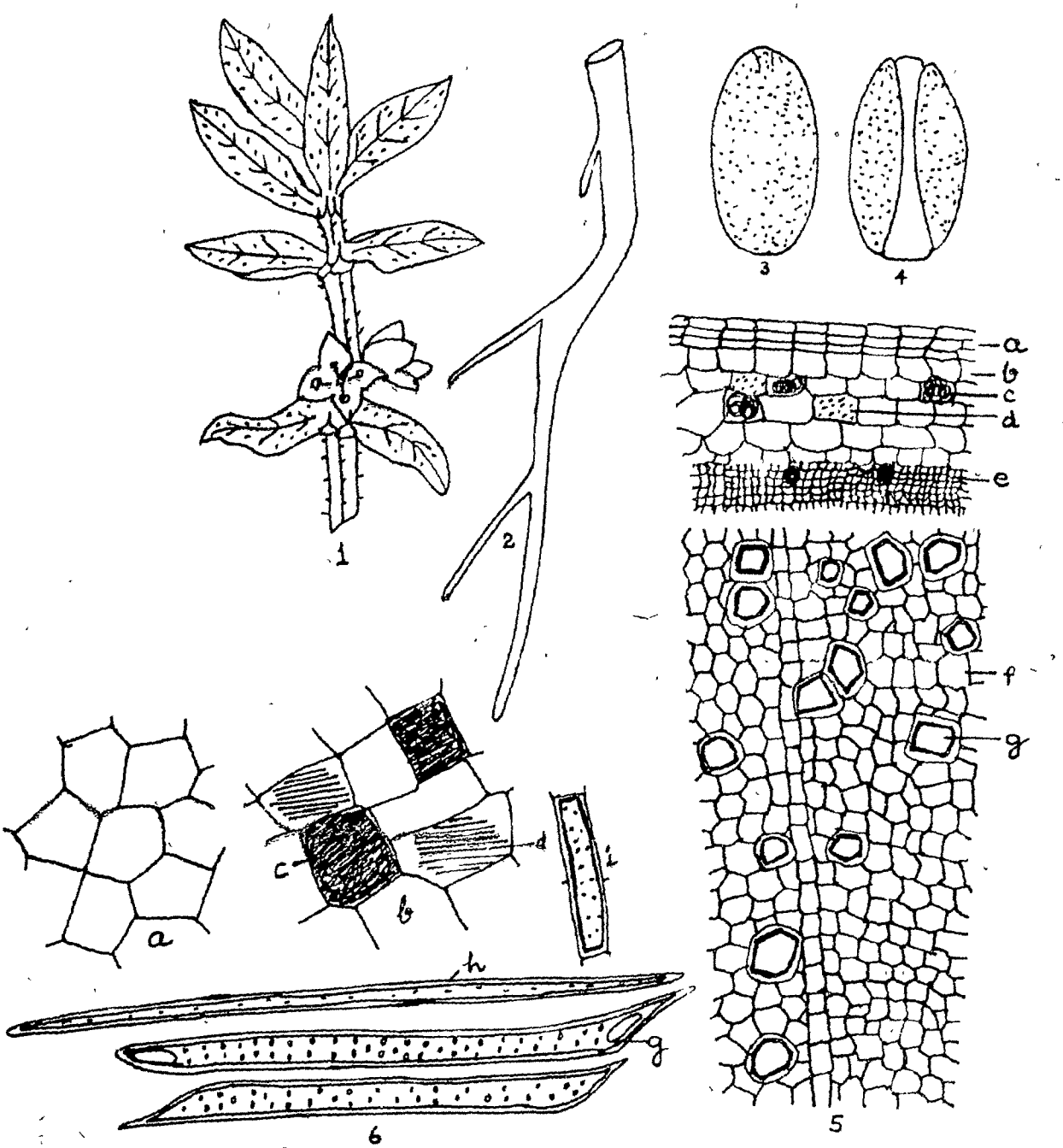



FIG.7. Borreria hispida Schum.

1.a branch with flowers 2.root 3.seed(dorsal-view 4.seed(ventral view) 5.t.s. of root x 200 6.root powder x 200 a.cork b.phelloderm c.brownish content d.raphides e.phloem f.xylem g.vessels h.xylem fibres i.xylem parenchyma.

Description of seed:

Shining, brown coloured seeds, 3 to 4 mm long, 1 mm wide, and 0.5 mm thick. The seeds are oblong, ½ ellipsoid, one end rounded the other end truncate, rounded on the back with a ventral deep groove, testa finely granulate.

## 4. Gardenia gum (Dikamali)

Vernacular names - Dikamali (Ben., Guj., Hin., Kan., Mal., Tam.,); Cambi resin (Eng.); Hingunadika, Nadi-hingu, Gandharaj, Pindava (San.); Kumbai (Tam); Tella manga, Karinga (Tel.).

Description of the plant:

Gardenia gum (Dikamali) refers to the naturally exuding resin from the apical buds of Gardenia gummifera Linn. and Gardenia lucida Roxb.

Gardenia lucida Roxb. is a small tree of about 7.5 M high. Young shoots resinous. Leaves 6 to 20 cm by 2.5 to 7.5 cm elliptic oblong, obtuse, narrowed into the petiole at the base, dark green above, paler beneath, stipules axillary, large, ovate, acute. Flowers solitary, axillary, large, white, turning to yellow when old, fragrant. Calyx 5-lobed. Corolla tube long, slender, lobes 5, obovate, obtuse, spreading, veined. Stamens5, anthers sessile, ovary with 2 parietal placentas, stigma entire. Fruit ellipsoid, crowned with the calyx lobes.

Gardenia gummifera Linn. differs from G.lucida in being a shrub of about 1¾ M high; leaves 4 to 6.5 cm by 2 to 2.5 cm. Flowers not odourous and are 1-3 together.

Medicinal part:

Resinous exudation from apical buds.

Medicinal uses:

Dikamali is antiperiodic, cathartic, anthelmintic, alterative and antispasmodic. Externally antiseptic and stimulant. A decoction of the resin is used in fever. A paste of the resin is applied for tooth ache, and to foul sores. Internally it is given to expel round worms. Resin is given in corpulence and to reduce spleen (Nadkarni, 1954).

Macroscopical description of Dikamali gum:

Dikamali gum appears golden yellow coloured transparent pearl like tears. Brittle when pressed between fingers or flexible when not completely dried. It has a very characteristic disagreeable odour.

Microscopical characters of dikamali gum:

Dried gum was powdered and examined under the microscope after mounting in glycerine. It appeared like light yellow coloured transparent flakes with a conchoidal fracture. When examined under the microscope in polarised light it appears non-polarising, and it showed small polarising crystals embedded in the amorphous mass.

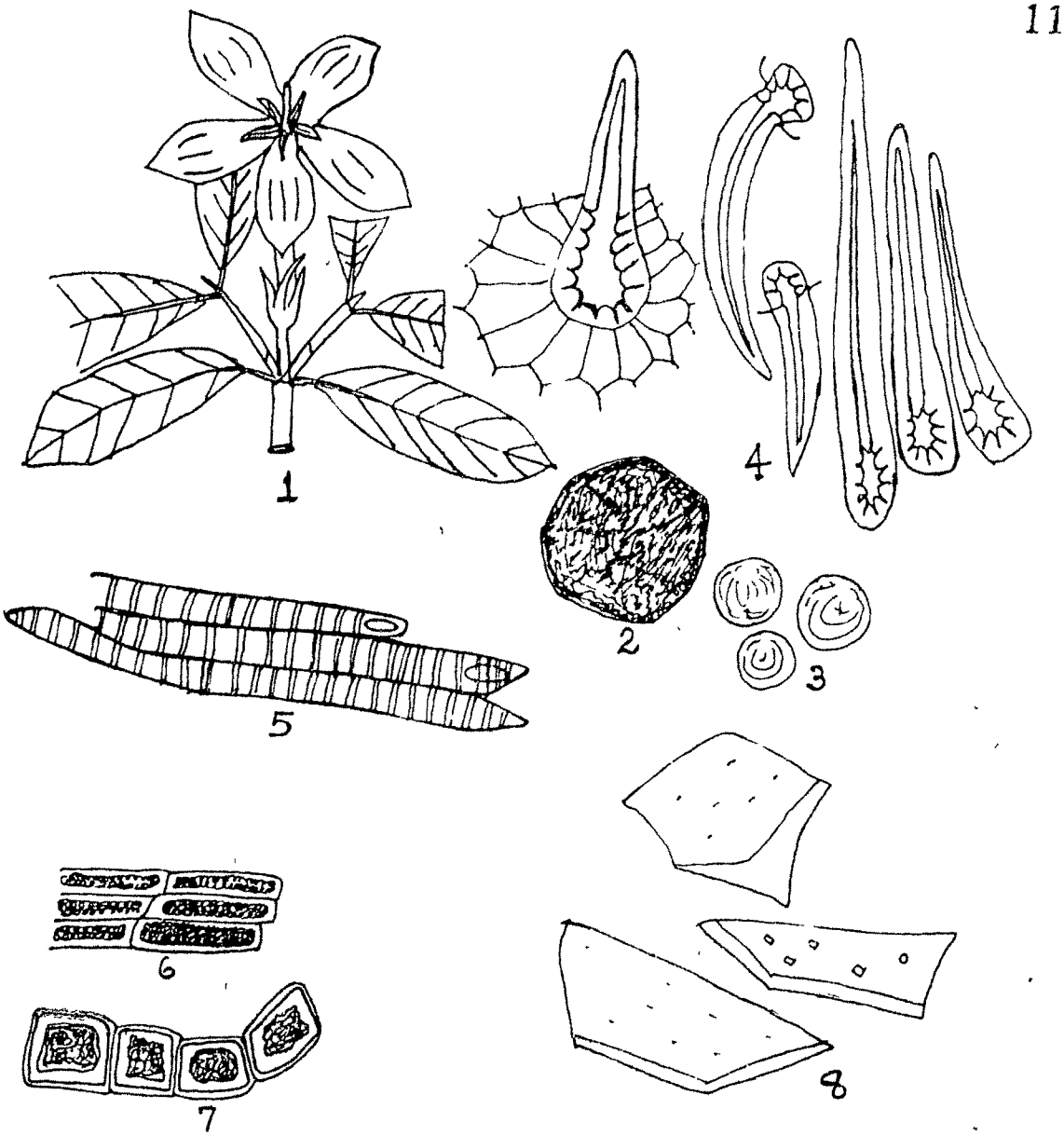
Since the Dikamali gum is always associated with plant parts of the same plant especially leaf, microscopical examination of commercial Dikamali gum reveals plenty of leaf tissues which are very characteristic for identifying Dikamali,

and also in compound formulations containing Dikamali alongwith many other ingredients. Leaf tissues include simple covering trichomes, which are unicellular with a lignified basal cell, appearing like a stone cell. The trichomes measure 175 to 400μ in length and 40μ wide at base. Other tissues of leaf seen are parenchymatous cells, palisade, vessels, etc., which are not helpful in identification of Dikamali.

The commercial Dikamali contains very little of pure resin but is a mixture of leaves, buds and young stem. Sometimes foreign matter like stones also are found.

Chemical study of Dikamali gum:

The Dikamali gum which is oozing out from the apical bud is not a gum but a resin. The gummy material available in the commercial samples are due to the polysaccharides present in leaves. The characteristic odour of Dikamali is due to the volatile oil containing atleast 19 monoterpenes. The medicinal properties of the Dikamali may be attributed to its volatile oil components. Dikamali contains a number of flavonoids. Flavones isolated from Dikamali by earlier workers are Gardenins A-E (Rama Rao and Venkataraman,1968, 1970), Desmethyl tangeretin, Nevadensin, 5,7-dihydroxy, 8,3',4',5 - tetramethoxy flavone, 3',4',5 - trimethoxy wogonin and 3', 4' - dimethoxy wogonin (Krishna murthi et.al. 1972). In addition to the flavones reported by earlier workers luteolin, 5,7,4'-trihydroxy 6,8-dimethoxy flavone, 3,6,7,4'-tetrahydroxy 8-methoxy flavone, and quercetin have been identified for the first time in the resin from the present study.




FIG·8, Gardenia gum (Dikamali)
1. a flowering branch of Gardenia lucida, Roxb. 2. a lump of market sample 3. tears from Gardenia 4. trichomes 5. vessels 6. palisade 7. parenchyma 8. transparent flakes.

5. Hymenodictyon excelsum Wall

(Syn. Cinchona excelsa Roxb.)

Vernacular names - Amarchhala (Guj.); Bhaulan (Hin.); Vilari (Kan.); Vella Katampu (Mal.); Bhoursal (Mar.); Dudippa (Tel.); Sagapu (Tam.)

Description of the plant:

A tree of 9-12 M high. Bark usually smooth. Leaves membranous 10 to 22 cm long and 7 to 10 cm. broad, ovate elliptic, abruptly acuminate, pubescent on both surfaces, base narrowed into the petiole; petioles 2.5 to 7.5 cm. long, pubescent; stipules broadly oblong, obtuse, recurved, deciduous. Flowers numerous, greenish white, fragrant, pedicelled, in clusters along the rachis of spiciform racemes in erect terminal panicles. Pedicel 3 to 6 cm. long, calyx 2 mm long, corolla 5 mm. long, pubescent outside; tube slender; limb broadly campanulate, with short acute lobes; style very long; capsule 2 cm long, ellipsoid.

Medicinal part: bark

Medicinal uses:

The bark is bitter and astringent and is used as a febrifuge and antiperiodic especially for tertian ague (The Wealth of India, 1959). The bark has a similar constituent as in Cinchona; contains a toxic alkaloid hymenodictine, a bitter substance aesculin (Nadkarni, 1954).

Macroscopical characters of bark:

Bark is thick and smooth externally. On drying longitudinal wrinkles are produced. Externally light brownish in colour, internally pale yellow in colour. Fracture, short outside, fibrous internally. Fractured surface is light brown exhibiting brownish spots and projecting fibres.

Microscopical characters of bark:

A transversely cut surface of bark shows externally a few layers of cork, then a wide cortex, limited internally by endodermis. The remaining part consists of phloem across which run medullary rays. Epidermis of young bark consists of single layered large cells.

The cork consists of numerous layers of thin walled, flat polygonal cells, without any contents. Cork cells measure T.45 μ, R.15 μ . The cortical parenchyma are also many layered and consist of large irregular shaped cells arranged with intercellular spaces, most of them are filled with reddish brown amorphous substance. Cortical cells are maximum upto T.70 μ, R.40 μ . Occasional cells of the cortex contain large rosette crystals of calcium oxalate measuring upto 50μ in diameter; large schizogenous canals are also present in cortex, filled with reddish brown amorphous substances. In between the periderm and cortex is present a single layered continuous band of lignified stone cells. These stone cells are large, thick walled, pitted and with a wide lumen and measure

T.60μ , R.40μ . The cortex is limited internally by endodermis. The phloem contain masses of sclereids similar to the sclereids present near the outer margin of the cortex and are smaller in size. They measure 50μ long axis and 25μ wide. A few isolated phloem fibres are also present which are up to 20μ in diameter. Phloem parenchyma also contain reddish brown amorphous substances as in cortex. Phloem parenchyma also contain plenty of prismatic crystals of calcium oxalate measuring upto 20μ long and 15μ wide. Large secretory canals are also present in phloem. Phloem is traversed by medullary rays but are not very distinct. Starch grains are absent in bark.

Powder microscopy of bark:

Powder of the bark is light yellowish brown in colour. The powder is dominated by cortical parenchyma containing reddish brown amorphous substance. Cortical parenchyma in powder measure 60μ X 40μ . The powder shows characteristic cork cells measuring 40 to 60μ X 30 to 40μ ; cortical parenchyma cells with large rosette crystals of calcium oxalate; lignified pitted sclereids from cortex with large lumen measuring 40 to 120μ X 30 to 40μ ; phloem fibres measuring upto 1.4 mm long X 20μ wide; and phloem parenchyma cells with prismatic crystals. These prismatic crystals are very long, and broken pieces only are present in powder which measure upto 280μ long and 20μ wide.

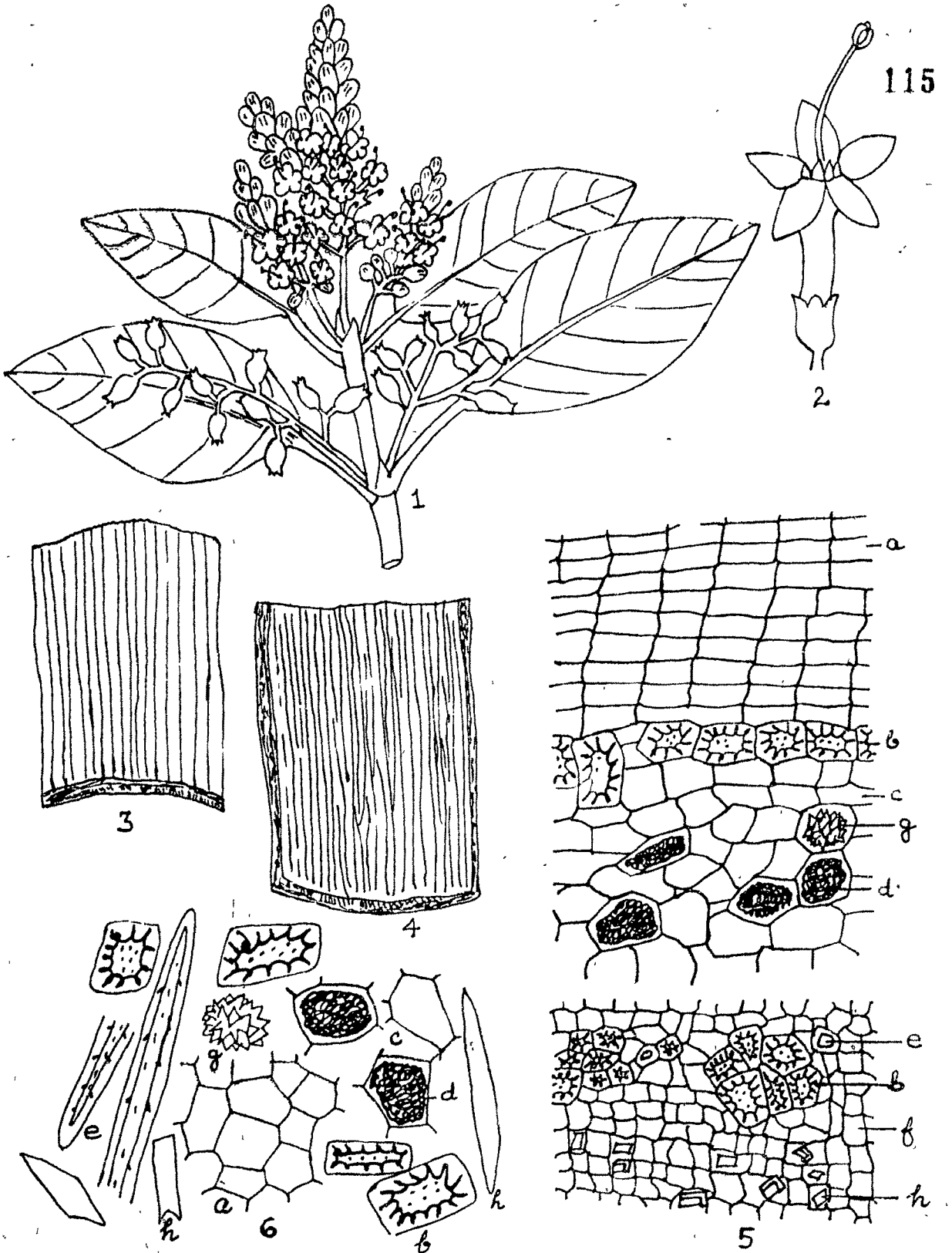



FIG.9. Hymenodictyon excelsum Wall.

1.a branch with inflorescence 2.a flower 3.bark(outer view) 4.bark(inner view) 5.t.s. of bark x 200 6.bark powder x 200. a.cork b.stone cells c.cortical parenchyma d.amorphous substance e.phloem fibre f.phloem g.rosette crystals h.prismatic crystals.

6. Ixora coccinea, Linn.

(Syn. Ixora bandhuca, Roxb.
Ixora grandiflora, Br.)

Vernacular names - Rangan, Ranjana (Ben. & Hin.)
Kepala (Kan.) Thechi (Mal.); Pentgul (Mar.)
Raktaka (San.); Cheddi (Tam.)

Description of the plant:

A glabrous shrub ½ - 1 M high. Leaves 5 - 10 cm by 3 - 6 cm, coriaceous, sessile or nearly so, oblong, obtuse, apiculate, base rounded, stipules with a long rigid cuspidate point. Flowers numerous, bright scarlet in dense sessile or very shortly peduncled corymbiform cymes; pedicels very short, glabrous or puberulous, bracts and bracteoles small, calyx 2 mm long, glabrous, corolla tube reaching 3.5 cm long, without hairs in mouth, lobes elliptic oblong, subacute. Fruit globose, having the size of a pea, smooth, fleshy, crowned with the calyx teeth, purple when ripe. Seeds deeply ventrally concave.

Medicinal part : Root & Flowers.

Medicinal uses:

Root is useful as a sedative in hiccup, nausea, loss of appetite. Root is used as a remedy in diarrhoea and dysentery, better than Ipecac; useful in fever and gonorrhoea. Flowers administered for dysentery mixed with other plants, also useful in gonorrhoea and leucorrhoea; used externally on sores and ulcers. (Nadkarni, 1954.)

Macroscopical characters of root:

Roots differ in size according to age. Younger roots are attached with rootlets; older roots are devoid of rootlets. The outer surface of the root is characteristically blackish brown in colour. The root is tough and difficult to break. Fracture is splintery. Broken surface shows an outer dark zone and an inner pale yellow zone. Odour, indistinct.

Microscopical characters of root:

A transverse section of the young root shows 3-4 layers of brown coloured cork as outermost layer. Cork cells measure upto 60$\mu$ x 30$\mu$. Inner to cork is phelloderm consisting of about 6 layers of tabular trangentially elongated cells. Phellogen is indistinct. Cortex is a large zone. The cortical parenchyma of peripheral region is thin walled and tangentially elongated and almost circular towards centre. Cortex also shows isolated or small groups (upto 3) of lignified fibres, narrow lumened measuring 1 mm long and 15$\mu$ wide. Cortical parenchyma also contain oily and resinous substances. Cortical parenchyma measures 45 to 65$\mu$ x 30 to 40$\mu$. Phloem consists of sieve tubes, phloem parenchyma and phloem fibres. Cambium is indistinct. Xylem occupies the wide central zone. Pith is absent. Xylem consists of broad vessels measuring 300$\mu$ long and 60$\mu$ wide, tracheids, and xylem fibres. Xylem parenchyma are very few. Uniseriate medullary rays traverse both xylem and phloem. Starch grains are present in xylem rays and xylem parenchyma.

Starch grains are 5$\mu$ in diameter. Starch is absent in cortex and phloem; crystals are also absent.

Powder microscopy of root:

Powder of the root is light brown in colour. Microscopical examination reveals the following characteristics;.brown coloured suberised tissues of cork measuring 60$\mu$ x 30$\mu$; some of the parenchyma cells of the cortex are with resinous contents, lignified fibres from the cortex, phloem, and xylem are long, slender, narrow lumened 15$\mu$ wide and upto 1 mm long; vessels measuring 300$\mu$ long and 60$\mu$ wide, xylem parenchyma with starch, starch grains 5$\mu$ in diameter; crystals are absent.

Macroscopical characters of Flower:

Flowers numerous, bright scarlet, in dense sessile or very shortly peduncled corymbiform cymes; pedicels very short, glabrous or puberulous, bracts and bracteoles small, lanceolate subulate, acute; buds fusiform, very acute. Calyx 2 mm long, glabrous; teeth 1 mm long, triangular, acute. Corolla-tube reaching 3.8 cm. long, slender, without hairs in the mouth; lobes 12 mm by 5 mm, elliptic-oblong, subacute.

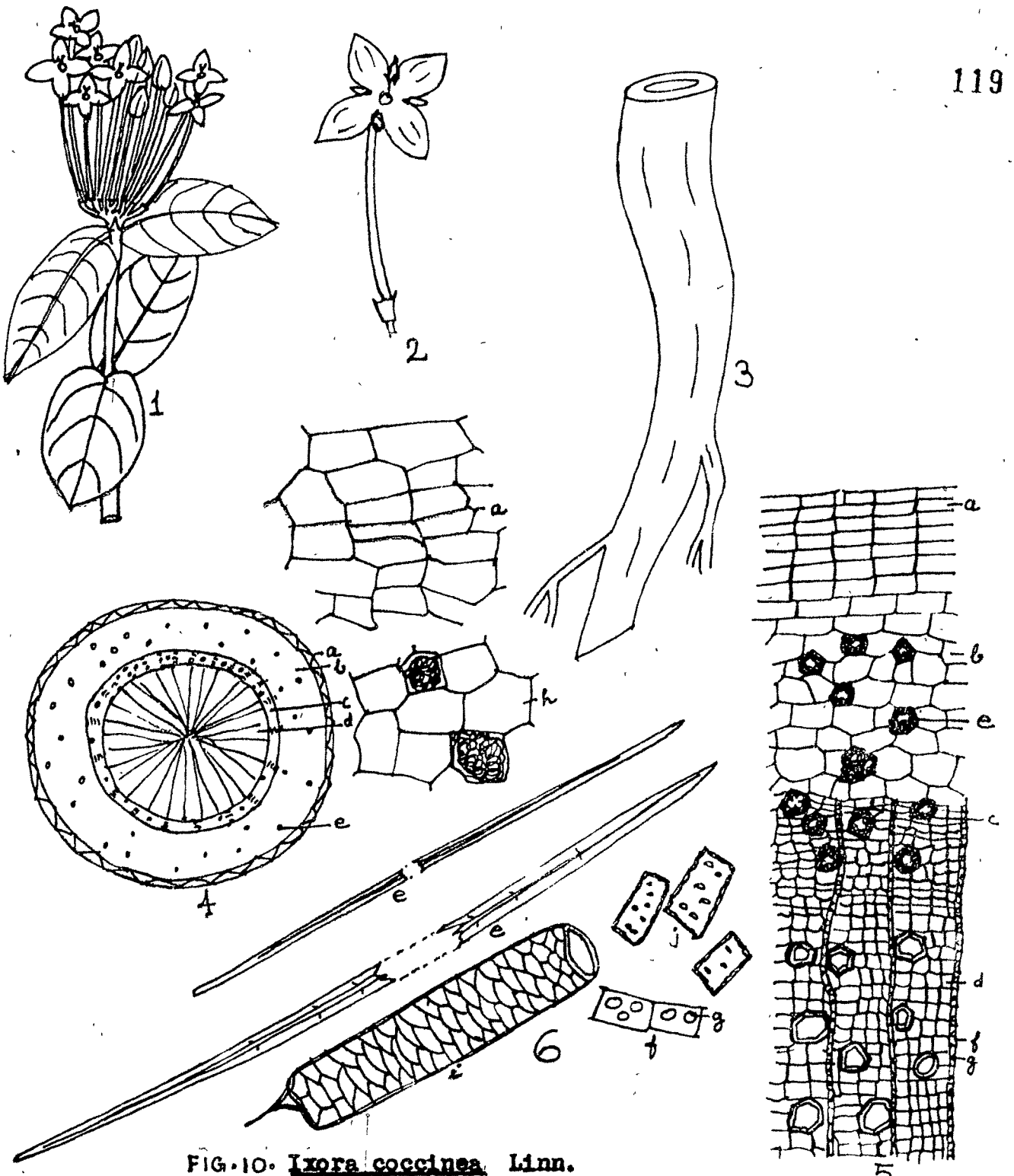



FIG.10. Ixora coccinea Linn.

1.a branch with flowers 2.aflower 3.root 4.t.s. of root(diagrammatic) 5.t.s.of root x 200 6.root powder x 200 a.cork b.cortex c.phloem d.xylem e. fibres f.m-rays g.starch h.cortical parenchyma i.vessels j.xylem parenchyma.

## 7. *Ixora nigricans* Br.

Vernacular names - Adayala (Kan.); Kat-kuda (Mar.); Mashagani, Udappu (Tam.)

Description of the plant:

Shrub or a small tree, young branches, leaves, and inflorescence turning black on drying. Leaves, 10 - 15 cm by 3.5 - 6.5 cm., membranous, elliptic - oblong, acute, glabrous, base acute or rounded. Petioles, 6 - 9 mm long; stipules with a long stiff bristle. Flowers, white, odourous, in brachiate cymes. Calyx, glabrous, teeth triangular, acute, subfleshy. Corolla tube 9 mm long, slender, glabrous, without hairs in the mouth, lobes oblong, subacute, glabrous. Style glabrous. Stigma branches recurved. Fruit, globose, size of a pea; seeds plano-convex, rugose on the back.

Medicinal part : Leaves

Medicinal uses: Leaves are considered to have antidysentric properties (Kirtikar and Basu, 1918).

Macroscopical character of leaf:

Leaves are 10 to 15 cm long and 3.5 to 6.5 cm wide, membranous, elliptic oblong, acute or shortly acuminate at the tip. The leaves turn back on drying. Leaves are glabrous, base acute or rounded; main nerves 12-15 pairs, petioles 6 to 9 mm long; stipules shortly triangular at base, cuspidate with a long stiff bristle.

Microscopical characters of leaf:

A transverse section through mid-rib of the leaf shows a dorsiventral structure with a single layer of palisade below upper epidermis and spongy parenchyma below the palisade. The outer wall of upper and lower epidermis is thick due to cuticle. Upper and lower epidermal cells in transverse section appear to be isodiametric and measure 10 to 15$\mu$ . Lower epidermis shows plenty of rubiaceous stomata. Trichomes are absent in leaf. Rosette crystals of calcium oxalate are present in mesophyll cells. Crystals measure 25$\mu$ in diameter. The midrib portion projects on lower side of leaf. Inner to upper and lower epidermis of mid-rib portion there are 3 to 5 layers of collenchymatous tissue, measuring 30$\mu$ in diameter. Inner to the collenchymatous tissue is the parenchymatous tissue consisting of irregular shaped big and small parenchyma cells with intercellular spaces. The small parenchyma are isodiametric measuring 10$\mu$ and big parenchyma are upto 50$\mu$ in diameter. These parenchyma cells also contain rosette crystals of calcium oxalate. The centre of the mid-rib is occupied by the vascular tissue arranged in an irregular circle. Additional medullary bundles are within the circle. Pericyclic fibres are present along the pericycle of the midrib. They are isolated or in groups and measure 10$\mu$ in diameter. The cortical cells and central parenchyma are filled with brownish resinous substances. Cells of the upper and lower epidermis are polygonal and straight walled in surface view. In surface view the size of

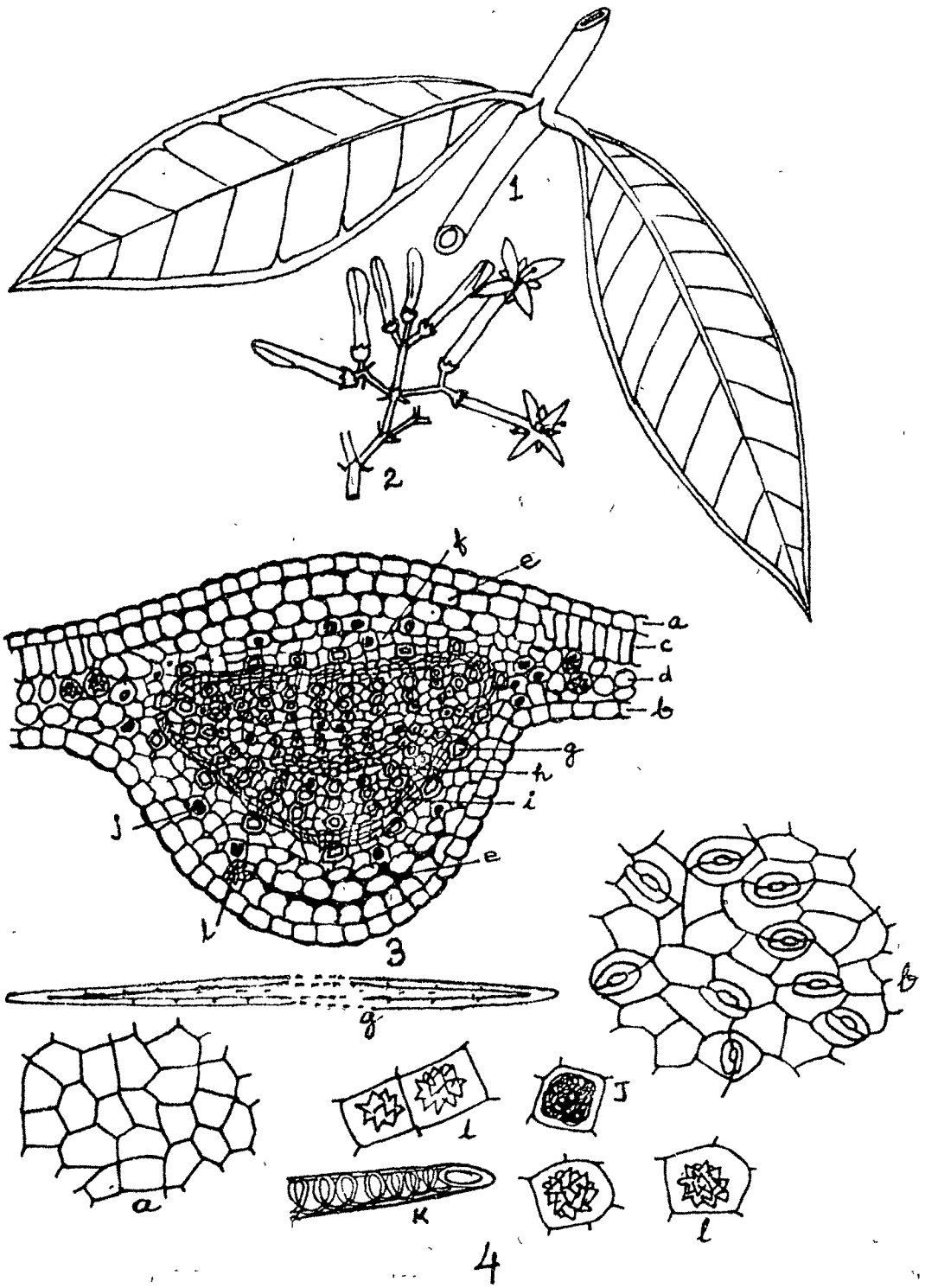



FIG.11. Ixora nigricans Br.

1.a branch with leaf 2.inflorescence 3.t.s.of leafx200, 4.leaf powder x 200 a.upper epidermis b.lower epidermis c.palisade d.spongy parenchyma e.collenchyma f. parenchyma g.fibres h.xylem i.phloem j.cells with brownish content k.vessels l.cells with rosette crystals.

the epidermal cells are almost similar and measures 40$\mu$ x 25$\mu$ .

Powder microscopy of leaf:

A powder of the leaf is dark green in colour. Microscopic examination reveals the following diagnostic characters. Pieces of upper and lower epidermis with polygonal straight walled cells. Lower epidermis with rubiaceous stomata. Epidermis is devoid of trichomes. Parenchyma cells of vein and mesophyll with rosette crystals of calcium oxalate measuring 25$\mu$ in diameter; parenchyma cells filled with brownish resinous substances, and also fibres and vessel elements.

8. Ixora parviflora Vahl.

(Syn. Ixora arborea Roxb.)

Vernacular names - Rangan (Ben.); Torch tree (Eng.); Kotagandhal (Hin.); Gorivi, Korgi (Kan.); Guavilakri, Kurat, Lokandi, Raikura (Mar.); Iswara (San.) Kora (Tam.); Karivi - pola (Tel.)

Description of the plant:

A small branched tree, leaves 7 to 12 cm by 4 to 7 cm; very coriaceous and hard, reticulately veined oblong and elliptic, obtuse, glabrous and shining, pale when dry, base usually rounded, some times cordate; main lateral nerves 8-10 pairs, slender, faint; petiole scarcely 3 mm long, rugose; stipules 5 mm long broadly ovate, with a cuspidate point about 3 mm long. Flowers white, odourous, small and very numerous, in subglobose clusters in sessile cymes, brachiate with 3-5 pairs of short branches, pedicels short or 0; calyx 1½ mm long, ovoid-oblong; teeth 4, minute not more than 0.5 mm long; triangular, subacute. Corolla tube 8 mm to 1 cm long without hairs in the mouth; lobes 4, linear-oblong, obtuse; 4½ to 6 mm by 1 mm. Style densely clothed with white hairs; branches of the stigma elliptic lanceolate. Fruit 6 mm in diameter, didymous.

Medicinal part:

Bark, flowers, root, fruit.

Medicinal uses:

Decoction of the bark is a tonic in anaemia and general debility. Flowers pounded in milk are given in whooping cough. Fruit and root are used for clearing red coloured urine. Root is used in epilepsy (Nadkarni, 1954; The wealth of India, 1959).

Macroscopical characters of bark:

Dried bark is curved, externally dark greyish brown in colour. External surface of older barks have a rugged and scaly appearance due to a massive external covering of rhytidoma consisting of dead cells which can be easily removed by hand. The inner surface is reddish brown in colour with longitudinal strations. Fracture is fibrous. Odour and taste indistinct.

Microscopical characters of bark:

In older bark the earliest phellogen ceases to divide and new phellogens are formed in the deeper layers leading to the death and exfoliation of the cortical tissues and finally, when the phellogens dip into the secondary phloem, masses of phloem are cut and die. There thus arises a dead tissue consisting of alternate layers of dead phloem and cork. A tissue which is termed rhytidoma is found in thicker barks. In this bark the outer most tissue is a multilayered cork tissue measuring T.25$\mu$ , R. 15$\mu$ . Inner to that is cortex consisting of one or two layers parenchyma

measuring T.35μ , R.30μ and inner to that is characteristic thick walled stone cells 4-5 layers, almost closely packed or sometimes interspaced with a few parenchyma cells. Stone cells are almost isodiametric and are upto 40μ in diameter. Inner to this layer is a wide zone of phloem. Phloem is characterised by many fibres in groups or isolated. Fibres are upto 60μ in length and 23μ wide. A few isolated stone cells are also found in phloem region. Many of the pholem parenchyma are filled with reddish colouring matter. Medullary ray parenchyma are radially elongated, single or two layered. phloem parenchyma also contain plenty of prismatic crystals of calcium oxalate measuring 15μ in length. Starch grains are absent.

Powder microscopy of bark:

A powder of the bark is brownish in colour. Microscopical examination reveals cork cells, stone cells, fibres, prismatic crystals of calcium oxalate and parenchyma cells with reddish contents as described in whole bark.

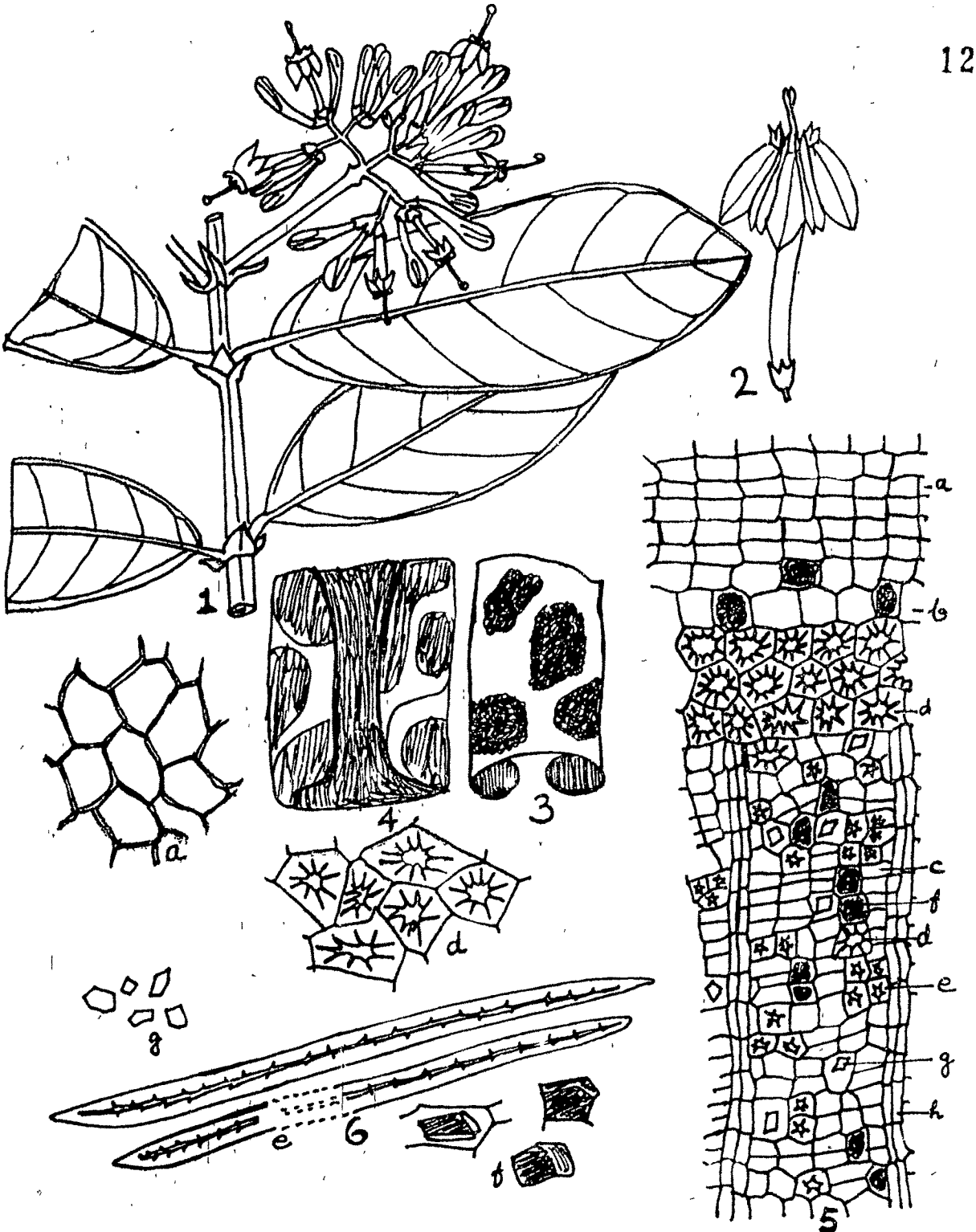



FIG. 12. Ixora parviflora Vahl.
1.a branch with flowers 2.a flower 3.Outer surface of bark 4.inner surface of bark 5.t.s.of barkx200 6.bark powderx200 a.cork b.cortex c.phloem d.stone cells e. fibres f.reddish contents g.crystals h.m.rays.

9. Meyna laxiflora Robyns.

(Syn. Vangueria spinosa Roxb.)

Vernacular names -Moyna (Ben.); Pundrika (Hindi); Alu, Chircholi (Mar.); Pinda (San.); Manakkarai (Tam.); Veliki (Tel.)

Description of the plant:

A small tree with straight sharp spines 1¼ to 4 cm long; bark dark coloured, leaves membranous, elliptic oblong, acuminate, glabrous; stipules 8 mm long, glabrous, broadly triangular at base, with a slender subulate acumination of about 5 mm long. Flowers greenish white, in peduncled cymes from the old scars below leaves; peduncles short; pedicels slender. Calyx 2 mm long, glabrous; tube cup-shaped, ribbed rugose; teeth 5, triangular, very acute, Corolla 8 mm long; tube very broad, lobes 5, ovate lanceolate; Fruit about 2.5cm in diam. on slender pedicels, globose; pyrenes 4-5, woody, smooth.

Medicinal part : Fruit and leaf

Medicinal uses :

Fruit is refrigerant and cholagogue and decoction of fruit and leaf is used in biliary complaints with hepatic congestion. The drug is described as strengthening, cooling, and an expellent of phlegm and bile (Kirtikar and Basu,1918).

Macroscopical characters of leaf:

Leaves are entire, 5 to 12 cm by 3 to 7 cm, membranous, glabrous, elliptic-oblong; apex acuminate, base shortly cuneate, main nerves 6-8 pairs, petiole 1.5 to 3 cm long. On drying the leaves become dark on ventral side and paler beneath.

Microscopical characters of leaf:

A transverse section of the leaf through midrib shows a dorsiventral structure. The upper and lower epidermis are covered externally with a thick and striated cuticle. Lower epidermis shows paracytic stomata. Unicellular covering trichomes are present at some places below the main veins. Trichomes are upto 230$\mu$ long and 12$\mu$ wide near base. The epidermal cells in transverse section appear radially elongated tabular cells with straight anticlinal walls, and they measure 20$\mu$ x 15$\mu$. In between the upper and lower epidermis is the mesophyll, differentiated into a single layer of palisade below upper epidermis and the rest consists of spongy parenchyma. The midrib portion projects on upper and lower side of the leaf. Inner to upper and lower epidermis of midrib portion there are collenchymatous cells. Inner to these collenchymatous cells are compact parenchyma cells. The central portion of midrib is occupied by vascular tissue consisting of a crescent shaped xylem below which is the phloem. Xylem vessels are with spiral thickening and measure

20$\mu$ in diameter. The phloem tissue, collenchyma, parenchyma and mesophyll tissues contain plenty of cells with large reddish brown amorphous resinous substances. Crystals and starch grains are absent in leaf.

Powder microscopy of leaf:

Powder of the leaf is dark green in colour. Microscopical examination shows plenty of cells with reddish brown amorphous resinous substances. Fragments of upper and lower epidermis with polygonal cells having straight walls measuring 20$\mu$ x 15 to 20$\mu$. Underneath the epidermal cells are seen mesophyl cells filled with reddish brown amorphous resinous substance. Lower epidermis sometimes bear rubiaceous stomata (paracytic) and unicellular covering trichomes near main veins. The trichomes measure up to 230$\mu$ long and 12$\mu$ wide at the widest region near base. Striated cuticle is seen covering the upper and lower epidermis. The powder also shows isolated mesophyll parenchyma, elongated parenchyma of veins, without and with reddish brown amorphous resinous substances; spiral vessel elements and other tissues of leaf are present in powder. The elongated parenchyma measure up to 150$\mu$ x 40$\mu$. The spiral vessels measure 200$\mu$ to very long and are 10 to 20 $\mu$ wide. Crystals of calcium oxalate and starch grains are absent in leaf.

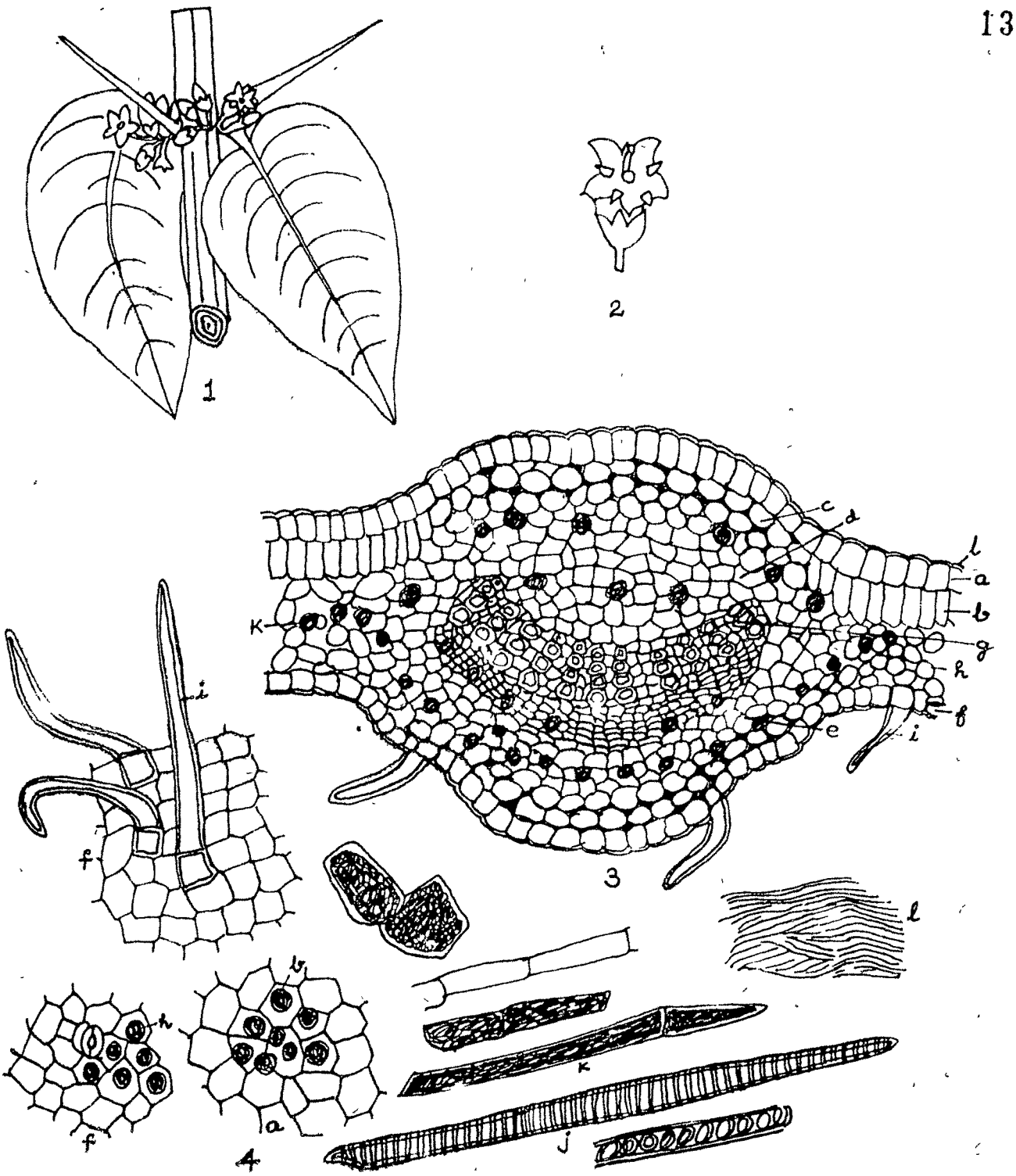



FIG.13. Meyna laxiflora Robyns

1.a branch with flowers 2.a flower 3.t.s.of leaf x 200 4.leaf powder x 200 a.upper epidermis b.palisade c. collenchyma d.parenchyma e.phloem f.lower epidermis g.xylem h.spongy parenchyma i.trichome j.vessels k. cells with resinous substance l.cuticle.

## 10. Morinda citrifolia Linn.

Vernacular names - Ach (Ben.); Al (Hin.); Kadappilava (Mal.); Bartindila (Mar.); Achuka (San.); Nuna (Tam.); Maddichettu (Tel.)

Description of the plant:

A small glabrous tree; trunk straight; bark smooth, yellowish white, branchlets obtusely 4 angled. Leaves 12 - 20 cm by 7 - 10 cm, broadly elliptic acute acuminate or obtuse, bright green, glabrous, shining, base acute, main nerves 8 - 10 pairs, prominent, petioles 12 mm long, stipules connate, short, broad, obtuse, membranous. Flowers, white, in dense ovoid heads over 2.5 cm long; peduncles solitary (rarely 2-3 together) usually leaf opposed, 2 - 5 cm long. Calyx - limb truncate. Corolla infundibuliform; tube 9 mm long, the mouth hairy, lobes 5, lanceolate, acute. Stamens 5; filaments hairy; anthers about ½ exerted. Fruit white when ripe, smooth and glossy, about the size of a small egg; pyrenes ovoid, compressed, concavo - convex, winged on the edges.

Medicinal part:

Most parts of the plant are reported to possess medicinal properties, root, leaves, fruits.

Medicinal uses:

The root is used as a cathartic and febrifuge, and applied externally to relieve pain in gout. Leaves are considered

tonic and febrifuge; they are used as a healing application for wounds and ulcers;.the juice of the leaves is externally applied in gout. Fruits are used for spongy gums, throat complaints, dysentery, leucorrhoea and sapraemia. (Chopra et al., 1958, Kirtikar and Basu, 1918)

Macroscopical characters of leaf:

Leaves are entire, 12 - 20 cm by 7 - 10 cm., broadly elliptic, acute, acuminate or obtuse, bright green, glabrous, shining, base acute, unequal in some; main nerves 8 - 10 pairs prominent, petioles 12 mm long.

Microscopical characters of leaf:

A transverse section through the mid-rib of the leaf shows a dorsiventral structure with a single layer of palisade parenchyma on the upper side and spongy parenchyma at lower side. The upper and lower epidermis are covered with a thin layer of striated cuticle. Lower epidermis shows plenty of rubiaceous stomata, trichomes are absent. Both the epidermis measure T.40$\mu$ and R.30$\mu$ . The vascular structure is seen at the mid-rib region. Below the upper and lower epidermis of mid-rib region is 2 - 4 layers of collenchymatous tissues. Inner to that is parenchymatous tissues. Inner to that is the pericyclic fibres measuring upto 30$\mu$ in dia consisting of about 6 to 9 layers enclosing the vascular bundles with xylem inside and pholem towards outside. The subepidermal layers

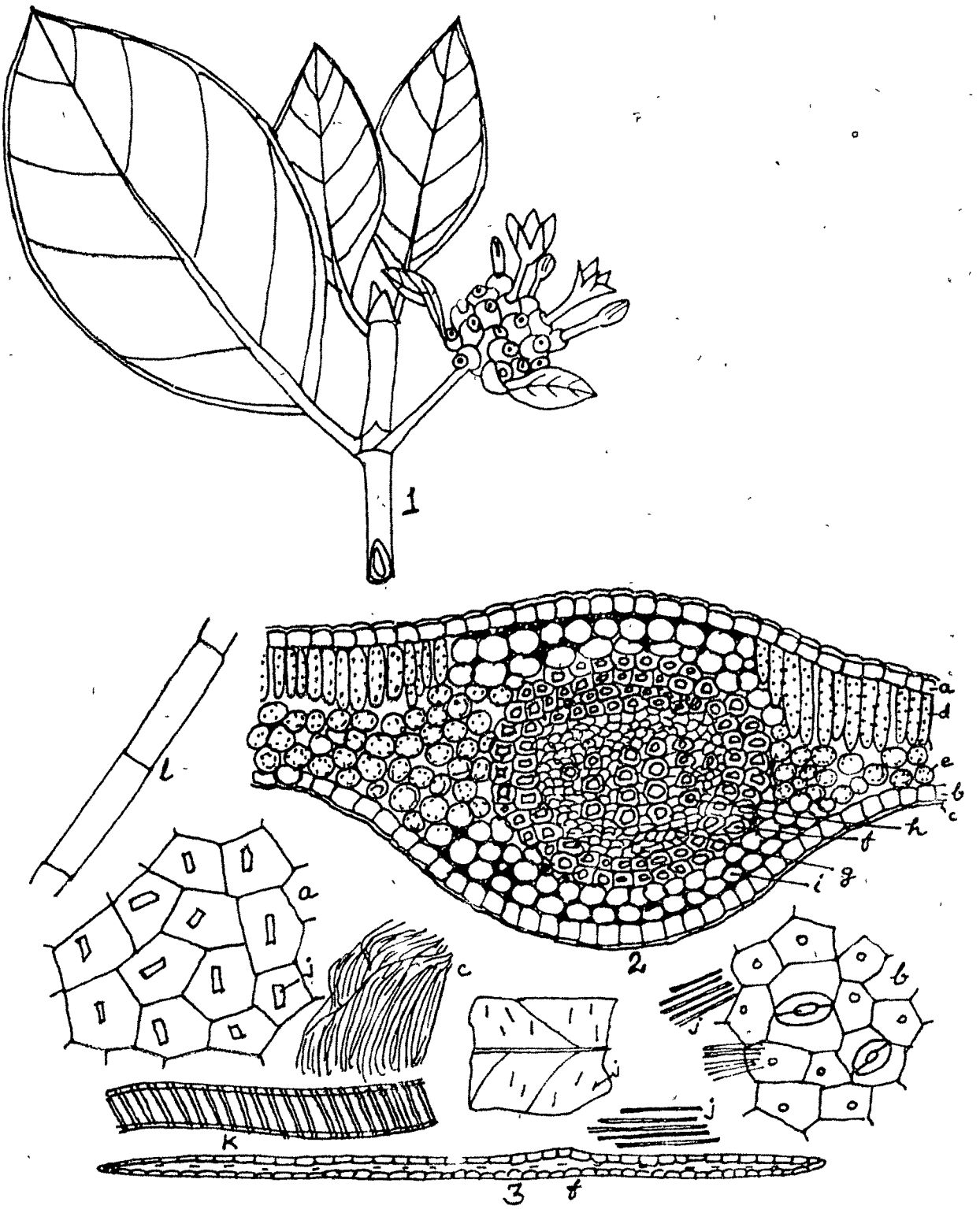



FIG. 14. Morinda citrifolia Linn.

1.a branch with flowers 2.t.s.of leaf x 200 3.leaf powder x 200 a.upper epidermis b.lower epidermis c.cuticle d.palisade e.spongy parenchyma f.fibres g.phloem h.xylem i.collenchyma j.crystals k.vessels l.parenchyma.

show bundles of raphide crystals of calcium oxalate measuring upto 100 μ long. The ventral (upper) epidermis shows characteristic crystals of calcium oxalate measuring upto 40μ in length. These are not seen in lower epidermis. A surface examination of the leaves show plenty of raphide bundles in the mesophyll when examined from both surfaces.

Powder microscopy of leaf:-

A powder of the leaf is dull green in colour. Microscopical examination shows the following diagnostic characteristics. Upper and lower epidermis of the leaf, lower epidermis with rubiaceous stomata, upper epidermis with characteristic prismatic crystals of calcium oxalate; pieces of striated cuticle covering the epidermis; plenty of raphide crystals of calcium oxalate in mesophyll tissue; fibres from the main nerves; xylem vessels and collenchyma cells. Trichomes are absent in the leaf.

11. Morinda tinctoria Roxb.

(Syn. Morinda coreia Buch-Ham.)

Vernacular names - Larnong (Ass.); Ach (Ben.); Al (Hin.); Manjishta (Mar.); Maddichettu (Tel.); Achu (Uri.)

Description of the plant:

A small to medium sized tree with a straight cylindrical stem 3.6 to 4.2 M. in length. Bark corky, pale brown, long fissured; leaves elliptic or lanceolate; flowers in dense ovoid heads, white scented; fruit of many drupes coalescent into a globose or ovoid, fleshy head about 2.5 cm in diameter, edible.

Medicinal part : Root

Medicinal Uses:

The root is used internally as an astringent. The root bark contains morindone and its glucoside morindin (Kirtikar and Basu, 1918)

Macroscopical characters of root:

Root is cylindrical in shape, variable in diameter, tortuous with branches. Externally brownish in colour, longitudinal wrinkles and deep furrows appear on drying and also exhibit transverse cracks in the bark. The dried root bark is easily separable and exposes the yellow coloured wood. Fracture, short in the centre and irregular in bark region. Fractured surface yellow in the centre and brownish in bark region.

Microscopical characters of root:

A 6 mm. thick root has 1 mm. bark and 5 mm wood. The dry root in transverse section is roughly circular in outline. While sectioning, the bark gets separated from the central xylem region (wood). The bark is a narrow zone. The major portion is occupied by the wood in the centre. The root in transverse section is surrounded by many layers of tabularly arranged suberised cork tissue. The cork cells measure, T.40$\mu$, R.15$\mu$. Within the cork tissue are 2 or 3 bands of lignified tissues of sclereids, 2 to 4 layered in each band. Sclereids measure T.30$\mu$, R.10$\mu$. Inner to the periderm is the parenchymatous cortex of about 25 to 30 layers wide. These parenchyma cells measure T.60$\mu$, R.25$\mu$. Cortex is followed by pholem tissue, consisting of sieve tubes and phloem parenchyma. Phloem tissue contain schizogenous canals filled with colourless amorphous substances; mechanical tissues are absent in phloem. The cortical cells contain starch grains and plenty of raphide crystals. Raphides are present in bundles as well as isolated needles. Starch grains measure 5$\mu$ in diameter and needle crystals are upto 100$\mu$ in long axis. Cambium layer is indistinct. Xylem occupies the large central zone. Xylem consists of vessels, tracheids, xylem parenchyma and xylem fibres. Vessels measure upto 150$\mu$ in diameter, xylem fibres measure 15$\mu$ in diameter, and xylem parenchyma measures R.30 to 40$\mu$, T.15 to 25$\mu$. Xylem is traversed by uniseriate

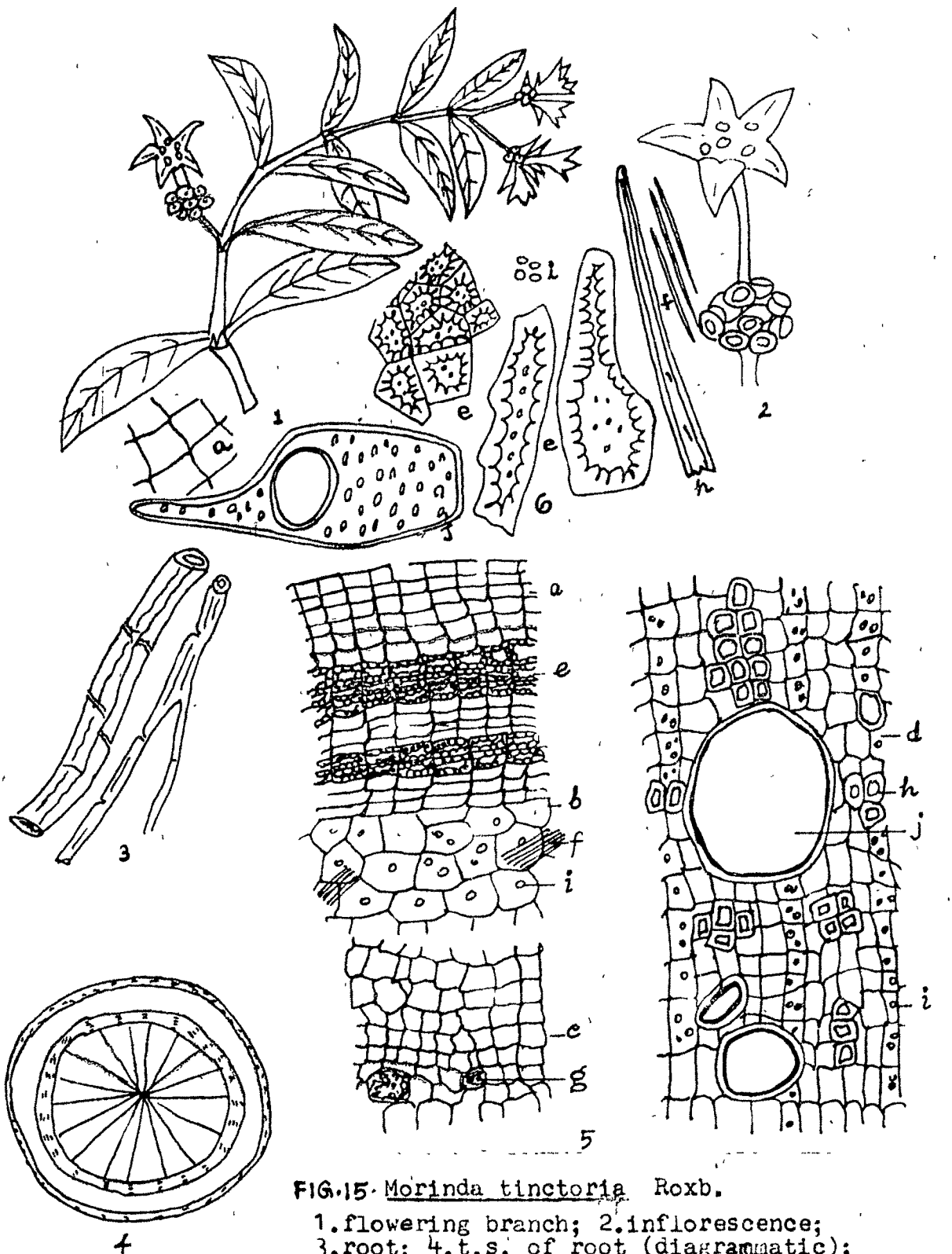



FIG.15. Morinda tinctoria Roxb.

1.flowering branch; 2.inflorescence;
3.root; 4.t.s. of root (diagrammatic);
5.a portion of root t.s. x 200; 6.root powder x 200
a.cork; b.cortex; c.phloem; d.xylem;
e.sclerieds; f.raphides; g.schizogenous
canals; h.fibres; i.starch; j.vessel.

parenchymatous medullary rays. Xylem parenchyma and ray cells are filled with starch grains, mostly simple and rarely compound . Starch grains are about 6$\mu$ in long axis. Pith is absent and centre is occupied by primary xylem.

Powder microscopy of root:

A powder of the root is yellowish brown in colour dominated by sclereids from periderm, thick walled and pitted measuring 40 to 120$\mu$ X 20 to 30$\mu$ ; xylem vessels with large opening and tail which are 300 to 320$\mu$ long and 80 to 160$\mu$ wide; xylem fibres, narrow lumened having 550 to 650$\mu$ in length and 17$\mu$ wide. Suberised characteristic tissues of cork measuring 35$\mu$ x 20$\mu$ ; raphide crystals of calcium oxalate up to 100$\mu$ long and a few starch grains of 5$\mu$ in diameter are also present. Other parenchyma present are not of diagnostic importance.

## 12. Oldenlandia corymbosa Linn.

(Syn. Hedyotis Burmanniana Br.
Oldenlandia herbacea DC.)

Vernacular names - Khet papra (Ben.); Damanpaper (Hin.); Kshetra-parpata (Mar.); Parpata (San.); Parpadagan (Tam.); Verrinelavemu (Tel.)

Description of the plant:

This is an annual varying from 8 to 38 cm high. Stem terete numerous, slender, erect, ascending or spreading, glabrous or pubescent. Leaves subsessile 1.5 to 4 cm. by 1.5 to 4 mm, linear or linear-lanceolate, acute, stipules short membranous, truncate, with a few short bristles. Flowers on filiform pedicels longer than the calyx, usually 2-3 (rarely 1 or very rarely 4) on the top of a very slender axillary solitary peduncle; bract beneath the pedicels 1 to 1.5 mm long, subulate. Calyx 2 mm. long, pubescent, teeth narrowly triangular. Corolla white 2.5 mm long; lobes acute, about 1 mm long capsules globose or pyriform, seeds pale brown, angular.

Medicinal part : Whole plant

Medicinal uses:

A decoction of the whole plant (root, stem, leaf) is used in liver complaints and as an alternative in low-forms of fever

i.e. remittent fever with gastric irritability and nervous depression, and also in chronic malaria as a good febrifuge. The plant is boiled in water and the brew is used for mouth wash in tooth ache. (The Wealth of India, 1966; Chopra et al., 1958; Kirtikar and Basu, 1918.)

Macroscopical characters of leaf:

Leaf is simple, lanceolate, pointed at the tip, margin serrate, venation reticulate unicostate, stipulate, stipule with bristle like projection.

Microscopical characters of leaf:

Leaf is dorsiventral in transverse section. Epidermal cells are irregular with wavy margin in surface view. Cuticle is thick on upper epidermis and thin in lower epidermis. Mesophyll tissue shows raphide crystals of calcium oxalate measuring up to 7$\mu$. Rubiaceous stomata are present mostly on lower epidermis. Upper epidermal cells are 25 to 65$\mu$ in length and 25 to 38$\mu$ in breadth. Cells of lower epidermis are 17 to 35$\mu$ in length and 12 to 33$\mu$ in breadth. Palisade cells are cylindrical 9 to 13$\mu$ in length and 2 to 5$\mu$ in breadth. Spongy parenchyma are 3 to 6$\mu$ in diameter, palisade is in two rows. Spongy parenchyma show air cavities. There is a well developed mid rib. Vascular bundles are large, semilunar to straight lateral bundles are present.

Macroscopical characters of stem:

Stem is green in colour, terete, slender, almost square in T.S.

Microscopical characters of stem:

Stem in transverse section shows an outer layer of epidermis with a thick cuticle on external wall. Inner to epidermis is cortical cells 3 to 4 layered; phloem consists of 3 to 4 layers. Xylem forms a circle. Xylem is highly lignified. Single layered cambium is seen between xylem and pholem. A large pith is present in centre. Nodes are unilacunar. Xylem vessels measure 83 to 25 to 300$\mu$ long, 15 to 23 to 29$\mu$ breadth. Vessels are with bordered pits, end walls oblique with simple large perforations and with tail at both ends. Xylem fibres are slender, long with pointed ends and with simple pits and measure 155 to 335 to 535$\mu$ long and 10 to 12 $\mu$ broad. Parenchyma cells are isodiametric.

Macroscopical characters of root:

Roots are woody and hard, branched, passing deep into the soil, primary roots thicker with secondary and tertiary branches, diameter 0.5 to 1 mm at base.

Microscopical characters of root:

A transverse section of the root shows single layered epidermis 2 to 3 layered cortex and 4 to 5 layered phloem. Xylem forms a circle with lignified cells, centre is occupied with a small pith. Vessels measure 145 to 235 to 360$\mu$ long and 12 to 17 to 19$\mu$ wide. Xylem fibres are thick-walled and lignified. They measure 170 to 300 to 415$\mu$ long and 12 to 13 to 16$\mu$ wide.

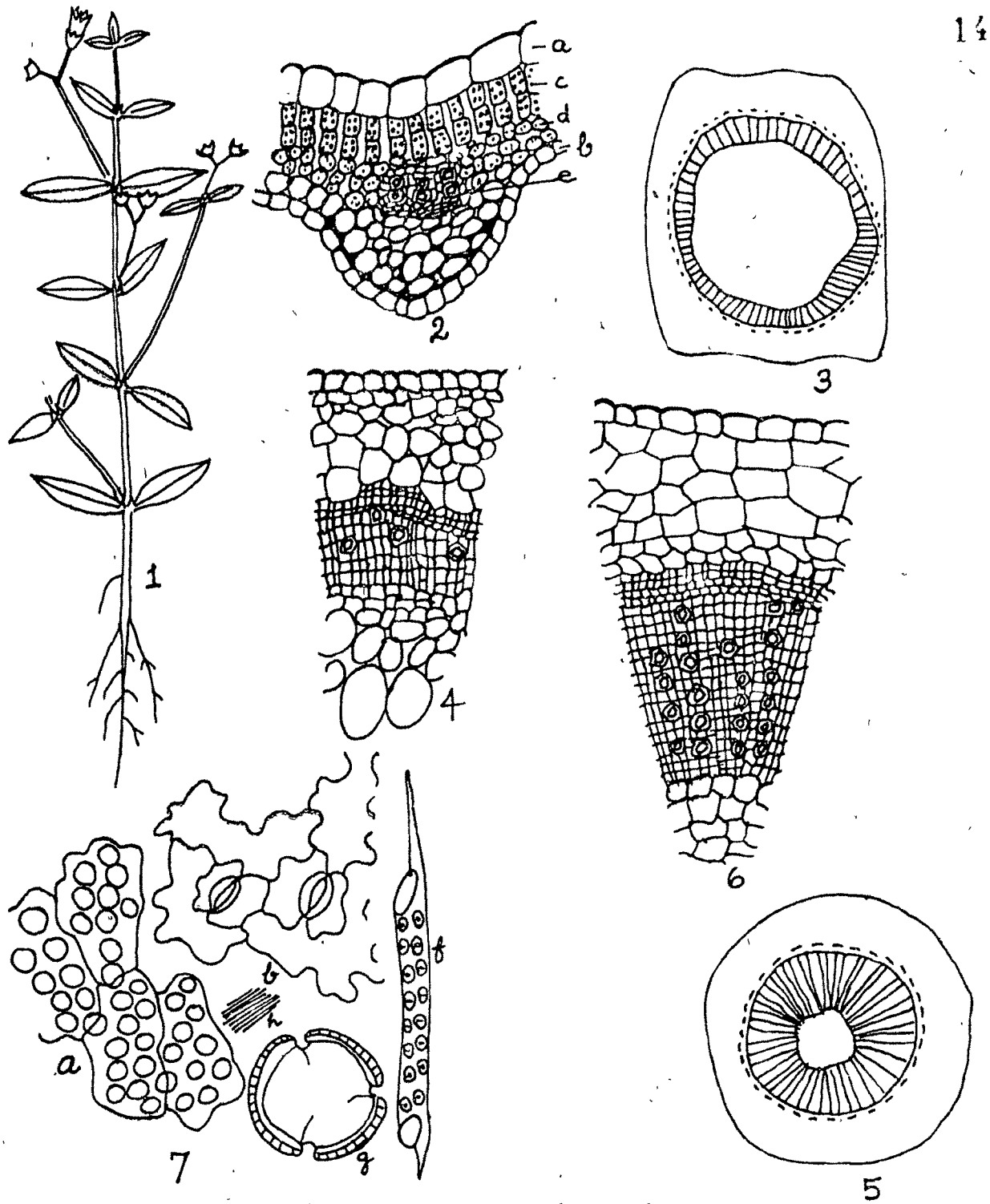



FIG.16. Oldenlandia corymbosa Linn.

1.whole plant 2.t.s.of leaf x 200 3.t.s.of stem(ground-plan) 4.t.s.of stem x 200 5.t.s.of root(ground plan) 6.t.s.of root x 200 7.powder x 200 a.upper epidermis b.lower epidermis c.palisade d.spongy parenchyma e. v.bundle f.vesels of stem g.pollen grain h.raphides.

Powder microscopy of the plant:

A powder of the plant is light green in colour. Microscopical examination of powder reveals characteristic debris from leaf, stem, and root. The epidermis of leaf with characteristic wavy margin and rubiaceous stomata, spongy parenchyma with raphide crystals of calcium oxalate, measuring up to 70$\mu$, vessel members of secondary xylem with tails. Pollen grains tricolpate with reticulate exine. The root and stem reveals presence of alkaloid when tested with Wagner's reagent. Alkaloid is absent in leaf.

13. Ophiorrhiza mungos Linn.

Vernacular names - Gandhanakuli (Ben.); Mongoose plant (Eng.); Mungusvel (Guj.); Sarahati (Hin.); Patalagaruda (kan.); Avilpori (Mal.); Nagvelli (Mar.); Sarpakshi, Nagasugandha (San.); Keerimpundu, Kiripurandan (Tam.); Sarpashi-cheetu (Tel.)

Description of the plant:

A suffrutescent herb, 45 to 60 cm high, erect, glabrous, stem hard and woody, bark light brown and corky, stipules small, leaves 5 to 13 by 2 to 6 cm; very thin elliptic or elliptic-lanceolate, acuminate, long-attenuate at base, flowers white in sub-umbellate cymes. Calyx-teeth very short. Corolla glabrous, round at the tip, lobes very short, obtuse, keeled at the back. Fruit is a compressed capsule, coriaceous. Seeds numerous, angular, minute, pale brown in colour.

Medicinal part - Root

Medicinal uses:

The root is intensely bitter and may be used as a tonic, popularly believed to be a remedy against the bites of venomous snakes and mad dogs (Kirtikar and Basu, 1918). The roots are said to be useful in the treatment of cancer. A decoction of the root is given as a laxative and sedative (Nadkarni, 1954).

Macroscopical characters of root:

The root is hard, woody, contorted and branched, about 15 cm. in length, with many hairy rootlets. The tap root is upto 0.5 cm thick, covered with a thin brown closely adhering bark. Fracture, hard and woody exposing a creamy central portion. Taste, moderately bitter.

Microscopical characters of root:

A transverse section of a 3mm thick root is circular in out line with a thin peripheral zone of cortex and phloem of about 150$\mu$ thick, and a large central zone of xylem. The outermost tissue consists of brownish suberised cork cells measuring T.40$\mu$ and R.20$\mu$ . Inner to that is the cortex consisting of 5 to 6 layers of rectangular parenchymatous cells measuring T.40 to 50$\mu$ and R.20$\mu$ . Some of the cortical parenchyma are filled with needle shaped microcrystals of calcium oxalate. Lignified tissues are absent in the cortex. Inner to cortex is a narrow zone of phloem. Phloem also is devoid of lignified tissues. The large central zone is occupied by xylem. Xylem consists of lignified xylem parenchyma, xylem fibres and vessels. Xylem parenchyma measures T.15$\mu$ and R.20$\mu$ . Vessels are 15 to 20$\mu$ . in diameter. Xylem is traversed by uniseriate medullary rays. Pith is absent in root. Root is devoid of starch grains.

Powder microscopy of root:

A powder of the root is creamy in colour and is moderately bitter in taste. Microscopical examination shows the following

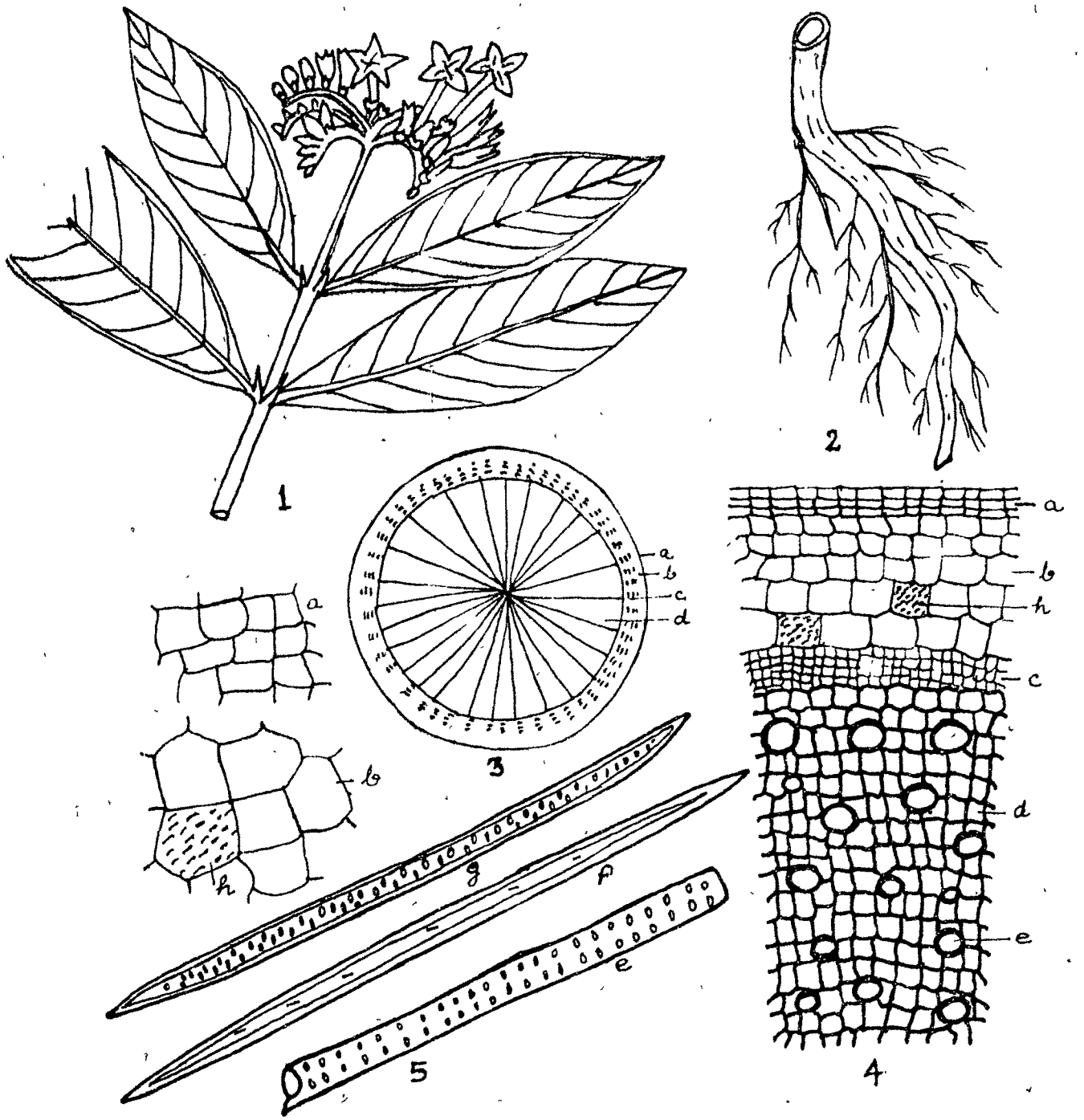



FIG.17. Ophiorrhiza mungos Linn
1. a branch with flowers 2. root 3. t.s. of root (diagrammatic) 4. t.s. of root x 200. 5. root powder x 200 a. cork. b. cortex c. phloem d. xylem e. vessel f. xylem fibre g. tracheid h. cortical parenchyma with microcrystals.

distinguishing characteristics: Suberised cork cells measuring 40$\mu$ x 25$\mu$ , and cortical parenchyma measuring 45$\mu$ x 25$\mu$ . Some of the cortical parenchyma are filled with needle shaped microcrystals of calcium oxalate. Xylem fibres are with a narrow lumen measuring 650$\mu$ long and 15$\mu$ wide. Vessels and tracheids are with reticulate and pitted thickenings. Vessels are with opening on the end walls and with a small tail; vessels and tracheids are upto 600$\mu$ long and 30$\mu$ wide.

14. Paederia foetida Linn.

(Syn. Paederia ovata Miq.

Paederia sessiliflora Dc.)

Vernacular names - Gandhabhadulia, Gandal (Ben.); Gandhana (Guj.); Gandhali Bakuchi (Hin.); Talanili (Mal.); Hiranwel (Mar.); Prasarini (San.); Penarisangai (Tam.); Savirela (Tel.)

Description of the plant:

Slender twining shrub, foetid when bruised. Leaves opposite, long petioled, ovate or lanceolate, base acute rounded or cordate, glabrous or nearly so, branches long in distant pairs, cymose at the extremity. Bracts minute, ovate or subulate, flowers sessile and pedicelled. Calyx small, tube campanulate, corolla 1.2 to 1.7 cm tomentose. Fruit broadly elliptic, compressed, pyrenes black with a broad pale wing.

Medicinal part : Leaf and root.

Medicinal uses:

Leaves (specially in the fresh condition) are used as an article of diet for making soup for patients suffering from stomach complaints. A soup prepared from the leaves is considered a good remedy for diarrhoea and dysentry and is one of the most popular house-hold remedy for use during convalescence from acute illness. Externally it is used for application in rheumatism

(Chopra et al., 1958). Root is an emetic, it is also emollient and carminative, useful in colic, spasms, rheumatism and gout Dymock et al., (1890)

Macroscopical characters of leaf:

Leaves are long petioled, crumpled when dry, oblong cordate, smooth, entire; stipules broad - cordate. The leaves emit a very offensive odour of carbonbisulphide when bruised.

Microscopical characters of leaf:

The leaf in transverse section shows epidermis on both sides covered with a thin layer of cuticle. Upper epidermis consists of large cells measuring T.23 to 46$\mu$ , R.25 to 45$\mu$ , * L.35 to 45$\mu$ . Lower epidermis measures T.18 to 35$\mu$ R.18 to 28$\mu$ L.23 to 46$\mu$ and shows stomata. Adjacent to the upper epidermis is single layered palisade containing choloroplasts. Spongy parenchyma is 4 to 5 layered circular in shape with inter-cellular spaces. Palisade cells are upto 46 x 12 $\mu$; spongy parenchyma 23 x 25 $\mu$. Mesophyll contains raphide crystals of calcium oxalate. Some of the spongy parenchyma contain amorphous contents which are odourous. The ventral ridge and dorsal side of the mid rib composed of collenchymatous cells. Vascular bundles show xylem on the ventral side and phloem on the dorsal side. Stomata are rubiaceous type. Multicellular trichomes measuring 80 to 250$\mu$ in length are present on the veins on upper and lower epidermis.

* L = Length

Powder microscopy of leaf:

Bulk colour of the leaf powder is greenish brown with a disagreeable odour of sulphuretted hydrogen. Microscopic examination of the powder shows fragments of epidermal cells, some are with rubiaceous stomata, collenchyma, palisade cells, spongy parenchyma cells with oil contents, characteristic multicellular trichomes with some what collapsed cells; raphide crystals of calcium oxalate, fragments of spiral vessels.

Chemical constituents:

The volatile oil present in the plant can be steam distilled. This plant also contain alkaloid which is called paederine (Dymock et al, 1890).

Root

Macroscopical characters of root:

The root in crude drug market occurs in small pieces of 2 to 5 cm long and 2 to 4 mm diameter, cylindrical to sub-cylindrical pieces with some what compressed sides. Outer surface is full of root scars. Root is externally brownish and internally light brown. Fracture fibrous. Taste bitter and odour resembles sulphurated hydrogen and is disagreeable.

Microscopical characters of root:

The outer most layer of root in transverse section consists of

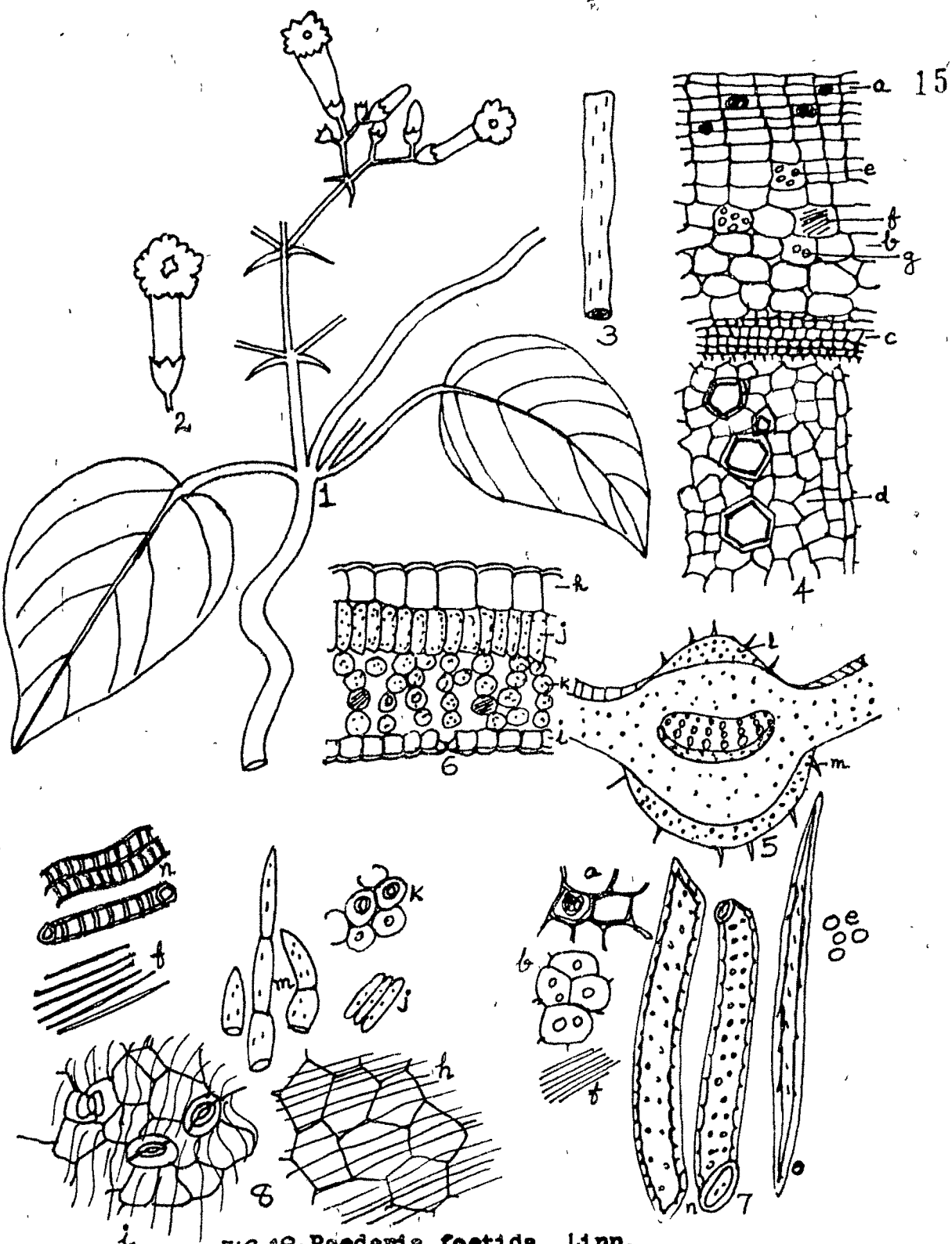



FIG.18. Paederia foetida Linn.

1.a branch with flowers 2.a flower 3.root 4.t.s.of root x 200 5.t.s.of leaf through mid rib(diagrammatic) 6.t.s.of leaf x 200 7.root powder x 200 8.Leaf powder x 200 a.cork b.cortex c.phloem d.xylem e.starch f.crystals g.oil h.upper epidermis i.lower epidermis j.palisade k.spongy parenchyma l.collenchyma m.trichomes.

6 to 8 layers of suberised cells with brownish contents. Cork cells are up to 51$\mu$ x 10$\mu$ . The cortex is a wide region consists of polygonal parenchyma containing starch grains and raphide crystals. Some cortical cells contain oil globules which cause the bad odour to the root. Cortical parenchyma measures upto 160 x 40$\mu$ . Xylem parenchyma and xylem rays also contain starch. Xylem and phloem show all usual elements and ray cells. The vessels have very large lumen and are with pitted thickenings on the walls and have end and oblique perforations. A few spiral elements are also present. The vessels are 85 to 187$\mu$x 25$\mu$ .

Powder microscopy of root:

A powder of the root is brownish in colour, showing cork cells with dark brown contents, cortical parenchyma, phloem and xylem elements, ray parenchyma, starch and raphide crystals of calcium oxalate.

15. Pavetta indica Linn.

(Syn. Ixora pavetta Roxb.,)

Vernacular names - Kukurchura (Ben.); Papat (Guj.); Papari, Kankra (Hin.) Pavatay, Sulay-bottu-gida, Patta (Kan.) Papadi (Mar.); Papata, Pappana, Tiryak phala (San.); Pavuttayvayr, Pavattai (Tam.); Paputta vayru, Papiti (Tel.)

Description of the plant:

It is a small bushy shrub. Leaves membranous, variable in size, elliptic oblong or elliptic lanceolate or obovate oblong, obtuse, acute or acuminate, glabrous on both sides, base tapering, stipules conate, triangular, acute, thin, deciduous. Flowers white in terminal sessile corymbose pubescent cymes, bracts broad, membranous, lower cupular; calyx truncate or with very short triangular teeth. Corolla tube twice or thrice as long as oblong lobes. Corolla tube 1.5 to 2 cm. Stigma very slender, fusiform. Fruit is a berry, size of a pea, 2-seeded.

Medicinal part : Root

Medicinal uses:

The root is bitter tonic and aperient. It is used as a purgative and in obstructions of the viscera. The powder of the root along with ginger and rice water is used in dropsy. The powder of the root, as such, is given to children for childhood ailments. The roots are used in Ayurvedic system of medicine. (Nadkarni, 1954.)

Macroscopical characters of the root:

Root in pieces of different sizes occur in market. Diameter varies from 6 to 25 mm. Younger roots are attached with thin rootlets. Older roots are devoid of rootlets. The outer colour is grey. Root is first slightly sweet and aromatic in taste followed by a bitter sensation.

Microscopical characters of root:

A transverse section of the root shows cork cells 4 to 5 layers externally. Cork cells measure T.20$\mu$ , R.8$\mu$. Inner to that is the cortex followed by phloem. The cortical cells are parenchymatous, filled with starch grains. Cortical parenchyma are almost isodiametric and are about 25$\mu$ in dia. Plenty of rhomboid crystals of calcium oxalate are present in the cortical cells. The starch grains measure from 10 to 35$\mu$ and crystals measure from 15 to 35$\mu$. Some are arranged in the form of crystal fibres which are seen in a macerated preparation of root. Bast fibres are absent in secondary phloem. Inner to the phloem is the xylem which consists of pitted vessels measuring upto 300$\mu$ long and 35$\mu$ wide, tracheids, long fibres, and parenchyma.

Powder microscopy of root:

A powder of the root is light grey in colour. Microscopical examination reveals cork cells, parenchyma, plenty of starch grains, calcium oxalate crystals, fragments of crystal fibres, pitted vessels, tracheids, and xylem fibres as mentioned in whole root.

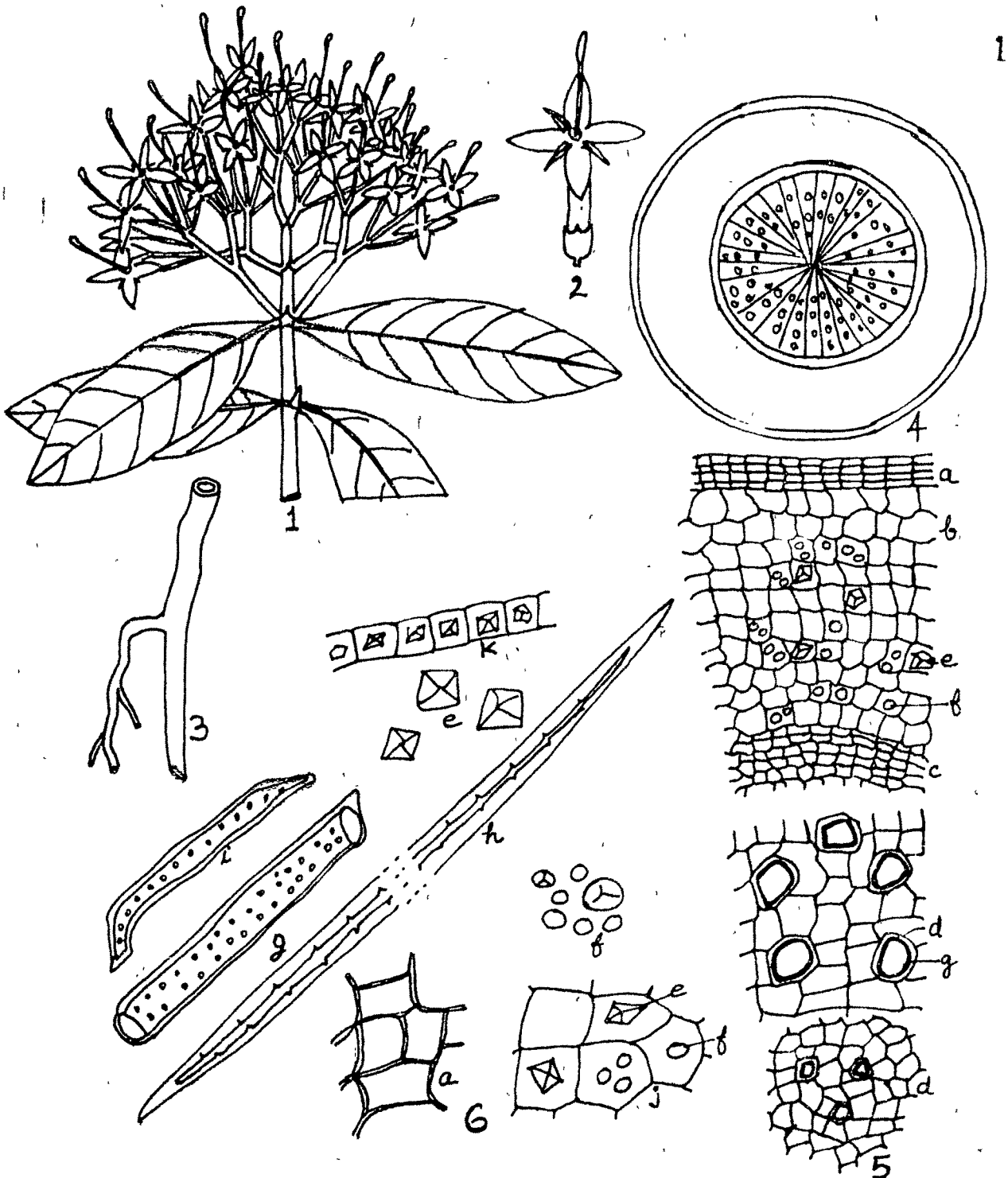



FIG.19. Pavetta indica Linn.
1.a flowering branch 2.aflower 3.root 4.t.s.of root (diagrammatic) 5.t.s.of rootx200 6.root powderx200 a. cork b.cortex c.phloem d.xylem e.crystals f.starch g. vessels h.fibres i.tracheids j.parenchyma k.crystal fibre.

16. Plectronia didyma Kurz.

(Syn. Canthium didymum Gaertn.
Plectronia Wightii Cooke
Psydrax dicoccos Gaertn.)

Vernacular names - Galkaranda (Kan.);
Verkoli (Tam.); Nalla (Tel.);
Dhalsingha (Uri.)

Description of the plant

Shrub or a small evergreen tree, young shoots 4-angled, the leaves variable in size and shape, polished and shining above, glabrous on both sides. Flowers 5-merous in cymes, shortly peduncled, fruit globose 8 to 12 mm. Bark dark grey, smooth, wood light brown, hard and close grained.

Medicinal part : Bark

Medicinal uses:

The bark is used in fevers (Kirtikar and Basu, 1918)

Macroscopical Characters of bark:

Bark is externally dark grey in colour with longitudinal striations and wrinkles. The younger bark shows the 4-angled structure of the stem. Lenticels are present on external surface. Internally light brown in colour and show striations due to fibres. Fracture is hard and fibrous, showing protruding fibres. Bark is variable in thickness according to age.

Microscopical characters of bark:

The bark in transverse section shows an outer cork region consisting of about 10 layers of tabularly arranged suberised cells. Cork cells T. 20$\mu$ , R.15$\mu$ . In younger bark where cork is not developed, a single layered epidermis is present with the periclinal walls thick due to cuticularization. Epidermal cells measure T.10$\mu$ , R.10$\mu$ . Some of the cork tissues are filled with brownish contents. Inner to the cork tissue are the cortical parenchyma consisting of circular or polygonal parenchymatous cells. The vertical tissues also show plenty of large schizogenous canals filled with reddish resinous substances. These cells have thicker walls than the surrounding parenchyma. These large cells are towards the inner region of the bark. Small cortical parenchyma measure T.25$\mu$ , R.20$\mu$ and large cortical parenchyma measure T.60$\mu$ , R. 40$\mu$ . Inner to the cortex is an almost continuous layer or groups of isodiametric pericyclic fibres measuring 10$\mu$ in diam. Intermingled with pericyclic fibres are isolated stone cells of 25$\mu$ wide. Large rossette crystals measuring 50$\mu$ in diameter are present in the cortical parenchyma. The innermost tissue is the phloem consisting of sieve tubes and phloem parenchyma. Phloem is traversed by single layered medullary ray parenchyma. Phloem tissue are tangentially elongated and measure T.15$\mu$, R.10$\mu$ . Starch grains are absent in bark.

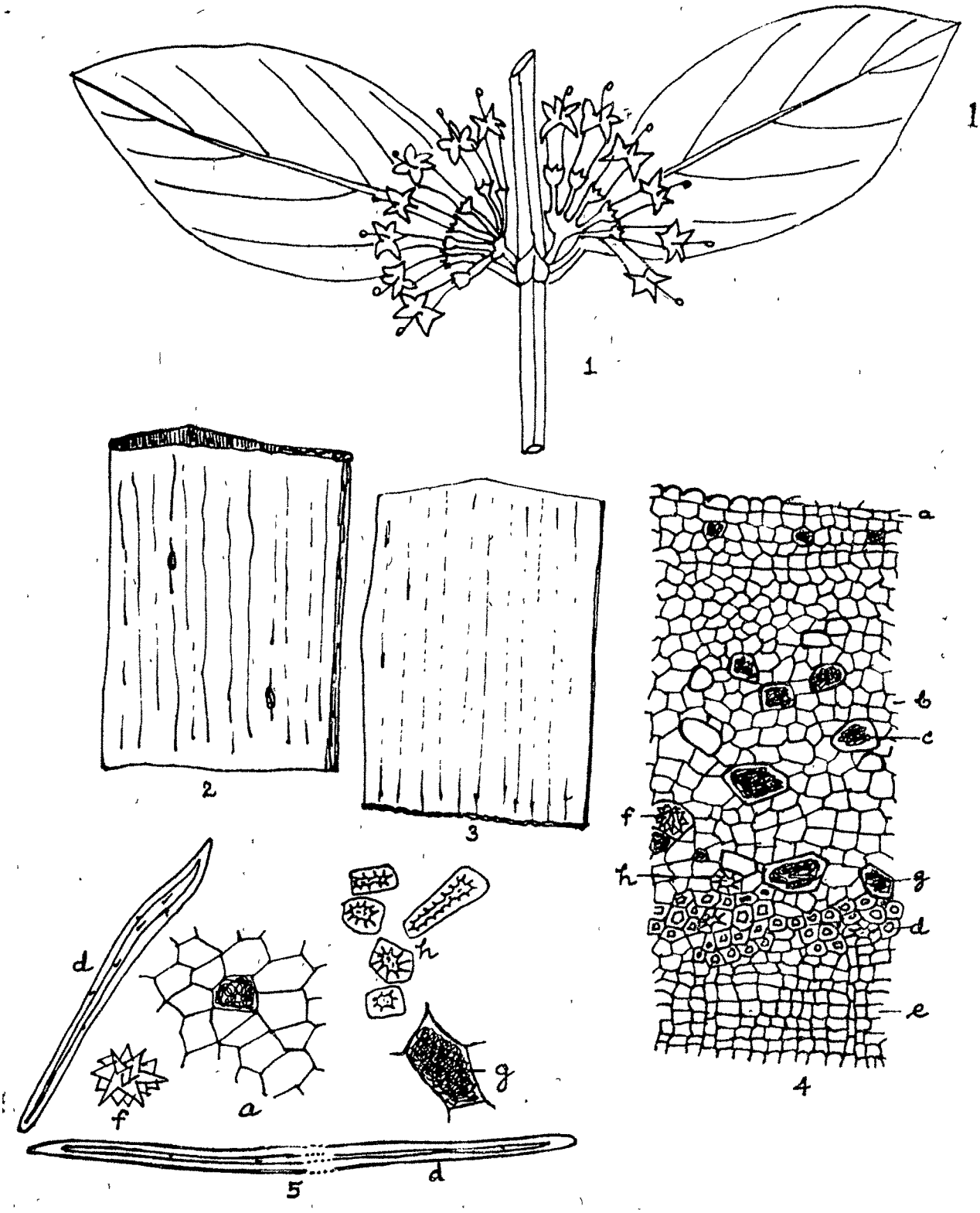



FIG.20. Plectronia didyma Kurz.

1. flowering branch 2. bark (outerview) 3. bark (inner view) 4. t.s. of bark x 200 5. bark powderx200 a. cork b. cortex c. schizogenous canals d. fibres e. phloem f. crystals g. resinous substance h. stone cells.

Powder microscopy of bark

The powder of bark is light brown in colour. Microscopical examination reveals the following diagnostic characteristics. Honey-comb like suberised tissues of cork measuring 40$\mu$ x 22$\mu$; some of the cork cells are filled with brownish contents; cortical parenchyma measuring 70$\mu$ x 40$\mu$, some are filled with reddish resinous substances, isodiametric and elongated stone cells from pericyclic region measuring 25$\mu$ x 75$\mu$, elongated stone cells measure up to 60$\mu$ in length; pericyclic fibres, long and slender measuring upto 850$\mu$ in length and9$\mu$ wide with a narrow lumen and cortical parenchyma with large rosette crystals of calcium oxalate measuring 50$\mu$ in diameter. Other tissues present are not of any diagnostic importance.

17. Randia dumetorum Lamk.

(Syn. Gardenia dumeterum Retz.
Gardenia spinosa Linn.
Randia longispina DC.)

Vernacular names - Menphal (Ben.); Emetic nut Eng.); Mindhala (Guj.); Mainphal (Hin.); Mangari-kai (Kan.); Mangakai (Mal.) Gelaphal (Mar.); Mindu-kolla (Pun.); Madana (San.); Marukkallan-kai (Tam.); Manda (Tel.)

Description of the plant:

A small but very variable much branched ramose tree, 2 to 4 meters high with horizontal rigid branches, armed with long stout straight strong nearly opposite decussate horizontal spines 2.5 to 3.8 cm. long, and bearing simple small opposite very short-petioled obovate glabrous leaves 3 to 5 cms. long, short pedicelled white or greenish - white fragrant flowers turning yellow as they wither, and ovoid thick rinded glabrescent somewhat dry, many-seeded berries of the size of a nutmeg that turn pale yellowish and emit a characteristic odour when ripe.

Medicinal part : Fruit, bark

Medicinal uses:

The dried fruit has been known to Ayurvedic and unani practitioners for a long time as an emetic and ecbolic. It is

pungent, beneficial in leprosy and phlegmatic swellings. It is a substitute for Ipecacuanha in dysentery and is used in abortion. It is used as a fish poison or as a preservative for protecting grains from insects. Bark is a sedative. Bark is used in rheumatism, it is also astringent and is useful in diarrhoea and dysentry. It is also used as an emetic. (Nadkarni, 1954.).

Macroscopical characters of the fruit:

A globose fruit, about 3.8 cm in diameter, appears like a nutmeg, yellowish to grey or brownish in colour externally. At its base is a small disc like stalk and crowned with the calyx limb. External surface minutely and roughly wrinkled and obtusely ribbed, ribs varying from five to seven; two-locular somewhat dry many-seeded berry, pericarp thick and woody enclosing a large quantity of firm fleshy gelatinous or greasy pulp having a peculiar sweetish sickly or nauseous taste and smell. Seeds several in each cell, small, hard, translucent, shining and oblong or rather kidney-shaped attached to and embedded in the centrally placed gelatinous pulpy placenta.

Powder microscopy of fruit:

The macro-and the microscopical characters of the fruits and seeds are available elsewhere (Atal and Lamba,1959). Therefore an attempt is made to draw the microscopic powder characteristics of R.dumetorium fruit to identify it in powder form or in a mixture.

A fine powder is studied for their distinguishing microscopical characters. The powder is pinkish brown in colour with a bitter taste and indistinct odour. The major characters are, brownish irregular resinous substances from mesocarp (a), other debris of the tissue include epidermis of the fruit (b), devoid of trichomes, but exhibits stomata and a circular pattern of arrangement of pigmented epidermal cells around stomata. Mesocarp tissues also show thin walled parenchyma cells some are filled with resinous substances. The endocarp is characterised by closely arranged fibres(c) with very narrow lumen arranged in a criss-cross pattern . Just inner to the fibre layer the endocarp tissue shows thick walled isodiametric stone cells (d), each one is characterised by the presence of a prismatic crystal in their lumen. Elements of fibrovascular tissues like fibres (e) and tracheids (f), are present in broken pieces. The testa of the seed (g), is brown coloured with characteristic thickenings. Thin walled cells with granular contents (h) from the pulpy placenta in which seeds are embedded are also present. Seeds contain plenty of endosperm (i). The endosperm contain aleurone grains in it.

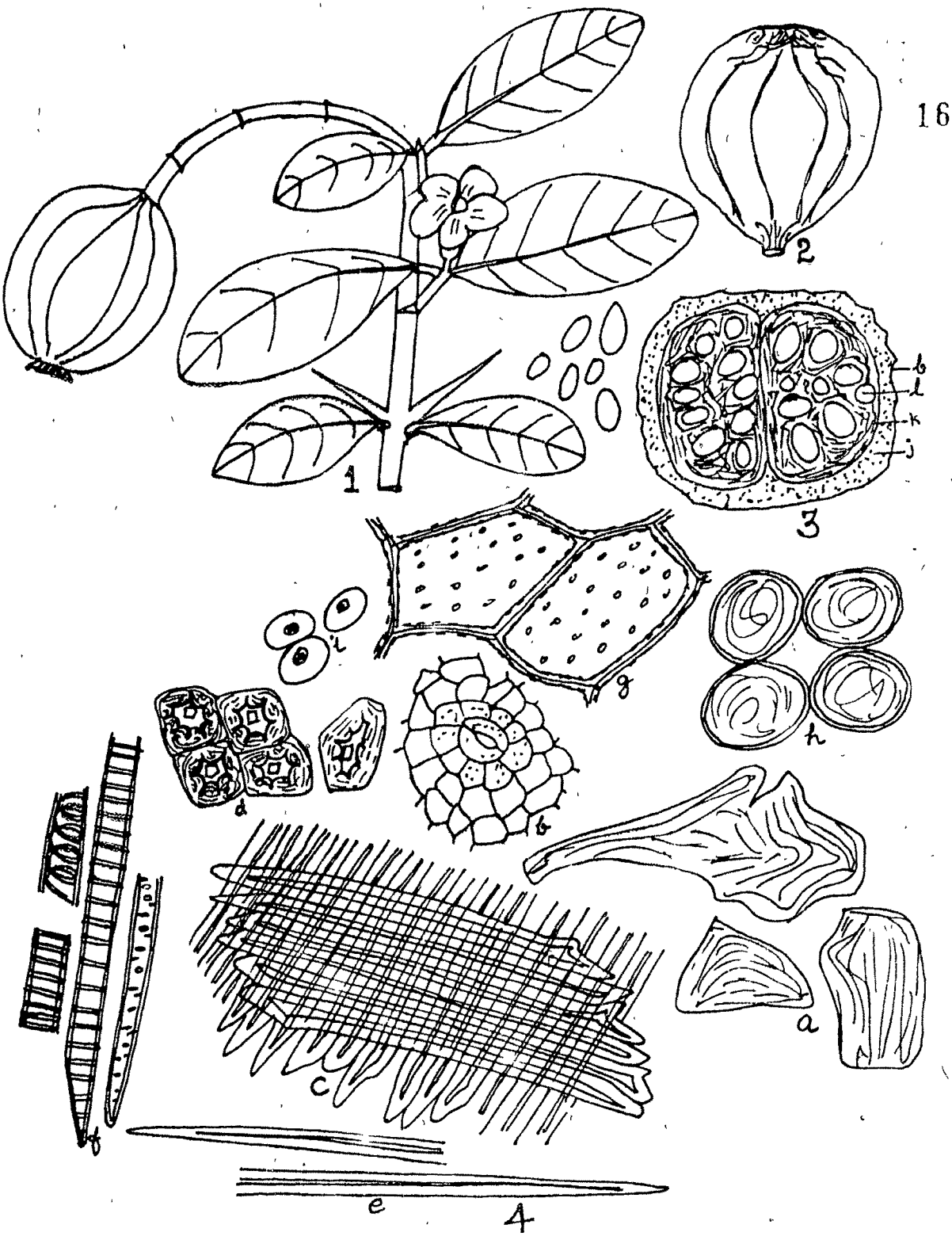



FIG. 21. Randia dumetorum Lamk.
1. a branch with fruit and flower 2. a fruit 3. t.s. of fruit 4. fruit powder x200. a. reddish resinous contents b. epicarp c. endocarpic fibres d. stone cells with crystals e. fibres f. tracheids g. testa of seed h. cells with granular contents i. endosperm j. mesocarp k. endocarp l. seed.

18. Rubia cordifolia Linn.

(Syn. Rubia alata. Wall.
Rubia munjista Roxb.
Rubia purpurea Done.
Rubia scandens Zoll & Morr.
Rubia secunda Moon.)

Vernacular names - Manjit (Hin. Pun.); Manjeeti (Mal.); Manjistha (Mar.); Manjistha (San.); Manjitti (Tam); Manjishtatige (Tel.)

Description of the plant:

It is a herbaceous climbing plant growing in the North West Himalayas, Nilgiris, and other hilly districts of India. Roots very long, cylindric, flexuose with a thin red bark; stem often many meters long; rough, grooved, becoming slightly woody at the base, quadrangular, prickly on the angles, glabrous, shining. Leaves 3.7 to 8.7 cm by 1.6 to 3.5 cm, in whorls of 4, one pair of each whorl often larger and with longer petioles than the other, ovate, acute, the lower leaves larger than the upper, all scabrous above, on the nerves beneath, and on the margins with minute white prickles, base rounded or slightly cordate, petioles triangular with many sharp recurved prickles on the edges, often deflexed; stipules 0. Flower in terminal panicled cymes, bracts ovate, acute, leafy. Calyx 0.8 mm long, tube globose, glabrous, limb 0. Corolla greenish, divided nearly to the base, lobes 5, ovate acute 3.2 mm long, style 2, stigmas globose, fruit 4 to 6 mm in diameter, didymous or globose,

smooth, shining, purplish-black when ripe.

Medicinal part: Root

Medicinal uses:

Root is a tonic, alterative, astringent, used in cobra bite and scorpion sting. Dried root was much used in dropsy, paralysis, jaundice, amenorrhoea and visceral obstructions. A paste made by rubbing up the roots with honey is a valuable application for freckles and other discolouration of the skin also in external inflamations, ulcers and skin diseases. The root is also used in rickets, spleen and liver disorders, renal and vesical calculi. The drug has a sedative effect on intestine. (Nadkarni, 1954; The Wealth of India, 1972; Kirtikar and Basu, 1918).

Macroscopical characters of root:

Roots are very long, cylindric, flexuous with a thin red bark. Externally grooved or with longitudinal wrinkles. Bulk colour reddish brown. Fracture, short with a dark brown coloured outer region and pale yellow porous central portion.

Microscopical characters of root:

A transverse section of the root shows a wide zone of cork as the outermost layer filled with reddish contents. Within the cork tissue are 2 or 3 continuous bands of parenchymatous tissue. Cork cells measure 110 $\mu$ long and 20 $\mu$ wide.

Inner to that is the cortex consisting of large parenchyma cells rectangular thin walled with wavy margin. They measure 120 to 150$\mu$ long and 50 to 80$\mu$ wide. Some of the cortical parenchyma are also filled with reddish contents. Inner to that is a distinct zone of phloem which also is filled with reddish oil globules. Phloem parenchyma are isodiametric and measures 20$\mu$ in diameter. Xylem occupies a wide central zone devoid of oil globules. Mechanical tissues are absent in phloem and cortical region. Raphide crystals of calcium oxalate are present in cortical parenchyma. Raphides consist of fine needles upto 65$\mu$ long. Starch grains are absent. Xylem consists of vessels, tracheids, xylem parenchyma and xylem fibres. Xylem is traversed by uniseriate parenchymatous medullary rays. Xylem vessels vary from 20 to 110$\mu$ in diameter; xylem parenchyma are almost isodiametric and measure 15$\mu$ x 20$\mu$ . Medullary ray cells are 30$\mu$ long and 20$\mu$ wide.

Powder microscopy of root:

A powder of the root is reddish brown in colour. Microscopical examination shows the following diagnostic characteristics. Suberised cork cells measuring 50$\mu$ x 40$\mu$ ; most of them are filled with reddish amorphous contents; large parenchyma cells measuring 120 to 140$\mu$ in diameter, some of them are also filled with reddish amorphous substances; xylem elements with lignified vessels measuring

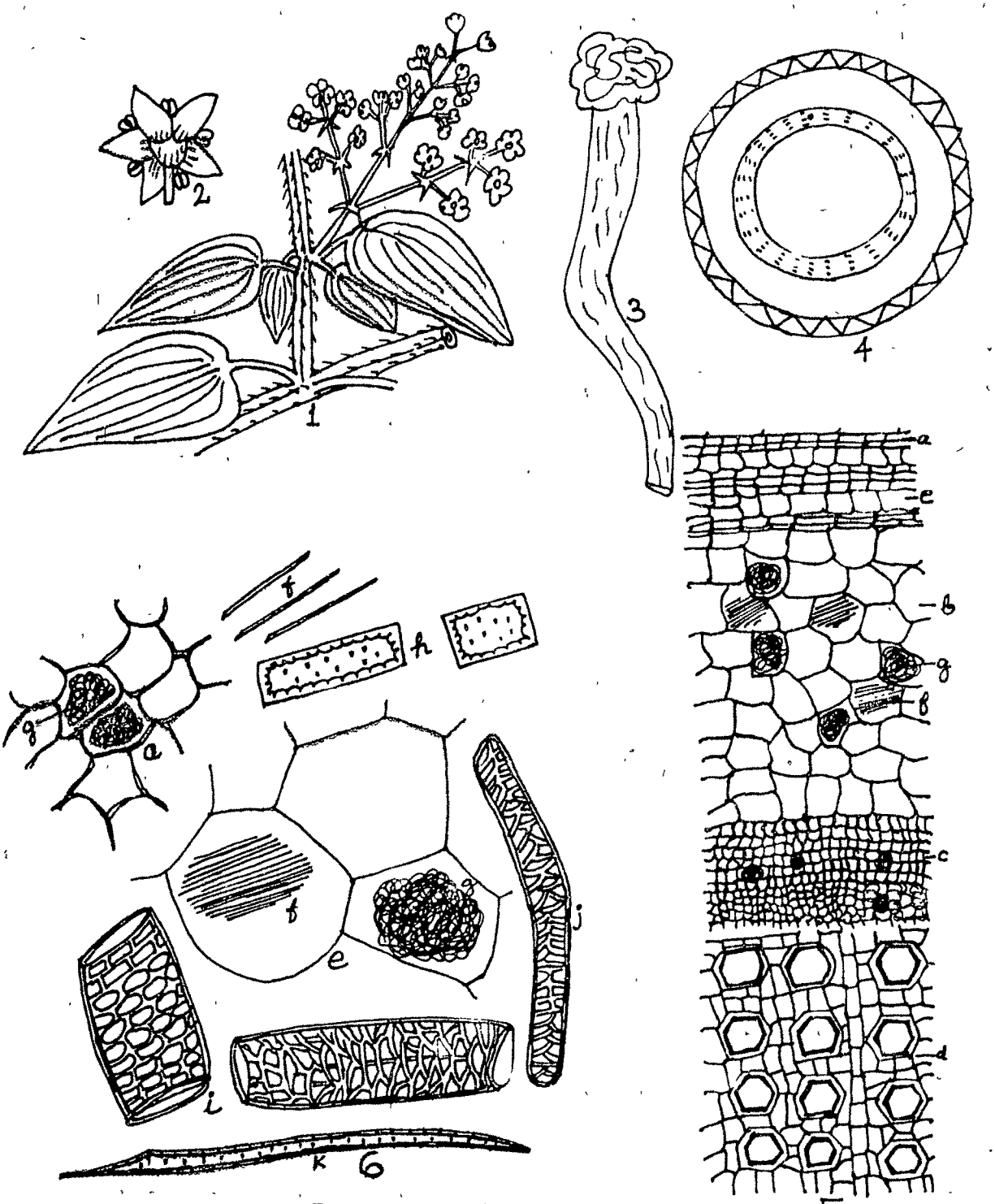



FIG. 22. Rubia cordifolia Linn.

1.a branch with flowers 2.a flower 3.root 4.t.s.of root (diagrammatic) 5.t.s.of root x 200 6.root powder x 200 a.cork b.cortex c.phloem d.xylem e.parenchyma f.crystals g.reddish contents h.xylem parenchyma i.vessels j.tracheid k.fibres.

100 to 200μ long and 60 to 90μ wide, tracheids measuring 250μ x 30μ, lignified xylem parenchyma, and long slender xylem fibres measuring 320μ x 15μ and cortical parenchyma with raphide crystals of calcium oxalate. Starch grains are absent in root.

19. Stephegyne parvifolia Korth.

(Syn. Mitragyna parvifolia (Roxb.) Korth)

Vernacular names - Gulikadam (Ben.); Kaim, Kalmi, Kadasa, Kaddam (Hin.); Kalmb, Kuddam (Mar.); Kalam (Pun.); China Kadambu (Tam); Nirkadambe (Tel.)

Description of the plant:

A large deciduous tree, leaves variable in size and shape, 5 to 12 cm by 3.5 to 7.5 cm elliptic, sub-orbicular or obovate, rounded, acute or bluntly acuminate at the apex, base rounded, or acute, sometimes cordate, petioles 9 to 18 mm long; stipules 12 mm by 8 mm, oblong spathulate, obtuse. Flowers greenish yellow, fragrant; peduncles solitary, terminal, short, each carrying a globose head of flowers; upto 2½ cm in diameter Calyx 12 mm long, funnel shaped; limb truncate. Corolla 8mm long; tube narrowly infundibuliform, glabrous; lobes 2½mm long, triangular, ovate, acute recurved. Style white, much exserted; stigma mitriform. Head of fruits 12 to 16 mm in diam.; capsules 3 mm long, oblong, with blunt rounded tops and 10 blunt ribs.

Medicinal part : Bark and root.

Medicinal uses:

The bark and root are used for fever and colic (Kirtikar and Basu, 1918).

Macroscopical characters of bark:

Dried bark is slightly recurved, externally greyish-white in colour. The inner surface is reddish-brown in colour. The outer surface is rough showing lenticels. Inner surface is fibrous. Odour indistinct. Fracture hard.

Microscopical characters of bark:

A transverse section of the bark shows many layers of tabular cork tissues outside; cork cells measure 80$\mu$ x 30$\mu$. Inner to that is the wide cortex, consisting of parenchyma cells, tangentially elongated. Many of the cortical cells are sclerified and are with lignified walls. Sclerified cells are isodiametric or slightly tangentially elongated, with lignified walls and with large lumen. These cells measure upto T.120$\mu$, R.50$\mu$. The phloem region can be distinguished by the presence of ray parenchyma traversing radially which consist of 2 to 3 layers of radially elongated parenchyma cells. Medullary rays are arranged in wavy bands. Phloem is also distinguished by the presence of phloem fibres which are arranged in small groups; they are very small lignified cells with a narrow lumen measuring 30 to 50$\mu$ in diameter. Phloem region also contains many lignified large cells as that of cortex with large lumen and are slightly thick walled. Large rosette crystals of calcium oxalate measuring 40 to 60$\mu$ in diameter are present in cortical parenchyma and phloem parenchyma. Cortical parenchyma and phloem parenchyma are

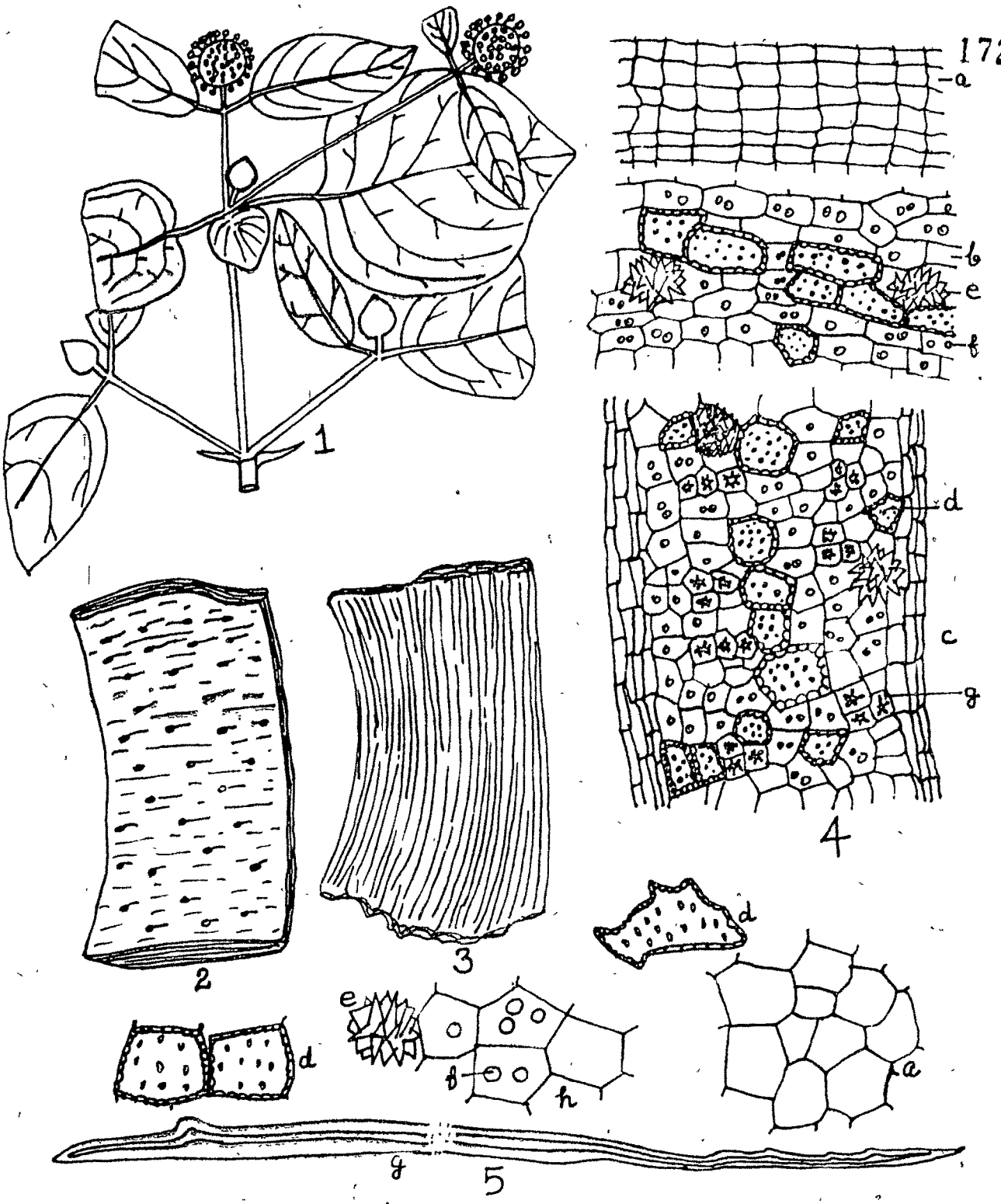



FIG.23. Stephegyne parvifolia Korth.

1.a branch with flowers 2.outer surface of bark 3.inner surface of bark 4.t.s.of bark x 200 5.bark powder x 200 a.cork b.cortex c.phloem d.sclereids e.crystals f.starch g.fibres h.cortical parenchyma.

filled with small simple and compound starch grains. Simple starch grains measure about 5 to 10 μ in diameter.

Powder microscopy of bark:

A powder of the bark is light brown in colour. Microscopical examination shows the following diagnostic characteristics. Characteristic cork cells; cortical parenchyma with starch grains and rosette crystals of calcium oxalate, slightly thick walled sclereids with large lumen; and long phloem fibres occur isolated and in groups.

20. Xeromphis uliginosa (Retz.) Maheshwari

(Syn. Randia uliginosa DC.
Gardenia uliginosa Retz.)

Vernacular names - Pedalu, Piralu (Ben.); Pinglu (Guj.); Pindalu (Hin.); Kara (Mal.); Pendari (Mar.); Pindaluka (San.); Vagata (Tam); Guaku, Peddamrangu(Tel.)

Description of the plant:

A small tree, bark reddish brown in colour, with short branches, many of them terminating in 1 to 2 pairs of strong, sharp thorns 1 to 3 cm long. Leaves obovate-oblong, obtuse, glabrous above, hairy on lower side, base tapering, petiole short, stipules acute from a broad base; with white fragrant flowers. Calyx green, fleshy, 1.3 cm long with 5 to 7 lobes of 3 mm. long. Corolla tube with a ring of white hairs at the mouth. Stamens 5 to 7, sessile. Ovary 2-celled , many-ovuled, style ribbed, stigma large. Fruit, ovoid, smooth, yellowish-brown, with presistent calyx, pulpy inside with compressed seeds.

Medicinal part: Root, fruit

Medicinal uses:

The fruit is diuretic. Unripe fruit is used as astringent, in diarrhoea and dysentery. Root boiled in ghee is also used in diarrhoea and dysentery. The root is considered cooling, diuretic, tonic, aphrodisiac and is used in billiousness and boils of children (Nadkarni, 1954).

Macroscopical characters of the root:

The roots occur in the market as small pieces 3 to 5 cm long; 0.2 to 0.4 cm in diameter. Knotty in appearance, dark brown externally and light yellow on the fractured surface. Fracture is fibrous; taste, indistinct.

Microscopical characters of the root:

A transverse section of the root shows a major xylem region and a small portion of cortex. Vessels are arranged radially. The cortex contain starch grains measuring 10$\mu$ in diameter, oil globules, brownish contents and a group of stone cells. The cork cells are brown in colour. In transverse section the cork cells measure 23 to 45$\mu$ x 13 to 23$\mu$ . The cortex is multi-layered, consisting of irregularly rounded to somewhat flattened parenchyma cells measuring 45 to 75$\mu$ by 25 to 45$\mu$ in T.S. Phloem region shows more brown-colouring matter than in the cortex, starch grains and group of stone cells are present in phloem region also. The stone cells measure 35 to 75$\mu$ x 35 to 100$\mu$x 40 to 75$\mu$ . Medullary rays are prominent in phloem and xylem region, one or two layer thick. Xylem elements consist of plenty of fibres, vessels and a few tracheids. Ray cells are big in size and thin walled than the other cells. Vessels are with simple pits, and measure 300 to 600$\mu$ x 40 to 120$\mu$ , fibres are liner with pointed ends, narrow lumened and pitted. Fibres measure 480 to 850$\mu$ x 10 to 22$\mu$ .

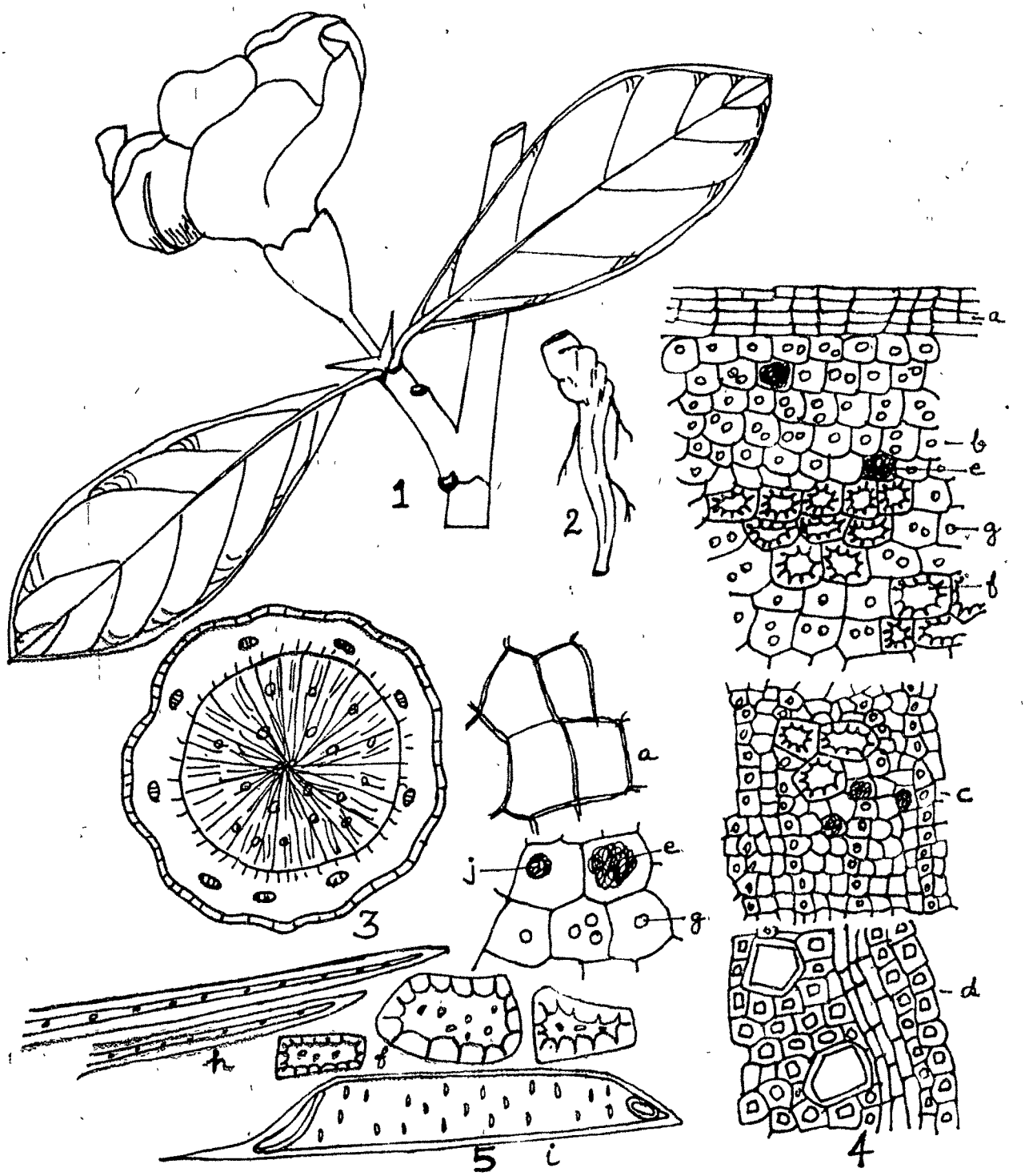



FIG.24. Xeromphis uliginosa (Retz.) Maheshwari
1.a branch with flower 2.root 3.t.s.of root(diagrammatic) 4.t.s.of rootx200 5.root powder x 200 a.cork b. cortex c.phloem d.xylem e.brownish content f.stone cells g.starch h.fibres i.vessels j.oil.

Powder microscopy of root:

A powder of the root is light brown in colour. Microscopical examination reveals plenty of fibres, stone cells in groups, idioblasts with brownish cell contents, oil globules, parenchyma with starch grains, brown coloured cork cells, liner tracheids and vessels with pointed ends as described in whole root.

## DISTINGUISHING PHARMACOGNOSTIC CHARACTERS

Among the anatomical characters, following are of importance and common feature in the family. The cells containing reddish or brownish resinous contents, secretory cells, the walls of trachea have either simple pores or scalariform perforations, vessels are small; wood fibres with bordered and simple pits. Calcium oxalate crystals are present in many plants and include crystal sand and clustered crystals. Acicular crystals in the form of raphides are a common character for the family. The fibrovascular bundles are collateral. Stomata are nearly always confined to lower surface, and are typically rubiaceous with the long axis of two subsidiary cells of the stoma arranged parallel to the stoma. Non-glandular hairs are either unicellular or uniseriate. The leaf is usually dorsiventral. The mid-rib, in transverse section, exhibits a cresent shaped or cylindrical median bundle, occasionally enclosing a few small medullary strands. In stem the pericycle includes a variable amount of sclerenchyma. Medullary rays are narrow, fibres are mostly non-septate.