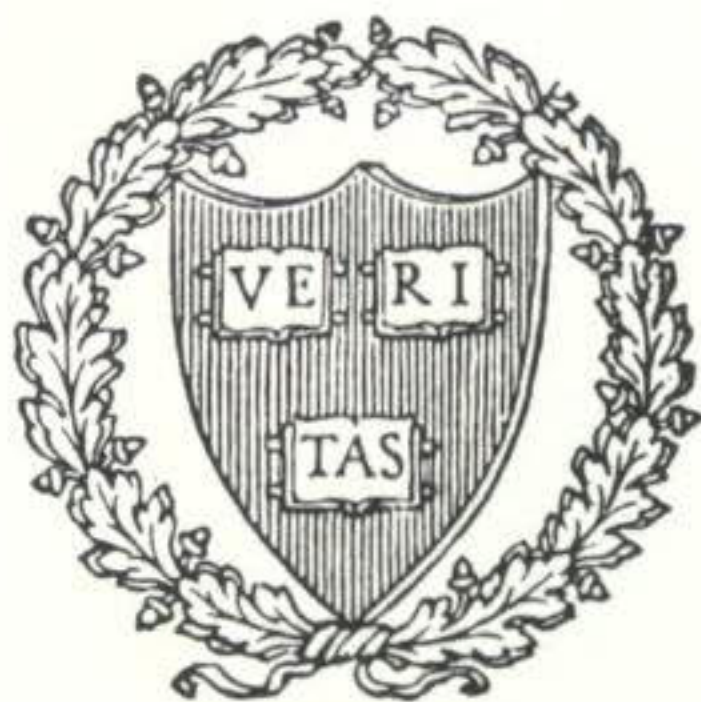


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VOL. XVIII.

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STUDIES IN THE BORAGINACEAE, XII

IVAN M. JOHNSTON

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1. TRIGONOTIS IN SOUTHWESTERN CHINA

THE GENUS *Trigonotis* has its greatest concentration of species and its most important center of endemism in the mountainous country of southwestern China. The present paper represents the first attempt to classify and distinguish the numerous species of the genus in that area. It is concerned with those known from Hupeh, Szechuan, Yunnan, Kweichow and Kwangsi. For its preparation I have studied the specimens of the genus preserved at the Gray Herbarium (G), the New York Botanical Garden (NY) and the Royal Botanic Garden at Edinburgh (Edinb). I have also had available for this study some critical notes on the Indian species which I made several years ago at Kew.

With the exception of one widely distributed weedy species, *T. peduncularis*, the species of *Trigonotis* in southern China are all evidently distinct from those in the region to the northward. For my work this has been fortunate for I have escaped becoming involved in the problems of classification still enveloping these northern congeners. The northern species are in great need of revision. They are so poorly understood that a number of them, even recently, have been described under the genus *Omphalodes*. The most useful work on the northern species is contained in the synopsis of the Korean and Japanese species by Nakai, Tokyo Bot. Mag. **31**: 215-218 (1917) and in the critical



notes and bibliography given by Herder, Act. Hort. Petrop. 1: 543–564 (1872).

During the study for the present paper several details concerning the morphology of the nutlets in *Trigonotis* have become clear. All the species of *Trigonotis* do not have tetrahedral nutlets. In such species as *T. heliotropifolia*, *T. Rockii* and *T. delicatula* the nutlets are bifacial and generally similar in gross aspect to those found in the genus *Myosotis*, having a rounded back and an obtusely angled adaxial face. A consideration of the nutlets in *T. Mairei* and *T. Rockii* has suggested how the tetrahedral form has been developed in other species of the genus. The inferior face of the truly tetrahedral nutlets is morphologically equivalent to the lower half or third of the dorsal face in the bifacial nutlets such as found in *T. heliotropifolia*, *T. delicatula* and *T. Mairei*. The dorsal face of the truly tetrahedral nutlets has been set off from the lower face by the formation of a medio-transverse angle across the back of an erect bifacial nutlet. The acute inner angle of the tetrahedral nutlets, that nearest to and paralleling the style, is the homologue of the obtuse medio-longitudinal angle on the ventral side of bifacial nutlets. The small attachment of nutlets in *Trigonotis* is therefore at the basal end of the ventral keel. It is not lateral nor is it at the broad base of the nutlet-body as it is in *Cryptantha* or *Lithospermum*.

#### KEY TO THE SPECIES

- Nutlets dark, with a pallid tumid cartilaginous margin on at least two edges of the dorsal face, faces usually muriculate; inflorescence bractless.
- Nutlets tetrahedral, the three inner faces evidently developed and subequal, the dorsal surface nearly plane. . . 1. *T. macrophylla*.
- Nutlets not tetrahedral, elongate, bifacial, the dorsal surface convex, rounded upward in a curve sweeping from the nutlet-attachment to the nutlet-apex, the ventral side broadly and very obtusely angled.
- Leaves broadly elliptic or lanceolate, 2.5–5 cm. broad, sparsely strigose; corolla 4–5 mm. broad; inflorescence conspicuously pedunculate . . . . . 2. *T. Mairei*.
- Leaves lanceolate, 1–2 cm. broad, densely strigose; corolla 2.5 mm. broad; inflorescence short-pedunculate . . . 3. *T. compressa*.
- Nutlets with margins acute or rounded or winged, not tumid nor cartilaginous, faces not muriculate.
- Nutlets (exclusive of the winged margin when present) tetrahedral, the 4 faces evident.
- Margin of nutlet conspicuously winged and incurving; nutlets hispidulous; leaves cordate . . . . . 4. *T. moupinensis*.
- Margin of nutlets rounded, angulate or very narrowly winged. Inflorescence naked, entirely devoid of bracts, racemes frequently geminate on naked peduncles.



- Nutlets with acute edges, pale; calyx-lobes oblong to linear, evidently surpassing the calyx-tube which does not embrace the nutlets at maturity. . . . 5. *T. omeiensis*.
- Nutlets with rounded edges, black; calyx-lobes broad and rounded, scarcely if at all longer than the calyx-tube, the latter embracing the nutlets at maturity.
- Plant with a simple raceme; pedicels becoming only 1-2 mm. long; leaves small, 2-3 cm. long, numerous, strigose below . . . . . 6. *T. brevipes*.
- Plant with dichotomous racemes; pedicels becoming 2-5(-8) cm. long; leaves large, few, usually with coarse spreading hairs beneath . . . . 7. *T. Cavaleriei*.
- Inflorescence bearing bracts between at least the lower flowers.
- Nutlets not stipitate or if stipitate the stipe not decurved.
- Plant villous, with spreading hairs; stems very slender, trailing, leaf-blades suborbicular . . . . . 8. *T. mollis*.
- Plant strigose; stems erect or decumbent.
- Plant 10-18 cm. tall; leaves mostly basal, blades orbicular to reniform, apex rounded or even retuse, veinless; corolla 6-7 mm. broad; nutlets with the lower ventral face smaller than the two upper faces . . . . . 9. *T. rotundata*.
- Plant 20-60 cm. tall; leaves mostly cauline, blades ovate to elliptic or lanceolate, evidently veined on lower face, apex obtuse to acute; corolla 2.5-5 mm. broad; nutlets with 3 ventral faces subequal . . . . . 10. *T. microcarpa*.
- Nutlets stipitate with the evident stipe abruptly bent to one side.
- Plant annual; corolla inconspicuous, 1-2 mm. broad. . . . . 11. *T. peduncularis*.
- Plant perennial, caespitose; corolla 4-5 mm. broad.
- Stems and leaves cinereous, densely slender-strigose. . . . . 12. *T. vestita*.
- Stems and leaves green, sparsely short-strigose. . . . . 13. *T. gracilipes*.
- Nutlets not tetrahedral, bifacial, back flat or merely rounded off towards the attachment, obtusely angled on the ventral side, nutlet-attachment nearly basal.
- Plant 2-7 dm. tall; corolla evidently strigose outside. . . . . 14. *T. heliotropifolia*.
- Plant less than 2 dm. tall; corolla glabrous outside.
- Inflorescence bracteate throughout; pedicels slender, recurving or contorted; stems slender, elongate, prostrate; plant apparently perennial . . . . . 15. *T. delicatula*.
- Inflorescence bracted only at the base; pedicels stiffly ascending; stems erect; plant a caespitose perennial. . . . . 16. *T. Rockii*.



1. **Trigonotis macrophylla** Vaniot, *Monde des Plantes*, sér. 2, 7: 42 (1905); Fedde, *Repert.* 2: 157 (1906). *T. pedunculata* var. *macrophylla* (Vaniot) Léveillé, *Fl. Kouy-Tchéou* 55 (1914).

KWEICHOW: vicinity of Kouy-yang, margin of mountain stream, July 20, 1893, *Emile Bodinier 2426* (TYPE, Edinb.).

In the type-collection the faces of the nutlets are smooth and glabrous. The following variants agree with the type in general habit of growth and in the size and shape of the nutlets, but differ in having the nutlet-surfaces characteristically roughened.

1a. **Trigonotis macrophylla** var. **trichocarpa** Handel-Mazzetti, *Sinensia* 5: 18 (1934).

KWEICHOW: Tungtse, Lou-shan, May 27, 1930, *Tsiang 5147* (ISOTYPE, NY); Liang Feng Yah, Tsunyi Hsien, 1150 m., Aug. 12, 1931, *Steward, Chiao & Cheo 303* (NY).

Faces of the nutlets bearing scattered spicular trichomes.

1b. **Trigonotis macrophylla** var. **verrucosa**, var. nov.

A varietate genuina differt facie nuculae verrucosa.

KWANGSI: Chy Fang Shan, 30 li southwest of Shan Fang, N. Lucheng, 1020 m., common in woods, fl. purplish, June 9, 1928, *R. C. Ching 5888* (TYPE, NY). TONKIN: near Chapa, bank of road in damp forest, July 1930, *A. Petelot 4192* (NY).

2. **Trigonotis Mairei** (Lévl.), comb. nov. *Omphalodes Mairei* Léveillé in Fedde, *Repert.* 12: 188 (1913). *T. muriculata* Johnston, *Candollea* 4: 309 (1931).

SZECHUAN: Ma-pien Hsien, 1300 m., herb in waste ground, May 10, 1931, *Wang 22839* (G). YUNNAN: Lungkai, in moist woods, 700 m., perennial, evergreen, fl. blue-violet, *Maire* (TYPE, *O. Mairei*, Edinb.; TYPE, *T. muriculata*, Geneva; ISOTYPES G); mountains of Ku-long-tchang, tufted perennial, fl. white, 800 m., *Maire* (G); sine loc., *Ducloux 98* (NY).

*Trigonotis Mairei* and *T. muriculata* were described from duplicates of the same collection and are clearly synonymous. The nutlets of the species are similar to those of *T. compressa* but are thicker with the inner face more prominently angled. The dorsal side is convex and margined and below rounded off in a sweeping curve towards the nutlet-attachment. There is, hence, no definite basal face to the nutlet.

3. **Trigonotis compressa**, sp. nov., herbacea foliosa ascendenter graciliterque ramosa 3 dm. alta; caulibus erectis sparse strigosis; foliis lanceolatis 5–7.5 cm. longis, 1.5–2.5 cm. latis, infra medium apicem



versus gradatim attenuatis, basi obtusis vel rotundis; petiolis 0.5–3 cm. longis; racemis gracilibus ebracteatis simplicibus vel geminatis 1–3 cm. longe pedunculatis; pedicellis floriferis 1–2 mm. longis, fructiferis 3–6 mm. longis ascendentibus; calyce florifero 1–2 mm. longo, fructifero 2.5 mm. longo, lobis lanceolatis 1.5 mm. longis ascendentibus; corolla “purpurea,” tubo 1 mm. longo, limbo ca. 2.5 mm. diametro; nuculis ca. 1 mm. longis erectis compressis bifacialibus nigris papillatis vel muriculatis, facie dorsali majore ovatis convexis, faciebus ventralibus obtuse angulatis.

SZECHUAN: Nanchuan Hsien, roadside, 1800–2100 m., one ft. tall, fl. purple, *Fang 1111* (TYPE, Gray Herb.; ISOTYPE, Edinb.).

Evidently related to *T. Mairei* but differing in its narrower more abundantly strigose leaves, smaller corollas, much less evidently pedunculate inflorescence, and more compressed nutlets. The nutlets are compressed perpendicularly to the floral axis and are practically bifacial. The apparent base of the nutlet (i.e. the part inferior and exterior to the point of attachment) is obscurely flattened. This narrow ill-defined basal surface is homologous to the basal face in the perfectly tetrahedral nutlets of other species. In *T. compressa* it is ill-defined and very much smaller than the other faces of the nutlet. The inner side of the nutlet is obtusely angled or in other words slopes gently towards the lateral margins from either side of the medio-longitudinal line. The two planes thus formed, which are very similar to those observable in other borages, for example in *Myosotis*, are homologous to those faces in tetrahedral nutlets which are nearest the style.

4. **Trigonotis moupinensis** (Franch.), comb. nov. *Omphalodes moupinensis* Franchet, Nouv. Arch. Mus. Paris, sér. 2, 10: 64 (1887) and Pl. David. 2: 102 (1888). *O. cordata* Hemsley, Jour. Linn. Soc. Bot. 26: 148 (1890).

HUPEH: *Henry 4029* (Edinb.), *5329* (G); *Wilson 241* (Edinb.).

According to Franchet the type was collected by David in “Moupine, in silvis passim. Fl. April, 1869.” Hemsley based his synonymous species upon collections from Patung, Hupeh (*Henry 1445, 4029* and *5412*) and South Wushan, Szechuan (*Henry 5610*).

The species is remarkable for the excessive development of the margin about the dorsal face of the nutlet. This thin upturned winged margin gives the nutlets a superficial resemblance to those of the European species of *Omphalodes*. Though this resemblance is striking enough to have misled Franchet and Hemsley, and recently even Brand, the present species is certainly not a member of the genus *Omphalodes*. The



body of the nutlet in the species is distinctly of the tetrahedral type and very similar to that of other species of *Trigonotis*. Of greatest importance is the nature and position of the nutlet-attachment. *Omphalodes* belongs to the Cynoglosseae and in agreement with the other genera of that tribe has the nutlet-attachment places supramedi ally or subapically on the rounded venter of the nutlet. This is certainly not the condition in the present species.

The nutlets in *T. moupinensis* are blackish and hairy. The outer surface of the upturned margin is pale and somewhat rugose. The species is related to the Indian *T. ovalifolia* (Wall.) Benth. which has black hispidulous nutlets with a narrow wing.

5. ***Trigonotis omeiensis*** Matsuda, Tokyo Bot. Mag. **33**: 148 (1919).

SZECHUAN: Mt. Omei, herb about thickets, 950 m., fl. bluish, *Wang 23129* (G); Nanchuan Hsien, roadside, 1500–2700 m., 1928, *Fang 915, 1159* and *1348* (G, Edinb.). KWANGSI: Nan Kan, Lin Yuin Hsien, 1360 m., 1933, *Steward & Cheo 184* (G, NY); sine loc., *Faber 598* (NY).

The species was described from collections made on the slopes of Mt. Omei by I. Yamazuta. I have seen no authentic material of this species. The original description, however, applies very clearly to the well-marked species treated here.

6. ***Trigonotis brevipes*** Maximowicz, Bull. Acad. St. Pétersb. **27**: 506 (1881); Nakai, Tokyo Bot. Mag. **31**: 215 (1917). *Eritrichium brevipes* Maxim. Bull. Acad. Sci. St. Pétersb. **17**: 446; Mém. Biol. **8**: 547 (1872).

HUNAN: near Changsha, along the Linyang-ho, 350 m., in thickets, April 1915, *Handel-Mazzetti 11687* (G).

The above cited collection does not have mature fruit. As far as comparisons can be made with half mature nutlets, however, the collection does seem to agree with *T. brevipes*, a species known otherwise only from Japan.

7. ***Trigonotis Cavaleriei*** (Lévl.) Handel-Mazzetti, Symb. Sin. **7**: 819 (1936). *Omphalodes Cavaleriei* Léveillé in Fedde, Repert. **12**: 188 (1913). *O. Esquirolii* Léveillé in Fedde, Repert. **12**: 188 (1913) and Cat. Seu-Tchouen, tab. 6 (1918). *O. Vaniotii* Léveillé in Fedde Repert. **12**: 188 (1933). *T. Faberi* Handel-Mazzetti, Anzeiger Akad. Wiss. Wien **61**: 165 (1924), and Symb. Sin. **7**: 819 (1935).

KWEICHOW: margin of streams, Pin-fa, April 13, 1902, *Cavalerie 411* (Edinb., TYPE of *O. Cavaleriei*) and *806* (Edinb.); Tang-Tchang (Hoang-Tiao-Pa), June 21, 1909, *Esquirol 1559* (Edinb., TYPE of *O.*



*Esquirolii*); without locality, moist places, May 1905, *Esquirol* 454 (Edinb., TYPE of *O. Vaniotii*); without locality, *Cavalerie* 4272 (G). YUNNAN: Yung-shan Hsien, 2300 m., moist shaded soil, fl. sky-blue with yellow eye, June 22, 1932, *Tsai* 51103 (G). SZECHUAN: Kuan Hsien, 900–1200 m., July 1928, *Fang* 2224, 2356 and 2380 (G, Edinb.); Mt. Omei, 1000 m., July 1931, *Wang* 23165 (G); "Mt. Omei, 1600 m.," *Faber* 671 (NY, ISOTYPE of *T. Faberi*); O-pien Hsien, 1800 m., May 1932, *Yü* 797 (G).

A well-marked species with a distinctive habit. The broad leaves are usually subcoriaceous and along with the stems usually more or less shaggy with slender brown hairs. The numerous stiff naked racemes are projected from the leafy mass of the plant on a well-developed peduncle.

8. ***Trigonotis mollis*** Hemsley, Jour. Linn. Soc. Bot. **26**: 153 (1890).

HUPEH: Fang Hsien, under rocks, 900–1200 m., May 1907, *Wilson* 3393 (G); Ichang, *Henry* 1574 (G); without locality, *Henry* 6735 (G, NY).

Hemsley describes this species as based upon collections from "Hupeh: Ichang, Fang, and Changyang (*A. Henry*, 630A, 1574, 6735, 7796!)."

9. ***Trigonotis rotundata***, sp. nov., perennis; caulibus strigosis erectis 10–18 cm. altis e caudice procumbente gracili laxo ramoso foliis dessicatis persistentibus vestito orientibus; foliis inferioribus maxime conspicuis, lamina orbiculari vel subreniformi 6–17 mm. lata, apice rotunda vel subretusa saepe apiculata, basi rotunda vel reniformi, petiolo lamina 1–2-plo longiori gracili conspicuo; foliis mediis et superioribus caulis sparsis abrupte reductis sessilibus vel breviter petiolatis; inflorescentia terminali solitaria basim versus sparse bracteata maturitate distantiflora; calycibus ad anthesim ca. 2 mm. longis strigosis 1–2 mm. longe pedicellatis; calycibus fructiferis 3 mm. longis, lobis ascendentibus lanceolatis ca. 2 mm. longis, pedicellis 5–10 mm. longis gracilibus ascendentibus; corolla 5–7 mm. diametro coerulea; nuculis 1 mm. longis et latis angulatis sessilibus depresso tetrahedraeis faciebus interioribus minoribus.

YUNNAN: Likiang, *Handel-Mazzetti* 3725 (G); Goodu Shan, 3300 m., *Forrest* 20519 (TYPE, Edinb.); Litang River divide, 4200 m., *Ward* 4016 (G, Edinb.).

This species of southwestern China has been confused with *T. rotundifolia* of the Indian Himalayas. That plant, however, has ebracteate geminate racemes and a distinctly tetrahedral nutlet similar to that found in *T. microcarpa*.

10. ***Trigonotis microcarpa*** (Wall.) Bentham ex Clarke, Fl. Brit.



India 4:172 (1883). *Myosotis microcarpa* Wallich, Numerical List 928 (1828). *Eritrichium microcarpum* (Wall.) De Candolle, Prodr. 10:123 (1846). *T. peduncularis* var. *microcarpa* (Wall.) Brand, Pflanzenr. [Heft 97] IV, 252<sup>2</sup>:198 (1931).

YUNNAN: Likiang, *Schneider* 3372 (G); Ping-pien Hsien, *Tsai* 55439, 55458, 60176, 60209, 60641, 60751, 62037, and 62368 (G); Shang-pa Hsien, *Tsai* 54717 (G); Kien Shuei Hsien, *Tsai* 53340 (G); Yengyueh, *Forrest* 24810 (G, Edinb.); Yunnan-sen, *Maire* 2244 (G, Edinb.); Mengtse, *Henry* 9354 and 9755a (NY); northwestern Yunnan, *Handel-Mazzetti* 9598 (G).

The type of this species was collected by Wallich in Nepal. It agrees closely with the Chinese specimens I have cited above.

11. ***Trigonotis peduncularis*** (Trev.) Bentham ex Baker & Moore, Jour. Linn. Soc. Bot. 17:384 (1879), nomen; Hemsley, Jour. Linn. Soc. Bot. 26:153 (1890); Nakai, Tokyo Bot. Mag. 31:216 (1917). *Myosotis peduncularis* Treviranus, Mag. Ges. Naturforsch. Freunde Berlin 7:147, tab. 2, fig. 6-9 (1816). *Eritrichium pedunculare* (Trev.) DeCandolle, Prodr. 10:128 (1846); Ledebour, Fl. Ross. 3:153 (1846-51); Herder, Act. Hort. Petrop. 1:543 (1872), excl. pl. himalay.

A weedy annual with inconspicuous corollas, which is widely distributed in eastern and southern China. The nutlets vary from glabrous to hispid. In some forms one nutlet (apparently the adaxial) is glabrous and the remaining three are hispid. The calyx-tube and adjacent portion of the pedicel tend to become rather characteristically thickened at maturity. The species is established upon collections made by F. Blume in damp ground near Astrakhan between 1810 and 1812. Treviranus, in publishing it, gave a good description and several figures, of fruit, corolla and calyx, all evidently applicable to this common weedy species of China. The species, consequently, ranges from the Caspian region across central Asia to Amur and then southward into China and Japan. I have seen no specimens from India.

12. ***Trigonotis vestita*** (Hemsley) Johnston, Contr. Gray Herb. 75:47 (1925). *Trigonotis pedunculata* var. *vestita* Hemsley, Jour. Linn. Soc. Bot. 26:154 (1890).

YUNNAN: Ta Ho Shan, western Likiang Snow Range, 3900 m., *Rock* 4237 (G). SZECHUAN: North Wushan, *Henry* 7072 (G, ISOTYPE); Muli, 2700 m., *Ward* 4588 (G, Edinb.); Muli, *Handel-Mazzetti* 7379 (G); Muli, 3000 m., *Ward* 4499 (G, Edinb.).

This species differs from *T. pedunculata* in habit, indument, calyx, and corolla. In fruit, however, it is very similar to that species.



13. **Trigonotis gracilipes**, sp. nov., caespitosa: caulibus gracilibus erectis vel decumbentibus 1–4 dm. altis simplicibus vel (saepissimae infra medium) sparse graciliterque ramosis strigosis; foliis numerosis utrinque strigosis, lamina elliptica vel oblongo-lanceolata saepe 1–3(–4) cm. longa 5–13(–20) mm. lata, inferioribus 2–4 cm. longe petiolatis, superioribus gradatim reductis subsessilibus; floribus extra-axillaribus solitariis secus (non rariter apicem usque ad basim) caulibus inter foliis dispositis, non rariter summum ad apicem caulis in racemum ebracteatum aggregatis; pedicellis gracilibus floriferis 1–5 mm. longis, fructiferis 5–25 mm. longis ascendentibus rectis vel flexuosis; calycibus ad anthesim 1–1.5 mm. longis strigosis, fructiferis 2–3 mm. longis, lobis ovatis acutis 1.5–2 mm. longis; corolla 4–5 mm. diametro; nuculis ca. 1 mm. longis tetrahedraeis angulatis non rariter sparse pubescentibus pallidis pedicellatis, pedicello deflexo.

SZECHUAN: Muli range, 4200 m., *Ward 5228* (G); northeast of Kulu, Muli, 4460 m., *Rock 17867* (TYPE, Gray Herb.; ISOTYPES, NY, Edinb.). YUNNAN: Mekong-Salwin divide, lat. 28° 20', 2700 m., *Forrest 14168* (Edinb.); northwest Yunnan, *Mombeig 197* (G, Edinb.); east flank of Likiang range, lat. 27° 20', 3300–3600 m., *Forrest 5783* (Edinb.); no locality given, *Tsai 57484* and *57614* (G); northern Yunnan and eastern Tibet, 3000 m., *Ward 665* and *418* (Edinb.); northern Yunnan and eastern Tibet, 3900 m., *Ward 636* (Edinb.). INDIA: Pheonp, eastern Himalaya, 4050 m., 1913, *Ribu & Rhomoo 6372* (Edinb.); Jongri, 4200 m., 1913, *Ribu & Rhomoo 6555* and *Lepcha 942* (Edinb.).

This species has been confused with *T. ovalifolia* of the Indian Himalayas, which has bractless inflorescences. One of the peculiarities of *T. gracilipes* is the occurrence of long-pedicellate flowers among the leaves on the middle and lower portions of the stem. The only other Chinese species that shows this development is *T. delicatula*.

14. **Trigonotis heliotropifolia** Handel-Mazzetti, *Anzeiger Akad. Wiss. Wien* 61:165 (1924) and *Symb. Sin.* 7:818 (1936).

SZECHUAN: Muli, lat. 28° 12', 3000 m., *Forrest 16807* (Edinb.); southeast of Muli, lat. 27° 50', 3300 m., *Forrest 22468* (Edinb.). YUNNAN: Yungpeh, 2675 m., *Handel-Mazzetti 3344* (Edinb., ISOTYPE); mountains between Yungpeh and Yungning, lat. 27° 20', 3000–3300 m., *Forrest 22054* (Edinb., NY).

A very well marked species that might be passed as a coarse form of *T. microcarpa*. It is, however, abundantly distinct from that species in fruit and flowers. By having the large corollas evidently strigose outside it is easily and quickly distinguished from all other Chinese members of the genus.



15. **Trigonotis delicatula** Handel-Mazzetti, Anzeiger Akad. Wiss. Wien **62**: 26 (1925, Feb.). *T. contortipes* Johnston, Contr. Gray Herb. **75**: 46 (1925, Sept.).

YUNNAN: east slope Likiang range, 3300–4000 m., *Forrest 2619* (Edinb.), and *5954* (Edinb.), *Rock 9449* (G) and *10637* (G, TYPE of *T. contortipes*; Edinb.); district of Likiang, 3900–4800 m., *Rock 4817* and *6069* (G); Likiang, 3000–3900 m., *Schneider 1800* and *1921* (G), *Forrest 2304* (Edinb.), *Handel-Mazzetti 3724* (G). SZECHUAN: Tschescha pass, south of Muli, 4100 m., *Handel-Mazzetti 7253* (G, Edinb., ISOTYPES of *T. delicatula*).

A well-marked species. It has slender elongate subsimple prostrate stems and usually characteristically contorted slender pedicels.

16. **Trigonotis Rockii** Johnston, Contr. Gray Herb. **75**: 47 (1925).

YUNNAN: Likiang, 3300–3600 m., *Schneider 3624* and *3868* (G), *Rock 5256* (G, TYPE; ISOTYPES Edinb., NY); Likiang range, 3300–3600 m., lat.  $27^{\circ} 35'$ , *Forrest 10144* (Edinb., NY); east flank of Likiang range, 3300–3600 m., *Forrest 6301* (Edinb.). BURMA: west fork of N'Maikla-Salwin divide, lat.  $26^{\circ} 30'$ , long.  $98^{\circ} 48'$ , 3600 m., *Forrest 26918* (G, Edinb.).

Although having nutlets that are very similar to those in *T. delicatula* this species differs widely from that species in almost all other structures. In gross habit *T. Rockii* most closely approaches *T. rotundata*.

#### EXCLUDED SPECIES

**Trigonotis Bodinieri** (Lévl.) Lévillé, Fl. Kouy-Tchéou 55 (1914). *Omphalodes Bodinieri* Lévillé in Fedde, Repert. **12**: 188 (1913).

This is not a borage but a member of the Loganiaceae. The type specimen at Edinburgh, Cavalerie 6<sup>bis</sup>, from Pin-fa, Kweichow, has been identified by Handel-Mazzetti as *Mitreola pedicellata* Benth.

#### 2. NOVELTIES AND CRITICAL NOTES

**Cordia cordiformis**, sp. nov., arborescens 6 m. alta rufo vel fulvo indumento vestita; ramulis (et petiolis) pilis gracilibus 1–2 mm. longis hirsutis; foliis cordatis 4–15 cm. longis et latis homomorphis, apice obtusis abrupte breviterque acuminatis, basi cordatis vel rotundis in petiolum 1–4 cm. longum abrupte attenuatis, margine denticulatis, supra strigosis vel appresse minuteque hirsutulis, subtus pallidis in nervulis ramosis numerosis pilis gracilibus flexuosis 0.5–1 mm. longis appressis intertextis subtomentosis; nervis 4–5-jugatis; cymis terminalibus 1–5 cm. longe pedunculatis laxe ramosis 10–15 cm. crassis; calycibus plus



minusve evidenter 10-costatis, in alabastro globoso-obovoideis ca. 3 mm. longis 2.5 mm. crassis, extus pilis brunneis 0.5–1 mm. longis curvatis appressis vestitis, intus apicem versus sparsissime strigosis, lobis deltoideis erectis ca. 0.9 mm. longis; corolla 7 mm. longa, tubo 3 mm. longo tubum calycis vix superante, faucibus vix differentiatis, lobis oblongis 3.5 mm. longis 1.3 mm. latis recurvatis apice rotundis; filamentis 2.5 mm. supra basim tubi affixis; antheris 1.5 mm. longis oblongis medio-affixis; ovario glaberrimo globoso; fructu ignoto.

GUATEMALA: Las Vacas near Guatemala, habit of apple-tree, 6 m. tall, July 1860, *Sutton Hayes 624* (TYPE, Gray Herb.); Naranjo, dept. Santa Rosa, 800 m. alt., May 1893, *Heyde & Lux 4731* (G, AA).

A very distinct species readily recognized by its combination of denticulate cordate leaves, comparatively well developed petioles, fulvous or rufous indument and stout 10-ribbed calyx. Though very different in general appearance I believe *C. cordiformis* is closely related to *C. diversifolia* Moc. and *C. salvadoriensis* Standley.

***Cordia decipiens***, sp. nov., "fruticosa" 12 m. alta; ramulis gracilibus dichotomis abundanter laxaque strigoso-velutinis saepe fulvescentibus; foliis ellipticis vel elliptico-ovatis 10–18 cm. longis 6–10 cm. latis ut videtur homomorphis 4–6 mm. longe petiolatis medium versus vel paullo infra medium latioribus, basi obtusis vel rotundis, apice acutis vel obtusis acuminatis, margine apicem versus manifeste pauciserratis, subtus pallidis evidenter elevato-reticulatis, supra viridibus conspicue nervatis, utrinque pilis 0.4–0.8 mm. longis erectis gracilibus vix abundantissimis velutinis, nervis 6–9-jugatis abundanter ramosis; cymis ramosis 8–10 cm. crassis, ramulis fulvescenter velutinis strigosisve flexuosis; calycibus sessilibus in alabastro obovoideis 3–3.5 mm. longis 2.5 mm. crassis extus plus minusve evidenter 10-costatis fulvescenter strigoso-velutinis, ad anthesin cupulatis, dentibus 5 deltoideis 1 mm. longis erectis aequalibus; corolla ignota; ovario dense strigoso; fructu oblique ovoideis ascendentibus dense pallide strigosis; calyce fructifero explanato.

BRAZIL: Santa Fe near Manicore, basin of Rio Madeira, Amazonas, "shrub 40 ft. high," terra firma "Chapeu de sol," Sept. 8–11, 1934, *Krukoff 6048* (TYPE, Arn. Arb.).

Much resembling and evidently related to the widely distributed *C. bicolor* DC. From that very constant species it differs in its indument of less abundant somewhat longer more erect hairs, its leaves coarsely dentate above the middle, and its costate calyx glabrous within. The indument on the leaves and calyces is very different from that in *C. bicolor*. On the lower surfaces of the leaves the veinlet-areoles are not covered by abundant appressed minute pale hairs converging from the



veinlets over the areole. The calyx is not smooth with very closely appressed short hairs. I have seen many specimens of *C. bicolor* and all of them have completely entire leaves. Krukoff's specimen has only half matured fruit. These are indistinguishable from those of *C. bicolor* at a similar state of immaturity.

***Cordia lomatology***, sp. nov., arborescens 15–25 m. alta subglabra; foliis coriaceis lanceolatis vel elliptico-lanceolatis homomorphis glaberrimis vel sparsissime perinconspicueque strigosis 8–14 cm. longis 2–5.5 cm. latis utrinque reticulatis medium versus vel paullo sub medium latioribus, supra lucentibus, subtus opacis pallidioribus, margine integerrimis, apice saepe acuminatis, basi acutis in petiolum 8–15 mm. longum sparse strigosum gradatim attenuatis; nervis primariis 6–8-jugatis abundanter manifesteque ramosis; cymis saepe in furcis ramulorum ortis plus minusve brunneo-pubescentibus laxe graciliterque ramosis ca. 10 cm. crassis; calyce sessili in alabastro 2 mm. crasso 2.5 mm. longo crassipyriformi, supra medium crassiore globoso, infra medium basim 0.5 mm. crassam versus abrupte contracto, lobis 5 deltoideis 0.8 mm. longis margine evidenter puberulente excepto subglabris; corolla alba 4 mm. longa, tubo 1 mm. longo, lobis ca. 1.8 mm. latis oblongis recurvatis apice rotundis; staminibus ca. 1.8 mm. supra basim tubi corollae affixis; filamentis basim versus villosis subulatis ca. 1.1 mm. longis; ovario glaberrimo; fructu ignoto.

BRAZIL: near mouth of Rio Macauhan, tributary of Rio Yaco, Acre Terr., basin of Rio Purus, on terra firma, tree 24 m. tall, Aug. 9, 1933, *Krukoff* 5345 (AA); near mouth of Rio Macauhan, terra firma, tree 18 m. tall, fl. white, Aug. 14, 1933, *Krukoff* 5497 (TYPE, Arnold Arb.); Humayta near Tres Casas on restinga alta, Amazonas, basin of Rio Madeira, tree 15 m. tall, "Louro," Sept. 14–Oct. 11, 1934, *Krukoff* 6291 (AA).

The collections cited have been distributed as *C. ecalyculata* Vell., a species which *C. lomatology* does simulate in gross aspect. From *C. ecalyculata*, a species of eastern Brazil, the proposed species differs sharply in its calyx, that being pyriform rather than globose in form, firm rather than papery in texture, regularly dehiscent by 5 equal teeth rather than bursting more or less irregularly, and, finally, pubescent along the teeth-margins rather than glabrous. There are also striking differences in the proportions of the corolla. Our plant, in fact seems to be closely related to the distinctly pubescent species of the northwestern Amazon basin and particularly so to *C. naidophila* of that region.

***Cordia Mexiana***, sp. nov., arborescens 5–7 m. alta; ramulis puberulentis; foliis ellipticis vel oblongo-ellipticis coriaceis utrinque reticulatis,



medium versus latioribus 1.5–4 dm. longis, 8–20 cm. latis, basi rotundis vel late acutis in petiolum 1–2.5 cm. longum abrupte contractis, apice obtusis acuminatis, margine integerrimis, supra lucentibus minutissime punctatis glaberrimis, subtus pallidioribus subpuberulentis, costa falcata; nervis 5–7-jugatis prominenter ramosissimis; cymis laxe ramosissimis ca. 2.5 dm. crassis, ramulis flexuosis strigoso-puberulentis; calycibus in alabastro elongatis ca. 6 mm. longis et 2 mm. crassis apicem versus crassioribus, extus dense breviterque brunneo-strigosis, intus supra medium puberulentis, lobis deltoideis 5 ca. 1 mm. longis erectis; corolla alba elongata 12 mm. longis, tubo 1.5 mm. crasso 4 mm. longo calyci aequilongo, faucibus evidenter differentiatis 2.5–3 mm. longis ad apicem ca. 3 mm. crassis gradatim expansis, lobis oblongis 2 mm. latis 4 mm. longis recurvatis apice rotundis; filamentis 4.5–5 mm. supra basim corollae (0.5–1 mm. supra basim faucium) affixis 7–8 mm. longis longe exsertis basim versus sparse villosis; antheris 1 mm. longis; ovario glaberrimo; stylo profunde bifurcato; fructu ignoto.

PERU: left bank of Rio Marañon below Rancho Indiana, dist. Iquitos, understory overflow bank, 110 m. alt., Jan. 28, 1932, *Mexia 6459* (TYPE, Gray Herb.). COLOMBIA: Umbría, Com. Putumayo, lat. 0° 54' N., 76° 10' W., 325 m. alt., Dec. 1930, *Klug 1839* (G).

The cited collections have been distributed as *C. colombiana* Killip. The elongate calyx and the well-developed throat of the corolla separate the plant quickly from *C. colombiana* of the mountains of Ecuador and southern Colombia. The exceptionally elongate tube of the calyx and the very well-developed throat of the corolla are very unusual in the *Pilicordia* section. The species is very distinct and well marked.

**Heliotropium Sessei**, sp. nov., fruticosum ascendenter ramosissimum; ramulis foliosis pallide adpresseque villosis; foliis alternis lanceolatis firmis 1.5–4.5 cm. longis 2.5–16 mm. latis infra medium laminae latioribus, apice acutis, basi late acutis vel subrotundis in petiolum gracilem appresse villosum 2–5 mm. longum abrupte transmutatis, supra viridibus enervatis sparse graciliterque villosis, subtus albicantibus abundanter graciliterque appresse villosis, margine subplanis; floribus in cymulas saepe geminatas 1–2 cm. longas ebracteatas 5–10-floras terminales vix pedunculatas aggregatis; calyce villosa 2.5–3 mm. longo 0.5–1 mm. longe pedicellato, lobis inaequalibus lanceolatis tubum corollae superantibus; corolla flavescens 4–4.5 mm. longa 2–2.5 mm. diametro extus strigosa intus glaberrima, lobis 1.5 mm. longis 1 mm. latis recurvatis saepe plicatis basim versus latioribus; antheris oblongis obtusis ca. 0.8 mm. longis inclusis ca. 1.2 mm. supra basim tubo corollae affixis, latere puberulentis, apice leviter cohaerentibus; ovario glabro; stigmatibus



subcylindrico 0.6–0.8 mm. longo basim versus in annulum stigmatosum incrassato; stylo 0.3–0.5 mm. longo; fructu ignoto.

MEXICO: Ixmiquilpan, Sierra de la Mesa, Hidalgo, July 1905, *Purpus 1402* (TYPE, Grey Herb.); Sierra de la Mesa, July 1905, *Rose, Painter & Rose 9122* (G).

A species related to *H. fallax* of southern Mexico and Guatemala from which it is quickly separated by its smaller more coriaceous yellow corollas, elongate recurving corolla-lobes, puberulent anthers, longer style, smaller cymes, etc.

I am of the opinion that this species is probably conspecific with that published as *Myosotis mexicana* Sesse & Mociño, Fl. Mex. 33 (1893), and given as from "in temperatis N. Hispan. montibus." I have seen in the Sesse & Mociño herbarium from Madrid two specimens (nos. 1725 and 5229) which are labeled *M. mexicana*. These agree perfectly with the description of *M. mexicana* and I believe them to be the basis of that species. They represent a plant collected late in the season and in a very mature state. The corollas, anthers and pistil in size form and pubescence are remarkable like those in the plants from Hidalgo. In fact the chief difference between the plant described by Sesse & Mociño and that which I have described above is that the former has corollas in which the tube surpasses (by ca. 0.5 mm.) the calyx and some leaves in which the nervation is impressed on the upper surface. The fruit is very pilose in *M. mexicana*, as it probably also is in *H. Sessei*. No matter what the eventual disposition of *M. mexicana* may be the name can not be transferred to *Heliotropium* for there already exists an *Heliotropium mexicanum* Sesse & Moc. (1888).

**Heliotropium fallax**, sp. nov., fruticosum 5–12 dm. altum laxe ramosum pallide vestitum e radice valida oriens; ramulis 1–3 mm. crassis partibus juventate tomentosus (pilis gracilibus saepe curvatis abundantibus) foliosis; foliis bicoloribus ellipticis vel late lanceolatis 1–5 cm. longis 5–20 mm. latis, medium versus laminae vel paullo infra medium latioribus, apice obtusis vel acutis, basi obtusis in petiolum gracilem 3–10 mm. longum abrupte attenuatis, margine vix revolutis, subtus albis strigoso-tomentosis saepissime prominenter paucivenosis, supra viridibus saepissime impresso-venosis sparse strigosis vel hispidulis non rariter pilos basi bulboso-incrassatos gerentibus; floribus in racemos scorpioideos saepe geminatos ebracteatos 3–7 cm. longos 5–25 mm. longe pedunculatos terminales et oppositifloros dense aggregatis; pedicellis 0.5–1 mm. longis ascendentibus; calycibus 2.5–3 mm. longis; corolla alba 4–6 mm. longa extus strigosa intus glaberrima, tubo 2–4 mm. longo quam calyce 0.8–1.5 mm. longiore, limbo patente 3–4 mm. diametro,



lobis planis ovatis ascendentibus 0.8–1.2 mm. longis rotundis; antheris glabris ca. 1.6 mm. longis elongatis ca. 1.5 mm. supra basim corollae affixis inclusis, tertia parte superiore angustiore, apice obtusis pilis brevissimis coronatis cohaerentibus; filamentis subnullis; stigmatibus elongato puberulento 1–1.3 mm. longo basi in anulum incrassato; stylo ca. 0.1 mm. longo; fructu pallide strigoso ca. 2.5 mm. diametro 1.5 mm. alto.

GUATEMALA: Santa Rosa, Baja Verapaz, 1500–1600 m., rocky slopes, April 1887 and July 1908, *von Tuerckheim 1201* and *112315* (G); Cuesta de Cacgil near Salamá, Baja Verapaz, 1200–1600 m., April 1905, *Pittier 158* (G); sparsely wooded limy hill, Chaculá, Huehuetenango, Aug. 3, 1896, *Seler 2992* (G); Aguacatán, Huehuetenango, 1950 m., rocky bushy hillside, frequently rooted in rock crevices, shrub usually 6 but rarely up to 12 dm. tall, fl. white, Dec. 13, 1934, *A. F. Skutch 1922* (TYPE, Gray Herb.). MEXICO: between Hacienda Juncana and San Vicente, Chiapas, 1300–1800 m., Dec. 1895, *Nelson 3502* (G).

***Heliotropium fallax* var. *Hintonii***, var. nov., a varietate genuina differt radice annua; foliis et ramulis pilis rectis rigidioribus dimorphis (brevibus et duplo longioribus) manifeste vestitis; racemis valde elongatis 1–2 dm. longis.

MEXICO: Ixtapan, dept. Temascaltepec, state of Mexico, in a barranca, 1000 m., March 21, 1933, *G. H. Hinton 3631* (TYPE, Gray Herb.); Salitre, dist. Temascaltepec, along stone fence, 1300 m., Nov. 15, 1932, *Hinton 2599* (G).

This species, *H. fallax*, is a very distinct one of northern Guatemala and adjacent Mexico which has passed as *H. coriaceum* Lehm. The latter was described over a hundred years ago from plants grown at Hamburg from seeds said to have come from Mexico. A careful reading of the original description of *H. coriaceum*, however, will show that it applies much more accurately to the Peruvian, *H. arborescens* L. than to our present plant from Guatemala and Mexico. Indeed the present species seems so devoid of special grace and usefulness that one naturally doubts that it could have been selected for cultivation in Germany. What is more the region in which it grows is not one explored by botanists and plant-collectors during Lehmann's time. Whatever the case may be the species described by Lehmann as *H. coriaceum* differs from our plant of Guatemala and adjacent Mexico in its very large coriaceous rugose leaves, subcorymbose inflorescences, long-tubed colored corollas, and rugose nutlets. All details certainly applicable to the horticulturally attractive *H. arborescens* of Peru.



The variety *Hintonii* is a more herbaceous plant with short-lived root and very much longer and more loosely and abundantly flowered racemes. The indument is composed of more rigid hairs which are of two distinct sorts, one very small and usually appressed and the other longer (1–2 mm. long) and either appressed or spreading. Its geographic range is to the north of that of typical *H. fallax* and far separated for it. It is quite possible that this northern plant may deserve more than varietal recognition.

The two species of *Heliotropium* above described belong to the ebracteate group within the section *Orthostachys*, a natural subdivision containing nine species in South America, cf. *Contr. Gray Herb.* 81: 48 (1928), and seven species in the region to the north. Below I have given a key for the identification of these latter. Synonymy has been provided and all the specimens representative of them in the herbaria at Harvard have been cited.

- Throat of corolla villous within; anthers distinctly contracted to a glandular tip, not coherent; stigma short and stout, sessile.  
 Leaves alternate; plant an annual herb; corolla-throat sparsely villous; anther-tips subulate; widely distributed in tropics . . . . . *H. procumbens*.  
 Leaves opposite; plant a shrub; corolla-throat densely villous; anther-tips obtusish; Mexican . . . . . *H. calcicola*.  
 Throat of corolla entirely glabrous; anthers coherent apically, apex obtuse and minutely hairy; stigma elongate.  
 Plants West Indian; stigma subsessile.  
 Leaves alternate, narrowly lance-linear, 1.5–3 mm. broad. *H. dichroum*.  
 Leaves opposite, lanceolate, 4–8 mm. broad . . . . . *H. uninerve*.  
 Plants Mexican; stigma (except in *H. fallax*) with evident style.  
 Leaves linear, subulate, lower surface nearly covered by the strongly revolute margins, 0.5–1.2 mm. broad; corollas 4.5 mm. long with plicate recurving cuneate lobes; anthers glabrous on sides . . . . . *H. angustifolium*.  
 Leaves lanceolate to elliptic, margins plane.  
 Corolla yellowish, 4–5 mm. long; inflorescence few-flowered, less than 3 cm. long; anthers puberulent on sides; leaves usually veinless; style evident . . . . . *H. Sessei*.  
 Corolla white, 5–7 mm. long; inflorescence abundantly flowered, 3–20 cm. long; anthers glabrous except at apex; leaves usually evidently veined; style scarcely developed . . . . . *H. fallax*.

***Heliotropium calcicola*** Fernald, *Proc. Amer. Acad. Sci.* 43: 62 (1907). *Antiphytum mexicanum* DeCandolle, *Prodr.* 10: 121 (1846) and *Calq. Fl. Mex.* tab. 901 (1874), not *H. mexicanum* Sesse & Moc. (1888), nor Greenm. (1898). *Symphitum fruticosum* Sesse & Mociño,



Pl. Nov. Hisp. 21 (1888), not *H. fruticosum* L. *H. petraeum* Brandegee, Univ. Calif. Publ. Bot. 4: 384 (1913). *H. pueblense* Standley, Contr. U. S. Nat. Herb. 23: 1234 (1924).

MEXICO: San Vicente, Tamaulipas, 1926, *Reiche 1073* (G); San Miguel, Sierra de San Carlos, Tamaulipas, 1930, *Bartlett 10680* (G); Baños del Carrizal, Vera Cruz, 1912, *Purpus 6180* (G, ISOTYPE of *H. petraeum*); Tehuacan, Puebla, 1912, *Purpus 6502* (G, COTYPE of *H. pueblense*); limestone cliffs of Iguala Canyon, Guerrero, 900 m., 10–15 dm. tall, 1906, *Pringle 10334* (G); Iguala Canyon, 750 m., 6–12 dm. tall, 1905, *Pringle 10062* (G, TYPE of *H. calcicola*); Cañon de la Mano Negro near Iguala, 1905, *Rose, Painter & Rose 9368* (G).

DeCandolle's description of *Antiphytum mexicanum* is based upon one of the Mociño plates at Geneva. This plate, number 901 of the DeCandolle series, bears number 288 of the original numbering given by Sesse & Mociño and also their name, *Symphytum fruticosum*. A plant bearing this botanical name is described and their plate no. 288 is cited in their *Plantae Novae Hispaniae* where the plant concerned is given as having come from Chilpancingo, Guerrero. There are three collections (nos. 861, 1716 and 5256) of *H. calcicola* among the Sesse & Mociño specimens at Madrid, all determined as *Heliotropium* and one of them (no. 861) bearing the specific name "*fruticosum*." The plate at Geneva is a good representation of the moderately small-leaved form of *H. calcicola* represented by all three of the specimens mentioned.

The species *H. pueblense* is founded upon material from Tehuacan (*Rose, Painter & Rose 9979*). It is a form of the species with small revolute-margined leaves. It agrees with typical *H. calcicola* in all technical details of reproduction, habit, leaf-arrangement, pubescence, etc.

***Heliotropium procumbens*** Miller, Dict. ed. 8, no. 10 (1768). *H. americanum* Miller, Dict. ed. 8, no. 11 (1768); Johnston, Contr. Gray Herb. 92: 89 (1930). *H. inundatum* Swartz, Prodr. 40 (1788). *H. inundatum* var. *cubense* DeCandolle, Prodr. 9: 540 (1845). *H. rigidulum* DeCandolle, Prodr. 9: 540 (1845). *H. Eggersii* Urban, Symb. Ant. 5: 481 (1908).

A weedy species in moist ground from Louisiana, Texas and Lower California southward through the tropics into South America. Common in Mexico and the West Indies.

I have given above only those names which are based upon material from north of Panama. Complete synonymy, which contains very many names, will be found in my treatment of the South American species, Contr. Gray Herb. 81: 52 (1928). It can be noted here that I was incorrect in citing the name, *H. simplex* Meyen, as a synonym of *H. pro-*



*cumbens*. A restudy of Meyen's collections at Berlin has shown that the type of *H. simplex* Meyen must be a collection of *H. angiospermum* Murr. which is labeled as from "Peru-Lima 1/31." This collection bears on its label the description given by Meyen in his *Reise*, 1:436, where he gives the species as from Arica.

***Heliotropium dichroum*** Urban, *Symb. Ant.* 5:481 (1908) and 8:590 (1921).

HAITI: Morne Bonpère, 500 m. alt., shrub 6–12 dm. tall, fl. white, *Buch* 729 (G, part of TYPE).

This endemic of Haiti agrees with *H. calcicola* in its opposite leaves and in the general nature and distribution of its strigose indument. The floral structures, however, seem very different from those in the Mexican species.

***Heliotropium uninerve*** Urban, *Arkiv Bot.* 17: no. 7, p. 51 (1921).

HAITI: between Port à Piment and Randelle, dept. Sur., limestone hills, Aug. 12, 1917, *Ekman* 675 (G, part of TYPE); Morne Rouge near Chapelle Mont Carmel, in arid calcareous hills at east end of Morne de la Hotte, dept. Sur, 600 m., Nov. 7, 1924, *Ekman* 2410 (G).

The strigose indument is very similar to that of *H. dichroum*. The two collections cited are very similar. Their leaves are distinctly narrower than in *H. dichroum* and show no tendency to be opposite.

***Heliotropium angustifolium*** Torrey, *Bot. Mex. Bound.* 137 (1859).

TEXAS: south of Loma Alta, McMullen Co., 1935, *Cory* 17204 (G); Montell, Uvalde Co., dry limestone hills, 1917, *Palmer* 12322 (G); Devils River, Valverde Co., rocky hills, 1900, *Eggert* (G); Del Rio, Valverde Co., 1930, *Jones* 25639 (G); 25 mi. northeast of Dryden, Terrell Co., 1930, *Cory* 3380 (G); Rio Grande Valley, 1936, *Parks* (G); Guadalupe Mts., 1882, *Havard* 27 (G); western Texas, 1890, *Nealley* 236 (G); head of the San Felipe, July 7, 1849, *Wright* 480 (G); stony prairies on Zoquete Creek, May 18, 1851, *Wright* 1546 (G). CHIHUAHUA: Cerro de Chupaderos near Jiménez, 1925, *Juzepczuk* 635 (G). COAHUILA: Sierra Mojada, 1925, *Juzepczuk* 667 (G); Saltillo, 1898, *Palmer* 36 (G); Cerro de Zapatero, 1910, *Purpus* 4558 (G); Soledad, 1880, *Palmer* 880 (G); Caracol Mts. southeast of Monclova, 1880, *Palmer* 879 (G); Juray, 100 mi. north of Monclova, 1880, *Palmer* 881 (G). NUEVO LEON: near Monterey, *Seler* 1054, *Pringle* 1880, *Palmer* 405 and 878 (G); Sabinas Hidalgo, 1933, *Mueller* 330 (G); Sierra Madre, 15 mi. southwest of Galeana, 1934, *Mueller* 977 and 1112 (G). TAMAULIPAS: near Victoria, 1907, *Palmer* 578 (G); Jaumauve, 1932, *Rozynski* 461 (G); Sierra de San Carlos, 1930, *Bartlett* 10605 (G).



INDEFINITE: road between Doctor Arroyo, N. L., and Matchuala, S. L. P., 1898, *Nelson 4514* (G); no locality given, 1848-49, *Gregg 298* (G).

When he described this species Torrey gave it as based upon collections from "Western Texas and along the Rio Grande, south to Eagle Pass, March-October. Near Monterey, Mexico, *Dr. Edwards and Major Eaton* (No. 480 and 1546, *Wright*).” Among its relatives this species is quickly distinguished by its very narrow strongly revolute-margined leaves. The racemes are characteristically solitary and opposite the leaves. Occasionally a bract may be developed near the base of the inflorescence though prevailingly it is bractless. The corolla is given as greenish or cream-colored.

***Heliotropium convolvulaceum* var. *racemosum*** (Rose & Standley), comb. nov. *Euploca racemosa* Rose & Standley, Contr. U. S. Nat. Herb. **16**: 17 (1912).

TEXAS: east of Encino, Brooks Co., 1935, *Cory 14208* (G); Atascosa County on highway near Bexar county line, 1935, *Cory 15521* (G); eleven miles northwest of Poteet, Frio Co., 1935, *Cory 11716* (G); Llano, Llano Co.?, July 1848, *Lindheimer* (G); 30 mi. west of San Antonio, Bexar Co., Sept. 1879, *Palmer 889* (G, ISOTYPE); Rio Coletto, Sept. 1885, *Thurber 12* (G).

This is a geographical variety which replaces the typical form of the species in southern Texas. It is a much more freely branched plant with more abundantly flowered denser racemes and conspicuously smaller flowers. The corollas are only 5-8 mm. in diameter.

***Heliotropium Jaffuelii***, sp. nov., fruticosum erectum glutinosum pilis crassis inconspicuis brevibus adpressis vestitum gracile laxe ramosum; foliis linearibus 5-10 mm. longis 0.5-0.8 mm. latis crassiusculis plus minusve fasciculatis subteretibus apice obtusis margine non rariter revolutis; floribus terminalibus in cymulas plures scorpioideas ebracteatas 1-4 cm. longas graciles rigidas dispositis; calycibus ca. 1.5 mm. longis 0-0.9 mm. longe pedicellatis carnosulis, lobis oblongis ca. 0.8 mm. longis apice obtusis dorso convexis, sinibus acutis; corolla 2.5-3 mm. longa glaberrima, limbo 2.5-3 mm. diametro, lobis rotundis ca. 0.8 mm. latis et longis; faucibus vix differentiatis; staminibus ca. 1 mm. supra basim tubi corollae affixis; antheris ca. 1 mm. longis lanceolatis glabris, apice acutis glandulosis paullo exsertis; stigmatе conico ca. 0.7 mm. longo ca. 0.6 mm. crasso apice truncatulo bidentato; stylo brevissimo; ovario glabro; nuculis ignotis.

CHILE: Tocopilla, Sept. 1931, *Father Felix Jaffuel 2524* (TYPE, Gray Herb.).



A species related to *H. chenopodiaceum* Clos but differing in its copiously glutinous leaves, twigs and calyces, thicker weakly revolute leaves, smaller corollas, and stout broadly conic (rather than very elongate) stigma. The stems and leaves bear curious short appressed falcate hairs. These are scattered and are immersed in the copious clear waxy-glutinous secretion which covers all the growing vegetative parts of the plant.

It is a pleasure to associate the name of Father Felix Jaffuel with another distinctive species of the Nitrate Coast. Taking advantage of the brief halts of the coast steamers, while traveling for his Order, he has made a number of highly interesting collections about the ports of arid northern Chile and has thereby contributed much to our scanty knowledge of the flora of that region.

**Heliotropium eremogenum**, sp. nov., fruticosum decumbens ramosissimum griseum pilis gracilibus falcatis appressis vestitum; foliis firmis integerrimis 4–8 mm. longis 1–2 mm. latis oblanceolatis supra medium latioribus, margine revolutis, apice acutis; floribus in cymulas terminales scordioideas 0.5–2 cm. longe pedunculatas congestis; calycibus saepissime sessilibus 3 mm. longis basim versus in lobos lineari-cuneatos erectos 5-fidis; corolla (ut videtur alba vel ochroleuca) ca. 6 mm. longa extus sparse strigosa intus glabra, limbo ca. 6 mm. diametro, tubo lobos calycis 1–1.5 mm. longe superante ca. 4 mm. longo, lobis rotundis 2 mm. diametro; antheris linearibus ca. 1.8 mm. longis inclusis 2.5 mm. supra basim tubi corollae affixis; stigmatibus ca. 1.5 mm. longo columnari imam ad basim in anulum stigmatosum angustum incrassato; ovario glabro.

CHILE: Antofagasta, Oct. 29, 1930, *Felix Jaffuel 1120* (TYPE, Gray Herb.); Antofagasta, Nov. 6, 1931, *Felix Jaffuel 2639* (G); Antofagasta, open rocky quebrada, 100–300 m. alt., April 3, 1925, *Pennell 13022* (G).

A relative of *H. Philippianum* Johnston, from which it differs in its decumbent habit, more copious grayish indument, very much smaller leaves, and proportionately shorter style. The incomplete collection by Pennell has been recognized for some years, cf. *Contr. Gray Herb.* 81: 38 (1928) and 85: 155 (1929), as representing what was probably an undescribed species. Happily Father Felix Jaffuel has collected the same interesting species in good flowering condition and the description of this new addition to the flora of the Nitrate Coast is now possible. The material from Iquique, which I formerly associated with Pennell's collection, appears to be conspecific with some collections recently made at Tocopilla by Father Jaffuel. The material at hand of this plant of Iquique and Tocopilla is, unfortunately, fragmentary. When good collections of it become available for study I believe that it will prove to represent a third species endemic to the Nitrate Coast.



**Heliotropium anomalum** var. **mediale**, var. nov., a varietate genuina differt gracilioribus erectioribus ascendente ramosis saepe 3–5 rariter 15 dm. altis; foliis gracilioribus leviter strigosis oblanceolatis vel linearibus acutis; calycibus minoribus ca. 2 mm. longis.

CHRISTMAS ISLAND: 4 miles west of Manulu Lagoon, shrub forming rounded mass 4 dm. tall, Oct. 21, 1934, *St. John & Fosberg 17486* (TYPE, Bishop Mus.; G, ISOTYPE), *17487* (G); Joe's Hill, prostrate, *St. John & Fosberg 17494* (G). FANNING ISLAND: Vai Tepu, saline flat, bush 5–15 dm. tall, April 22, 1934, *St. John & Fosberg 14121* and *14122* (G); Cable Islet, coral slabs, 3–4 dm. tall, April 21, 1934, *St. John & Fosberg 14109* and *14110* (G).

Typical *H. anomalum* H. & A. of southern and eastern Polynesia is a coarser and more laxly branched prostrate or trailing plant with coarser much more loosely appressed indument, larger inflorescences and coarser calyces. The Hawaiian var. *argenteum* Gray, Proc. Amer. Acad. **5**: 339 (1861), is similar to typical *H. anomalum* except for its closely appressed lustrous silky indument. In indument, therefore, the plants of Christmas and Fanning islands much resemble the Hawaiian variety. The var. *mediale*, however, is very different from the Hawaiian form in its bushy habit, very slender leaves, smaller calyces, etc.

**Echium connatum** Léveillé, Cat. Pl. Yunnan 22, fig. 4 (1915).

This is not a species of the Boraginaceae, but one of the Caprifoliaceae, *Triosteum himalayanum* Wall. I have seen the type at Edinburgh.

**Arnebia Hancockiana** (Oliver), comb. nov. *Lithospermum Hancockianum* Oliver, Hooker's Icones **25**: tab. 2467 (1896). *Lithodora Hancockiana* (Oliver) Handel-Mazzetti, Symb. Sin. **7**: 818 (1936). *Lithospermum Mairei* Léveillé in Fedde, Repert. **12**: 286 (1913).

An examination of the type of *L. Mairei* proves it an evident synonym of Oliver's species. Recently Handel-Mazzetti has treated this endemic of Yunnan as a member of the Mediterranean genus *Lithodora*. Though fruit of this Chinese plant is unknown and it can not therefore be excluded from *Lithodora* with finality, I am positive that it is not a member of the genus *Lithodora* but rather of the great Asiatic genus *Arnebia*. Its relations are with such Asiatic species as *A. euchroma* (Royle) Johnston and *A. fimbriata* Maxim.

**Lithospermum officinale** Linnaeus, Sp. Pl. 132 (1753). *L. albiflorum* Vaniot, Monde des Plantes, sér. 2, **7**: 42 (1905); Fedde, Repert. **2**: 197 (1906); Léveillé, Fl. Kouy-Tchéou 54 (1914).

I have examined the type of *L. albiflorum* Vaniot, now preserved at Edinburgh, and find it inseparable from the common form of *L. officinale* growing in eastern Asia.



**Amsinckia intermedia** Fischer & Meyer, Ind. Sem. Hort. Petrop. 2: 2 and 26 (1836). *Lithospermum Komarovianum* Léveillé in Fedde, Repert. 8: 280 (1910).

Léveillé's species was based upon collections having only immature fruit. As far as comparisons can be made it seems inseparable from the common and variable *A. intermedia* of California. I suspect it is the same introduced species as that reported from Saghalin by Mayabe & Miyake, Fl. Saghalin (1915), under the name *A. tessellata*.

**Onosmodium dodrantale**, sp. nov., rhizomatosum; caulibus pluribus simplicibus 1.5–2.5 dm. altis erectis foliosis 2 mm. crassis hirsutis; foliis oblongis vel ovato-oblongis nervatis supra medium caulis grandioribus (3–4.5 cm. longis 6–15 mm. latis) basim versus caulis evidenter reductis pilis 1 mm. longis rectis appressis e basi pustulato-bulbosa erumpentibus vestitis, infra medium laminae latioribus apice acutis vel obtusis basi rotundis subsessilibus supra viridioribus; cymulis terminalibus solitariis ca. 5-floris foliosis; calyce ad anthesin ca. 1 cm. longo hirsuto, lobis linearibus erectis 0.5–1 mm. latis acutis tubo corollae aequilongis, pedicello 2–5 mm. longo; corolla flava 12–18 mm. longa extus in faucibus lobisque strigosa intus (lobis exceptis) glaberrima; lobis 3–3.5 mm. longis 2–2.5 mm. latis a basi apicem versus gradatim attenuatis virescentibus erectis, sinibus acutis; staminibus 9–10 mm. supra basim corollae (imam ad basim faucium plus minusve ampliatae) affixis inclusis glaberrimis, filamentis lateraliter compressis ca. 1.2 cm. longis; antheris elongatis 2–3 mm. longis apice in subulas graciles ca. 0.2 mm. longas abrupte contractis basi subcordulatis; stylo ca. 2 cm. longo filiformi 2–4 mm. longe extruso, stigmatibus minutissime geminatis; nuculis ignotis.

MEXICO: Cerro Potosi, Galeana, Nuevo Leon, scattered colonies in upper pine woods, fl. cream-yellow, July 21, 1935, *C. H. Mueller 2259* (TYPE, Gray Herb.); El Infernillo, ca. 25 km. southwest of Galeana, Nuevo Leon, 2700–3000 m. alt., common, fl. yellow with greenish lobes, July 29, 1934, *Mueller 923* (G); El Infernillo, Pablillo, southwest of Galeana, rocky summit, 3000–3100 m., fl. yellow, June 29, 1934, *Pennell 17116* (G).

A well-marked species notable for its small stature, simple stems, reduced lower leaves and small few-flowered cymes. It may be separated from *O. unicum* Macbr., of southern San Luis Potosi, and from *O. bejariense* DC., of Texas, by having a simple indument of spreading or appressed hairs. In the two relatives the indument is duplex there being fine short usually appressed hairs under the coarse hispidity clothing the stems and leaves.



**Cryptantha** (§ OREOCARYA) **Grahamii**, sp. nov., perennis caespitosa; caudice denso breviter ramoso e radice crasso lignoso oriente; caulibus 1–2 dm. altis erectis setosis et adpresse pubescentibus supra medium fertilibus; foliis viridibus utrinque pilis minutis inconspicuis vestitis et setis ca. 2 mm. longis (e basi pustulata orientibus) horridis, basalibus 3–4.5 cm. longis supra medium in laminam lanceolato-ovatum 5–10 mm. latam explanatis apice rotundis vel obtusis, caulinis oblanceolatis vel oblongis medis 2–2.5 cm. longis 6–7 mm. latis obtusis; inflorescentia elongata laxa; cymulis laxis 3–10-floribus setosis bracteis foliaceis suffultis; calycibus abundanter setosis et pubescentibus ad anthesim ca. 7 mm. longis, lobis lineari-lanceolatis acutis fauces corollae 0.5–1 mm. superantibus; pedicellis gracilibus 0.5–1 mm. longis; corolla alba conspicua, limbo patente 12–16 mm. lato, lobis rotundis ca. 5 mm. latis et longis, tubo cylindrico 5–6 mm. longo 1–1.3 mm. crasso; ovulis 4; nuculis ignotis.

UTAH. Uinta County: bench west of Green River north of mouth of Sand Wash, 4500 ft. alt., fl. white, May 28, 1933, *Edward H. Graham* 7924 (TYPE, Gray Herb.) and 7927 (G); east slope of Big Pack Mt., west of Willow Creek near Thome Ranch, 5400 ft., on light-colored slate bench, fl. white, May 23, 1935, *Graham* 8962 (G); shale breaks east of Willow Creek, 5 mi. north of Agency Draw, 5500 ft., fl. white, fragrant, *Graham* 8937 (G).

A very distinct and readily recognizable species. Its conspicuous white corollas are the largest known in the genus. The immature nutlets appear to be smooth and rather similar to those of *C. confertiflora* (Greene) Payson. I can suggest no close relative for this remarkable new species.

The species is named for Dr. Edward H. Graham of the Carnegie Museum of Pittsburgh who discovered it during his intensive botanical investigation of the Uinta Basin of northeastern Utah. It is eminently fitting that his name should be associated with this remarkable endemic of the region he has studied so thoroughly.

**Cryptantha** (§ KRYNITZKIA) **Hooveri**, sp. nov., herbacea annua 5–15 cm. alta laete viridis; caulibus solitariis vel pluribus erectis vel non rariter basim versus subdecumbentibus gracilibus 0.5–1.2 mm. crassis strigosis infra medium simplicibus supra medium breviter ascendenterque ramosis; ramulis floriferis 1–2.5 cm. longis; foliis ascendentibus crassulis firmis pilis rigidis adpressis (vel in foliis supremis pilis ascendentibus) vestitis, subtus prominenter costatis abundanter pustulatis, supra sparse pustulatis; foliis basalibus caulis ramorumque evidenter oppositis 10–25 mm. longis angustissime spathulatis apicem obtusam versus 0.9–2.2 mm.



latis, margine saepe subplanis; foliis caulinis ramulisque mediis et superioribus alternis sublinearibus 1 mm. latis 1–2 cm. longis apice acutis margine revolutis; inflorescentia elongata dense thyrsoidea vel paniculata; floribus in axillis foliorum glomerulatis vel solitariis haud scorpioideis; calycibus fructiferis elongatis subsessilibus 4–5 mm. longis tarde deciduis; lobis calycis maturi linearibus in costa setis flavescensibus 2–3 mm. longis munitis et in marginibus dense ascendenter villosis; corolla inconspicua tubulosa 2–2.5 mm. longa ad anthesim calycem ca. 3 mm. longam vix superante; nuculis 4 homomorphis (nucula adaxillari subpersistenti?) triangulari-ovatis ca. 1.3 mm. longis ca. 0.9 mm. latis lucentibus, apice acutis, basi late truncatis, margine acutis minime incrassatis, dorso convexis prominenter papillatis, ventre obtuse angulatis sparse tuberculatis  $\frac{3}{4}$  longitudinis ad gynobasim angustum ca. 1 mm. longam afixis sulco infra medium in areolam deltoideam abrupte dilatatis; stylo nuculas vix superante.

CALIFORNIA: eight miles west of Chowchilla, Madera Co., a single colony in dry coarse sand, May 7, 1935, *R. F. Hoover 558* (TYPE, Gray Herb.); Gobin Ranch, about 13 mi. east of Waterford, Stanislaus Co., in coarse sand on a flat among rolling hills, May 2, 1936, *Hoover 1103* (G); sand hills east of Antioch, Contra Costa Co., April 16, 1908, *Heller 8888* (G).

I can suggest no close relative for this very distinct species. The peculiar inflorescence, characterized by a complete lack of scorpioid cymes, is unique among the North American species of the genus. The nutlets though not aberrant are distinctive and I believe the species can be recognized from them alone. The corollas are very small and possibly may be cleistogamic though the corollas surmounting the ripening ovary have their tiny lobes expanded and not permanently closed as in the indubitably cleistogamic flowers of the South American section *Eucryptantha*.

I have associated with this unusual species the name of Mr. Robert F. Hoover of Modesto, Calif., to whom I am indebted for the excellent specimens here described. The material was collected by Mr. Hoover during botanical trips about the San Joaquin Valley made in furtherance of his study of the floristics of that region. It is a pleasure to associate his name with this remarkable addition to the known flora of that interesting area.

***Cryptantha corollata*** (Johnston), comb. nov. *C. decipiens* var. *corollata* Johnston, Contr. Gray Herb. **74**: 61 (1925); Johnston in Munz, Man. So. Calif. Bot. 428 (1935).

Since this plant of the drier inner Coast Ranges of California was first



distinguished over ten years ago I have seen many collections of it. Among the scores of specimens studied I have found none that give any indication that *C. corollata* and *C. decipiens* intergrade in any way, or that their geographical ranges overlap or even approach one another closely. The plant I distinguished as *corollata* is very constant and readily identifiable and has a range that is eminently natural. I now believe it should be given specific recognition.

**Hackelia brachytuba** (Diels), comb. nov. *Paracaryum brachytubum* Diels, Notes Royal Bot. Gard. Edinburgh **5**: 168 (1912). *Lappula Dielsii* Brand in Fedde, Repert. **14**: 147 (1915). *Hackelia Dielsii* (Brand) Johnston, Contr. Gray Herb. **68**: 45 (1923).

The type of *P. brachytubum* came from the Tali Valley (*Forrest 4474*) that of *L. Dielsii* from the Likiang Range (*Forrest 2255*), also in Yunnan. They are evidently conspecific.

**Trigonotis sericea** (Maxim.), comb. nov. *Omphalodes sericea* Maximowicz, Bull. Acad. Sci. St. Pétersb. **17**: 453; Mém. Biol. **8**: 558 (1872).

This species is evidently a relative of *T. Icumae* (Maxim.) Makino, *T. radicans* Maxim. and *T. myosotideae* Maxim. and not a member of the genus *Omphalodes* as it has been accepted for so long.

**Antiotrema Dunnianum** (Diels) Handel-Mazzetti, Anzeiger Akad. Wiss. Wien **57**: 239 (1920). *Cynoglossum Dunnianum* Diels, Notes Royal Bot. Gard. Edinburgh **5**: 168 (1912). *Cynoglossum Cavaleriei* Léveillé in Fedde, Repert. **12**: 534 (1913) and Cat. Seu-Tchouen, tab. 5 (1918). *Henreyettana mirabilis* Brand in Fedde, Repert. **26**: 171 (1929).

The type of *C. Cavaleriei* (*Cavalerie 2117*) has its flowers at anthesis and shows no fruit. It is a mediocre specimen but one clearly conspecific with the type of *A. Dunnianum*. Léveillé had other collections of the species, *Bodinier 1579* and *2160*, which do possess mature fruit but these were not associated by him with his *C. Cavaleriei*. They are in fact the basis upon which he reported, *Bothriospermum Kusnezowii* from Kweichow, Fl. Kouy-Tchéou 52–53 (1914).

In his recent treatment of this remarkable plant, Handel-Mazzetti, Symb. Sin. **7**: 825 (1936), is incorrect in stating that the nutlets and embryo are "erect." As I have already indicated, Contr. Gray Herb. **75**: 44–45 (1925), the nutlets and embryos are in fact inverted in *Antiotrema*. This is a very unusual condition in the Boraginaceae and is found in only two other genera of the family.

HERBARIUM, ARNOLD ARBORETUM,  
HARVARD UNIVERSITY.