

OBSERVATIONS ON SOME COLCHICINE-CONTAINING PLANTS

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Received January 15, 1951

COLCHICUM LUTEUM BAKER

COLCHICUM LUTEUM BAKER (Liliaceæ, tribe Colchiceæ) has been included in the Indian Pharmacopœial List (1946) and is considered a good substitute for *Colchicum autumnale* Linn.

C. luteum has a somewhat limited distribution. It is met with at altitudes of 4,000 to 7,000 ft. in N.W. Himalayas and Kashmir, Afghanistan and Turkistan. In N.W. Himalayas and Kashmir it grows plentifully in grasslands and is the earliest species to flower after the snow melts. The time of flowering varies from December to the end of March according to altitude.

The parent corm is covered with a dark brown scale. It is gibbously ovoid, broad in the lower region and gradually narrowed upwards, and has a marked longitudinal groove on one side, at the base of which is a bud or "daughter corm." There is another accessory bud near the top on the opposite side which sprouts if that at the base fails to develop. The parent corm is densely stored with food material, mainly in the form of starch. The corm remains buried under the snow during winter when the buds lie dormant. As soon as the snow melts the basal bud sprouts and produces a short scape (Fig. 2 (1) St.), which bears at the top 1 or 2 bright golden-yellow flowers. When young the scape is protected by two membranous sheaths. At this time the leaves are just emerging.

The flower has a pleasant faint fragrance and has the usual liliaceous plan. The 6 subequal perianth leaves are united below to form a tube 3 to 4 in. long, the lower part of which is below the soil surface, affording protection at the base to a tricarpellary syncarpous superior ovary. The flower is 1 to 1½ in. across. The 6 stamens are included. Their anthers are yellow, highly elongated, narrow, linear and much longer than their stalks. The three filiform styles are exserted. After fertilisation the ovary remains for some time below the soil, but is soon carried above ground with the growth of leaves. The mature capsule is trilocular, 1½ in. long dehiscing by septicial valves with recurved beaks, and contains numerous seeds.

The leaves, which appear soon after the flowers, are radical, 3 to 5 in number, dark green, 6 to 12 in. long and ¼ to ½ in. broad, linear-oblong or oblanceolate with obtuse apex and parallel venation. At the base of the scape are many fibrous unbranched roots. The parent corm gradually decays as it supplies food material to the growing plant. Meanwhile there develops a daughter corm at the base which grows at the cost of the food material manufactured by the leaves.

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The life-history is completed during the short spring season, and by summer the parent corm is completely decayed and a fully grown daughter corm developed which similarly has two buds, one basal and one

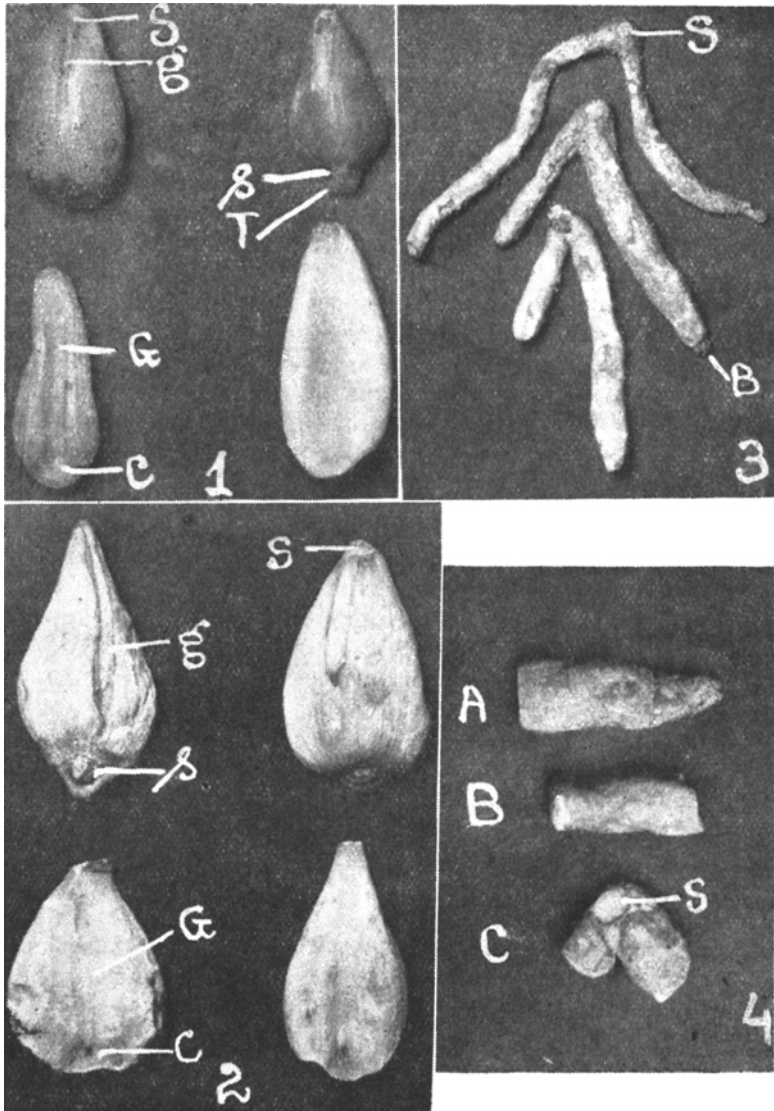


FIG. 1.—(1) *Colchicum luteum* Baker. The drug $\times 4/5$. (2) *Merendera persica* Boiss. and Kotsch. The drug $\times 3/4$. (3) *Gloriosa superba* Linn. Fresh rhizomes $\times 1/4$. (4) *Gloriosa superba* Linn. The drug $\times 1/2$. S, scar left by flowering shoot; G, groove on the straight side of the corm; g, short groove on the convex side of the corm; s, place of attachment to the parent corm; C, the principal bud; T, flat tail-like process; B, the bud at the tip of the rhizome.

accessory near the apex on the opposite side. This mature corm lies dormant in the soil for the rest of the year.

The Drug. The description given by Dymock² is incomplete, but the Indian Pharmacopœial List (1946) gives additional information. These appear to be the only two accounts of the drug.

The drug consists of the dried fully developed whole corms collected from May to July after the leaves have died down. The corms are dug out and separated from the shrivelled remains of the flower stalk and the adhering soil, then tied in a piece of cloth and dipped for a short while in boiling water, and dried. This practice does not seem to be desirable as a certain amount of the active principle, colchicine, which is water-soluble, is sure to be leached out. From the point of view of the collectors this process has a certain advantage. During treatment with boiling water the starch in the outer tissue is gelatinised, and after drying gives a horny texture to the corm which makes it less prone to insect attack during storage. A better way to achieve the same object without loss of colchicine is to expose the corms for a short time to steam before drying. Colchicum of the British Pharmacopœia, which is obtained from the corms of *C. autumnale*, is prepared by cleaning, slicing transversely and drying below 65°C. The slices have a starchy texture.

The major supplies of the crude drug come from Kashmir; it is sent through various Divisional Forest Offices to the Utilisation Division, Baramula, and distributed to the rest of India through Amritsar dealers.

Macroscopically, the drug is in the form of pale yellow to deep brown horny corms 1 to 2 in. long and 0.5 to 1 in. broad, gibbously ovoid with a tapering apex and a prominent groove on one side (Fig. 1(1) G). The bud "C" at the base of this groove may be located by careful observation in good specimens. On the opposite convex side a little below the apex is a small groove "g" with an accessory bud. The apex of the corm is marked by a dark brown depression "S" indicating the position of the flowering shoot. At the bottom on the convex side is a conspicuous scar "s" marking the point of attachment with the parent corm and numerous small root scars. The corm extends in a flat tail like process "T" beyond the scar. The corm possesses numerous longitudinal and transverse fissures which make their appearance on drying after treatment with boiling water. It is odourless and has a bitter taste. The fracture is horny.

Histology. The histology of the corm can best be studied after soaking it for a few hours in water. In transverse section it appears reniform, being depressed in the region of the groove (Fig. 2(2)). The epidermis is formed of rectangular cells (Fig. 3, Ep.) some of which contain a few starch grains. This layer is frequently ruptured in storage. Next is a thin-walled hypoderm composed of similar cells but with little contents. In the young corms this layer is more prominent. The ground tissue is composed of thin-walled parenchyma densely loaded with starch. Some of the cells near the periphery on the groove side are more or less

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crushed laterally forming 2 to 4 fine streaks. There are numerous scattered vascular bundles mostly located in the central region of the corm near the basal bud (Fig. 2(2)). The bundles near the periphery are poorly developed and are more scattered. The bundles are collateral but occasionally a few bicollateral bundles are also met with (Fig. 3).

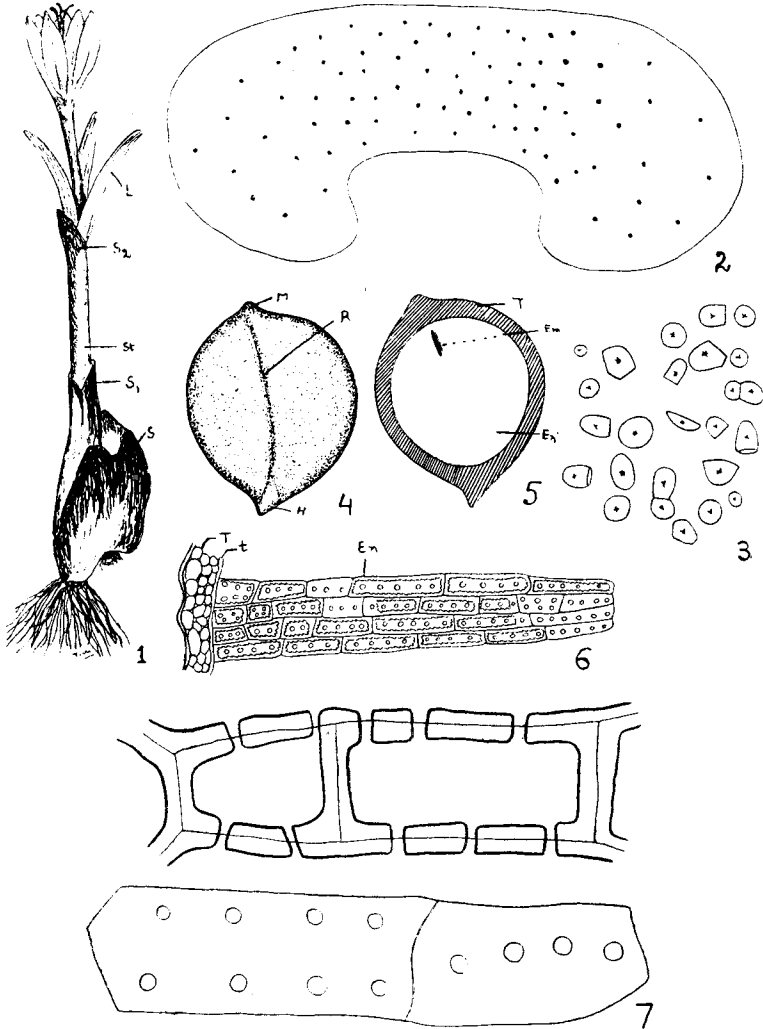


FIG. 2.—*Colchicum luteum* Baker. (1) A plant $\times \frac{1}{2}$. S, cover of the corm, S₁ and S₂ two sheaths protecting the scape (St) while young; L, leaves which have just emerged above ground along with the flower at the top. (2) T.S. of a mature corm with scattered vascular bundles $\times 5$. (3) Simple and a few compound starch grains from a fresh corm $\times 435$. (4) A seed $\times 10$. M, micropylar beak; H, hilar beak; R, faint ridge joining the two beaks. (5) A vertical section of a seed $\times 10$. T, testa; Em, Embryo; En, endosperm. (6) A portion showing the anatomy of the seed $\times 73$. T, testa; t, tegmen; En, endosperm. (7) Cells of endosperm $\times 435$. Radial longitudinal section showing the wall and the pits and two isolated cells showing one or two rows of pits.

The xylem elements are annular or spiral. Surrounding the bundles is a small-celled parenchymatous layer.

The starch grains in the parenchymatous ground tissue are simple, ovoid, spherical or polyhedral (Fig. 2(3)). They vary in size from 2 to 13 to 21 μ and possess a 2 to 6-angled stellate hilum. Loosely jointed compound grains of 2 to 3 components are not uncommon. In the scalded corms the gelatinised starch grains form a lump inside the cells. The starch grains in *B.P. colchicum* are chiefly compound with 2 to 7 components.

The Seed. The seeds are oval (Fig. 2(4)) but may become angular by shrinkage. They vary in length from 2 to 5 mm. and possess a finely pitted dark brown testa (Fig. 2(5), T). There are two beaks on opposite ends, the hilar beak being better developed than that on the micropylar end (Fig. 2(4) H and M). The two beaks are connected by a feebly developed ridge "R" which is somewhat wavy. This becomes clearer in soaked seeds. A longitudinal section through the seed shows on the outside a 3 or 4 layered testa composed of dark brown somewhat thick-

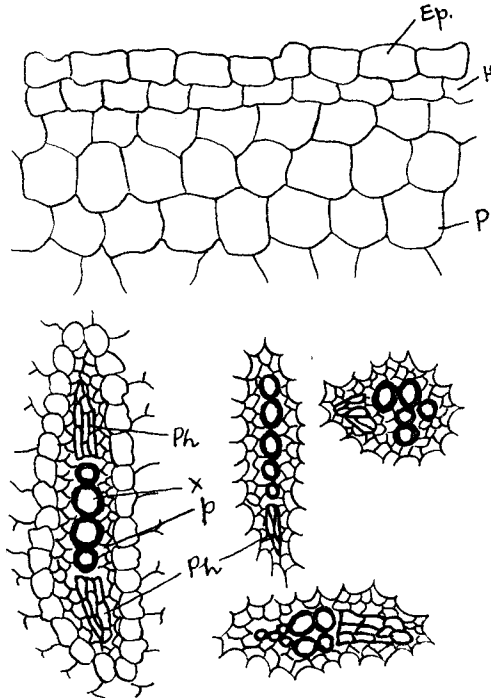


FIG. 3.—*Colchicum luteum* Baker. T.S. of a portion of a corm drawn in detail $\times 145$. Ep, epidermis; H, hypodermis; P, parenchymatous ground tissue. Four vascular bundles, one on left is bicollateral. Ph, phloem; X, xylem; p, small sized parenchyma.

walled cells (Fig. 2(6) T) followed by tegmen "t." The major portion of the seed is occupied by endosperm formed of radiating rows of thick-

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walled pitted cells. These are shown on a magnified scale in Figure 2(7). The pits are usually in a single row but cells with a double row of pits are not uncommon (Fig. 2(6) and (7)). Near the micropylar end is observed a spindle-shaped embryo (Fig. 2(5), Em). The endosperm contains fixed oil and protein grains. There is no micropylar beak in B.P. colchicum seeds and instead of a ridge there is a prominent strophiole on the hilar end whose cells contain starch.

Active Principle. By the B.P. method of assay the colchicine content in the crude drug available in the local market was found to be 0.15 per cent. Chopra¹ states the amount of colchicine for the air-dried corms as 0.21 to 0.25 per cent. by the U.S.P. method. The discrepancy may be in part due to the practice of putting the corms in boiling water for varying lengths of time prior to drying. The Indian Pharmacopoeial List (1946) allows 0.20 per cent. of alkaloid in dried corms. B.P. colchicum corms contain 0.25 to 0.6 per cent. of colchicine (Trease²).

MERENDERA PERSICA BOISS AND KOTSCH

This plant also belongs to the family Liliaceæ, tribe Colchiceæ, and in its habit and general mode of growth closely resembles *C. luteum*. It grows in the Punjab (Pakistan), from Salt Range to Jhelum, West Afghanistan and North Iran.

The corm is covered by a dark reddish brown sheath and is gibbously ovoid like the Indian colchicum but with no marked longitudinal groove.

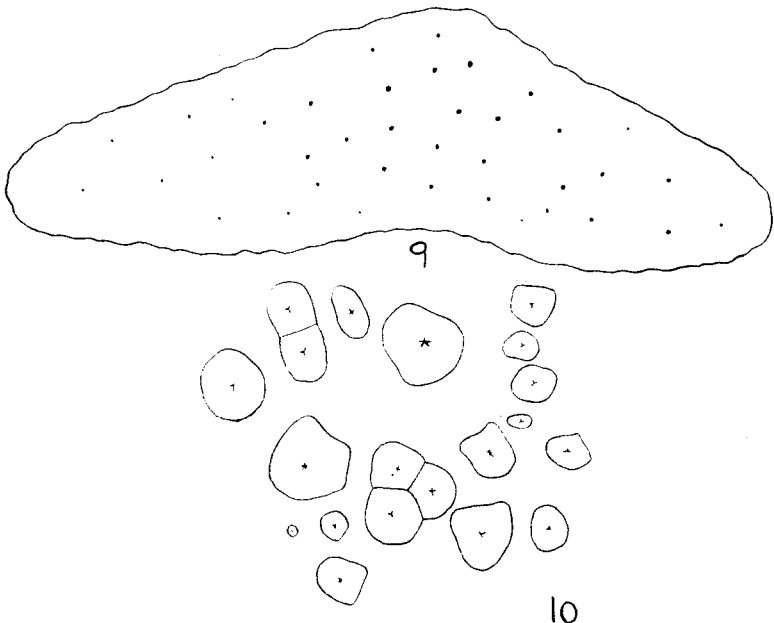


FIG. 4.—*Merendera persica* Boiss. and Kotsch. (9) T.S. of a mature corm with scattered vascular bundles $\times 4$. (10) Simple and compound starch grains from the drug $\times 250$.

There is, however, a general depression in the middle extending throughout the length. A bud, which becomes active on the approach of spring, is present at the base of this depression. An accessory bud is also met with on the reverse side as in Indian colchicum. The basal bud grows at the expense of the food material, mainly starch, stored in the parent corm. A flower shoot is given out which bears at the top 1 to 4 flowers. The leaves appear with the flowers and measure only 1 to 2 inches at the flowering time. The flowers are pale lilac, $1\frac{1}{2}$ to 2 inches in diameter and have the usual Liliaceous structure. The perianth is polyphyllous and has a fairly long tube. The segments are lanceolate, subacute and possess a reddish keel on the dorsal surface. The anthers are as long as their filaments. At the time of fruiting the leaves become 6 to 8 in. long. They are linear, acute and parallel veined. The fruits ripen in the summer.

The Drug. The only available description of the drug is the brief one given by Dymock². It consists of dried whole mature corms collected from March to May after the fruits have ripened and the leaves withered. The corms, after proper cleaning, are dried without further treatment.

The drug is gibbously ovoid below and drawn out above (Fig. 1(2)). It is bigger than Indian colchicum, being 1 to 2.5 in. long and 7 to 1.5 in. broad. Extending from the apex to the base on one side there is a shallow depression "G." At the base of this is the principal bud "C." On the opposite convex side near the top is a prominent groove "g" which extends up to $\frac{3}{4}$ the length of the corm. At the base of this groove is an accessory bud. There is also a scar left by shrivelled remains of the flower stalk (Fig. 1(2), S) on the same side. At the base of this side is a dark brown scar "s" marking the place of attachment to the parent corm, and root scars. The flat tail-like process extending beyond this scar is relatively shorter than in Indian colchicum. The colour is

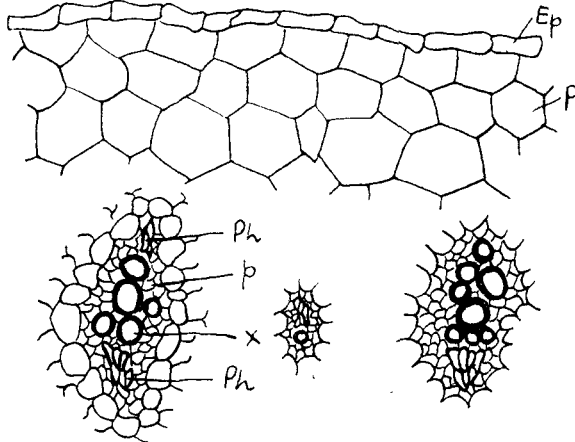


FIG. 5.—*Merendera persica* Boiss. and Kotsch. T.S. of a portion of corm drawn in detail $\times 145$. Ep, epidermis; P, parenchymatous ground tissue. Three vascular bundles, one on left is bicollateral, centre one has only one xylem element. Ph, phloem; X, xylem; p, small sized parenchyma.

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pale yellow or whitish. The surface possesses numerous fine longitudinal wrinkles which produce an uneven outline in transverse section. The drug is odourless and has no marked taste. The fracture is short and powdery owing to the presence of abundant starch.

Histology. A transverse section of the soaked drug shows that the gross outline is triangular (Fig. 4(9)). There is a faint depression on the broad side. The epidermis is formed of rectangular cells (Fig. 5, Ep) some of which contain a few starch grains. This is followed by parenchymatous ground tissue whose cells contain starch. The vascular bundles are scattered and are fewer than in Indian colchicum (Fig. 4(9)). Those in the centre are bigger and contain a greater amount of xylem than those at the periphery. The bundles are simple and have a few annular or spiral elements. Bundles are usually collateral, occasionally bicollateral, and surrounded by a layer of small celled parenchyma (Fig. 5).

The starch grains are mostly simple, round, oval or polyhedral with a 3- to 6-angled hilum (Fig. 4(10)). A few compound grains with 2 to 3 components are also observed. The number of compound grains is relatively more than in Indian colchicum. The size of the grain is from 3 to 19 to 30 μ .

Active Principle. The colchicine content of the drug obtained from the local market was 0.02 per cent by the B.P. method. Chopra¹ found only traces of physiologically inactive alkaloid. We have found that the alkaloid of this species possesses activity on the mitosis of plant cells. Wehmer⁴ gives the content of colchicine in *Merendera bulbocodium* Ram. as 0.912 per cent.

GLORIOSA SUPERBA LINN.

This species also belongs to the family Liliaceæ but to a different tribe, Uvulariæ. It grows throughout tropical India from N.W. Himalayas to Assam and Deccan Peninsula, extending up to 5,000 ft. It is distributed from China, Burma, Malacca, Ceylon to tropical Africa. In India it is commonly cultivated in gardens for the sake of its beautiful showy flowers. Hardwar forests are the principal source of its supply to the Amritsar drug market. Its collection is also undertaken in Bengal and other parts of India on a commercial basis.

The thick rhizomatous underground portion is bifurcated and usually "V" shaped (Fig 1(3)). The two arms of the "V" are cylindrical and may be equal or unequal in length. Each arm is 3 to 9 in. long and up to 1 in. in diameter. On the upper side of the angle of the "V" there is a prominent round scar indicating the point of attachment of previous years' aerial shoot (Fig. 1(3) S). At the same position on the lower side the root scars are observed. The ends of the arms are pointed and at the extreme tip of each is lodged a bud "B" protected by scales. In early summer each bud forms an aerial climbing stem, which attains a height of 10 to 15 feet, with numerous roots. The leaves are sessile or subsessile and are 6 to 8 in. long with long pointed spirally coiled tactile tips. The flowers are solitary or in loose corymbs at the ends of

the branches. Each flower is borne on a pedicel, curved near the top, 4 to 6 in. in length. The flower, 3 to 4 in. in diameter, with 6 linear-lanceolate reflexed perianth leaves, which have wavy margins, and are bright red with golden yellow base and margins. The 6 stamens have golden yellow stout spreading filaments about 2 in. long; connectives, green; anthers dorsifixed, versatile and extrorse; pistil, tricarpeillary,

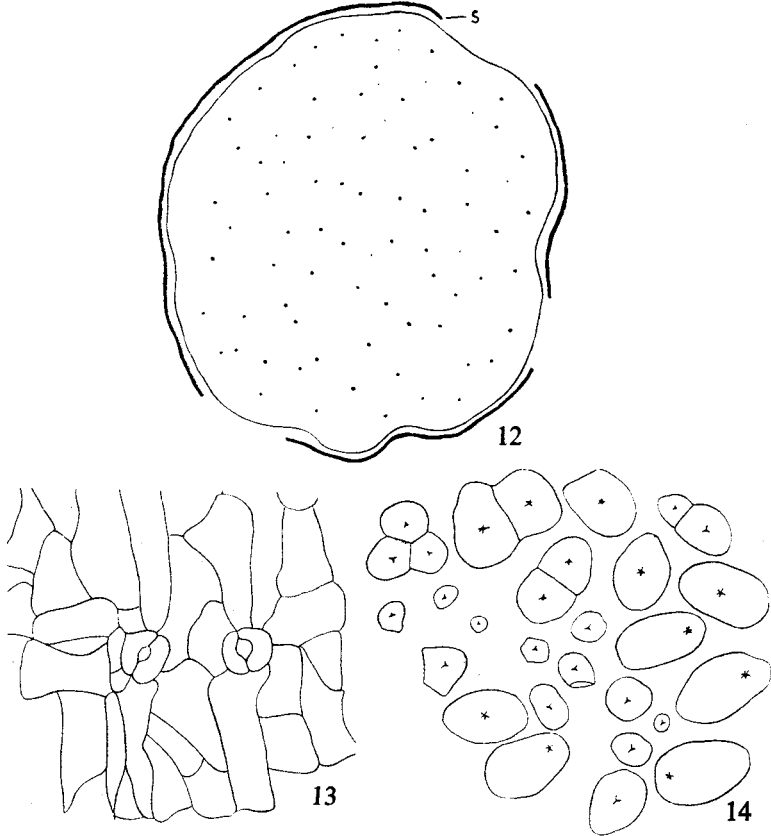


FIG. 6.—*Gloriosa superba* Linn. (12) A transverse section showing the scattered vascular bundles $\times 4$. S, scales covering the rhizome incompletely. (13) A portion of scale epidermis showing stomata $\times 435$. (14) Simple and compound starch grains from the drug $\times 250$.

syncarpous, superior; style up to 2 in. long, trifid at the top, obliquely placed to the body of the ovary; fruit, a septicidal capsule about 2 in. long.

As the plant grows the base of the aerial shoot becomes massive and quite early there are differentiated two meristematic regions. The further growth of the rhizome takes place in these regions so that it assumes the form of a "V." It is covered by thin scales.

The Drug. Watt's⁵ description appears to be the only account of the morphology of the drug. It consists of dried rhizomes which are collected

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during and after the rains when the flowers mostly are beginning to fade. The rhizomes are thoroughly cleaned and the scales removed. They are then washed and divided into pieces measuring up to 3 in. in length and finally dried. Three kinds of pieces are met with in the market, those representing the ends of the arms (Fig. 1(4) A), middle pieces (Fig. 1(4) B) and the angles connecting the two arms (Fig. 1(4) C). In the last type the scar left by the aerial shoot and the root scars on the lower side are quite prominent. The colour is dirty brown. It has a powdery fracture, bitter taste and no odour.

Histology. A transverse section has a nearly circular, somewhat laterally compressed, outline (Fig. 6(12)). Each scale possesses 1 to 4 layers of dark brown cells traversed by the vascular bundles. Stomata are present in the outer epidermis only (Fig. 6(13)). The scales are not found in the dried drug. The epidermis, composed of rectangular cells (Fig. 7, Ep.), covers a homogeneous parenchymatous ground tissue. Some epidermal cells and all ground tissue cells are loaded with starch.

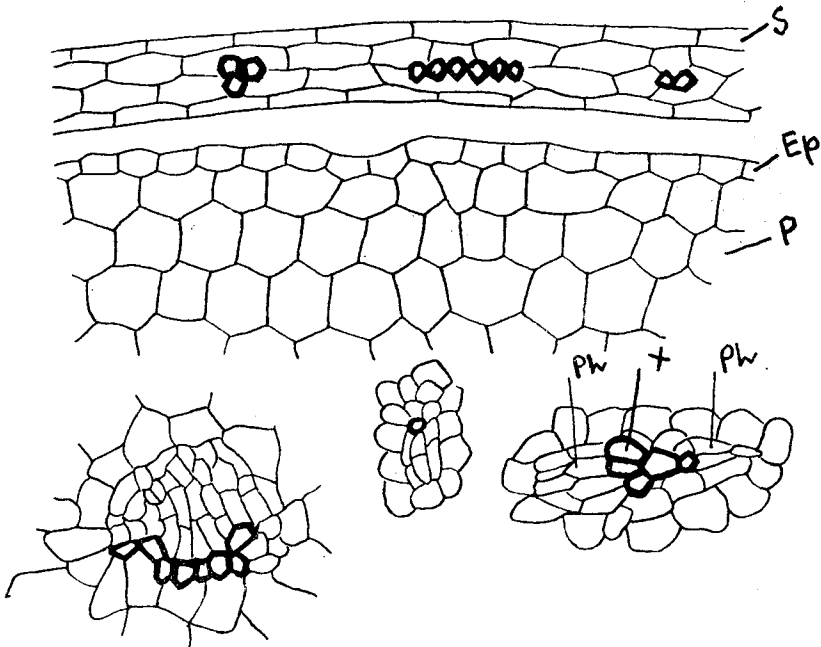


FIG. 7.—*Gloriosa superba* Linn. T.S. of a portion of rhizome drawn in detail $\times 145$. S, scale with vascular bundles running through it; Ep, epidermis; P, parenchymatous ground tissue. Three vascular bundles, one on right is bicollateral, centre one has only one xylem element. Ph, phloem; X, xylem.

The scattered vascular bundles (Fig. 6(12)) are simple with a few annular or spiral xylem elements. Vascular bundles with only one xylem element are not uncommon (Fig. 7). As a rule the bundles are collateral but occasionally phloem may be met with on both sides (Fig. 7). Sur-

rounding the bundles is a layer of small-celled parenchyma. The starch grains are chiefly simple, oval, round or polyhedral in outline (Fig. 6(14)). Compound grains with 2 to 3 components are not uncommon. The size of the grains is 9 to 25 μ to 63 μ . The starch grains of the drug from Sikkim are somewhat smaller. The hilum is not discernible in unstained preparations and is 3 to 6-angled. Lamellæ are more easily seen in fresh material than in the dried drug.

Active Principle. The colchicine content of material purchased locally was 0.03 per cent. by the method of the British Pharmacopœia. Clewer, Green and Tutin (Vide Parthasarthy⁶) found 0.3 per cent. It may be that collection at the proper time and proper storage gives a better yield of colchicine than we have found and the drug may thus turn out to be a useful source of the alkaloid. Another principle, superbin, is also present (Watt⁵).

SUMMARY

Illustrated descriptions are given of three colchicine-containing plants belonging to the family Liliaceæ:—*Colchicum luteum* Baker, *Merendera persica* Boiss. and Kotsch, and *Gloriosa superba* Linn.

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