THE GENUS GRAELLSIA

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The genus *Graellsia*, described by Boissier in 1841, has previously included only three species:—*G. saxifragifolia* in Iraq, Persia, Turkmenistan and Afghanistan, *G. chitralensis* in Chitral, and *G. integrifolia* in N.E. Persia. The discovery by Dr. P. H. Davis of a fourth species in Turkey, in the Anti-Taurus, is therefore of considerable interest.

In facies and general habit this genus shows a remarkable resemblance to the genus *Physalidium* Fenzl (represented by two species, one in N. Persia and the other in the U.S.S.R., prov. Hissar) and also to *Draba hederifolia* Coss. (including *D. Cossoni* Schulz) from the Atlas Mts. (R. Maire, in Bull. Soc. Hist. Nat. Afr. N., xv, 72 : 1924, and xix, 30 : 1928). All have a rootstock giving rise to several caudices which are densely clothed with the scaly persistent bases of the dead petioles, and radical leaves which are long petioled, reniform or orbicular, and usually lobed. This facies is most unusual for the Cruciferae and, as previous authors have noted, is reminiscent of *Saxifraga rotundifolia*. Beyond general vegetative characters, however, the relationship with *Draba hederifolia* ceases. The *Draba* is hairy, whilst *Graellsia* and *Physalidium* are entirely glabrous. It has larger flowers than these two genera, and the flowers are distinct in having large and obvious nectaries, 5–12 seeds borne on filiform funicles, and a style that is 4–8 mm. long.

In floral as well as vegetative characters the resemblance between *Physalidium* and *Graellsia* continues, and the only character on which they can be distinguished is the latiseptate or angustiseptate fruit. Fenzl, in his description of *Physalidium*, noted the close similarity to *Graellsia*, but despite this the two genera have been widely separated by various authors, including Bentham & Hooker (Gen. Pl., 1862), Boissier (Fl. Or., 1867) and Schulz (Nat. Pflanzenf., 1936), because of this difference in the fruits. Prantl (Nat. Pflanzenf., 1891) included them in the same subtribe, *Cochlearineae*, of the tribe *Sinapeae*, but kept three other genera between them. Hayek (Beih. Bot. Centralbl., xxvii, (1), 210 : 1911), in his phylogenetic classification of the Cruciferae, put them together in the subtribe *Parlatorineae* of the tribe *Arabideae*, with *Parlatoria* Boiss. and *Sobolewskia* M. Bieb., on account of the similarity of the nectaries, and the presence of myrosin cells in the mesophyll.

In view of the similarity of morphological and anatomical characters, I think that there can be little doubt of the close relationship of the two genera. The distinction between latiseptate and angustiseptate has often been considered of great significance in the classification of the Cruciferae, as has the distinction between siliqua and silicula. Zohary (Pal. J. Bot., Jer. Ser., iv, 159 : 1948) and Burtt (Kew Bull., 124 : 1951) both stress that this latter distinction is unjustifiable. In the case of *Graellsia* and *Physalidium* the former distinction would appear to be equally unjustifiable. Examination of the ovary in flowers of *Graellsia saxifragifolia* subsp.

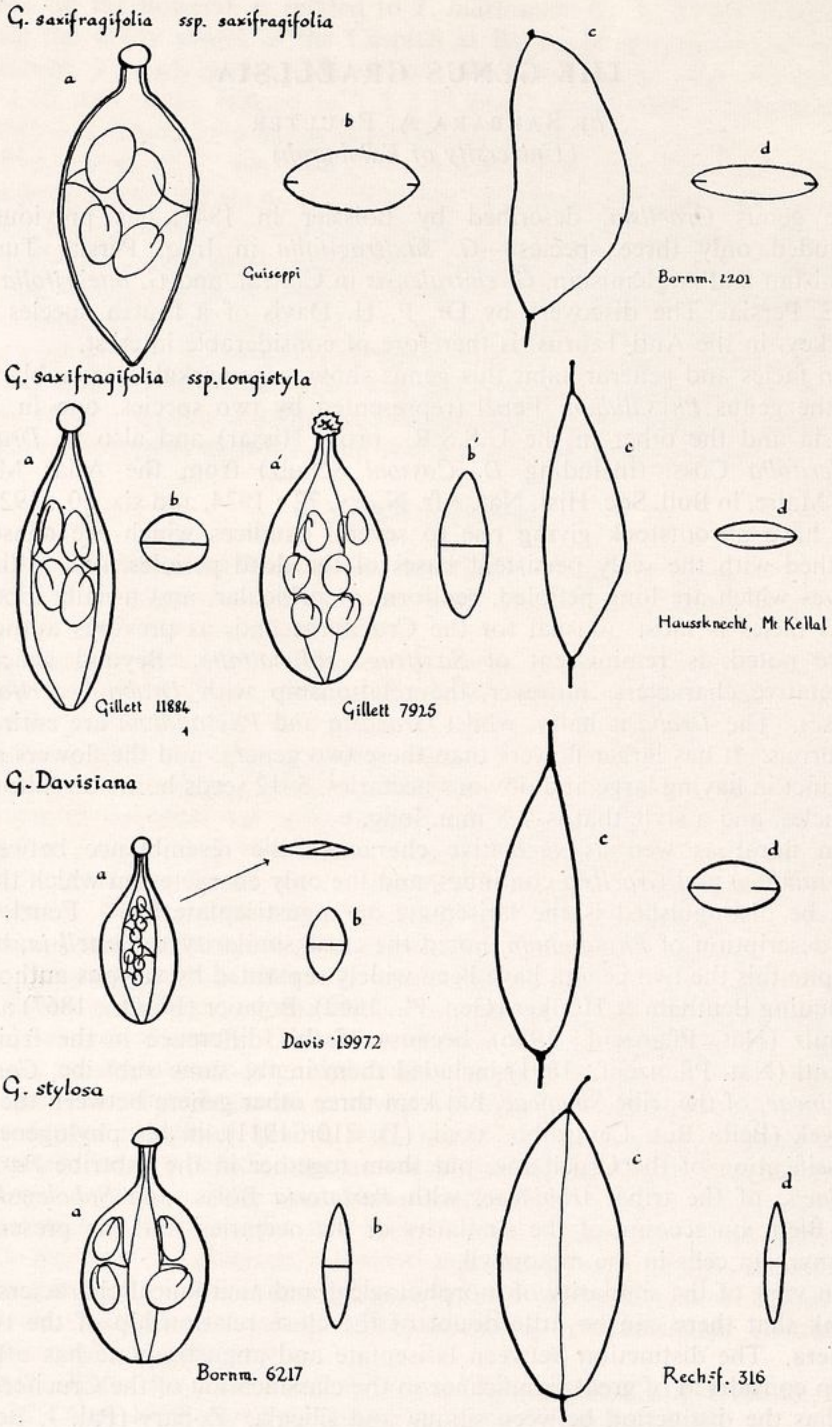

FIG. 1. Ovaries and fruits of *Graellsia saxifragifolia*, *G. Davisiana* and *G. stylosa*. a. ovary, cleared in lactic acid ; b. ovary in T.S. ; c. fruit ; d. fruit in T.S. a., b. × 15 ; c., d. × 3. The collector's numbers refer to the specimens from which the material illustrated was taken. In all but *G. saxifragifolia* the ovary has been drawn obliquely in order to show greater detail (cf. *G. Davisiana*).

saxifragifolia and subsp. *longistyla*, *G. Davisiana* and *Physalidium stylosum* has shown that there is a gradual transition from the latiseptate to the angustiseptate condition in the ovary (see Fig. 1). It can be seen that in *Graellsia Davisiana* and *G. saxifragifolia* subsp. *longistyla* (Gillett 7925) conditions approaching that of *Physalidium stylosum* occur, and in all these the ovary is angustiseptate, *i.e.* the septum is narrower than the broadest plane of the ovary. In all specimens of *Graellsia saxifragifolia* subsp. *saxifragifolia*, and in some of subsp. *longistyla* (*e.g.* Gillett 11884), the ovary is latiseptate, *i.e.* the septum is as broad as the broadest plane of the ovary. The latiseptate or angustiseptate condition of the fruit appears to arise from a difference in the relative growth rates of valves and septum, rather than from a fundamental difference in the ovary.

In view of this, and of the great similarity in morphological and anatomical characters, I have included the genus *Physalidium* within *Graellsia*. In the following taxonomic revision of the genus, *G. Davisiana* and *G. saxifragifolia* subsp. *longistyla* are described, and two new combinations are made.

Graellsia Boiss. in Ann. Sci. Nat., ser. 2, xvi, 379 (1841), et xvii, 172 (1842); Bentham & Hooker, Gen. Pl., i, 72 (1862); Boiss., Fl. Or., i, 306 (1867); Prantl in Engler & Prantl, Nat. Pflanzenf., iii (2), 167 (1891); Hayek in Beih. Bot. Centralbl., xxvii (1), 210 (1911); Schulz in Engler & Prantl, Nat. Pflanzenf., 2 Aufl. 17b, 524 (1936).

Syn.: *Physalidium* Fenzl in Tchih., As. Min., iii, Bot. (1), 327 (1860); Bentham & Hooker, Gen. Pl. i, 88 (1862); Boiss., Fl. Or. i, 318 (1867); Prantl in Engler & Prantl, Nat. Pflanzenf. iii (2), 166 (1891); Hayek in Beih. Bot. Centralbl., xxvii (1), 209 (1911); Schulz in Engler & Prantl, Nat. Pflanzenf. 2 Aufl. 17b, 318 (1936).

Saxatile glabrous plants, with woody rootstock giving rise to several caudices, each clothed with the pale brown, scaly, persistent bases of the dead petioles. Basal leaves long petioled, ovate and cuneate, or reniform, or suborbicular and deeply cordate; margins varying from almost entire to 5–9–14-sinuately lobed. Stem leaves small, subtending the branches of the inflorescence. Myrosin cells in the mesophyll. Flowers white. Sepals equal, spreading. Petals ovate-orbicular, clawed. Stamens 6, edentate. Lateral nectaries forming a ring round the base of the short stamens, and joined by the broad median nectaries in a closed ring. Ovary sessile or subsessile, ovate-orbicular, 4–12-ovuled; style 0·02–0·75 mm. long, stigma depressed capitate or slightly 2-lobed. Silicula obovate or oblong or elliptical, angustiseptate or latiseptate, dehiscent or indehiscent, 1–6-seeded, curved or straight; style in fruit 0·3–2 mm. long; valves membranous or fairly thick, convex to deeply folded, with a more or less obvious middle nerve and lateral network; septum entire or windowed or almost absent; funicles free. Seeds of *G. saxifragifolia*, *G. chitralensis*, and *G. integrifolia* correspond closely to the detailed description given below for *G. Davisiana*; seeds of the other two species have not been examined.

TYPE: *Graellsia saxifragifolia* (DC.) Boiss.

Key to the species

1. Fruit latiseptate:
   2. Fruits 2–6-seeded, dehiscent; leaves (7–)9–14-lobed *G. Davisiana*
   2. Fruits 1–3-seeded; leaves 5–9-lobed or ± entire:
      3. Fruits dehiscent, 5–7 × 1·5–2 mm.; inflorescence simple or with one branch near the base, very lax . . *G. chitralensis*
      3. Fruits indehiscent, 5–13 × 2·5–5·5 mm.; inflorescence with 1–5 branches in the upper part of the stem, lax or compact:
         4. Leaves 5–9-lobed, and at least the larger ones markedly cordate; fruits 7–13 × 1·5–5·5 mm.; pedicel shorter than, or not much longer than the fruit:
            5. Style in fruit 0·3–0·5 mm. long; fruit 7–13 × 2·5–5·5 mm., usually markedly curved . . *G. saxifragifolia* subsp. *saxifragifolia*
            5. Style in fruit 0·75–1·5 mm. long; fruit 9–13 × 3–4 mm., curved or ± straight . . . . *G. saxifragifolia* subsp. *longistyla*
         4. Leaves weakly lobed or ± entire, not cordate; fruits 5–8 × 2·5–4 mm.; pedicel 1–2½ × longer than the fruit *G. integrifolia*

1. Fruit angustiseptate:
   6. Style in fruit 1·5–2 mm. long; leaves 9–13-lobed *G. stylosa*
   6. Style in fruit c. 0·5 mm. long; leaves 5-lobed or ± entire *G. graellsiifolia*

In the following annotation of the species all specimens cited have been examined, unless otherwise indicated.

1. **G. saxifragifolia** (DC.) Boiss. in Ann. Sci. Nat., ser. 2, xvii, 173 (1842). Icon.: Engler & Prantl, Nat. Pflanzenf., iii (2), 167, f. 107 (1891), ed. 2, 17b, 524, f. 324 (1936).

subsp. **saxifragifolia;** Boiss., Fl. Or., i, 307 (1867). Icon.: Deless., Ic., ii, t. 50 : 1823.

Syn.: *Cochlearia saxifragaefolia* DC., Syst., ii, 370 (1821).

G. saxifragaefolia β *Yezdana* Boiss., Fl. Or., 1, 307 (1867).

Type : Persia, ad montem Elwend, *Olivier & Brugière* (P, n.v.).

PERSIA. Mt. Elwend, 15–16 June 1895, *Bornmüller* 98. Kuh Hezar, May 1931, *Balls*. Schir Kuh, cliffs, 2,850 m., 18 May 1932, *Giuseppi* 41. Kuh Daena, ad latera sept. reg. super., 29 July 1842, *Kotschy* 767. Prov. Kerman, Kuh Lalesar: in reg. alp. c. 3,800 m., 17 July 1892, *Bornmüller* 2201, 2201b.; sheer granite cliffs, in shade at 3,000 m., 12 June 1932, *Balls* 48. Sultanabad, 31 May 1890, *Strauss*. Mt. Zarde, 1895, *Aucher* 490. Yezd, May 1849, *Buhse*.

TURKMENISTAN. In angustis montium pr. Aschabad, locis umbrosis c. 1,200 m., 27 Apr. 1897, *Litwinow* 584.

AFGHANISTAN. Paghman, in crevices in rock, 2,550 m., 12 May 1935, *Hay* 139.

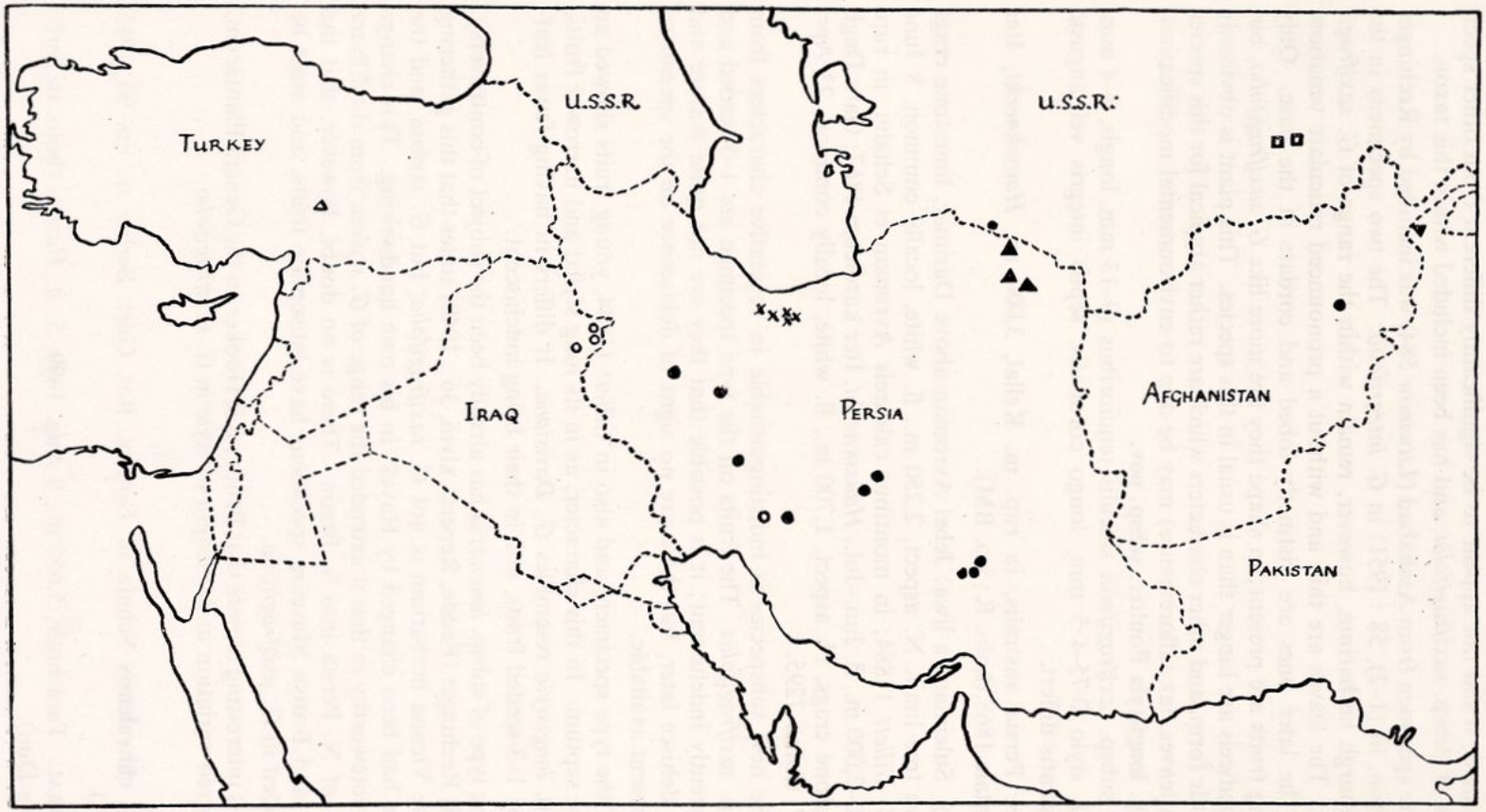

FIG. 2. Sketch map to show the distribution of the genus *Graellsia*. ● *G. saxifragifolia* subsp. *saxifragifolia*, ○ *G. saxifragifolia* subsp. *longistyla*, ▼ *G. chitralensis*, △ *G. Davisiana*, ▲ *G. integrifolia*, × *G. stylosa*, □ *G. graellsiifolia*.

The type specimen of Boissier's var. *yezdana* (*Buhse*, a. 1849) was examined; it did not appear to be significantly different from other specimens of subsp. *saxifragifolia*, and has been included within this taxon.

The specimen from Aschabad (*Litwinow* 584) was included by Rechinger (Phyton, iii (1–2), 58 : 1951) in *G. integrifolia*. The two specimens in the Edinburgh herbarium, however, remain within the range of *G. saxifragifolia*. The leaves are thin and without a pronounced reticulate venation, and the later ones are distinctly lobed and cordate at the base. Only young fruits are present; in shape they are more like *G. saxifragifolia*, but the pedicels are longer than is usual in this species. This plant is obviously a shade form, and other characters which are rather atypical for this species (thin leaves, lax inflorescence) may be due to environmental modification.

subsp. **longistyla** Poulter, **subsp. nov.**

A subsp. *saxifragifolia* siliculis tenuioribus (9–13 mm. longis, 3–4 mm. latis), stylo 0·75–1·5 mm. longo coronatis, septis integris vel anguste fenestratis differt.

Type : Persia australis, in rup. m. Kellal, 3,000 m., *Haussknecht*, Iter orientale 1868 (holo. K; iso. BM).

IRAQ. Suleimaniya liwa: Jebel Avroman above Darimar, limestone crags above tree limit, N. aspect, 2,250 m., fl. white, locally common, 8 June 1948, *Gillett* 11884; in montibus calcareis Avroman et Schahu, in rup. 2,100–3,000 m., fl. Jun.–Jul., *Haussknecht*, Iter kurdicum 1867; Qara Dagh limestone crags, N. aspect, 1,700 m., fl. white, locally common, 23 Apr. 1947, *Gillett* 7295.

The new subspecies is indistinguishable in vegetative characters from subsp. *saxifragifolia*. The fruits on the type specimen are 1–3-seeded and apparently indehiscent; it is possible that they are not quite mature and may dehisce later, but there are no signs of dehiscence on the specimens at present available.

In the type specimen, and also in *Gillett* 11884, young fruits showed an entire septum. In this character, as in its long styled and narrower fruits, subsp. *longistyla* resembles *G. Davisiana*. It differs in having fewer leaf-lobes, 1–3-seeded fruits, and in their being indehiscent.

The type of subsp. *longistyla* has already been the subject of controversy. K. H. Rechinger (Fedde, Repert., xlviii, 36 : 1940) states that this gathering in the Vienna herbarium is not *G. saxifragifolia*, but *G. stylosa*, and the name had been changed by Hayek, in his own handwriting. This change was noteworthy in that it extended the range of *G. stylosa* from the Elburz Mts. of N. Persia into S. Persia. There is no doubt, however, that the Kew and British Museum specimens have latiseptate fruits, and must be included in *G. saxifragifolia*.

It is interesting to note that Bentham & Hooker, in the Genera Plantarum, observed variation in the length of style in *G. saxifragifolia*.

2. **G. chitralensis** Schulz in Notizbl. Bot. Gart. Berlin, ix, no. 90, 1085 (1927).

CHITRAL. Taráshmir, 5,650 m., 9 Aug. 1899, *S. A. Harriss* (holo. in herb. Dehra Dun).

PLATE 4. *Graellsia Davisiana* Poulter.

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3. **G. Davisiana** Poulter, **sp. nov.**

A *G. saxifragifolia* (DC.) Boiss. siliculis dehiscentibus 2–6-seminatis, foliis 9–14-lobatis recedit; a *G. chitralensi* Schulz siliculis majoribus, stylo longiore, caulibus superne in inflorescentiam 3–4-ramosam abeuntibus, foliis 9–14-lobatis differt.

Planta perennis, ex toto glaberrima, pluriceps, saxatilis. *Radix* crassa, lignosa, 0·75–1·5 cm. lata, caudices plures basibus petiolorum persistentibus pallide fuscis squamigeros emittens. *Caules* fructiferi 20–30 cm. alti, caudicibus singulatim affixi, arcuato-ascendentes vel suberecti, tenuiter striati, superne foliis parvis 2–3 ad ramos inflorescentiae praediti. *Folia radicalia* longe petiolata; petiolus 4·5–13 cm. longus, tenuis, ad basin dilatatus; lamina reniformis vel suborbicularis, profunde cordata, 1·5–6 cm. longa, 2–7 cm. lata, (7–)9–14-sinuato-lobata, lobis (1–)2–10 mm. longis, acutis vel subacutis vel obtusis. *Folia caulina* 1–3·5 cm. longa, 0·5–3 cm. lata, inferiora ad 12-lobata, superiora integra, elliptica, petiolis laminas aequantibus vel minoribus. *Inflorescentia* fructescens 7–19 cm. longa, sublaxa, e ramis 3–4 simplicibus ascendentibus robustis 12–24-floris composita. *Pedicelli* florum 5–6 mm. longi, tenues; ei fructum 8–18 mm. longi, paulo incrassati (c. 0·3 cm. lati), angulo c. 30–60° ascendentes. *Flores* albi, ebracteati, imperfecte cogniti. *Sepala* membranacea, 2·5–3 mm. longa, 1–1·5 mm. lata, oblonga, obtusa, ad basin plana, ad apicem concaviuscula. *Petala* 3–4·5 mm. longa, 1·75–2 mm. lata, obovata, obtusa, integra, ad $\frac{1}{3}$ (rarius $\frac{1}{4}$) supra basin in ungulam sensim angustata. *Nectaria* valde obscura. *Stamina* (in flore imperfecto 4) 2·5 mm. longa; filamenta robusta, curvata, antheris duplo longiora. *Ovarium* subsessile, anguste obovatum vel oblongum, 4–12-ovulatum, 2–2·5 mm. longum, 0·75–1·25 mm. latum; stylus 0·5–1 mm. longus, stigmate depresso-capitato. *Siliculae* maturae strictae, 5–12 mm. longae, 2–3·5 mm. latae, latiseptatae, oblongae vel ellipticae vel obovatae, brevissime (0·25 mm.) stipitatae, stylo 1–2 mm. longo coronatae, ex toto dehiscentes, 2–6-seminatae; immaturae paulo curvatae; valvae naviculares, reticulato-nervatae, obscure medio-nervatae, vix membranaceae; septa fenestrata vel integra; funiculi basi incrassati. *Semina* 2·5–3·5 mm. longa, 1·5–2 mm. lata, compressa, fusca, ovata vel oblonga vel obovata, ad basin emarginata vel funiculo-cristata, ad apicem ala parva vel apiculo parvo munita.
TURKEY. Prov. Maraş, dist. Göksun (Anti-Taurus): Binboga dağ, in ravine above Yalak, 2,000 m., shady cliffs, perennial, fl. white, 14 July 1952, *Davis, Dodds & Çetik*, D. 19972 (holo. E; iso. K, BM, Aberdeen, Ankara).

I have great pleasure in naming this new species after Dr. Davis. The only characters in which *G. Davisiana* differs from *G. saxifragifolia* and *G. chitralensis* are the number of leaf lobes (7–14, as compared with 5–11 in the former, and 5 in the latter) and the 2–6-seeded, nearly straight fruits. In the new species the young fruits are often curved, but the mature fruits are more or less straight and not markedly curved, as is usually the case in its allies. Like *G. chitralensis*, the new species has dehiscent fruits borne on rather stout, ascending pedicels. The type specimen of *G. chitralensis* is rather poor, but it would appear to have fairly thick valves, as in *G. Davisiana*, and the septum is nearly always windowed. It is im-

possible to determine the number of seeds, but judging from the size of the fruit it is unlikely that there were more than one or two. In *G. chitralensis* the inflorescence is simple, or may have one branch towards the base of the stem, and is very lax, the flowers starting just above, or even below, the level of the leaves. In *G. Davisiana* the inflorescence is 3–4-branched; the first branch is always in the upper two-thirds of the stem, and the flowers are borne well above the leaves.

In its completely dehiscent and more numerously seeded fruits, this species would appear to be less specialised than its allies.

4. **G. integrifolia** (Rech. f.) Rech. f. in Phyton, iii (1–2), 58 (1951).

Syn.: *Physalidium integrifolium* Rech. f. in Fedde, Repert., xlviii, 35 (1940), et in Ann. Nat. Mus. Wien, *51*, 381 (1940).

Type: Persia, Khorasan: Kopet-Dagh inter Kučan et Lutfabad, in fissuris rupium calc. jugi Allah Akbar, 1,800 m., *K. H. Rechinger* 1710 (W, n.v.).

PERSIA. Khorasan: Hasar Masjid, 2,800 m., 8–9 June 1948, *Rechinger & Aellen* 5060; Kuh-e Nishapur, Darreh Abschar prope Akhlomat, 1,800 m., 30 May 1948, *Rechinger & Aellen* 4602.

This species is distinct from *G. saxifragifolia* in its leaves and fruits. The leaves are broadly cuneate or truncate at the base, very weakly lobed or almost entire, and have a pronounced reticulate venation. The fruits are shorter and relatively broader than those of *G. saxifragifolia*, and are scarcely narrowed at the base and very blunt at the apex. The pedicel is always longer than the fruit, and may be up to two and a half times as long (in *G. saxifragifolia* it is shorter, or not much longer than the fruit).

5. **G. stylosa** (Boiss. et Hohen.) Poulter, **comb. nov.**

Syn.: *Sobolewskia stylosa* Boiss. et Hohen. in Boiss., Diagn., ser. 1 (8), 41 (1849).

Physalidium stylosum (Boiss. et Hohen.) Fenzl in Tchih., As. Min., iii, Bot. (1), 327 (1860).

Type: Persia: in declivibus septentrionem versus spectantibus in monte Elbrus, pr. Derbend, 5 May 1843, *Kotschy* 85 (G. n.v.; K, BM).

PERSIA. Elburz Mts.: Totschal supra Imam-sade Davud, c. 2,700 m., 29 May 1902, *Bornmüller* 6217; Totschal, pr. Scheheristanek, in subalpinis ad basin septentr. c. 2,200 m., 1 June 1902, *Bornmüller* 6218; Totschal, wedged between rocks with slight moisture, 3,150 m., July 1935, *Lindsay* 517; Teheran, in faucibus supra Ferasad, 2,000 m., 29 May 1902, *Bornmüller* 6219; in ditione oppidi Keredj, in montibus Kuh-e Dasht, in rupium fissuris, c. 1,800 m., 21 May 1937, *K. H. Rechinger* 316.

6. **G. graellsiifolia** (Lipsky) Poulter, **comb. nov.**

Syn.: *Physalidium graelsiaefolium* Lipsky in Act. Hort. Petrop., xviii, (1), 12 (1900) et xxiii, 75, tab. 3 (1904).

U.S.S.R. Prov. Hissar, in rupibus umbrosis humefactis in angustiis Rustambest, 23 July 1896; prov. Darwas, ad glaciem fl. Ticharvi (confl. Arzyng), 16 July 1899, *Lipsky* (syntypes, L., n.v.).

In the original description, the septum of this species is given as being narrow, or broader at the base (in one specimen at the apex) and windowed. Even in this species, which has an angustiseptate fruit, the width of the septum varies; this further narrows the distinction between latiseptate and angustiseptate fruits, and supports their inclusion within the same genus when other characters show such marked similarity.

I should like to thank the Directors of the herbaria at Kew, Geneva, Vienna and Dehra Dun for the loan of types, and other specimens cited in this paper.