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BORAGINACEAE OF THE SOUTHWESTERN UNITED STATES

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ABSTRACT.—The borage Family Boraginaceae is treated for the southwestern United States. Treated are 18 genera, 113 species, and 24 varieties from Arizona, New Mexico, and the desert regions of southeastern California. A key to the genera and species is included along with detailed descriptions, distribution data, chromosome counts when known, and comments for many of the taxa. A proposed new combination is *Plagiobothrys scouleri* (H. & A.) I. M. Johnston var. *cusickii* (E. L. Greene) Higgins.

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The Family is both large and taxonomically complex. In the present treatment 113 taxa are recognized as occurring mainly in the states of Arizona and New Mexico, but also including the desert regions of southeastern California.

Generic limits within the family are fairly well defined; however, species are not so easily separated. The genus *Cryptantha* is such an example, in which both flowering and fruiting specimens are needed for precise identification. A more perplexing group is that of *plagiobothrys*, with its great variability in nutlet forms, flowers, and habitats that all run together, especially in the section *allocarya*. In the southwestern area the problems in the Boraginaceae are not as great as in other areas, such as the Great Basin and the coastal ranges of California.

Most borages are of little or no economic value, but form a very conspicuous part of the early spring flora throughout the southwest.

The following new combination in *plagiobothrys* is necessary at this time: *plagiobothrys scouleri* (H. & A.) I. M. Johnston var. *cusickii* (E. L. Greene) L. Higgins Comb. et. stat. nov., based upon *allocarya cusickii* Greene, pitt. 1:17, 1887.

BORAGINACEAE

Borage Family

Plants herbaceous, shrubby or arborescent, usually bristly hairy; *leaves* simple, alternate, or rarely opposite or whorled, entire, variously pubescent; *inflorescence* cymose, cymes gloomerate, racemose or spikelike, frequently scorpioid and unilateral, usually bracteate; *calyx* usually deep 5-lobed or parted; *corolla* sympetalous, 5-lobed, regular or rarely somewhat irregular, sometimes crested with folds or saccate-intruded appendages (fornices) in the throat; *stamens* 5, borne on the corolla tube alternate with the lobes, included or less often exserted; *ovary* superior, 2-carpellate,

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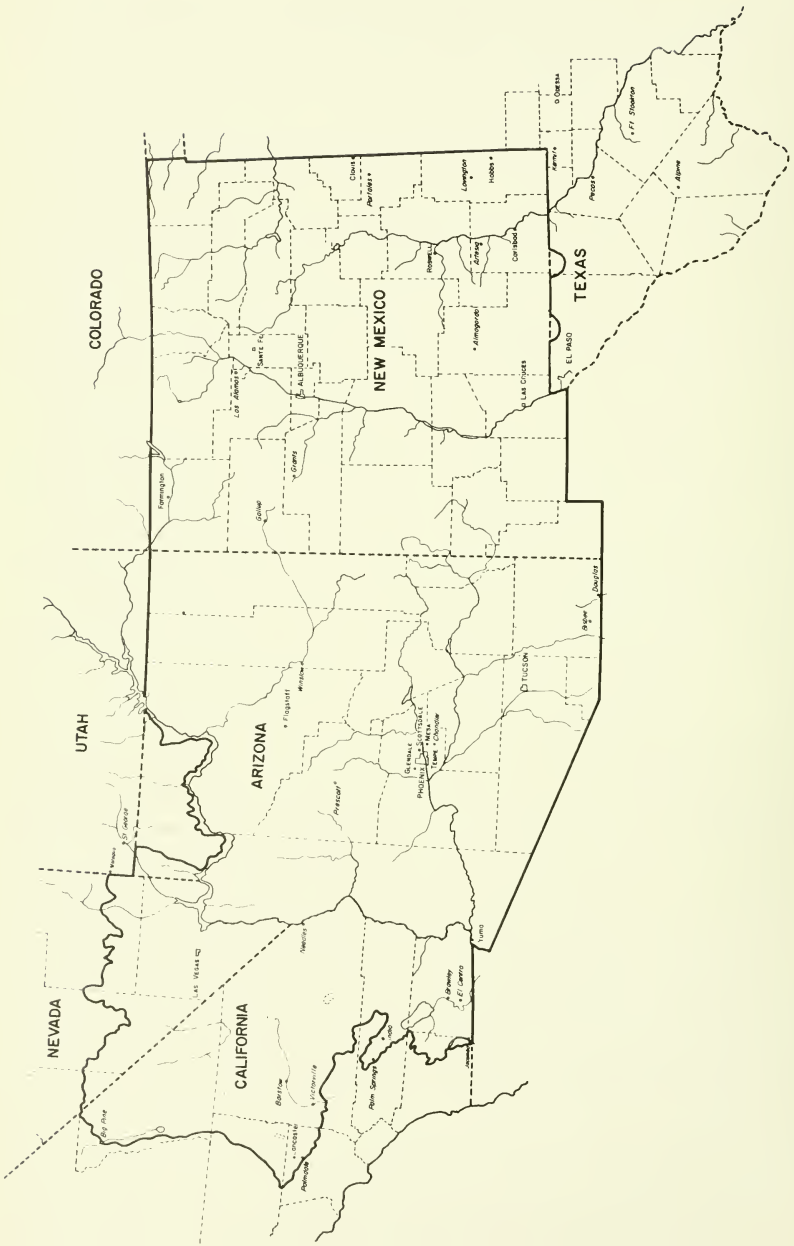


Fig. 1. Area included in the treatment of the Boraginaceae of the Southwest.

usually 4-ovulate, entire or the carpels usually deeply 2-lobed, at maturity becoming tough and bony; *fruit* commonly breaking up into 4 simple-seeded mericarps (nutlets); *style* simple, entire or 2-lobed, produced from the pericarp at the apex of the fruit or borne between the nutlets on the receptacle, or on an upward elongation of the receptacle (gynobase); *endosperm* none or scarce; *embryo* straight or curved.

A family of about 100 genera and 2,000 species of worldwide distribution, with two principle centers of distribution; one about the Mediterranean region of the Mideast and

the other in southwestern United States (Fig. 1).

The Boraginaceae are of little economic value, but some genera have numerous species that have been cultivated as ornamentals, principally in the genera *Myosotis* (forget-me-not), *Heliotropium* (heliotrope), *Anchusa*, and *Echium* (blue-weed).

The classification of the family is based primarily upon the characteristics of the fruit. In many cases it is nearly impossible to recognize the genus and species without the specimen having mature fruit.

- | | | |
|---------|--|-------------------------|
| 1. | Ovary entire or shallowly lobed, the style terminal | 2 |
| — | Ovary deeply 4-lobed, the style gynobasic | 4 |
| 2(1). | Style twice cleft, the four branches each bearing a stigma | 1. <i>Cordia</i> |
| — | Style cleft or divided once or simple or none | 3 |
| 3(2). | Style distinctly cleft or divided to the base | 2. <i>Tiquilia</i> |
| — | Style simple, very short, or absent | 3. <i>Heliotropium</i> |
| 4(1). | Stigma geminate or style bifid | 5 |
| — | Stigmas solitary and simple, capitate or disk-shaped | 8 |
| 5(4). | Corolla irregular, oblique, stamens unequal | 4. <i>Echium</i> |
| — | Corolla regular or nearly so, stamens equal | 6 |
| 6(5). | Corolla large, 2.5–8 cm long, lobes acute; stamens very long, reaching at least to corolla sinuses and frequently much beyond | 5. <i>Macromeria</i> |
| — | Corolla of small or medium size, less than 2.5 cm long; stamens very short, not equalling corolla sinuses | 7 |
| 7(6). | Corolla lobes acute or acuminate, erect; style long, exerted, anthers sagittate .. | 6. <i>Onosmodium</i> |
| — | Corolla lobes rounded or obtuse, ascending, spreading or recurved; style included or short exerted; anthers oblong | 7. <i>Lithospermum</i> |
| 8(4). | Nutlets attached near the apical end, widely spreading in fruit, armed with barbed or hooked prickles | 9 |
| — | Nutlets attached near base or middle, erect or parallel | 10 |
| 9(8). | Nutlets subglobose, armed all over with barbed prickles; prickles; perennials; corolla usually blue or purplish | 8. <i>Cynoglossum</i> |
| — | Nutlets flat, armed on the margins with hooked bristles; slender annuals; corolla white | 9. <i>Pectocarya</i> |
| 10(8). | Fruiting calyx distinctly irregular, three of the lobes nearly distinct, the other united enclosing the fruit, with 7–9 long glochidiate processes | 10. <i>Harpagonella</i> |
| — | Fruiting calyx regular or nearly so, not armed with glochidiate processes | 11 |
| 11(10). | Corolla-lobes convolute in the bud; small herbs with usually ebracteate racemes and smoothly basally attached nutlets | 11. <i>Myosotis</i> |
| — | Corolla-lobes imbricate in the bud | 12 |

- 12(11). Corolla bright yellow or orange, the throat open and not crested (with
fornices) 12. *Amsinckia*
— Corolla white or blue, sometimes light yellow; the throat usually crested 13
- 13(12). Nutlets with definite medial ventral groove formed by the nonfusion of the
pericarpial walls 13. *Cryptantha*
— Nutlets with the pericarpial wall fused at least above the middle and
commonly forming a medial ventral keel 14
- 14(13). Dorsal surface of nutlets not encircled by an upturned rim or flange, with
glochidiate appendages 15
— Dorsal surface of nutlets encircled by an upturned rim or flange which is
usually toothed or lacerate, commonly with uncinatate hairs or glochidiate
appendages 16
- 15(14). Corolla white, throat very short and shallow, tube exceeded by or rarely just
exceeding calyx; nutlets with a median dorsal keel; style usually shorter than
nutlets 14. *Plagiobathrys*
— Corolla blue, throat cylindrical or funnelform, tube usually much surpassing
calyx; nutlets usually lacking a dorsal keel; style usually exceeding nutlets 15. *Mertensia*
- 16(14). Nutlets not armed with conspicuous prickles, oblique, sometimes with a
toothed rim or flange; low depressed pulvinate plants of high altitudes
..... 16. *Eritrichium*
— Nutlets conspicuously armed with barbed prickles along the margins and also
sometimes dorsally; plants with tall, well developed stems 17
- 17(16). Annuals; pedicels erect in fruit; gynobase subulate, as long as the nutlets
..... 17. *Lappula*
— Perennials or biennials; pedicels recurved in fruit; gynobase broad and
pyramidal, about half the length of the nutlets 18. *Hackelia*

1. *Cordia* L.

Trees or shrubs; *leaves* small to large, usually evidently petiolate, with entire, crenate or serrate margins; *inflorescence* mostly corymbose, ebracteate; *flowers* homomorphous or heterostyled or functionally more or less unisexual; *corolla* campanulate to funnel form, small to large, white, yellow, orange, or red, usually 5 merous; *stamens* exerted to included; *filaments* often hairy toward the base; *style* terminal on ovary, dichotomous, simple at the base, the two branches in turn forked to produce 4 ultimate branches; *stigmas* 4, clavate to spatulate or capitate; *fruit* a drupe with watery or glutinous mesocarp, or a nut; *endocarp* bony; *seeds* 1-4.

About 250 species of tropical or warm temperate areas, with the majority of the species and the greatest diversity in America.

1. *Cordia parvifolia* A. DC.

Cordia parvifolia A. DC. Prodrômus 9: 498. 1845.
(Coahuayanam, in western Michocán)

Cordia greggii Torr. Bot. Mex. Bound. 135: 1859.
(The type probably came from near Mapimi, Durango, Mexico)

Cordia watsoni Rose, in Vasey & Rose, Contr. U.S. Natl. Herb. 1: 89. 1890. (E. L. Palmer 174, Guaymas, Mexico)

Shrub 1-3 m tall; *stems* with purplish black or dark gray bark, densely strigose when young but becoming glabrate with age, the lenticels small and pale gray; *leaves* obovate to ovate or nearly orbicular, serrate, 1-3 cm long, 3-15 mm wide, acute to rounded at apex, broadly cuneate at base, scabrous with short strigose hairs, pustulate at the base especially on the dorsal surface, veins conspicuous beneath, impressed above; *petioles* 2-10 mm long, slender; *inflorescence* cymose, few flowered, headlike; *calyx* tubular-camp-

annulate, 5-8 mm long, 10-costate, abundantly hairy, grayish at base of tube, gradually becoming dark brown near and on the lanceolate teeth, the teeth 1.5-4 mm long; *corolla* white, thin, campanulate, 1.5-2.5 cm long, 1-3 cm broad, turning purplish or brownish in age; *style* heterostylous; *fruit* 6-9 mm broad, enclosed within the enlarging calyx.

Alluvial flats, rocky hillsides and wash bottoms in the lower sonoran zone. Extreme southern Arizona, south into Sonora, Coahuila, Durango, and Zacatecas, Mexico, and in central Baja California. February to November.

This shrubby borage is very common just to the south of our area in Mexico, but has only been collected once in the United States by *Altfillisch*, among *Larrea*, about 17 miles south of Tucson, Pima County, Arizona, in 1951.

2. TIQUILIA Pers.

Plants herbaceous or suffruticose; *stems* slender, forking, usually prostrate or widely spreading; *leaves* small, entire, usually strongly veined, sessile or petiolate; *flow-*

ers small, generally white, usually extra-axillary, along leafy twigs or at the forks of the branches, sometimes glomerate, commonly opening in late afternoon; *calyx* 5-parted, regular or slightly irregular; *corolla* with a short, cylindrical or ampliate tube and spreading lobes, throat naked or sometimes appendaged; *stamens* 4-5, included, their filaments adnate to the corolla-tube; *style* terminal on the ovary, short to long, bilobed or biparted; *stigmas* 2, not much differentiated from the style-branch; *ovary* 2-celled or sometimes 4-celled by the septunlike placenta, entire or 4-lobed; *fruit* dry, pyramidal or hemispheric, divided into usually 4 single-seeded nutlets; *nutlets* more or less broadly united ventrally or joined to the elongated gynobase.

References

Johnston, I. M. 1961. Notes on some Texas Borages. *Wrightia* 2:156-162.
 Lundell, C. L. 1964. Flora of Texas (Boraginaceae) 1(2):129-138.
 Richardson, A. T. 1975. Monograph of the Genus *Tiquilia*. Unpublished dissertation Univ. of Texas.

- 1. Plant a small erect shrub; flowers and fruits aggregated into dense globose clusters terminating the leafy branches; *bracts* inconspicuous, simulating the filiform, plumose, elongate calyx lobes. 1. *T. greggii*
- Plants low and spreading, usually prostrate; flowers and fruits borne in the leaf axils or mixed among the leaves in clusters borne along the branches 2
- 2(1). Fruit nearly globose, unlobed at maturity, breaking apart into quarter-sections, each quarter forming a nutlet; *leaves* commonly with an ovate or elliptic blade; plant pallid, tomentose 2. *T. canescens*
- Fruit deeply 4-lobed, the lobes joined only by their inner angle, each lobe forming a nutlet 3
- 3(2). Leaves not evidently nerved, oblong to oblanceolate or linear, 1-2 mm broad, setose, base of petiole expanded, indurate, usually villous 4
- Leaves with evident impressed nerves, ovate or obovate to nearly orbicular, strigose or merely short-hispid; base of petiole not expanded or indurate or villous 6
- 4(3). Corolla bud bearing abundant minute stipitate glands, otherwise glabrous; attachment-scar on nutlet entirely closed or opened only above the middle 3. *T. gossypina*
- Corolla bud villulose, or rarely also sparsely glanduliferous; attachment-scar of nutlets opened for its entire length, or at least below the middle 5

- 5(4). Leaf 5-17 mm long, 1.1-4.2 mm broad, blade obovate to narrowly obovate, petiole densely ciliate; nutlet obpyriform to ovoid, 1.5-2.0 mm long 4. *T. latior*
- Leaf 4-8 mm long, 0.5-2 mm broad, blade linear to narrowly obovate, petiole not noticeably ciliate, nutlet ovoid, 1-1.5 mm long 5. *T. hispidissima*
- 6(3). Plants annual; corolla pink or white; sepals with short pungent hairs; style shorter than calyx 6. *T. nuttallii*
- Plants perennial; corolla blue or bluish; sepals villous; style longer than the calyx 7
- 7(6). Leaves with about 6 pairs of deeply impressed veins; calyx long-villous within; nutlets elongate 7. *T. plicata*
- Leaves with only 2-3 pairs of shallowly impressed veins; calyx glabrous or short pubescent within; nutlets nearly globose 8. *T. palmeri*

1. *Tiquilia greggii* (Torr. & Gray) A. Richardson

Ptilocalyx greggii Torr. & Gray Pacif. R. R. Reports 2: 110. 1857. *Coldenia greggii* A. Gray, Synop. Fl. N. Amer. 2: pt. 1. 182. 1878. *Tiquilia greggii* A. Richardson sida 6(3):336. 1976. (*Gregg*, near Buena Vista, Mexico)

Usually a small, erect, rounded shrub 2-5 dm tall; *stems* or old branches decidedly fruticose, the twigs pale and hispidulous or tomentose; *leaves* numerous, ovate or elliptic, 5-9 mm long, 2.5-6 mm broad; thickish, usually veinless, the margin revolute, the surfaces densely tomentulose; *flowers* in dense capitate clusters 1-2 cm in diameter, borne terminally on the leafy stems and uppermost branchlets; *bracts* inconspicuous, filiform, plumose, like the calyx-segments; *calyx* sessile, deciduous, 5-9 mm long, the segments filiform, plumose, unequal, purplish or grayish at maturity; *corolla* pink, densely villous in the bud, 6.5-8 mm long, the lobes rounded, 2-3.5 mm broad; *style* 2.5-3.2 mm long, slender, the lobes 0.5-0.8 mm long, persistent on the mature fruit; *fruit* lance-ellipsoidal, 2-2.5 mm long, 1-1.2 mm broad, thin-walled, by abortion always 1-celled and 1-seeded, dorsal surface shiny, sparsely hispidulous above the middle, ventral surface dull, the papery tissue representing the three aborted cells of the fruit.

Widely distributed on limestone soils. Southern New Mexico in the Organ Mountains, western Texas and southward in eastern Chihuahua, western and southern Coahuila, to northern Zacatecas and Durango. May to October.

This plant is a Calciphile and usually restricted to limestone soils. It enters our area only along the southern boundary in extreme southern New Mexico.

2. *Tiquilia canescens* (DC.) A. Richardson

Coldenia canescens DC. Prodrornus 9: 559. 1845. *Stegnocarpus canescens* Torr. in Torr. & Gray Pacif. R. R. Reports 2: 170. 1857. *Tiquilia canescens* A. Richardson, sida 6(3): 236, 1976. (*Berlandier* 2256, between Santander and Victoria, Mexico)

Stegnocarpus leiocarpa Torr. in Torr. & Gray Pacif. R. R. Reports 1: 320. 1855. (Pecos River Valley of the Rio Grande, Texas)

Coldenia canescens var. *subnuda* I. M. Johnst. Proc. Calif. Acad. Sci. Ser. 4. 12: 1137. 1924. (I. M. Johnston 3731, San Nicolas Bay, Lower California)

Coldenia canescens var. *pulchella* I. M. Johnst. J. Arnold Arbor. 20: 379. 1939. *Tiquilia canescens* var. *pulchella* (I. M. Johnst.) A. Richardson, sida 6(3):236. 1976. (*F. Shreve* 6257, Kofa Mountains, Arizona) = var. *pulchella*

Suffrutescent perennial, often forming mats 2-6 dm in diameter; *stems* numerous, mostly prostrate but sometimes ascending, furcately branched, older stems with exfoliating epidermis, rough, dark colored, leafy stems and branches pallid, tomentose; *leaves* numerous, white tomentose, the petiole slender, 2-7 mm long, at extreme maturity usually breaking off near the middle leaving a stub attached to the stem, the blade ovate to elliptic-lanceolate, obtuse to broadly acute at both ends 7-10(15) mm long, 2-7(9) mm broad, thickish, the margins somewhat revolute; *flowers* usually solitary in the leaf axils and along the main stem and branches; *calyx* sessile, persistent, at anthesis 3-4 mm long, in

fruit becoming 4–8 mm long, the segments lanceolate with long-attenuate tips; *corolla* 5–6(12) mm in total length, pink, rose, or white, the lobes broad and rounded, 1.8–3(4.5) mm wide, 1.5–2(3.5) mm long, usually villous in the bud, margins frequently erose; *style* seated in the pericarp at the apex of the fruit, persistent, 1.5–2.5 mm long; *fruit* at maturity ovoid or globose, glabrous or hairy, 2.5–3 mm in diameter, 2–2.5 mm high, not lobed; *nutlets* bony, densely and minutely tuberculate.

Rocky ridges, hillsides, and bajadas, mostly on limestone soils below 4,000 feet elevation; lower sonoran life zone. Southeastern California and southern Nevada, east to southwestern Utah, through Arizona and New Mexico into Texas and south through most of the desert area of Mexico. March to May.

Plants from south of our range tend to have pubescent fruits, while those in our range tend to have glabrous fruits; however, there seems to be no geographical correlation, so is not recognized nomenclaturally. Variety *pulchella* (Johnston), Richardson seems to be worthy of at least some recognition, as it can be separated from typical material by the larger flowers 9–12 mm long, 5–8 mm wide, and by the bluish or lavender rather than white corolla. This variety is best developed in the Kofa Mountains of Arizona and just west into California in the Chocolate and Chuckwalla mountains.

3. *Tiquilia gossypina* (Woot. & Standl.) A. Richardson

Eddya gossypina Woot. & Standl. Contr. U.S. Natl. Herb. 16: 164. 1913. *Tiquilia gossypina* A. Richardson sida 6(3):236. 1976. (E. O. Wooton, Tortugas Mountains southwest of Las Cruces, Dona Ana County, New Mexico. September 2, 1894).

Plant prostrate, forming mats 2–4 dm broad; *stems* numerous, dichotomously branched, when young densely villulose; *leaves* somewhat cinereous, clustered, borne mostly on very short branchlets along the main stem, the petiole triangular or ovate, 1.5–2 mm long, indurate, the blade oblong or oblanceolate, 4–8 mm long, 1–2 mm wide, in age detaching from the persistent petiole, upper surface hispid, pustulate, also finely villulose, lower surface only partially covered by the revolute leaf margins, midrib prominent, villulose-hispidulous; *flowers* borne in the

leaf clusters, the bud minutely stipitate glandular, otherwise glabrous; *calyx* at anthesis 3–3.5 mm long, sessile, persistent, the segments lanceolate, short villous or hispidulous; *corolla* pink to magenta, 7–8 mm long, the lobes rounded, 2.5–3 mm broad; *style* somewhat compressed, 3–3.5 mm long, the two lobes each 0.6–0.8 mm long; *fruit* ovoid or globose, 0.9–1.5 mm high, covered with grayish papillae; *nutlets* bony, dusky, papillate, the scar closed or narrowly open only above the middle.

Growing in gypsum soils on desert flats and slopes, 4,000 feet elevation or lower. Dona Ana County, New Mexico, south and eastward along the Rio Grande Valley into Trans-Pecos Texas and Chihuahua and western Coahuila Mexico. April to October.

This plant is closely related to *T. hispidsissima* from farther north, but with no evidence of hybridizing between the two species.

4. *Tiquilia latior* (I. M. Johnst.) A. Richardson

Goldenia hispidsissima var. *latior* I. M. Johnst. Contr. Gray Herb. 68: 92. 1923. *Tiquilia latior* A. Richardson sida 6(3):236. 1976. (Kennedy & Goodding 79, Muddy Valley, Lincoln County, Nevada)

Plants prostrate perennials, forming mats 2–6 dm in diameter; *stems* numerous, dichotomously branched, spreading from a woody taproot, the younger branchlets villulose-hispidulous; *leaves* clustered, borne mostly on very short branchlets along the main stem, the petioles 1–2 mm long, broadest (1–1.5 mm) at the base, becoming indurate, usually pallid, the margin hispid-ciliate, the blade usually obovate (rarely ovate or elliptic), 5–17 mm long, 1.1–4.2 mm wide, usually broader than the petiole; *flowers* borne among the leaves; *calyx* sessile, broadly and permanently attached in the leaf axil, at anthesis 2.5–3.5 mm long, the segments lanceolate, united at the base, villulose-ciliate below the middle, frequently terminated with a stiff bristle; *corolla* usually pink, 4–8 mm long, 4–5 mm broad, the lobes rounded, spreading; *style* 1.5–2.2 mm long, somewhat flattened, apex bilobed; *fruit* ovoid; *nutlets* oblong-ovoid, usually only 1 or 2 maturing, 1.5–2.0 mm long, papillate or vesicular papillate, scar open, nearly as long as the nutlet, surrounded by a nonpapillate ridge.

Sandy dunes and dry open slopes or on gypsum flats, mostly below 5,000 feet elevation. Central Utah and Arizona.

5. *Tiquilia hispida* (T. & G.) A. Richardson

Eddyia hispida T. & G., Senate Executive Doc. No. 78, 33 Cong., 2nd session vol. 2:170, 171. plate 8. 1857. *Coldenia hispida* Gray. Proc. Amer. Acad. Arts 5:340. 1862. *Tiquilia hispida* A. Richardson sida 6(3):236. 1976. (Wright 1557, common on the Rio Grande about El Paso, 1852)

Plants prostrate perennials forming mats to 6 dm in diameter; *stems* numerous, dichotomously branched, spreading from a woody taproot. The young branchlets hispidulous-appressed; *leaves* clustered, on short brittle branches, the petioles very short, elliptic or somewhat rectangular, glabrous, with pungent bristles along the margins, the blade linear or narrowly lanceolate, 4–8 mm long, 0.5–2 mm broad; *flowers* axillary, solitary; *calyx* sessile at anthesis 2.5–3.5 mm long, the segments narrowly triangular or subulate, united at the base, ciliate or villous with scattered sharp bristles; *corolla* usually pink 2.5–6.5 mm long, 4–5 mm broad, the lobes rounded, spreading; *style* 1.5–4.2 mm long, cleft at the apex; *fruit* ovoid; *nutlets* ovoid, 1–1.5 mm long.

Occurring mainly on gypseous soils, or occasionally calcareous soils in central New Mexico and Trans-Pecos Texas.

This plant is closely allied to *T. latior* from farther west in Utah and Arizona, but is distinguished from that taxa by its linear leaves, less ciliate petioles, and smaller ovoid, white colliculate nutlets.

6. *Tiquilia nuttallii* (Benth. ex. Hooker) A. Richardson

Coldenia nuttallii Hook. J. Bot. Kew Gard. Misc. 3: 296. 1851. *Tiquiliopsis nuttallii* A. A. Heller, Muhlenbergia 2: 239. 1906. *Tiquilia nuttallii* A. Richardson sida 6(3):236. 1976. (Ceyer 80. Utah. Utah Co., Sandy desert of muddy rivers edge near the Great Salt Lake timpanogos, Aug. 1845)

Tiquilia brevifolia Nutt. ex Torr. Bot. Mex. Bound. 136. 1859. (Schott, desert west of the Colorado. California, March)

Prostrate annual herb forming mats 1–3.5 dm broad; *stems* slender, dichotomously branched, somewhat brittle, finely strigose; *leaves* ovate to nearly suborbicular, 4–8 mm long, narrowly revolute, often hispid on the margins, dorsal surface with 2–3 pairs of dis-

tingent veins, hirsute, ventral surface thinly strigose with impressed veins, the petioles slender, usually as long or longer than the blade; *flowers* in compact clusters in the forks and at the ends of the branchlets; *calyx* sessile, 4–5 mm long, the segments linear-subulate, villous or setulose on the back, the margins sparsely but conspicuously hispid; *corolla* pink or nearly white, 3–4 mm long, the limb 2–2.5 mm broad, the tube with 5 triangular scales near the base; *style* about 1 mm long; *fruit* ovate-ovoid; *nutlets* oblong-ovoid, smooth and shiny, somewhat mottled with brownish patches, scar closed or narrowly linear.

Dry sandy or alkaline plains and hillsides, up to 7,000 feet elevation. Eastern Washington to California on the eastern slope of the Sierra Nevada Mountains eastward to Wyoming, Utah, and Arizona, also in Argentina. May to August.

7. *Tiquilia plicata* (Torr.) A. Richardson

Tiquilia brevifolia var. *plicata* Torr. Bot. Mex. Bound. 136. 1859. *Coldenia plicata* Coville, Contr. U.S. Natl. Herb. 4: 163. 1893. *Tiquilia plicata* A. Richardson sida 6(3):237. 1976 (Lt. Emory sn. desert west of the Colorado, California)

Matted perennial from a deep woody root; *stems* several, freely dichotomously branched, the branches puberulent or glabrate; *leaves* obovate, 4–9 mm long, densely hairy with felt-like grayish pubescence, strongly plicate, the ventral surface with 4–7 pairs of deeply impressed veins, the petioles about as long as the blade; *flowers* clustered in the forks and at the ends of the branchlets; *calyx* 2–3 mm long, the segments subulate, tomentose especially inside; *corolla* 4–6 mm long, 2–3 mm broad, bluish or lavender; *style* about 2 mm long, cleft $\frac{1}{2}$ to $\frac{3}{4}$ of its total length; *fruit* ovoid; *nutlets* ovoid, 1–3 usually maturing, about 1 mm long, smooth, shiny, the scar orbicular.

Sandy desert flats and bajadas in the *Larrea-Ambrosia* association, mostly below 3,000 feet elevation. Southern California and Northern Mexico eastward to southern Nevada and western Arizona. April to July.

8. *Tiquilia palmeri* (A. Gray) A. Richardson

Coldenia palmeri A. Gray, Proc. Amer. Acad. Arts 8: 292. 1879. *Coldenia brevicalyx* S. wats. Proc. Amer. Acad. Arts. 24: 62. 1889. *Tiquilia palmeri* A. Richardson sida 6(3):236. 1976. (E. Palmer,

southeastern California, Arizona, on the lower Colorado, 1869)

Prostrate or ascending perennials 1-3 dm tall, or forming mats 2-10 dm broad; *stems* many, dichotomously branched from the woody root, white-barked, with the bark exfoliating in age; *leaves* obovate to ovate, grayish strigose to setulose, 4-9 mm long, 3-5 mm wide, the blade equal to or occasionally much shorter than the petiole, which is 3-11 mm long, irregularly veined with 2-3 pairs of moderately impressed veins; *calyx* 2-3.5 mm long, ovate, the segments linear-subulate, villose; *corolla* lavender, 5-7 mm long, 5-6(8) mm broad; *style* 3-4 mm long, cleft about half its length; *fruit* ovoid; *nutlets* subglobose, ca. 1 mm long, smooth, shiny, 1 or more usually aborted.

Sandy places usually below 500 feet elevation. Southeastern California and western Arizona to northern Mexico, along the Colorado River to above Needles.

A plant closely allied with *T. plicata* but easily recognized by the leaves with 2-3 pairs of impressed veins.

3. HELIOTROPIUM L.

Heliotrope

Annual or perennial, herbaceous or more or less shrubby plants; *stems* erect or ascend-

- 1. Plant very succulent, glabrous, usually glaucous 1. *H. curassavicum*
- Plant not succulent, hairy, never glaucous 2
- 2(1). Plant perennial, rhizomatous, the parts above the ground renewed annually
..... 2. *H. greggii*
- Plant annual 3
- 3(2). Corolla 8-15 mm wide, with a long-exserted tube; style elongate, many times
longer than the stigma 3. *H. concolulaceum*
- Corolla 2-4 mm wide, usually with an included tube; style short, about as long
as the stigma 4. *H. fruticosum*

1. *Heliotropium curassavicum* L.

Heliotropium curassavicum L. Sp. Pl. 1: 130. 1753. (Curacao, in Dutch West Indies)

H. xerophyllum Cockrell, Bot. Gaz. 33: 379. 1902. *H. curassavicum* var. *xerophyllum* Nels. & Macbr. Bot. Gaz. 61: 35. 1916. (D. A. Cockrell, East Las Vegas, New Mexico, 3 December, 1901) = var. *curassavicum*.

H. curassavicum var. *obovatum* A. DC. Prodrumus 9: 538. 1845. (Douglas, Columbia River) = var. *obovatum*.

ing to nearly prostrate, glabrous to pubescent; *leaves* small to large, sessile or petiolate; *inflorescence* unilateral and generally conspicuously scorpioid, with or without bracts; *calyx* 5-lobed; *corolla* white, yellow, or purple, variable in form, the throat frequently pubescent inside; *anthers* included; *filaments* extremely short; *style* present or absent; *stigma* usually frustumlike or conic, mostly sterile, receptive only in a band around the base; *fruit* dry, at maturity breaking up into 4 single-seeded or 2 2-seeded nutlet.

A genus of about 250 species widely scattered throughout the warmer parts of the world. They are particularly abundant in arid regions. (Greek, helios, sun, and trope, turning, referring to the summer solstice when the species were supposed to come into flower.)

Reference

Ewan, J. A. Review of the North American weedy *Heliotropes*. Bull. So. Calif. Acad. Sci. 41: 51-57. 1942.

H. spathulatum Rydb. Bull. Torrey Club 30: 262. 1903. (R. S. Williams 542, Great Falls, Montana) = var. *obovatum*.

H. oculatum A. Heller, Muhlenbergia 1: 58. 1904. *H. curassavicum* var. *oculatum* I. M. Johnston, ex Tidestr. Proc. Biol. Soc. Wash. 48: 42. 1935. *H. spathulatum* subsp. *oculatum* Ewan, Bull. S. Calif. Acad. Sci. 4: 56. 1942. (A. A. Heller 5813, sand along the Russian River at Healdsburg, Sonoma County, California) = var. *oculatum*.

Annual or short-lived perennial herbs; *stems* branched, prostrate or decumbent, suc-

culent or rubbery, glabrous, frequently glaucous, 1-6 dm long; *leaves* oblanceolate to obovate or spatulate, glabrous, thick and succulent, 1-4 cm long, 3-20 mm broad, apex obtuse to acutish; *inflorescence* terminal or extra-axillary and lateral along the leafy stems, cymes scorpioid, single or paired, densely flowered, in fruit elongating, 6-12 cm long; *bracts* lacking; *calyx* parted to near the base, sessile, the segments lanceolate to oblong, equal, fleshy, at anthesis 1-3 mm long, slightly accrescent in fruit; *corolla* white or bluish, the throat often with a violet purple

eye, 1.5-3.5(5) mm long, 3-15 mm wide, the limb ascending or loosely outcurved; *stigma* conic, obscurely 4-lobed at apex; *fruit* subglobose, obscurely didymous, separating into 4 nutlets.

Sandy to clayey alkaline soils along beaches, near ponds, streams, playa lakes or similar areas. Throughout the United States and south into Mexico, widely distributed on all continents.

H. curassavicum, in our flora, can be divided into three varieties with some consistency by the following key.

1. Plant scarcely glaucous, slender, only slightly succulent; leaves narrowly oblanceolate to linear; calyx less than 2 mm long, spreading; corolla 1-2.5 mm long, mostly in southern and eastern New Mexico var. *curassavicum*
- Plants conspicuously glaucous, thickish, usually very succulent; leaves obovate or broadly oblanceolate; calyx over 2 mm long, the lobes erect; corolla 2.5 mm or longer 2
- 2(1). Corolla 5-9(16) mm broad, at most only purplish-tinged at the throat; fruit 2.5 mm wide; northern New Mexico, rare var. *obovatum* A. DC.
- Corolla 3-5(7) mm broad, usually becoming distinctly purple or purplish at the throat; fruit 1.5-2 mm wide; southeastern California, southern Nevada and western Arizona var. *oculatum* I. M. Johnston ex Tidestr.

2. *Heliotropium greggii* Torr.

Heliotropium greggii Torr. Bot. Mex. Bound. 137. 1859. (Gregg, Valley of Conchos, near Santa Rosalia, Chihuahua, Mexico, May)

H. pabueri A. Gray ex S. Wats. Proc. Amer. Acad. Arts. 18: 121. 1883. (*E. Palmer* 891, 892, at Soledad, Coahuila, Mexico)

Plants perennial, arising from a deep rhizome; *stems* numerous, prostrate or loosely decumbent, ascendingly branched, 5-15 cm long, strigose with closely appressed hairs; *leaves* numerous, thickish, lanceolate to linear, strigose, 10-25(30) mm long, 2-5 mm wide, midrib conspicuous but veins absent, margins revolute; *inflorescence* at first glomerate, then elongating into a unilateral cyme 10-50 cm long, 5- to 10-flowered; *bracts* few and inconspicuous; *calyx* 5-lobed, 2-3 mm long, the segments lanceolate, strigose; *corolla* white with a yellow eye, fragrant, the tube 3-5 mm long, the limb 7-12 mm broad; *style* short about 1 mm long, puberulent, the tip bidentate; *fruit* radially 4-lobed, very pubescent, 3 mm wide, 1.5 mm high, usually 4 nutlets maturing.

Frequent along roadsides and in bar ditches, in sand, gravel, or clay soils, usually forming colonies where water collects temporarily. Southeastern New Mexico, Trans-Pecos Texas, and south through Coahuila and eastern Chihuahua to northern Zacatecas and northeastern Durango, Mexico. April to September.

3. *Heliotropium convolvulaceum* (Nutt.) A. Gray

Batschia albiflora Raf. New. Fl. N. Amer. pt. 4: 19. 1836. non *H. albiflorum* Engelm. 1924. *Euploca albiflora* I. M. Johnston. Contr. Gray Herb. 70: 53. 1924. (Nuttall, Arkansas River, on sand bars)

Euploca convolvulaceum Nutt. Trans. Amer. Philos. Soc. 5: 190. 1837. (Nuttall, sandy banks of the Arkansas)

E. grandiflora Torr. in Emory, Notes Mil. Recon. 147. 1848. (Emory, Rio Grande below Santa Fe, New Mexico)

Heliotropium californicum E. L. Greene, Bull. Calif. Acad. Sci. 1: 202. 1885. *H. convolvulaceum* var. *californicum* I. M. Johnston. Contr. Arnold Arbor. 3: 83. 1932. *Euploca albiflora* var. *californica* Jeps. & Hoover in Jepson, Fl. Calif. 3: 299. 1943. (Mrs. Curran, Mohave Desert, June 1884)

Erect annual 1–4 dm tall; *stems* simple below, branched above with ascending branches, strigose to spreading hispid; *leaves* numerous, the blade lanceolate to ovate, 10–45(50) mm long, 4–15(20) mm broad, entire, apex acute, strigose to hispid, the petiole slender 3–8 mm long; *flowers* extra-axillary, borne along the leafy branches; *bracts* leaf-like, numerous; *calyx* in anthesis 4–6 mm long, in fruit becoming 6–8 mm long, the segments linear-lanceolate, slightly unequal, strigose or appressed setose; *corolla* white with a yellow throat, fragrant, the tube 8–12 mm long, strigose outside, the limb broadly funnelform, 15–22 (30) mm wide, not lobed, pentagonal, plicate in the bud; *style* slender, 3–4 mm long; *fruit* laterally compressed, hairy, 2-lobed, 3–4 mm long; nutlets paired.

An abundant plant especially on sand dune areas or sandy soils. California eastward to Utah, Wyoming, and Nebraska and southward into Chihuahua Mexico. June to December.

The morning glory heliotrope is a very striking and handsome plant especially in late summer and fall when it covers low sandy areas. In California and western Arizona a phase of the species has conspicuous spreading setose or hispid pubescence. This is varietal *californicum* (E. L. Greene) Johnston.

4. *Heliotropium fruticosum* L.

Heliotropium fruticosum L. Syst. Nat. ed. 10. 913. 1759. (Browne, Jamaica)

H. phyllostachyum Torr. Bot. Mex. Bound. 137. 1859. (Santa Cruz, Sonora, Mexico)

Annuals; *stems* sparingly branched from the base and above, spreading-ascending, 0.5–2.5(4) dm long, strigose with whitish hairs; *leaves* elliptic to oblanceolate, 1–2(3.5) cm long, 2–7 mm broad, acute to rounded at apex, broadly cuneate at the base, strigose, midribs producing coarser hairs with pustulate bases, dark green above, paler beneath, the margin narrowly and tightly revolute; *inflorescence* spike-like; *flowers* extra axillary; *bracts* leaf-like, conspicuous; *calyx* elliptic, 1–1.5 mm long in anthesis, the segments narrowly ovate-lanceolate, unequal, strigose and somewhat pustulate; *corolla* small, white, the tube 1–1.5(2.5) mm long, the limb 3–4 mm wide, finely strigose on the outside, also papillate; *style* 0.6–0.8 mm long; *fruit* depressed-globose, puberulent with fine white

hairs, 1.2–1.5 mm high; *nutlets* rounded on the back, brownish, lateral faces each bearing a central pit.

Sandy to rocky slopes, ridges and wash bottoms, 5,000 feet elevation or less. Colombia and Venezuela northward in the West Indies and Central America to Mexico and southern Arizona in the United States.

4. ECHIMUM L.

Blueweed

Plants biennial or possibly perennial; *stems* erect, hispid; *leaves* alternate, entire; *inflorescence* of a series of sympodial scorpioid cymes which are usually bracteate; *calyx* 5-parted; *corolla* blue to violet purple, irregular, tubular-funnelform; *fores* lacking, the throat thus open; *stamens* unequally exerted on the corolla, the longer ones surpassing the corolla; *style* exerted from the corolla, 2-cleft at apex; *gynobase* flat or nearly so; *nutlets* erect, rugose, attached at their bases, the scar large and sometimes surrounded by a low rim.

A genus of about 50 species native to Europe, the Mediterranean region, South Africa, and the Atlantic islands. (From Greek echion, name for several members of the Boraginaceae, echion, in turn, comes from echis, viper.)

1. *Echium vulgare* L.

Echium vulgare L. Sp. pl. 139. 1753. (Europe)

Plants biennial or short-lived perennials; *stems* erect, usually solitary, (2)4–6(10) dm tall, hispid, the hairs often pustulate; *leaves* mostly basal, reduced upward, oblanceolate to linear oblong, the cauline sessile, setose-hirsute, also finely tomentose, 3–15(22) cm long, 8–15(35) mm broad; *inflorescence* virgate, elongate, occupying most of the stem cymose-paniculate with numerous, aggregated scorpioid cymes 2–5 cm long; *bracts* conspicuous, lanceolate to ovate-lanceolate 0.5–3 cm long; *pedicels* short, 1 mm or less long; *calyx* 5–6 mm long in anthesis, in fruit becoming 6–9 mm long, setose-hirsute; *corolla* 10–15(20) mm long, irregular, bright blue, pubescent externally; *fores* lacking, the tube open; *stamens* conspicuously exerted from the corolla; *style* exerted, hairy, 17–20 mm long; *nutlets* about 3 mm long, rugose. N = 18, 16.

Roadsides, fields, and waste places; native of southern Europe, now widely introduced in the eastern United States and westward to Washington, Colorado, and New Mexico. June to September.

Echium vulgare is known from our area only by a single collection made by Cockerell at Mesilla, New Mexico.

5. MACROMERIA DON.

Plants erect, abundantly rough-hairy, usually branched near the base; *stems* usually several from the branched caudex, abundantly pubescent; *leaves* lanceolate to ovate, entire, strongly veined; *flowers* in terminal leafy-bracted, scorpioid racemes, whitish, greenish-white or yellowish; *calyx* deeply 5-parted; *corolla* much surpassing the calyx, trumpet shaped, the lobes erect or recurved, ovate, acute; *stamens* just surpassing the corolla lobes to long exerted, the versatile anthers oblong, obtuse, the filaments elongate-filiform; *ovary* 4-lobed; *style* exerted from the corolla tube, enlarged and persistent at the base; *nutlets* ovoid to globular, usually all 4 maturing.

A genus containing about 8 species in Mexico and southwestern United States.

1. *Macromeria viridiflora* DC.

Macromeria viridiflora DC. Prodrromus 10: 68. 1846. (In Mexico)

Onosmodium thurberi A. Gray, Synop. Fl. N. Amer. 2: pt. 1 205. 1878. *Macromeria thurberi* Mack. Bull. Torrey Club 32: 496. 1905. (*Thurber*, Bigelow & Wright, New Mexico)

Plants erect perennials; *stems* several, branched only from the base, 3-10 dm tall, setose-hispid with spreading bristles 2-3 mm long; *leaves* at base oblanceolate, the upper ones becoming lanceolate to elliptic, sessile, entire, strongly veined, 3-10(15) cm long, (6)10-23 mm broad, grayish pubescent with spreading setose hairs; *calyx* in fruit 13-17(20) mm long, setose, the segments linear; *corolla* trumpet shaped, greenish yellow, 40-50 mm long, canescent, the lobes ovate, erect, 4-5 mm long; *stamens* barely exerted; *filaments* flattened, elongate; *anthers* versatile, 3-4 mm long, oblong; *style* tardily elongating, inconspicuously geminate, exceeding the corolla lobes 5-10 mm; *nutlets* ovoid, to nearly globose, smooth or slightly pitted, all 4 maturing

Open or wooded areas in the higher mountains, 6,000 to 10,000 feet elevation. Eastern Arizona and western New Mexico, south into Mexico. July to September.

It is reported that the Hopi Indians used a mixture of this plant with tobacco in their "rain bringing" ceremony.

6. ONOSMODIUM Michx.

Plants rough-hairy perennial herbs; *stems* erect or ascending, several branched from the base; *leaves* largely or nearly all cauline, alternate, entire, strongly veined; *inflorescence* 5-parted, the segments unequal, narrow, sometimes disarticulating at the base; *corolla* white or yellow, tubular, slightly enlarged at the throat, 5-lobed, glabrous within, more or less hairy outside, the lobes erect, acute or acuminate, the sinuses inflexed; *formices* lacking; *stamens* 5, included; *style* exerted; *nutlets* globular, 4 mm long or less, smooth or sometimes sparingly pitted, broadly attached at the base to the depressed gynobase, commonly only 1 or 2 maturing.

A genus consisting of about 5 species in the United States and Canada. (Named for its resemblance to *Onosma*, an old world genus of the Boraginaceae)

Reference

Mackenzie, K. K. *Onosmodium*. Bull. Torrey Club 32: 495-506. 1906.

1. *Onosmodium molle* Michx.

Onosmodium molle Michx. Fl. Bor. Amer. 1: 133. 1893. *Lithospermum molle* Muhl. Cat. pl. 19: 1513. *Parshia mollis* Lehm. Asperif. 353. 1818. *O. carolinianum* var. *molle* A. Gray, Synop. Fl. N. Amer. 2 pt. 1: 206. 1878. (About Nashville, Tennessee)

Onosmodium occidentale Mack. Bull. Torrey Club. 32: 502. 1905. *O. molle* var. *occidentale* I. M. Johnston. Contr. Gray Herb. n. s. 70: 18. 1924. (Numerous specimens are cited from Canada to Texas)

Perennial herbs; *stems* several arising from a woody root, branching above or often from the base, erect, 3-6(12) dm tall, coarsely and loosely pubescent throughout; *leaves* 4-8 cm long, 10-20 mm broad, acutish, prominently 5-7 nerved on both surfaces, strigose or spreading setose, minutely pustulate on the ventral surface; *bracts* leaflike, often 2-rank-

ed, 10–24 mm long; *calyx* 6–12 mm long, the segments lanceolate-linear, acute, setose with spreading bristles; *corolla* greenish white, 12–20 mm long, canescent on the outside, the acute lobes 3–4 mm long; *style* exceeding the corolla lobes 5–10 mm; *nutlets* ovoid, acutish, 3.5–4 mm long, dull, smooth, little if at all pitted.

In open rocky woods, prairies, wastelands, and moderately dry hillsides. United States and adjacent Canada from the Appalachian Mountains to the Rocky Mountains and south into New Mexico and Texas. March to July.

In the past monographers have recognized *O. molle*, *occidentale*, *bejariense*, *hellerei*, *hispidissimum*, and *subsetosum* as distinct species; however, I believe that these represent weak variants of the same species. In our flora only the variety *occidentale* occurs, this phase just entering northeastern New Mexico in Union County.

7. LITHOSPERMUM L.

Puccoon

Plants annual or perennial, herbaceous or fruticose; *stems* usually erect, 1 to several,

1. Stems arising out of a basal cluster of leaves, the largest leaves at the base of the stem 2
- Stems arising from a bud on a caudex, root-crown, or rhizome, the largest leaves usually on the midstem, the lowest leaves scalelike and very reduced 5
- 2(1). Flowers heterostylis, none cleistogamic; corolla usually about as broad as long, funnellform, the throat unappendaged but conspicuously stipitate-glandular, the tube villous inside; plant spreading by rhizomes 1. *L. cobrense*
- Flowers monomorphic, sometimes cleistogamic; corolla usually longer than broad, salverform, the throat with fornicis, only sparsely stipitate-glandular, the tube glabrous inside; plant with a taproot 3
- 3(2). Corolla-lobes erose or fimbriate; fruiting calyx usually drooping or nodding; nutlets smooth or somewhat pitted; cleistogamous flowers very abundant 2. *L. incisum*
- Corolla-lobes with entire margins; fruiting calyx erect 4
- 4(3). Nutlets roughened, strongly verrucosic or rugosic; chasmogamic flowers abundant, large 3. *L. parksii*
- Nutlets smooth and shiny; chasmogamic flowers few or none, plant commonly almost completely cleistogamic 4. *L. confine*
- 5(1). Flowers heterostylis; corolla tube not narrowly constricted at top 5. *L. multiflorum*
- Flowers not heterostylis; corolla tube cylindrical, elongate, narrowly and distinctly constricted at the top 6. *L. viride*

simple below, branched above, often dye stained at the base; *leaves* alternate; *inflorescence* racemose, bracteate; *calyx* 5-parted, the lobes usually narrow; *corolla* white, yellow, or violet, tubular or salverform, tube cylindrical, the imbricate lobes spreading, the throat with fornicis or with pubescent or glandular areas; *stamens* included, affixed in the tube; *filaments* short; *anthers* oblong; *style* filiform; *stigmas* geminate; *nutlets* 4, or rarely less by abortion, erect, ovoid or angular, smooth or verrucosic; *gynobase* broadly pyramidal or flat.

A genus consisting of about 60 species, mostly North American with about 20 species of the old world. A purple dye was obtained from the roots of many species by the North American Indians.

Reference

- Johnston, I. M. Studies in the Boraginaceae XXIII. A survey of the genus *Lithospermum*. J. Arnold Arb. 33: 299–363. 1952.

1. *Lithospermum cobrense* E. L. Greene

Lithospermum cobrense E. L. Greene, Bot. Gaz. 6: 157. 1881. (E. L. Greene, Santa Rita del Cobre)

Plant perennial, stoloniferous, forming colonies; *stems* erect, simple, 2-6 dm tall, strigose to somewhat setose; *leaves* at base of plant withering before anthesis, oblanceolate, 5-10 cm long, 5-16 mm broad, the cauline leaves very numerous, crowded, much smaller than the basal ones, narrowly oblong to linear, obtuse, sessile, 1-3.5(5) cm long, 2-5 mm broad, the margins loosely revolute; *inflorescence* scorpioid, simple or geminate, loosely flowered, racemes 10-20 cm long at maturity; *bracts* conspicuous; *calyx* at anthesis 5-7 mm long, in fruit becoming 6-10 mm long, the segments linear-oblong, unequal, strigose; *pedicels* 3-5 mm long in fruit, much shorter in flower; *corolla* funnellform, pale yellow, the tube 7-9 mm long, villous inside, stipitate glandular, the limb (12)15-20 mm broad, margins entire; *style* heteromorphic, 2-8 mm long; *nutlets* white, lustrous, plump, smooth or sometimes obscurely tuberculate, 2.5-3 mm long.

Dry to moderately moist openings in oak or pine forests, 5,000 to 10,000 feet elevation. Southern Arizona and New Mexico east to western Texas and south in the mountainous areas of Chihuahua and Durango, Mexico. June to August.

2. *Lithospermum incisum* Lehm.

Lithospermum angustifolium Michx. Fl. Bor. Amer. 1: 130. 1803. non Forsk 1775. *Cyphorina angustifolia* Nieuwl. Amer. Mid. Nat. 3: 194. 1914. (Ohio River)

Batschia longiflora Pursh. Fl. Am. Sept. 132. 1814. *Lithospermum longiflorum* Spreng. Syst. 1: 544. 1825. non Salisb. 1796. *Pentalophus longiflorus* A. DC. Prodr. 10: 86. 1846. (Nuttall, banks of the Missouri.)

Lithospermum incisum Lehm. Asperif. 303. 1818. (Missouri)

Batschia decumbens Nutt. Gen. pl. 1: 114. 1818. *Lithospermum mandanense* Spreng. Syst. 1: 544. 1825. *Pentalophus mandanense* A. DC. Prodr. 10: 87. 1846. *Cyphorina mandanense* Nieuwl. Amer. Mid. Nat. 4: 515. 1916. non *Lithospermum decumbens* Vent. 1800. (Nuttall, Fort Mandan on the Missouri)

Lithospermum linearifolium Goldie, Edinb. New Philos. Journal 6: 322. 1822. (Head of Lake Ontario)

Lithospermum breviflorum Engelm. & A. Gray. Journ. Bost. Soc. N. H. 5: 252. 1845. (Lindheimer 278, clay prairie near Industry, Austin County, Texas. 1844)

Lithospermum cryptanthiflorum Brand, Feddes Rept. Spec. Nov. Regni Veg. 28: 13. 1930. (Bourgeau, Winnipeg Valley. 1859)

Plant perennial, from a stout woody taproot; *stems* clustered, 0.5-3(6) dm tall, strigose or occasionally weakly setose; *leaves* mostly cauline, the lowermost reduced and chaffy or rarely developed and oblanceolate, the other linear-oblong to narrowly lanceolate, loosely revolute, numerous, 2-6 cm long, (1)2-4(6) mm wide; *inflorescence* racemose, the flowers extra-axillary, those developing early in the season showy, yellow, well developed; *bracts* very conspicuous; *calyx* 5-12 mm long in fruit, the segments linear, very unequal; *pedicels* recurving in fruit; *corolla* salverform, yellow, the tube 12-30(40) mm long, the limb 10-15(20) mm wide, the lobes erose or fimbriate; *style* heteromorphic, 5-30 mm long; *nutlets* ovate, with a conspicuous ventral keel, 3-3.5 mm long, gray, shiny, sparsely pitted, the scar sunken and bearing a nearly central projection that is attached by a ridge to the dorsal part of the prominent collar. N = 12.

Widely distributed in various habitats, but usually in sandy or gravelly soils along roadsides, on prairies or in wasteland. In the United States chiefly on the Great Plains and along the Rocky Mountains, but extending westward into Arizona and Nevada, north into Canada and south into Mexico. March to August.

Flowers developing early in the season are very showy with long styles; however, they are nearly always sterile. Those developing later in the growing season are cleistogamous, mostly fertile, and with short styles.

3. *Lithospermum parkii* I. M. Johnston

Lithospermum parkii I. M. Johnston. J. Arnold Arbor. 33: 345. 1952. (R. McVaugh 7725, Devils Lake, about 20 miles north northwest of Del Rio, Val Verde County, Texas)

Plant perennial, with a deep, thick, somewhat woody taproot; *stems* erect or ascending, 2-5(6) dm tall, simple or several, weakly setose with spreading pubescence; *leaves* at base of stem 5-9 cm long, 4-13 mm broad, oblanceolate, obtuse at apex, usually drying up by anthesis, the cauline leaves numerous, linear to oblance-linear, gradually reduced in size; *inflorescence* terminal and extraaxillary, scorpioid, the racemes unilateral and 10-20 cm long; *bracts* conspicuous; *calyx* at anthesis

4–12 mm long, in fruit 9–15 mm long, the segments linear; *pedicels* 1–5 mm long; *corolla* salverform, yellow, the tube 5–17 mm long, the limb (7)12–20 mm broad, the tube finely strigose on the outside, the lobes entire; *fornices* conspicuous, 0.5–0.8 mm long, invaginate, sparsely glandular; *style* slender and elongate, 4–15 mm long; *nutlets* opaque, verrucose or rugulose, about 3 mm long, attachment scar triangular, about 1.7 mm broad.

Rocky open ridges and slopes mostly on exposed limestone soils. Eddy County, New Mexico, in the Guadalupe Mountains, south through western Texas into northern Chihuahua, Mexico. March to August.

L. parksii is principally a species which occurs to the south and east of our range. Our plants belong to variety *parksii*, but variety *rugulosum* Johnston is a more southerly ranging plant of Coahuila and Nuevo León, Mexico. This plant is small and less robust with smoother, shiny nutlets.

4. *Lithospermum confine* I. M. Johnston

Lithospermum confine I. J. Johnst. J. Arnold Arbor 33: 346–347. 1952. (Mueller 2378, Canyon de los Capulines, about San Enrique, Hacienda San José de Raices, Nuevo León, Mexico, 6 August 1935)

Plants perennial; *stems* several, erect, strigose, 2–4 dm tall; *leaves* at base oblanceolate, obtuse at apex, 2–6 cm long, (1)3–10 mm wide, strigose, cauline leaves lanceolate to linear, the margin narrowly revolute; *inflorescence* terminal, at maturity the racemes 5–10 cm long; *bracts* conspicuous; *calyx* at anthesis 4–5 mm long, in fruit becoming 6–10 mm long, the segments linear; *pedicels* erect, 2–10 mm long; *corolla* yellow, *chasmogamic* flowers with the corolla tube 7–10 mm long, the limb 5–6 mm wide, the lobes entire; *fornices* trapeziform, invaginate, slightly glanduliferous; *style* 5–10 mm long; *cleistogamic* flowers inconspicuous 1–3 mm long, style 1.5–3 mm long; *nutlets* whitish, smooth, 3–3.5 mm long, 2–2.5 mm wide, smooth, the base more or less constricted.

Dry open slopes, canyons, to moderately moist oak and evergreen woodlands. Southern New Mexico and Arizona south into western Texas, and Coahuila, to Neuvo León, Mexico. April to July.

5. *Lithospermum multiflorum* Torr. in A. Gray

Lithospermum multiflorum Torr. in A. Gray, Proc. Amer. Acad. Arts 10: 52. 1874. (No type indicated, originally given as from "Colorado in the lower mountains, to New Mexico and Texas")

Plant perennial; *stems* erect, 1 to several, 2–5 dm tall, simple or late in season ascendingly branched, pubescence thin, grayish, strigose, frequently pustulate; *leaves* at the base poorly developed, ovate to lanceolate, scalelike, acute, 3–10 mm long, usually dye stained, the cauline gradually becoming larger and better developed, sessile, lanceolate to lance-linear, 2–7 cm long, 3–9 mm wide; *inflorescence* simple or forked, terminal on the stem and branches, 5–15 cm long at maturity, late in season producing some very fertile cleistogamic flowers; *calyx* of normal flowers 4–6 mm long at anthesis, the segments linear, very unequal, in fruit becoming 6–10 mm long; *pedicels* in anthesis 1–3 mm long, in fruit 3–8 mm long; *corolla* orange-yellow, the tube 8–10 mm long, limb 8–9 mm broad; *fornices* very obscure, these and the throat conspicuously stipitate glandular; *style* 3–9 mm long, heterostyled; *nutlets* ovoid, white or brownish, usually smooth 2.5–3.5 mm long, 2–2.5 mm wide, usually only one maturing.

Widely distributed in the mountains, 5,000 to 10,000 feet elevation, mostly in open areas on sandy or gravelly soils. Eastern Utah and northern Arizona, east to Colorado and south through New Mexico, and western Texas into the mountainous areas of Chihuahua, Mexico. June to October.

6. *Lithospermum viride* E. L. Greene

Lithospermum viride E. L. Greene, Bot. Gaz. 6: 158. 1881. (E. L. Greene, Mimbres Mountains near Georgetown, Grant County, New Mexico. 1877)
L. palmeri S. Wats. Proc. Amer. Acad. Arts 18: 122. 1883. (E. Palmer 903, Sierra Madre, south of Saltillo, Coahuila, Mexico)

Plant perennial; *stems* few to numerous, 2–10 dm tall, simple or loosely ascendingly branched, pubescence of two kinds, the more abundant spreading or retrorsely appressed, the less abundant spreading and ascending, more rigid and shorter; *leaves* all cauline, the basal third of stem with scalelike leaves that are 3–20 mm long, the largest leaves near the middle of the stem, 2–5.5(8) cm long, 8–32

mm broad, the blade elliptic to lance-ovate, with an evident midrib and 1 or more pairs of prominent veins, the upper surface dark green, scabrous, pustulate, lower surface velvety strigose and paler; *inflorescence* simple or forked, terminal on the stems, in age elongating, loosely flowered, 10-30 cm long; *bracts* leaflike; *flowers* all monomorphic; *calyx* at anthesis 8-13 mm long in fruit becoming 10-18 mm long, the segments linear, very unequal; *pedicels* in anthesis 1-2 mm long in fruit 3-10 mm long; *corolla* greenish yellow, pubescent externally, with a large cylindrical tube 10-30 mm long, limb small reflexed; *fores* lacking, but abundantly glanduliferous in the throat; *style* slender and elongate 10-30 mm long; *nutlets* ovoid, plump, white or brownish, smooth or obscurely pitted, 3.5-4.5 mm long, 2.7-3 mm broad.

Usually on limestone soils in the mountainous areas, 6,000 to 10,000 feet elevation. Arizona and southern New Mexico, southeast through Trans-Pecos Texas and Coahuila into the mountains of Nuevo Leon, Mexico. June to September.

8. CYNOGLOSSUM L.

Hound's Tongue

Plants biennial or perennial rarely annual; *stems* mostly tall, erect, commonly coarse and pubescent; *leaves* alternate, the basal ones long petioled, the upper sessile; *inflorescence* elongating, racemose, bractless or bracted only at the base; *calyx* 5-parted, to below the middle, spreading or reflexed and somewhat accrescent at maturity; *corolla* funnelform or salverform, purple, blue, or white, the tube short, the lobes broad, spreading imbricate, the throat closed by the 5 fores; *stamens* included; *filaments* short; *anthers* oblong or elliptic; *nutlets* 4, depressed-ovoid or orbicular, glochidiate, ascending or divaricate, attached above the middle.

A cosmopolitan genus of about 75 species. (Greek kuno, dog, and glossa, tongue, because of leaf texture in some of the species)

1. *Cynoglossum officinale* L.

Cynoglossum officinale L. Sp. pl. 134. 1753. (Europe)

Biennial; *stems* stout, erect, 4-5 dm tall, leafy to the top, villous-tomentose throughout; *leaves* at base of plant oblong to oblong-lanceolate, 15-30 cm long, 2-7 cm wide, the upper leaves lanceolate, acute or acuminate, sessile or clasping; *inflorescence* racemose, the racemes several to many, simple or branched, much elongating in fruit; *bracts* evident or lacking; *calyx* 5-7 mm long in fruit, the segments ovate-lanceolate, obtuse to acutish, villous-strigose; *pedicels* 5-12 mm long; *corolla* reddish purple to blue, the broad tube 3-5 mm long, the limb 6-8 mm broad; *style* subulate, 4-5 mm longer than mature fruit; *nutlets* ascending on the pyramidal gynobase, 5.5-6 mm long, flattish on the upper surface and margined, glochidiate all over, splitting away from the gynobase at maturity but hanging attached to the subulate style.

Dry to somewhat moist open areas in mixed evergreen or oak woodlands, 5,000 to 9,000 feet elevation. Native to Europe and Asia, now widely introduced in the United States westward to Montana, Utah, and Arizona. May to July.

9. PECTOCARYA DC ex. Meisn.

Small annual herbs; *stems* slender, spreading; *leaves* linear, with closely appressed strigose hairs; *inflorescence* a series of leafy-bracteate false racemes which constitute most of the plant; *calyx* 5-parted, the narrow lobes spreading or reflexed in fruit; *corolla* white, the tube shorter than the calyx, the lobes ovate, the throat nearly closed by the 5 fores; *stamens* included; *style* very short; *stigma* capitate; *nutlets* 4, flattened, attached above the middle, obovate-spathulate to nearly linear, spreading, usually paired, mostly margined with hooked hairs that are spreading or recurving; *gynobase* broadly pyramidal.

About 10 species of western North America and western South America. (From the Greek pektos, combed, and karyon, nut, from the row of bristles on the margin of the nutlet.)

1. Nutlets orbicular or nearly so, both the body and the very thin conspicuous wing with slender uncinatate bristles 1. *P. setosa*
- Nutlets oblong or linear, the body without uncinatate bristles 2
- 2(1). Nutlets with the margins pectinately lacerate or toothed most of their length, also commonly uncinatate-bristly near the distil end 3
- Nutlets with the margins entire or undulate, armed only at the distil end where densely uncinatate-bristly 5
- 3(2). Nutlets conspicuously recurved; the margin narrow with nearly distinct teeth ..
..... 2. *P. recurvata*
- Nutlets nearly straight 4
- 4(3). Margin of nutlets broad and conspicuous, the teeth confluent 3. *P. platycarpa*
- Margin of nutlets narrow, the teeth usually not confluent 4. *P. linearis*
- 5(2). Nutlets all winged margined 5. *P. penicillata*
- Nutlets heteromorphic, 1 of each divergent pair wingless, or merely margined, the other with a broad somewhat incurved uncinatate-toothed wing
..... 6. *P. heterocarpa*

1. *Pectocarya setosa* A. Gray

Pectocarya setosa A. Gray. Proc. Amer. Acad. Arts 12: 81. 1876. *Grucella setosa* Rydb. Bull. Torrey Club 40: 479. 1913. (*E. Palmer*, southeastern California on the desert plains of the upper Mohave River)

P. setosa var. *aptera* I. M. Johnston. Contr. Gray Herb. 70: 38. 1924. (*L. Abrams* 3671, Campo, San Diego County, California)

P. setosa var. *holoptera* I. M. Johnston. Ibid. 70: 39. 1924. (*I. M. Johnston* 6459, Granite Well, Mohave Desert, California)

Stems usually simple at base, but branched just above with ascending branchlets, 5–20 cm tall, setose with spreading bristlelike hairs, also thinly strigose; *leaves* linear to linear-oblancoolate, 5–20 mm long; *calyx* 3–4 mm long in fruit, the segments narrowly linear, armed with 3–6 straight divergent bristles; *nutlets* divergent in pairs, broadly obovate to orbicular, 2 of them bordered all around with a thin scarious wing, 2 wingless, the body and usually the wings producing slender uncinatate bristles, the wing usually slightly undulate and slightly curved upward and saucerlike.

Dry, usually sandy or gravelly slopes, hillsides or flats, up to 7,000 feet elevation. Eastern Washington and Idaho, south through western Utah, Nevada, and Arizona to southern and lower California. April to June.

2. *Pectocarya recurvata* I. M. Johnston

Pectocarya recurvata I. M. Johnston. Contr. Arnold Arb. 3: 97. 1932. (*Harrison & Kearney* 6507, near Chandler, Maricopa County, Arizona, 26 March 1930)

Stems slender, diffusely branched from the base, the branches ascending, 5–25 cm long, sparsely strigose with closely appressed hairs; *leaves* linear to narrowly lance-linear, 1–3.5 cm long, 0.5–2 mm broad, acute, strigose or weakly setose, pustulate on the dorsal surface; *calyx* 2–3 mm long in fruit, the segments linear-lanceolate, strigose; *nutlets* divergent in pairs, linear, strongly recurved at full maturity, the wing divided to or almost to the body into prominent subulate straw-colored uncinatate bristles, at the apex the wing prolonged into a short scarious tip, uncinatate bristly on the margin.

Dry, sandy to gravelly slopes and mesa below 4,000 feet elevation. Southeastern California and Baja California, Mexico eastward to southern Nevada, southern Utah, Arizona, Hildago County, New Mexico, and south into Sonora, Mexico. March to April.

This delicate little plant is readily recognized because of its strongly recurved nutlets.

3. *Pectocarya platycarpa* (Munz. & Johnston) Munz. & Johnston.

Pectocarya gracilis var. *platycarpa* Munz. & Johnston. Contr. Gray Herb. 70: 36. 1924. *P. platycarpa* Munz. & Johnston. Contr. Gray Herb. 81: 81. 1925. (*Pringle*, Mesas near Camp Lowell, Arizona, 16 April, 1881 in part)

Stems slender, diffusely branched from the base, prostrate or widely ascending, 5–20(37) cm long, strigulose; *leaves* narrowly linear to linear-oblancoolate, 1–3.5 cm long, 0.5–1.5 mm broad, cinereous-strigulose, acute; *calyx*

3-4 mm long in fruit, the segments linear-oblong, strigose, nearly as long as the nutlets; *nutlets* divergent in pairs, sometimes heteromorphous, linear-oblong to spatulate-oblong, 2.5-3(4) mm long, with a broad conspicuous winged margin bearing irregular uncinete teeth, the odd nutlet, when present, with a more deeply lacerate wing, and a more pubescent body.

Dry, gravelly or sandy mesas or bajadas or rocky hillsides usually below 4,000 feet elevation. Baja California, Mexico, and south-eastern California eastward through southern Nevada into southwestern Utah, Arizona, southern New Mexico and extreme western Texas, El Paso County, and south into Sonora, Mexico. March to April.

4. *Pectocarya linearis* (R. & P.) DC.

Pectocarya linearis var. *ferocula* I. M. Johnston. Contr. Arnica Arbor. 3: 95. 1932. (Munz & Crow 11846, Lady Harbor, Santa Cruz Island, California)

Stems slender, diffusely branched from the base, the branches prostrate to ascending, 8-25 cm long, strigose; *leaves* linear, 0.5-2.5 cm long, 0.5-1.5 mm broad, acute, strigose; *calyx* 1.5-2.5 mm long in fruit, the segments linear; *nutlets* divergent in pairs, 3-4 mm long, linear-oblong, the winged margin very narrow and producing 5-8 small, narrowly subulate, nearly distinct uncinete bristly teeth on each side, the body nearly straight, not recurved.

Dry, sandy, or gravelly slopes mostly below 4,000 feet elevation. Islands off the coast of southern California and on the mainland from Monterey County south to Baja California, Mexico, also South America in the dry arid regions. March to May.

P. linearis var. *ferocula* is the North American phase of the species. Although it is closely allied to the South American plant, the nutlets of var. *ferocula* tend to be monomorphic with slightly broader based teeth than in the typical material.

This plant is extremely rare in our flora, entering only near the extreme western boundary on the foothills of the San Bernardino Mountains, at the desert edge, and Kern County near Mohave.

5. *Pectocarya penicillata* (H. & A.) A. DC.

Cynoglossum penicillatum H. & A. Bot. Beechey Voy. 371. 1840. *Pectocarya penicillata* A. DC.

Prodrromus 10: 120. 1846. *P. linearis* var. *penicillata* M. E. Jones, Proc. Calif. Acad. Sci. 5: 709. 1895. (Douglas, California)

Stems many, diffusely branched from the base, prostrate or widely ascending, 5-15(25) cm long, cinereous-strigose; *leaves* linear, 1-2(3) cm long, 0.5-2 mm broad, setose-strigulose, pustulate on the dorsal surface; *calyx* 1.5-2 mm long in fruit, the segments linear, nearly as long as nutlets; *nutlets* divergent in pairs, monomorphic, oblong, 1.6-2.4 mm long, the margin unequal, upturned and incurved, broadest near the base and apex, subentire and armed only at the apex with uncinete-bristles, all the bristles slender and not dilated near the base.

Dry, sandy or gravelly hillsides, slopes or mesas, usually below 4,500 feet elevation. British Columbia and eastern Washington, south to southern California and eastward through Idaho to western Wyoming, and Arizona. February to June.

6. *Pectocarya heterocarpa* (I. M. Johnston) I. M. Johnston

Pectocarya penicillata var. *heterocarpa* I. M. Johnston. Contr. Gray Herb. 70: 37. 1924. *P. heterocarpa* I. M. Johnston. J. Arnold Arbor. 20: 399. 1939. (Munz & Keck 4870, Corn Springs, Chuckwalla Valley, Riverside County, California)

Stems slender, diffusely branched from the base, ascending or spreading, 5-15(25) cm long, strigose; *leaves* narrowly linear, 1-3 cm long, 0.5-2 mm broad canescent-strigulose, commonly pustulate on the dorsal surface; *calyx* 1.5-2 mm long in fruit, the segments narrowly lanceolate to elliptic; *nutlets* about 2 mm long, heteromorphic, divergent, 2 narrower and with or without a narrow-winged margin, and 2 with prominently winged margins, the wings uncinete bristly mostly at the apex, irregular, few toothed and with or without scattered bristles on the sides.

Dry, sandy, or gravelly bajadas or mesas mostly below 3,000 feet elevation. Southern California and Baja California, Mexico, eastward to southwestern Utah, extreme western Texas in El Paso County, and south into Sonora, Mexico. February to April.

10. HARPAGONELLA A. Gray

Small pubescent annual; *stems* branching from near the base, prostrate or ascending; *leaves* linear-lanceolate or linear, canescent;

inflorescence racemose, floriferous to near the base of the stem, subbracteate; *calyx* unequal, 3 of the lobes distinct, the other 2 fused, the whole accrescent and closely enclosing the fruit, armed with 5-9 soft hooked spines; *corolla* white, minute; *style* entire; *nutlets* 1 or 2 dissimilar, thin-coreaceous, smooth to finely muriculate, obliquely attached by the narrow base; *gynobase* depressed, small.

A monotypic genus of southwestern United States and northern Mexico. (Name diminutive of Latin harpago, grappling hook.)

1. *Harpagonella palmeri* A. Gray

Harpagonella palmeri A. Gray, Proc. Amer. Acad. Arts 11: 88. 1876. (*E. Palmer*, Guadalupe Island, off Lower California, 1875)

Stems slender, diffusely branched from the base, nearly prostrate to ascending, 4-30 cm long; *leaves* linear or narrowly lanceolate, acute, 1-3.5 cm long, 1-3 mm broad, strigose, the dorsal surface evidently pustulate; *calyx* segments 1-1.5 mm long in anthesis, in fruit becoming 2-3.5 mm long; *pedicels* short, stout, recurving in fruit; *corolla* white, minute, 1.5-2 mm long; *nutlets* about 3 mm long, one enclosed in the indurate calyx tube, the other free, minutely muricate to nearly smooth, often covered with small trichomes.

Dry, sandy to gravelly mesas and bajadas mostly below 1,700 feet elevation. Los Angeles County to San Diego County and Baja California, Mexico, eastward to southwestern Arizona and Sonora, Mexico. February to April.

Rare and local species, usually occurring only during favorable years with sufficient moisture for good seed germination. A very unusual borage because of the highly modified asymmetrical calyx which resembles a grappling hook.

II. MYOSOTIS L.

Forget-me-not

Annual or perennial herbs; *stems* slender, usually erect; *leaves* alternate, entire; *inflorescence* racemose, bracted or bractless; *calyx* 5-parted, cut to beyond the middle into lanceolate or triangular lobes; *corolla* blue, white, or rarely pink, the tube short, salverform, the throat with prominent fornications; *stamens* adnate to the corolla tube, in-

cluded or exserted; *nutlets* 4, small, ovoid, smooth and shiny, sharply margined, the attachment scar flat; *gynobase* short and depressed.

A genus of about 30-35 species widely distributed in the temperate regions of the world. (From the Greek, mus, mouse, and otos, ear, because of appearance of the leaves of some species.)

1. *Myosotis scorpioides* L.

Myosotis scorpioides L. Sp. pl. 131. 1753. (Europe)

M. scorpioides var. *palustris* L. Ibid. *M. palustris* Lam. Fl. France 2: 283. 1778. (Europe)

Fibrous rooted perennial herbs; *stems* 2-6 dm tall, often creeping at the base, commonly stoloniferous as well, strigose; *leaves* oblong to oblanceolate, sessile, 2-8 cm long, 7-15(20) mm broad, obtuse; *inflorescence* terminal, the racemes usually in pairs, becoming loose and open; *bracts* lacking; *calyx* in anthesis 1.5-2.5 mm long, in fruit becoming 3-5 mm long, the segments triangular, short, strigose, equalling or shorter than the tube; *pedicels* in fruit spreading, 4-7 mm long; *corolla* blue with a yellow eye, tube short about 2 mm long, the limb 5-8(10) mm broad; *nutlets* angled, keeled on the inside, smooth. N = 32.

In shallow water or moist places. Native of Europe, now widely distributed in North America as an escapee from cultivation.

Myosotis scorpioides was reported in Kearney and Peebles in *Arizona Flora*. They noted that the species had been planted in gardens around Flagstaff and that it may become naturalized in that area of our flora.

12. *AMSINCKIA* Lehm.

Fiddleneck

Taprooted, bristly-hairy annuals; *stems* usually simple below, branched above; *leaves* alternate, linear to ovate, entire; *inflorescence* racemose, scorpioid, usually bractless; *calyx* cleft to the base or nearly so, or some of the lobes connate so as to appear if fewer than 5 segments; *corolla* bright yellow or orange, tubular or salverform, glabrous, the throat without fornications; *stamens* included, the filaments short; *nutlets* 4, erect, angulate-ovoid, with a conspicuous ventral keel extending from the tip to near

the middle or below, often somewhat keeled dorsally also, the scar small and placed at the end of the ventral keel, often elevated and carunclelike; *gynobase* short pyramidal.

A genus of about 15 species of western North America and South America. (Named for William Amsinck, burgomaster of Hamburg and patron of its botanical garden during the early part of the 19th century.)

- 1. Sepals 5, essentially distinct; corolla tube with 10 traces at the base; nutlets muricate or rugose 1. *A. intermedia*
- Sepals 3–4, reduced in number, unequal in width; corolla tube with 20 traces at the base; nutlets smooth or tessellate 2
- 2(1). Nutlets smooth 2. *A. vernicosa*
- Nutlets tessellate 3. *A. tessellata*

1. *Amsinckia intermedia* Fisch & Meyer

Amsinckia intermedia Fisch. & Mey. Ind. Sem. Hort. Petrop. 2: 26. 1836. (Near Bodega Bay, California)

- A. echinata* A. Gray, Proc. Amer. Acad. Arts 10: 54. 1876. (*J. G. Cooper*, sandy plains in the Mohave district of s.e. part of California, February 1861)
- A. parishii* Suksd. Werdenda 1: 70. 1931. (First specimen cited is *S. B. Parish 6043*, San Bernardino Valley, California, 10 April 1907)
- A. uana* Suksd. Ibid. 84: 1931. (*A. Eastwood 6016*, Hermit Creek, Grand Canyon of the Colorado River, Arizona, 10 April 1917)
- A. dimissa* Suksd. Ibid. 88: 1931. (*Norman C. Wilson*, Diamond Creek Canyon, Arizona, April 1893)
- A. ridida* Suksd. Ibid. 91: 1931. (First specimen cited is *F. Shreve 5134*, Tanamoe Hills, near Tucson, Arizona, 27 March 1917)
- A. arizonica* Suksd. Ibid. (First specimen cited is *A. Eastwood 6119*, Glendale, Arizona, 17 April 1917)
- A. microphylla* Suksd. Ibid. *J. W. Tomey*, Tucson, Arizona, 3 April 1894)

Stems simple to erectly or widely branched 3–8(10) dm tall, sparsely spreading bristly; *leaves* at base of plant linear or linear-lanceolate 2–7(10) cm long, 1–5 mm broad, the upper leaves becoming lanceolate or lance-ovate, clasping at the base, the apex acute, thinly hirsute and pustulate on both surfaces; *inflorescence* open and spikelike, the spikes much elongating in fruit 5–15(25) cm long; *bracts* evident only at the base; *calyx* 5–7(10) mm long in fruit, the segments linear-lanceolate to linear, the tips attenuate, hirsute-hispid the hairs often rufous; *pedicels* 1–3 mm long, erect; *corolla* orange yellow,

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the tube 8–10 mm long, 10 nerved, the limb 3–6 mm broad; *style* 3–4 mm long, slender; *nutlets* ovate, 2.5–3 mm long, incurved, grayish, narrowly keeled on the back, sharply rugose, also muricate or papillate between the rugae. N = 15, 17, 19. (Ray & Chisaki 1957)

Dry to moderately moist places from the deserts to the grassy hills and meadows, a common roadside weed below 5,000 feet elevation. Washington to Baja California, Mexico, and eastward to Idaho, Utah, and Arizona. March to June.

Amsinckia intermedia is a highly variable species, especially in leaf shape and size, pubescence, and nutlet ornamentation. Suksdorf recognized over 100 species that fall within this taxon.

2. *Amsinckia vernicosa* H. & A.

- Amsinckia vernicosa* H. & A. Bot. Beechey Voy. 370. 1838. (*Douglas*, California, probably on his trip from Monterey to Santa Barbara)
- A. carosa* M. E. Jones Contr. W. Bot. 8: 35. 1898. (*M. E. Jones*, Shepherd's Canyon, alt. 4,600 feet, 30 April 1897)
- A. glauca* Suksd. Werdenda 1: 113. 1931. (*A. A. Heller 7722*, Sunset, Kern County, California, 20 April 1905)

Stems simple or sparingly branched above, 2–6 dm tall, glabrous and glaucous or green, or occasionally with a few scattered bristles above; *leaves* nearly glabrous, 2–8 cm long, 2–10(14) mm broad, ovate-lanceolate to linear-lanceolate below, clasping, conspicuously pustulate ventrally less so below, the pustules

sometimes producing a very short bristle, often ciliate-bristly on the margins; *inflorescence* open, terminating each branch, the spikes 3–12 cm long; *bracts* lacking or 1–2 at the base of the spike; *calyx* 8–11(15) mm long in fruit, the segments narrowly lanceolate, sometimes 2 or more partially united, hirsute-hispid with somewhat appressed and spreading pustulate bristles; *corolla* 10–12 mm long, limb 3–6 mm wide; *style* monomorphic; *nutlets* lance-ovate, 3–5 mm long, gray, smooth and shiny, the angles sharp and carinate, scar very narrow. $N = 7$.

Dry plains and hillsides, near sea level to moderate elevations in the mountains. Monterey and Fresno Counties, California, south to Kern County and east to the central Mohave Desert. March to May.

3. *Amsinckia tessellata* A. Gray

Amsinckia tessellata A. Gray, Proc. Amer. Acad. Arts 10: 54. 1874. (*W. H. Brewer 1119*, near Mount Diablo, Contra Costa County, California, 1862)

A. tessellata var. *macrosepala* M. E. Jones, Contr. W. Bot. 12: 58. 1908. *A. macrosepala* Suksd. Werdenda 1: 108. 1931. (Three specimens cited, no type given)

A. macra Suksd. Werdenda 1: 108. 1931. (*A. Eastwood 5025*, Sacaton, Arizona, 19 March 1919)

Stems branched just above the base and throughout, stout 3–6 dm tall, hispid, the bristles spreading, pustulate at base; *leaves* linear-lanceolate to ovate-lanceolate, 2–7 cm long, 4–15 mm broad, sessile, moderately hispid-pustulate on both surfaces; *inflorescence* spikelike, terminating each branch, the spikes 5–12(17) cm long; *bracts* lacking; *calyx* 9–13 mm long in fruit, the segments linear-lanceolate to oblong, 3 or 4 by fusion of 1 or 2 of the segments and then appearing notched at the apex, hispid, the back rufous, the margins white-ciliate; *corolla* orange, the tube 6–10 mm long, the limb 2.5–5 mm broad; *style* monomorphic; *nutlets* ovoid, 3–3.5 mm long, densely tessellate, carinate and often transversely rugose. $N = 12$.

Dry, mostly desert regions in sandy to rocky soils, on hillsides, bajadas, and mesas.

Eastern Washington, southeast of the Cascades and Sierra Nevada, to southern California, Nevada, western Utah, Arizona, and southern New Mexico. March to June.

13. CRYPTANTHA Lehm.

Catseye

Annual, biennial, or perennial, herbaceous or fruticulose plants; *stems* erect or ascending, usually with coarse stiff pubescence; *leaves* opposite at base, or alternate throughout, firm, veinless; *flowers* white or rarely yellow; *inflorescence* spikelike or racemose, bracted or bractless; *calyx* divided to the base, the lobes erect or connivent, linear or oblong, when mature investing the nutlets and falling away entire, or the calyx persistent and the nutlets falling away separately; *corolla* with a short to somewhat elongate cylindrical tube with or without scales at the base of tube, the fornicies usually conspicuous; *style* slender, short or long, included; *stigma* capitate; *nutlets* 1–4, erect, ovate to triangular, roughened or smooth, winged, margined or marginless, affixed laterally through a median ventral and commonly basal forked groove; *gynobase* usually columnar, subulate, or pyramidal.

An exclusively American genus of about 100 species of western North and South America. (From the Greek, *cryptos*, hidden, and *anthos*, flower, because of the minute corolla in some species.)

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- | | | |
|-------|--|---------------------------|
| 1. | Plants annual, with slender stems (of longer duration in <i>C. racemosa</i>) | 2 |
| — | Plants biennial or perennial | 34 |
| 2(1). | Calyx circumsicssile at maturity; low diffuse plant; inflorescence compact, each flower in axil of leafy bract | 1. <i>C. circumsicssa</i> |
| — | Calyx not circumsicssile | 3 |

- 3(2). Gynobase subulate, protruding beyond the nutlets, bearing a sessile stigma on its tip; root and base of plant with a purple dye; each flower in the axil of a leafy bract 2. *C. micrantha*
- Gynobase shorter than the nutlets; style developed; root or herbage usually with very little or no dye; flowers all or in part bractless (except *C. maritima*) 4
- 4(3). Nutlets roughed or (in *C. maritima*) at least one of them so 5
- Nutlets smooth and shining, not roughened 31
- 5(4). Margins of nutlets decidedly winged or knifelike 6
- Margins of the nutlets rounded or obtuse 14
- 6(5). Pedicels usually evident, slender, 1–4 mm long; lateral angles of nutlets distinctly winged 7
- Pedicels obscure or none, less than 1 mm long 8
- 7(6). Nutlets homomorphous, broadly winged 3. *C. holoptera*
- Nutlets heteromorphous, narrowly winged 4. *C. racemosa*
- 8(6). Lateral margins of the nutlets usually distinctly winged; nutlets 4; calyx symmetrical 9
- Lateral margins of the nutlets knifelike or acute 10
- 9(8). Corolla conspicuous, 4–7 mm broad; nutlets homomorphous 5. *C. oxygona*
- Corolla inconspicuous, ca. 1 mm broad; nutlets heteromorphous, the odd one often wingless 6. *C. pterocarya*
- 10(8). Nutlets 1 or 2, odd nutlet axial 7. *C. utahensis*
- Nutlets 4; odd nutlet abaxial 11
- 11(10). Nutlets homomorphous; obscurely roughened 12
- Nutlets heteromorphous, plainly muricate 13
- 12(11). Nutlets lucid, somewhat bent, margin thickish 8. *C. pusilla*
- Nutlets dullish, straight, margin thin, the back high, convex 9. *C. costata*
- 13(12). Nutlets 1.3–1.7 mm long, the margins of the lateral angles knifelike; calyx 2.5–3.5 mm long, in fruit; corolla 1 mm broad 10. *C. inaequata*
- Nutlets ca. 1 mm long, the margins of the lateral angles merely sharp; calyx ca. 3 mm long in fruit; corolla 1–2.5 mm broad 11. *C. angustifolia*
- 14(5). Nutlets decidedly heteromorphous 15
- Nutlets homomorphous 20
- 15(14). Mature calyx strongly appressed to the flattened rachis, decidedly gibbous on the axil side, persistent 12. *C. dunetorum*
- Mature calyx somewhat spreading, not at all gibbous 16
- 16(15). Odd nutlet abaxial, surpassed by style 17
- Odd nutlet axial; style surpassed or occasionally reaching to the nutlet tips 18
- 17(16). Nutlets 1.3–1.7 mm long; calyx 2–3 mm long 10. *C. inaequata*
- Nutlets ca. 1 mm long, calyx 3–4 mm long 11. *C. angustifolia*
- 18(17). Odd nutlet smooth and shiny 13. *C. maritima*
- Odd nutlet tuberculate or papillate 19
- 19(18). Spikes bracteate 14. *C. minima*
- Spikes naked 15. *C. crassisepala*

20(19).	Style surpassing the nutlets	21
—	Style definitely surpassed by or about reaching to the tips of the nutlets	25
21(20).	Spikes bracted throughout	22
—	Spikes bractless or only sparingly so	23
22(21).	Plant spring flowering; stems dichotomously branched from the base outward; plant usually low 5–15 cm high, and spreading	16. <i>C. mexicana</i>
—	Plant summer flowering; main stems straight and erect, forming a central axis producing dichotomously branching laterals; plants usually taller, 15–40 cm high	17. <i>C. albidia</i>
23(21).	Nutlets bent, lucid, gynobase narrowly pyramidal	8. <i>C. pusilla</i>
—	Nutlets straight, usually dull, gynobase subulate	24
24(23).	Nutlets triangular ovate, with a suggestion of a median dorsal ridge; plant dull dark green	18. <i>C. muricata</i>
—	Nutlets lanceolate or lance-ovate; plants canescent	19. <i>C. intermedia</i>
25(24).	Corolla conspicuous 2–5 mm broad	26
—	Corolla inconspicuous 0.5–2.2 mm broad	27
26(25).	Nutlets only 1 or 2 in a normal fruit; style not more than half as long as nutlet .	
—	Nutlets normally 4; style often more than half as long as nutlets	20. <i>C. decipiens</i>
	19. <i>C. intermedia</i>
27(25).	Nutlets usually solitary	28
—	Nutlets usually 4	29
28(27).	Mature calyx and nutlet conspicuously recurved or deflexed	21. <i>C. recurvata</i>
—	Mature calyx and nutlets straight	20. <i>C. decipiens</i>
29(27).	Nutlets ovate or triangular ovate	22. <i>C. echinella</i>
—	Nutlets lanceolate	30
30(29).	Stems spreading hirsute	23. <i>C. barbiger</i>
—	Stems strigose	24. <i>C. nevadensis</i>
31(4).	Spikes bracteate, stems reddish	13. <i>C. maritima</i>
—	Spikes naked, stems greenish	32
32(31).	Style reaching one-fourth–three-fourths height of nutlets; calyx densely hispid-villous	25. <i>C. gracilis</i>
—	Style almost reaching the nutlet tips or surpassing them	33
33(32).	Margins of nutlets acute at least above the middle; Californian	
—	26. <i>C. mohavensis</i>
—	Margin of nutlets rounded or obtuse; plants with a definite central axis; not californian	27. <i>C. fendleri</i>
34(1).	Corolla tube elongate, distinctly surpassing the calyx; flowers usually heterostyled	35
—	Corolla tube short, scarcely if at all surpassing the calyx; flowers not heterostyled	44
35(34).	Nutlets smooth and shining	36
—	Nutlets more or less roughened or wrinkled at least on the dorsal surface	38

- 36(35). Corolla yellow 37
 — Corolla white 30. *C. capitata*
- 37(36). Inflorescence an elongate, cylindrical thyrses; nutlets lanceolate, with acute margins, usually only one developing 28. *C. flava*
 — Inflorescence consisting of a large terminal cluster with one or more remote, at maturity frequently stalked, much smaller lateral clusters; nutlets broadly ovate, with winged margins, all four usually maturing 29. *C. confertiflora*
- 38(35). Nutlets muricate or verrucose 31. *C. fulvocanescens*
 — Nutlets rugose or tuberculate 39
- 39(38). Ventral or inner surface of the nutlets smooth or nearly so 40
 — Ventral surface of the nutlets distinctly roughened 41
- 40(39). Corolla tube 7–10 mm long; calyx lobes 5–7 mm long in anthesis; plants not heterostyled; nutlets conspicuously tuberculate and short rugose 32. *C. oblata*
 — Corolla tube 12–14 mm long; calyx lobes 7–9 mm long in anthesis; plants strongly heterostyled; nutlets finely tuberculate or rugose 33. *C. paysonii*
- 41(39). Inflorescence 0.1–0.4 dm long; corolla tube 10–12 mm long; margins of nutlets not in contact; plants less than 1.2 dm tall 34. *C. paradoxa*
 — Inflorescence 0.5–3 dm long; corolla tube 5–10 mm long; margins of nutlets in contact or nearly so; plants usually over 1.2 dm tall 42
- 42(41). Scar of nutlets surrounded by an elevated margin but tightly closed; style 1–2 mm long; calyx 3.5–4 mm long in anthesis 35. *C. bakeri*
 — Scar of nutlets conspicuously open; style 3–8 mm long; calyx 4.5–7 mm long in anthesis 43
- 43(42). Corolla tube 7–10 mm long; scar of nutlets conspicuously open and surrounded by a definite elevated margin 36. *C. flavoculata*
 — Corolla tube 5–7 mm long; scar of nutlets slightly open and with only an inconspicuous elevated margin if any 37. *C. tenuis*
- 44(34). Nutlets smooth on their dorsal surface 45
 — Nutlets more or less roughened on the dorsal surface 47
- 45(44). Plants strong perennials; crests at base of corolla tube conspicuous; calyx not noticeable accrescent, widespread species 38. *C. jamesii*
 — Plants biennial or weak perennials; crests at base of corolla tube lacking; calyx noticeable accrescent 46
- 46(45). Inflorescence capitate or nearly so; calyx segments in fruit 5–7 mm long, a narrow endemic of Coconino Co., Arizona 39. *C. atwoodii*
 — Inflorescence broad topped due to the elongation of the cymules in age; calyx segments in fruit 7–10 mm long; SE New Mexico south into Texas and Mexico 40. *C. palmeri*
- 47(44). Ventral surface of nutlets smooth or nearly so 48
 — Ventral surface of nutlets rugose or variously roughened 49
- 48(47). Nutlets bordered by a conspicuous wing; robust plants 5–10 dm tall, with long ebractate spikes; Arizona 41. *C. setosissima*
 — Nutlets never conspicuously winged; plants 2–4 dm tall; inflorescence very broad and bracteate; NE New Mexico 42. *C. thyrsoflora*
- 49(47). Scar somewhat constricted below the middle of the open portion, NE Arizona 43. *C. osterhoutii*

- Scar triangular and not constricted below the middle or (closed in *C. bakeri*) 50
- 50(49). Cymules elongating and so the inflorescence broad; biennial or short-lived perennials; nutlets usually with an evident dorsal ridge 51
- Cymules shorter and the inflorescence narrow; long-lived perennials; nutlets with only a slight dorsal ridge if any 53
- 51(50). Surface of the leaves with inconspicuous appressed bristles; inflorescence open, with only a few elongate cymules, 7–14 cm long terminating the stem; endemic to near Las Vegas, Nevada; known only from the type and may not exist any longer due to urbanization in the area 44. *C. insolita*
- Surface of the leaves conspicuously setose-hispid with spreading bristles; inflorescence open, at least at maturity 52
- 52(51). Calyx lobes 7–12 mm long in fruit; nutlets 3–4.5 mm long, prominently carinate on the dorsal side 45. *C. virginensis*
- Calyx lobes 5–7 mm long in fruit; nutlets 2.5–3 mm long, with only an indistinct central ridge toward the apex 46. *C. hoffmannii*
- 53(50). Nutlets indefinitely tuberculate and rugose to nearly smooth; W Nevada and E California 47. *C. tumulosa*
- Nutlets definitely tuberculate, rugose or muricate 54
- 54(53). Scar of nutlets open 55
- Scar of nutlets closed 35. *C. bakeri*
- 55(54). Ventral surface of nutlets deeply rugose and tuberculate, the dorsal less so 48. *C. abata*
- Ventral surface of nutlets muricate or verrucose, the dorsal also or with some of the murications connected to form short irregular ridges 49. *C. humilis*

1. *Cryptantha circumscissa* (H. & A.) I. M. Johnston

Lithospermum circumscissum H. & A. Bot. Beechey Voy. 370. 1840. *Piptocalyx circumscissus* Torr. in S. Wats. Bot. King Exp. 240. 1871. *Eritrichium circumscissum* A. Gray, Proc. Amer. Acad. Arts 10: 58. 1874. *Krynitzkia circumscissa* A. Gray, Proc. Amer. Acad. Arts 20: 275. 1885. *Wheelerella circumscissa* Grant, Bull. S. Calif. Acad. Sci. 5: 28. 1906. *Greeneocharis circumscissa* Rydb. Bull. Torrey Club 36: 677. 1901. *Cryptantha circumscissa* I. M. Johnston. Contr. Gray Herb. 68: 55. 1923. (*Tolmie*, Snake Ft. Snake County, Idaho)

Small annual herbs; stems erect or bushy branched, forming round clumps 0.2–1 dm tall, strigose to very hirsute; leaves oblanceolate to nearly linear, 0.4–1.5 cm long, 1–2 mm broad, obtuse, strigose or hirsute, pustulate with small inconspicuous pustules, the petioles somewhat siliceous; inflorescence short, congested, the racemes obscure; bracts evident, appearing as if a continuation of the foliage leaves; calyx 2.5–4 mm long in fruit, oblong-ovate, connate to near the middle, the lobes falling away by a circumscission near

the sinuses, hirsute, the tube ciliceous, persistent; pedicels about 0.5 mm long; corolla minute, white, inconspicuous, 1–2(3) mm broad; style just exceeded by the nutlets or equalling them; gynobase about $\frac{2}{3}$ height of nutlet; nutlets 4, homomorphous, or with the abaxial one slightly larger, triangular-ovate or oblong-lanceolate, 1.2–1.7 mm long, margins acute, the surfaces smooth or inconspicuously muricate, scar closed and forked below.

Dry, open, usually sandy slopes and plains, widely distributed in many plant communities, however in our area found mostly in the *Larrea* and *Juniperus* communities. Central Washington to Baja California, mostly east of the Cascade and Sierra Nevada ranges to southern Idaho, Utah, and Arizona; also Chile and Argentina. March to July.

2. *Cryptantha micrantha* (Torr.) I. M. Johnston

Eritrichium micranthum Torr. Bot. Mex. Bound. 141. 1859. *Krynitzkia micrantha* A. Gray, Proc. Amer. Acad. Arts 20: 275. 1885. *Eremocarya micrantha*

E. L. Greene, *Pittonia* 1: 59. 1887. *C. micrantha* I. M. Johnst. Contr. Gray Herb 68: 56. 1923. (Thurber, sand hills, Frontera, Texas, and in other places along the Rio Grande, March-April)

Eremocarya muricata Rydb. Bull. Torrey Club 36: 677. 1909. (Parry 164, Valley of the Virgin near St. George)

Eritrichium micranthum var. *lepidum* A. Gray. Syn. Fl. N. Amer. 2 pt. 1. 193. 1886. *Krynitzkia micrantha* var. *lepida* A. Gray. Proc. Amer. Acad. Arts 20: 275. 1885. *Eremocarya lepida* E. L. Greene, *Pittonia* 1: 59. 1887. *Eremocarya micrantha* var. *lepida* Macbr. Proc. Amer. Acad. Arts 51: 545. 1916. *Cryptantha micrantha* var. *lepida* I. M. Johnst. Contr. Gray Herb. 68: 57. 1923. (Cleveland, San Diego, California, 1876) = var. *lepida*

Slender annual herbs; *stems* dichotomously branched throughout, 0.5–1.5 dm tall, root and lower part of the stem dye stained, strigose; *leaves* linear to oblong-oblancheolate, 0.3–0.7 cm long, 0.8–1.4 mm wide, strigose to villous-hirsute, pustulate on the dorsal side; *inflorescence* short, dense, 1–4 cm long, the spikes unilateral solitary or geminate, numerous; *bracts* conspicuous, subtending each flower; *calyx* 1.8–2.5 mm long in fruit, ovate-oblong, slightly asymmetrical, conspicuously biseriolate, the segments oblong-lanceolate, hirsute; *pedicels* 0.5–0.8 mm long; *corolla* inconspicuous to evident, 0.5–2.5(3.5) mm broad; *style* short, the stigma sessile; *gynobase* subulate, much longer than the nutlets; *nutlets* 4, homomorphous to slightly heteromorphous, the abaxial one the most persistent and slightly larger, lanceolate with apex attenuate, 1–1.3 mm long, margins rounded, plumbeous or brown, smooth or tuberculate, scar extending entire length of nutlet, narrow, only slightly broadened at the base.

Dry, open, sandy slopes and plains. Nevada and Utah, south to Baja California and Arizona, eastward to southern New Mexico and Transpecos Texas; also northern Mexico. March to June.

The species is easily recognized because of its dense bracteate spikes, dye-stained root, and the long, protruding gynobase.

3. *Cryptantha holoptera* (A. Gray) MacBride
Eritrichium holopterum A. Gray. Proc. Amer. Acad. Arts 12: 81. 1876. *Krynitzkia holoptera* A. Gray. Ibid. 20: 276. 1885. *Oreocarya holoptera* E. L. Greene, *Pittonia* 1: 58. 1887. *Cryptantha holoptera* Macbride, Contr. Gray Herb. 48: 44. 1916. (E. Palmer, Ehrenber, Arizona, 1876)

Coarse annual herbs; *stems* erect, somewhat woody toward the base, 1–6 dm tall,

the branches ascending, rather numerous, hirsute also somewhat strigose; *leaves* oblanceolate to linear-lanceolate, 3–6 cm long, 3–8(12) mm wide, hirsute, conspicuously pustulate on the dorsal side, less so above; *inflorescence* racemose, the racemes usually geminate, 0.4–0.7(1) dm long; *bracts* inconspicuous or evident on a few racemes; *calyx* 2.5–3.5 mm long in fruit, oblong-ovate, the segments lanceolate, connivent, midrib thickened and hirsute; *pedicels* ascending or recurved, 0.7–1.5 mm long; *corolla* white, minute; *style* evidently surpassing the nutlets; *gynobase* slender, nearly equalling the nutlets; *nutlets* 4, homomorphous, ovate to slightly oblong-ovate, 1.5–2.5 mm long, margins narrowly to broadly winged, the surface of the nutlets dark with lighter tuberculations, scar subulate, closed above, clearly open below.

Dry, gravelly, or rocky slopes and ridges mostly in the *Larrea* community. Inyo County, California, south to southern Imperial County, California, and eastward to Mohave and Yuma counties, Arizona, not common. February to April.

4. *Cryptantha racemosa* (S. Wats.) E. L. Greene

Eritrichium racemosum S. Wats. in A. Gray, Proc. Amer. Acad. Arts 17: 226. 1882. *Krynitzkia racemosa* E. L. Greene, Bull. Calif. Acad. Sci. 1: 208. 1885. *C. racemosa* E. L. Greene, *Pittonia* 1: 115. 1887. *Johnstonella racemosa* Brand, Feddes Rept. Spec. Nov. Regni Veg. 21: 249. 1925. (S. B. & W. F. Parish 775, canyon near Mesquite Station, San Bernardino County, California, March 1881)

C. suffruticosa Piper, Proc. Biol. Soc. Wash. 32: 42. 1919. (Orcutt 2070, Camp Muchacho, Colorado Desert)

C. racemosa var. *lignosa* I. M. Johnst. Univ. Calif. Publ. Bot. 7: 445. 1922. *J. racemosa* var. *lignosa* Brand, Feddes Rept. Spec. Nov. Regni Veg. 21: 249. 1925. (Hall & Chandler 7034, Panamint Canyon, Panamint Mountains, California)

Long-lived somewhat suffruticose annual; *stems* simple, with many ascending branches or diffusely branched from near the base, 1–10 dm tall, younger parts green, hirsute and also strigose, older parts brown, woody, with exfoliating epidermis; *leaves* oblanceolate, acute, hirsute, conspicuously pustulate, 1.5–4(6) cm long, 2.5–4(12) mm broad; *inflorescence* paniculate, the racemes branched and loosely flowered, 0.3–1.5 dm long; *bracts* irregular and inconspicuous; *calyx* 2–4 mm

long in fruit, oblong-ovate, tardily deciduous, the segments linear-lanceolate, strigose and hirsute along the thickened midrib; *pedicels* 1–4 mm long, slender, frequently recurved; *corolla* very inconspicuous, about 1 mm broad; *style* much surpassing the nutlets; *gynobase* subulate, nearly equalling the consimilar nutlets; *nutlets* 4, heteromorphous, ovate, the acute tips slightly out-curved, odd nutlet next the abaxial calyx-lobe, 1–2 mm long, subsistent, muricate or tuberculate or both, consimilar nutlets 0.8–1.5 mm long, the margins narrowly winged, dark with pale tuberculations, scar open or closed above, but opening out into a triangular areola below.

Dry, sandy slopes or rocky ridges mostly below 4,500 feet. Inyo County, California, south to northeastern Baja California and eastward to southern Nevada, southwestern Utah, and Mohave and Yuma counties, Arizona, not common. March to June.

Cryptantha racemosa is the only annual with stems that become somewhat woody or subfruticose near the base.

5. *Cryptantha oxygona* (A. Gray) Greene

Eritrichium oxygonum A. Gray, Proc. Amer. Acad. Arts 19: 89. 1883. *Krynitzkia oxygona* A. Gray, Proc. Amer. Acad. Arts 20: 227. 1885. *C. oxygona* E. L. Greene, Pittonia 1: 120. 1887. (C. G. Pringle, hills bordering the Mohave Desert, California, 1882)

Erect annual herbs; *stems* mostly solitary, 1–4 dm tall, with several well-developed ascending branches from near the base, strigose also villous-hispid; *leaves* linear or linear-lanceolate, 1–4(6) cm long, 1–2(3) mm broad, strigose or short-hispid, obtusish, pustulate with small numerous inconspicuous pustules; *inflorescence* dense, the spikes geminate or ternate, 1–3(6) cm long; *bracts* lacking; *calyx* 2.5–4 mm long in fruit, ovate to oblong-ovate, obscurely biserial, the segments lanceolate, with somewhat thickened sparsely hirsute midribs, the margins silky strigose, somewhat connivent; *pedicels* short 0.5 mm long; *corolla* conspicuous, the limb 4–7 mm broad; *style* evidently surpassing the nutlets; *gynobase* about two-thirds as long as nutlets, nearly subulate; *nutlets* 4, homomorphous, oblong-ovate, 2–2.5(3) mm long, margins narrowly winged or knife-like, dorsal side of nutlet low convex, muricate or tuberculate, scar closed or open above, open below with a broadly forked triangular areola.

Dry slopes and benches below 5,000 feet. California in the inner southern Coastal Ranges from western Merced and Fresno counties to Kern County, western Mohave Desert to Santa Rosa Mountains, Riverside County, eastward just into western Nevada. March to May.

A species closely related to *C. pterocarya* but having much larger corollas, and ranging more westward, just entering our flora along the western boundary in Kern County.

6. *Cryptantha pterocarya* (Torr.) E. L. Greene

Eritrichium pterocaryum Torr. Bot. Mex. Bound. 142. 1859. *Krynitzkia pterocarya* A. Gray, Proc. Amer. Acad. Arts 20: 276. 1885. *C. pterocarya* E. L. Greene, Pittonia 1: 120. 1887. (Pickering & Brackenridge 1047, Walla Walla, Washington; lectotype by I. M. Johnston)

Eritrichium pterocaryum var. *pectinatum* A. Gray, Proc. Amer. Acad. Arts 10: 61. 1874. *Krynitzkia pterocarya* var. *pectinata* A. Gray, Proc. Amer. Acad. Arts 20: 276. 1885. (C. C. Parry 168, 169, in the Virgin River Valley near St. George, Utah) = var. *pterocarya*.

Krynitzkia cycloptera E. L. Greene, Bull. Calif. Acad. Sci. 1: 207. 1884. *C. cycloptera* E. L. Greene, Pittonia 1: 120. 1887. *C. pterocarya* var. *cycloptera* Macbr. Contr. Gray Herb. 48: 44. 1916. (C. G. Pringle, hills near Tucson, Arizona, 1884) = var. *cycloptera*

Erect annual herb; *stems* 1–4 dm tall, ascendingly branched from the base and throughout, strigose or very short hirsute; *leaves* lanceolate to linear, 1–2.5(4) cm long, 1–3(5) mm broad, obtuse, strigose or hispid, dorsal surface conspicuously pustulate, ventral surface finely pustulate or the pustules nearly lacking; *inflorescence* open, the spikes geminate or rarely solitary or ternate, 2–6(12) cm long; *bracts* inconspicuous or lacking; *calyx* in fruit (2)3–5 mm long, very accrescent, broadly ovate, the segments ovate to ovate-lanceolate, the midrib slightly thickened and sparsely hirsute, the margins tawny strigose or hirsute; *pedicels* 0.5–1 mm long; *corolla* inconspicuous, 0.5–1(2) mm broad; *style* surpassing the body of nutlet but occasionally surpassed by the broad wing margin of nutlet; *gynobase* slender, about two-thirds height of nutlet; *nutlets* 4, homomorphous and all winged or heteromorphous and the axial one wingless, the body oblong-lanceolate or lanceolate, 2–2.5(3) mm long, margin of nutlet broad and winglike or narrow, entire but usually crenate, entending completely around

the nutlet, surface muricate, scar open or closed above, at the base opening into a dilated areola.

Dry sandy to gravelly washes and bajadas, below 6,000 feet. East of the Cascades and Sierra Nevada from southern Washington to

northern Baja California, eastward to southern Idaho, Utah, Arizona, and northern Sonora, Mexico. March to June.

Cryptantha pterocarya can be separated into two rather weak varieties on the basis of the nutlets as follows:

1. Nutlets heteromorphic, axial one wingless var. *pterocarya*
 — Nutlets homomorphic, all winged var. *cycloptera* (Greene) Macbr.

Variety *pterocarya* tends to be more southerly ranging than variety *cycloptera*; also there are very few intermediates between the two varieties.

7. *Cryptantha utahensis* (A. Gray) E. L. Greenl

Krynitzkia utahensis A. Gray, Synop. Fl. N. Amer. 2: pt. 1. suppl. 427. 1886. *C. utahensis* E. L. Greene, Pittonia 1: 120. 1887. *Eritrichium holopteron* var. *submolle* A. Gray, Proc. Amer. Acad. Arts 13: 374. 1878. *Cryptantha submollis* Coville, Contr. U. S. Natl. Herb. 4: 166. 1893. (*E. C. Palmer* 352, St. George, Utah)

Erect ascendingly branched herb; *stem* solitary at base branched just above the base and throughout, 1-3(4) dm tall, strigose or appressed short hirsute; *leaves* few, scattered, reduced above, linear to linear-oblongate 1-5(7) cm long, 1-4 mm broad, obtuse, short hirsute, conspicuously pustulate especially on the dorsal surface, less so above; *inflorescence* open, the spikes geminate or solitary, dense, 0.8-2.5(5) cm long; *calyx* 2-3(4) mm long in fruit, ovate to oblong, the base oblique-conic, spreading or recurving, the segments lanceolate, strongly connivent, the brownish thickened midrib occasionally bearing spreading or recurved bristles, the margins densely silky villous-hirsute; *pedicels* obscure; *corolla* conspicuous 2-4(5) mm broad; *style* just slightly shorter than nutlets; *gynobase* subulate, differing only slightly from the style; *nutlets* 1 or rarely 2, lanceolate, 1.7-2.5 mm long, margins acute or with a narrow knifelike wing, the surface pale, muricate, papillate, or occasionally spinulose, the back low convex or flat, scar open, linear and slightly dilated below into a small areola.

Dry, sandy or rocky washes and hillsides. Desert region of Inyo, San Bernardino, and Riverside counties, California, eastward through southern Nevada into southwestern

Utah, and western Arizona in Mohave County. March to May.

8. *Cryptantha pusilla* (Torr. & Gray) E. L. Greene

Eritrichium pusillum Torr. & Gray, Pacif. R. R. Report 2: 171. 1856. *Krynitzkia pusilla* A. Gray, Proc. Amer. Acad. Arts 20: 174. 1885. *C. pusilla* E. L. Greene, Pittonia 1: 115. 1887. (*Pope*, Rio Pecos to Llano Estacado, March)

Low annual herbs; *stems* numerous, prostrate to ascending, very slender, 0.3-1.5 dm tall, canescent, strigose to villous-hirsute; *leaves* mostly basal, scattered above, linear to linear-spathulate, 1-3 cm long, 1-2 mm wide, hispidulous and pustulate on the dorsal surface, less so ventrally; *inflorescence* compact, the spikes solitary or geminate, 2-8 cm long, densely flowered; *bracts* lacking or the bracts few and minute; *calyx* 2-2.5 mm long in fruit, broadly ovate, early deciduous, the segments ovate-lanceolate or oblong-lanceolate, hirsute, the midrib only slightly thickened; *pedicels* obscure; *corolla* minute, shorter than the calyx, about 0.6 mm wide; *style* conspicuously surpassing the nutlets; *gynobase* narrowly pyramidal, about equaling the nutlets; *nutlets* 4, homomorphous, lucid, broadly ovate, bent, 0.8-1.2 mm long, margins acute or knifelike, surface light brown or tan with pale tuberculations, scar subulate and expanded at base into a triangular areola.

Dry, sandy or gravelly slopes and washes. Southern Arizona east through southern New Mexico into Trans Pecos Texas; ranging southward into Sonora, Chihuahua, and Durango, Mexico. March to May.

Cryptantha pusilla is a relatively rare plant which just enters our area along the southern boundary or the Mexican border.

9. *Cryptantha costata* Brandegee

Cryptantha costata Brandegee, Bot. Gaz. 27: 453. 1899. (*Brandegee*, Borregos Springs, California, 1895)

C. scorsa Machbride, Contr. Gray Herb. 48: 46. 1916.
(*M. E. Jones 3841*, Needles, California)

Coarse low annual herbs; *stems* erect, few branched, 1–2 dm tall, densely villous-strigose and somewhat hirsute; *leaves* lanceolate to linear, 1–3 cm long, 2–4 mm wide, dorsal surface hispid, also pustulate, ventral surface villous-strigose and sparsely hispidulous the pustules few and inconspicuous; *inflorescence* open, the spikes rigid, solitary or geminate, 2–5 cm long; *bracts* remote, few; *calyx* in fruit 4–6 mm long, ovate-oblong, deciduous, the segments linear lanceolate, connivent with slightly spreading tips, midrib thickened, hirsute, margins strigose; *pedicels* obscure; *corolla* inconspicuous, the tube shorter than the calyx, the lobes ascending; *style* very similar to the gynobase, much surpassing the nutlets; *gynobase* subulate; *nutlets* 4, homomorphous, or slightly heteromorphous with the nutlet next the abaxial calyx-lobe the largest, triangular or oblong-ovate, 1.6–1.9(2) mm long, margins knifelike or narrowly winged, dorsal surface strongly convex, slightly rugulose or obscurely muriculate, ventral surface flat or slightly concave, scar shallow, closed above opening below into a triangular-subulate areola.

Dry sandy washes and bajadas. Inyo County to San Diego County, California, eastward just into Arizona in Yuma County. February to May.

An interesting plant because of its unusual nutlets which have a flat ventral face and a very high, convex dorsal surface.

10. *Cryptantha inaequata* I. M. Johnston

C. inaequata I. M. Johnston. Univ. Calif. Publ. Bot. 7: 444. 1922. *Johnstonella inaequata* Brand, Feddes Repert. Spec. Nov. Regni. Veg. 21: 250. 1925. (*Hall & Chandler 6925*, among rocks, Pleasant Canyon, Panamint Mountains, California, 600 meters altitude)

Erect annual herbs; *stems* ascendingly branched, coarse, 2–4 dm tall, hispid and strigose; *leaves* linear to linear-oblongate, 1.5–4 cm long, 1–3(4) mm broad, acute, hispid, pustulate on the dorsal surface; *inflorescence* open, the spikes solitary or geminate, 4–12 cm long; *bracts* few and scattered or lacking; *calyx* in fruit 2–3(4) mm long, ovate-oblong, the segments lanceolate midrib moderately thickened and hirsute, axial lobe the most thickened and hirsute; *pedicels* very short, less than 0.5 mm long; *corolla* small,

1–2(3) mm broad; *style* conspicuously surpassing the nutlets; *gynobase* narrowly subulate, equalling consimilar nutlets; *nutlets* 4, heteromorphous, triangular-ovate, margins acute or knifelike, surface brownish with pale tuberculations, odd nutlet about 1.7 mm long, more persistent and slightly lighter in color than the others, next the abaxial calyx-lobe, the consimilar nutlets 1.3–1.5 mm long, scar subulate, closed above, narrowly triangular below.

Dry, usually clay soils, on desert slopes and rocky ridges. Inyo and San Bernardino counties, California, eastward to southern Nevada, southwestern Utah, and western Arizona in Mohave County. March to May.

This species is relatively rare throughout its range, but in certain localities, as northeast of Henderson, Nevada, it becomes more common, especially when the moisture supply is sufficient. The species is nearly always on heavy gumbo clay soil.

11. *Cryptantha angustifolia* (Torr.) E. L. Greene

Eritrichium angustifolium Torr. Pacif. R. R. Reports 5: 363. 1857. *Krynitzkia angustifolia* A. Gray, Proc. Amer. Acad. Arts 20: 272. 1885. *C. angustifolia* E. L. Greene, Pittonia 1: 112. 1887. (*Thomas*, Fort Yuma, Arizona)

Diffuse annual herbs; *stems* much branched from near the base, ascending to nearly decumbent, 0.5–2(3) dm tall, hirsute to strigose-villous; *leaves* linear, 1.5–4 mm long, 1–2(4) mm wide, hispid or strigose, pustulate especially on the dorsal surface; *inflorescence* rather dense, the spikes geminate, 2.5–6(9) cm long, densely flowered; *bracts* lacking, *calyx* in fruit 2–4 mm long, ovate-oblong, ascending, strongly biseriate, the segments linear-lanceolate, midrib thickened and hirsute, the margins villous-hirsute and ciliate; *pedicels* obscure, less than 0.5 mm long, *corolla* inconspicuous to evident, 1–2.5 mm broad; *style* usually surpassing even the odd nutlet; *gynobase* columnar, equalling the consimilar nutlets; *nutlets* usually 4, heteromorphous, ovate-oblong, margins obtuse, acute, or narrowly winged, the surface brown with pale tuberculations or murications, odd nutlet next abaxial calyx-lobe, slightly larger than the consimilar nutlets which are about 1 mm long, scar very narrowly linear-lanceolate.

Dry, sandy or gravelly washes. South-

eastern California from the Death Valley region to northeastern Baja California and eastward to southwestern Utah, western Texas, and Sonora, Mexico. March to June.

12. *Cryptantha dumetorum* E. L. Greene

Krynitzkia dumetorum Greene, Pittonia 1: 112. 1887. (*Curran*, half climbing among bushes at Tehachapi Pass, California 1884)

Sprawling annual herb; *stems* erect, or in age, elongate and scrambling or supported by various shrubs, 1-4(5) dm tall, closely strigose; *leaves* lanceolate, 1-3(4) cm long, 2-4(8) mm wide, thickish, sparsely appressed hispidulous, conspicuously pustulate on the dorsal surface, less so above; *inflorescence* open, the spikes solitary or geminate, loosely flowered, 5-10 cm long; *bracts* mostly lacking or occasionally with 1 or 2 near the base; *calyx* in fruit 2-3 mm long, closely appressed to the flattened rhachis, conspicuously asymmetrical, persistent, gibbous at the base on the axial side, the 3 abaxial lobes lanceolate, with thickened hispid midribs, the 2 axial lobes partly united, strigose and deflexed hispid; *pedicels* lacking; *corolla* minute, about 1 mm broad; *style* subequal to nutlets or slightly shorter than the nutlets; *gynobase* subulate, narrow; *nutlets* 4, heteromorphous, ovate-lanceolate, to lanceolate, muciculate, odd nutlet axial, persistent, 2-3 mm long, the base enlarged and distorting the calyx, scar open and broad, consimilar nutlets 1.5-2 mm long, deciduous, scar closed or very narrow and linear.

Sandy bajadas and hillsides or occasionally in the wash bottoms. Central Mohave Desert of California eastward through southern Nevada into southwestern Utah. April to May.

The Utah collection of this species is from the west shore of Ivins Reservoir, a considerable extension of range from that previously known. The plant probably also occurs in Mohave County, Arizona, but has not been documented.

13. *Cryptantha maritima* E. L. Greene

Krynitzkia maritima E. L. Greene, Bull. Calif. Acad. Sci. 1: 204. Aug. 1885. (*C. maritima* E. L. Greene, Pittonia 1: 117. 1887. (*E. L. Greene*, Guadalupe Island, California, 26 April 1885))
Krynitzkia ramosissima E. L. Greene, Bull. Calif. Acad. Sci. 1: 203. Aug. 1885. non *K. ramosissima* A. Gray 1885. (*Mrs. Curran*, Mohave Desert, California, 1884)

C. maritima var. *pilosa* I. M. Johnst. Univ. Calif. Publ. Bot. 7: 445. 1922. (*Palmer 551*, stony ridges, Los Angeles Bay, Lower California)

Erect annual herbs; *stems* reddish, ascendingly branched throughout, 1-3(4) dm tall, mostly strigose or occasionally hirsute; *leaves* linear to lanceolate, acutish, 1-3.5 cm long, 1-3.5 mm wide, sparsely hirsute, coarsely pustulate; *inflorescence* dense, the spikes solitary or geminate 1-7(12) cm long, congested, or glomerate especially when immature; *bracts* evident, and scattered throughout; *calyx* in fruit 1-3(3.5) mm long, ovate-oblong, ascending, deciduous at length, the segments linear-lanceolate, connivent, the midrib thickish and hirsute, the margins hirsute-villose to villous; *pedicels* obscure or lacking; *corolla* minute, 0.5-1 mm broad; *style* nearly equalling consimilar nutlet; *gynobase* subulate one-half-two-thirds length of nutlets; *nutlets* 1-4, heteromorphous, odd nutlet often the only one developing, abaxial, lanceolate, 1-2 mm long, margins rounded, surface smooth and shiny, brownish, scar closed or open at base into a small areola, consimilar nutlets similar, but tuberculate and grayish, early deciduous.

Dry washes and desert bajadas. Inyo County and throughout southeastern California to northern Baja California and east to southern Nevada, southwestern Utah, Arizona, and Sonora, Mexico. March to May.

The variety *pilosa* I. M. Johnston, is distinguished from the typical material by the densely white-villose calyx-segments. The range of *pilosa* is scattered within the range of the species.

14. *Cryptantha minima* Rydb.

C. minima Rydb. Vull. Torrey Club 28: 31. 1901. (*Rydberg & Vreeland 5697*, Cuchara River, above La Veta, Colorado, 2100 m)

Small annual herbs; *stems* erect or ascending-spreading, numerous, 0.5-1.5(2) dm tall, finely strigose and coarsely hirsute; *leaves* oblanceolate, 1-3(4) cm long, 1.5-4 mm broad, obtuse, hirsute or hispid in age, moderately pustulate; *inflorescence* dense, the spikes solitary or occasionally geminate 2-9(15) cm long; *bracts* evident throughout; *calyx* in fruit 4-7(9) mm long, oblong-ovate, spreading, asymmetrical, the segments lance-linear, connivent, midrib conspicuously thickened and bony, hispid, margins sparsely hirsute or ap-

pressed hispid; *pedicels* short, 0.5–1.5 mm long; *corolla* small, 1–1.5 mm broad; *style* surpassed by odd nutlet, equalling or surpassing consimilar ones; *gynobase* oblong about 0.7 mm long; *nutlets* 4, heteromorphous, odd nutlet ovate 2–3 mm long, margins angled, the surface brownish, finely muriculate or granulate, persistent, next abaxial calyx-lobe, consimilar nutlets 1.2–1.5 mm long, thick, tuberculate, scar broadly open especially at the base, not forked.

Widely distributed on great variety of soils. Principally on the plains east of the Continental Divide, from Saskatchewan, Canada, south to northern New Mexico and Texas. April to July.

This plant is closely related to *C. crassise-pala* (Torr. & Gray) Greene, a more southern and westwardly growing species. The bracted inflorescences serve best to distinguish it from its southern relative.

15. *Cryptantha crassise-pala* (Torr. & Gray)

E. L. Greene

Eritrichium crassise-palum Torr. & Gray, Pacif. R. Reports 2: 171. 1857. *Krynitzkia crassise-pala* A. Gray, Proc. Amer. Acad. Arts 20: 268. 1885. (Pope, vicinity of Permanent Camp on Rio Pecos, 6–7 April 1856)

C. dicarpa A. Nelson, Proc. Biol. Soc. Wash. 16: 30. 1903. (*T. D. A. Cockerell* 30, Mesilla Park, New Mexico) = var. *crassise-pala*

C. crassise-pala var. *elachantha* I. M. Johnston, Wrightia 2: 20. 1959. (*R. McVaugh* 8040, north end of Quitman Mountains, 8 miles west of Sierra Blanca, Hudspeth County, Texas) = var. *elachantha*

Erect or spreading annual herbs; *stems* many, ascendingly branched, 0.5–1.5(2.5) dm tall, hirsute to hispid; *leaves* oblanceolate, 1–3(6) cm long, 2–4(6) mm wide, rounded or obtuse, hirsute, pustulate, the upper scarcely reduced; *inflorescence* moderately dense, the spikes solitary or geminate 3–10(15) cm long; *bracts* lacking or 1 to 2 subtending the lowermost flowers; *calyx* in fruit 5–7(10) mm long, oblong-ovate, slightly asymmetrical, the segments lance-linear, connivent above, midrib very hard and thickened, hispid-hirsute; *pedicels* about 0.5–1 mm long; *corolla* inconspicuous to 5 mm in diameter; *style* surpassed by odd nutlet, equalling or slightly longer than consimilar ones; *gynobase* narrowly oblong; *nutlets* 4, or occasionally less by abortion, heteromorphous, odd nutlet persistent, next abaxial calyx-lobe, ovate, acute, 2–2.5(3) mm

long, the surface granulate or spinular-muricate, brownish, consimilar nutlets early deciduous, ovate-oblong, 1.2–1.5(2) mm long, tuberculate, scar large, open, occupying most of ventral surface.

Usually dry sandy soils on ridges and in washes. Southern Utah and Arizona, eastward to southwestern Colorado, New Mexico, western Texas, and northern Mexico. March to July.

16. *Cryptantha mexicana* (Brandeg.) I. M. Johnston

Krynitzkia mexicana Brandeg. Zoe 5: 182. 1905. *C. mexicana* I. M. Johnston, Wrightia 2: 161. 1961. (*Purpus* 8301, near Viesca, southwestern Coahuila, Mexico, 1903)

Dense, low, rounded herbs; *stems* numerous, erect, spreading or ascending, 0.5–2 dm tall, hispid or sparingly strigose-villous; *leaves* oblong-lanceolate, 2–4(5) cm long, 2–6 mm broad, obtuse, hispid, pustulate, the upper only slightly reduced; *inflorescence* dense, very floriferous, the spikes solitary or geminate, 5–15 cm long; *bracts* evident throughout; *calyx* in fruit 3–4 mm long, broadly ovate, the segments lanceolate, connivent, hirsute to hispid villous; *pedicels* obscure; *corolla* inconspicuous about 1 mm broad; *style* barely surpassing nutlets; *gynobase* pyramidal, shorter than nutlets; *nutlets* 4, homomorphous, triangular-ovate, 1–1.3 mm long, margins rounded, the surface tan or brownish with white tuberculations, scar triangular, conspicuously excavated.

Exposed slopes and rocky ridges, mostly on limestone or caliche. Southeastern New Mexico, western Texas, and southward into northern Mexico in the state of Nuevo León and Coahuila. March to July.

This species is closely allied to *C. albida* (H.B.K.) Johnston. There should be no confusing the two as *C. albida* has a straight erect central axis or stem while this species is much branched from the base and throughout; also the flowering times are very different: *C. mexicana* is early spring and summer, while that of *C. albida* is in July and August.

17. *Cryptantha albida* (H.B.K.) I. M. Johnston

Myosotis albida H.B.K. Nov. Gen. et Sp. 3: 91. Aug. 1818. (San Juan del Río, Queretaro, Mexico)

Lithospermum ramosum Lehm. Asperif. 2: 328. Nov. or Dec. 1818. *Eritrichium ramosum* DC.

Prodromus 10: 132. 1846. *Krynitzkia ranosa* A. Gray, Proc. Amer. Acad. Arts 20: 274. 1885. *C. ranosa* E. L. Greene, Pittonia 1: 115. 1887. (Type probably came from San Juan del Rio, Mexico)

C. densiflora Nels. & Kenn. Proc. Biol. Soc. Wash. 19: 156. 1906. (*Keenedy* 952, Verdi, Nevada, 1904)

Erect annual herb; *stems* single or more commonly several, with numerous loosely ascending branches, the main stem becoming somewhat woody or very stiffened below in age, 1.5–4 dm tall, strigose and sparingly hispid; *leaves* spatulate to spatulate-linear, usually folded, 2–3 cm long, 2–5 mm broad, acute to obtuse, dorsal surface hirsute, conspicuously pustulate, ventral surface sparsely hirsute to nearly glabrous; *inflorescence* terminal on the main stem and the numerous branches, the spikes solitary or rarely geminate, 1–6(10) cm long; *bracts* numerous, small; *calyx* in fruit 2.5–3 mm long, ovate, the segments lanceolate, connivent, unequal, hispid; *pedicels* obscure, nearly sessile; *corolla* inconspicuous, 1.5–2.5 mm broad; *style* surpassing mature nutlets about 0.5 mm; *gynobase* pyramidal; *nutlets* 4, homomorphous, triangular ovate, 1–1.3 mm long, margins rounded, the surface tan or brownish, with low whitish tuberculations, scar triangular, occupying much of ventral face, excavated.

Moderately tall erect annual herbs; *stems* single or several, 1–10 dm tall, ascendingly few to several branched, hirsute also somewhat strigose; *leaves* linear to linear-oblancoate, 1–5(9) cm long, 1–3(4) mm wide, acute, villous-hirsute, inconspicuously pustulate; *inflorescence* terminating the main stem and branches, the spikes geminate to quinate, 2–15 cm long; *bracts* lacking; *calyx* in fruit 2–4 mm long, ovate, deciduous, the segments lanceolate, very connivent, midrib slightly thickened and tawny-hirsute, the margins hispid; *pedicels* obscure; *corolla* inconspicuous to conspicuous, 1–7 mm broad; *style* usually much surpassing the nutlets or rarely slightly shorter than them; *gynobase* linear subulate; *nutlets* 4, homomorphous, broadly ovate, 1.5–2.5(3) mm long, lucid or dull, muricate or tuberculate, also sometimes granulate, margins acute to rounded, base truncate, scar narrow and nearly closed but at the base broadly forking and with a very small areola.

Dry gravelly bajadas and washes, or mountain slopes. Southern California from the transition zone to arid desert zone and eastward to Nevada and Arizona. April to July.

Slopes, canyons, and ridges of volcanic or limestone origin. Southeastern Arizona, possibly in extreme southern New Mexico. Occurring in Trans-Pecos Texas and south in Mexico in the states of Sonora, western Coahuila, Chihuahua, Durango, and Queretaro, as well as northwestern Argentina.

Two rather well-defined varieties occur within the area of our flora, the typical variety has conspicuous corollas 2–6 mm broad, while variety *denticulata* (E. L. Greene) Johnston has inconspicuous corollas 1–2 mm broad; otherwise the plants are quite the same. Two other varieties may occur within our area, variety *jonesii* (Gray) Johnston, and variety *clokeyi* (Johnston) Jepson.

The species just enters our area in southeastern Cochise County, Arizona, but may be expected in the Guadalupe Mountains of southern New Mexico.

18. *Cryptantha muricata* (H. & A.) Nels. & Macbr.

Myosotis muricata H. & A. Bot. Beechey's Voy. 369.

1840. *C. muricata* Nels. & Macbr. Bot. Gaz. 61: 42. 1916. (*Douglas*, without locality)

Eritrichium muriculatum A. DC. Prodrornus 10: 132. 1846.

Krynitzkia muriculata A. Gray, Proc. Amer. Acad. Arts 20: 273. 1885. *C. muriculata* E. L. Greene, Pittonia 1: 113. 1887. (Type not given)

C. horridula E. L. Greene, Pittonia 5: 55. 1902. (*Mrs. Curran*, Salinas River, California. 1885)

Krynitzkia denticulata E. L. Greene, Bull. Calif. Acad. Sci 1: 205. 1885. *C. denticulata* E. L. Greene, Pittonia 1: 114. 1887. (*Curran*, western Nevada, 1884)

19. *Cryptantha intermedia* (A. Gray) E. L. Greene

Eritrichium intermedium A. Gray, Proc. Amer.

Acad. Arts 17: 225. 1882. *Krynitzkia intermedia*

A. Gray, Proc. Amer. Acad. Arts 20: 273. 1885.

C. intermedia E. L. Greene, Pittonia 1: 114.

1887. (*Nevin*, Los Angeles, California 1880–1882)

C. quentinensis Macbride. Contr. Gray Herb. 56: 58. 1918. (*Palmer* 608, San Quentin Bay, California)

C. barbiger var. *fergusonae* Macbr. Ibid. 59. 1918. (*Ferguson* 42, Palm Springs, California)

C. intermedia var. *johnstonii* Macbr. Ibid. 59. 1918. (*Johnston* 1938, Claremont, California)

Erect annual herbs; *stems* 1–several, erectly branched, 1.5–5 dm tall, very hirsute

with spreading or ascending hairs, also strigose; *leaves* lanceolate to linear, acute to obtuse, 2-6(7.5) cm long, 1-5(7) mm wide, hirsute or strigose, minutely pustulate; *inflorescence* open and lax, the spikes geminate to quinate, mostly ternate, 1-15 cm long; *bracts* lacking; *calyx* in fruit (2)4-6 mm long, ovate-oblong, ascending, the segments lance-linear, connivent with spreading tips, midrib moderately thickened and very hirsute, margins strigose or hispid villous; *pedicels* obscure, 0.5 mm long; *corolla* conspicuous, 3-6(8) mm broad; *style* subequal to the nutlets, or slightly longer or shorter than them; *gynobase* linear-subulate; *nutlets* usually 4, or somewhat less by abortion, homomorphic, lanceolate to ovate, 1.8-2.3 mm long, surface muricate to tuberculate, grayish or tannish, somewhat granulate also, margins mostly obtuse, scar narrow and linear, or closed but with a small areola at the base.

Dry sandy slopes and hillsides. Northern California to northern Baja California mostly west of the Sierra Nevada Mountains but entering the desert edge along the eastern foothills. March to July.

Cryptantha intermedia is a highly variable species and tends to intergrade quite completely with *C. barbiger* in our area, and to a lesser extent also with *C. nevadensis*. The larger corolla of *C. intermedia* will usually separate it from its close relatives.

20. *Cryptantha decipiens* (M.E. Jones) Heller

Krynitzkia decipiens M. E. Jones Contr. W. Bot. 12: 6. 1910. *C. decipiens* Heller, Muhlenbergia 8: 48. 1912. (M. E. Jones, Yucca, Arizona, 14 May 1884)

Slender erect annual herbs; *stems* ascendingly branched throughout, 1-4(5) dm tall, strigose rarely sparsely hirsute; *leaves* mostly basal, reduced upward, linear, 1-4 cm long, 1-3(4) mm broad, obtuse to acutish, strigose and sparsely hispid, sparsely but evidently pustulate; *inflorescence* open, the spikes geminate or occasionally ternate or solitary, slender, usually densely flowered, 3-10(14) cm long; *bracts* lacking; *calyx* in fruit 2-5 mm long, ovate to oblong, strictly ascending, asymmetrical, the segments lance-linear, conspicuously connivent with spreading or recurving tips, the midrib moderately thickened and hirsute, margins strigose or weakly hirsute, the abaxial lobe usually slightly the

longest; *pedicels* obscure or lacking; *corolla* minute to evident, 0.8-3.5 mm broad; *style* short, much surpassed by nutlets; *gynobase* short pyramidal; *nutlet* 1 or rarely 2, next abaxial calyx lobe, ovate-lanceolate, 1.5-2.4 mm long, margins rounded, the surface brownish, muricate to tuberculate, scar narrowly linear, but opening at base to form a small areola.

Sandy, gravelly, or rocky slopes or hillsides, often growing on limestone. Inyo and Kern counties, California, south to northern Mexico, and eastward through southern Nevada to Washington county, Utah, and western Arizona. March to May.

21. *Cryptantha recurvata* Coville

C. recurvata Coville, Contr. U. S. Natl. Herb. 4: 165. 1893. (Coville & Funston 713, Surprise Canyon, Panamint Mountains, California)

Sprawling annual herbs; *stems* slender, ascendingly branched just above the dye-stained root, 1-3 dm tall, strigose rarely hispidulose; *leaves* remote, oblanceolate or linear-oblanceolate 1-2(3.5) cm long, 1-4(5) mm broad, rounded or obtuse, strigose, inconspicuously pustulate; *inflorescence* open, the spikes solitary or geminate, slender, 2-10(12) cm long; *bracts* lacking; *calyx* in fruit 3-4 mm long, conspicuously asymmetrical, bent and strongly recurved, tardily deciduous, the segments linear, the abaxial the longest, midrib moderately thickened and hirsute, the margins appressed hirsute or strigose; *pedicels* lacking; *corolla* minute, shorter than the calyx; *style* much shorter than nutlet; *gynobase* short and slender; *nutlet* 1, persistent, next abaxial calyx-lobe, lanceolate, incurved ca. 2 mm long, the tips attenuate-acute, margins obtuse, the surface dull brownish, granulate or muriculate, scar narrowly linear or closed above, below opening into a small basal areola.

Sandy or occasionally gravelly washes or slopes. Southeastern Oregon south to Inyo county, California, in the Panamint Mountains and eastward to San Juan County, Utah, and Mohave County, Arizona. April to June.

22. *Cryptantha echinella* E. L. Greene

C. echinella E. L. Greene, Pittonia 1: 115. 1887. *C. ambigua* var. *echinella* Jepson & Hoover, Fl. Calif. 3: 336. 1943. (Soune, Mount Stanford, above Donner Lake, California 2640 m, 1886)

Annual herbs; *stems* simple below, branched above, with ascending branches,

1-3(4) dm tall, setose or occasionally strigose or hispid; *leaves* linear to oblance-linear, 1-4(6) cm long, 1-3(4.5) mm broad, obtuse, hispid, pustulate; *inflorescence* open, the spikes slender, solitary or geminate, 1-5 cm long; *bracts* evident only near the base; *calyx* in fruit 4-6 mm long, oblong-ovate, deciduous, spreading, the segments linear-lanceolate, connivent with spreading tips, midrib moderately thickened and hirsute, the margins hispid or strigose; *pedicels* obscure, about 0.5 mm long; *corolla* minute, 1-2 mm broad; *style* slightly surpassed by the nutlets; *gynobase* narrow, two-thirds as long as nutlets; *nutlets* 4, homomorphous, ovoid, 2-2.2 mm long, margins rounded, the surface finely muriculate or granulate, or verrucose, scar very narrowly linear or closed, broadly forked at the base.

Open dry ridges and slopes in the upper arid transition zone, associated with *Juni-perus*, *Pinus*, and *Artemisia*. Sierra Nevada Mountains of California eastward to the Charleston Mountains, Nevada, with an isolated collection in northwestern Colorado, Moffatt County. *Weber* and *Salamun* 12612. June to August.

23. *Cryptantha barbiger* (A. Gray) E. L. Greene

Eritrichium barbigerum A. Gray, Synop. Fl. No. Amer. 2: 194. 1878. *Krynitzkia barbiger* A. Gray, Proc. Amer. Acad. Arts 20: 273. 1885. *C. barbiger* E. L. Greene, Pittonia 1: 114. 1887. (*Parry* 171, Washington County, Utah)

Krynitzkia mixta M. E. Jones, Contr. W. Bot. 13: 6. 1910. (*M.E. Jones* 5106, St. George, Washington County, Utah)

Erect annual herbs; *stems* 1-several, erectly branched, hirsute, 1-4(5) dm tall; *leaves* oblong to lance-linear, obtuse, 1-5(7) cm long, 3-7(13) mm wide, hirsute, inconspicuously pustulate; *inflorescence* terminating the main stem and branches, the spikes usually geminate, sometimes solitary or ternate, 2-11(16) cm long; *bracts* lacking; *calyx* in fruit 4-8(10) mm long, oblong-lanceolate, ascending, the segments lance-linear, with the tips spreading or recurving, midrib moderately thickened and hirsute, the margins long white-villous; *pedicels* obscure, 0.5-0.8 mm long; *corolla* inconspicuous, 1-2 mm broad; *style* subequal to nutlets or slightly longer; *gynobase* linear; *nutlets* 1-4, homomorphous, lanceolate, 1.5-2.5 mm long,

margins rounded or slightly angled, the surface verrucose, brownish, scar linear-lanceolate, broadened at the base into a narrowly triangular areola.

Dry slopes, wash bottoms, and hillsides. Very common throughout most of the desert southwest from southeastern California and northern Baja California east through southern Nevada to southwestern Utah, Arizona, and southern New Mexico into Sonora Mexico. February to May.

24. *Cryptantha nevadensis* Nels. & Kenn.

Krynitzkia barbiger var. *inops* Brandg. Zoe 5: 228. Sept. 1906. *C. nevadensis* Nels. & Kenn. Proc. Biol. Soc. Wash. 19: 157. Nov. 1906. *C. barbiger* var. *inops* Macbr. Proc. Amer. Acad. Arts 51: 548. 1916. (*T. Brandegee* s.n. Mohave Desert.)

C. arenicola Heller, Muhlenbergia 2: 242. Dec. 1906. (*Heller* 8203, Laws, 3 miles west, Inyo Co., Calif.)

C. leptophylla Rydb. Bull. Torrey Club 36: 678. 1909. (*Palmer* 350, St. George, Utah.)

C. nevadensis var. *rigida* I. M. Johnst. Contr. Gray Herb. 74: 68. 1925. (*Pringle*, hills bordering the Mohave Desert, California, 1882)

Erect or ascending annual herbs; *stems* 1-several, slender, often flexuous, laxly branched, 1-5 dm tall, closely appressed strigose, or rarely sparsely hirsute; *leaves* linear-oblanceolate to linear, acute to obtuse, 1-4 cm long, 1-5(7) mm broad, sparsely appressed hispid, moderately pustulate; *inflorescence* lax to somewhat glomerate, spikes geminate or ternate, congested or elongate, 2.5-15 cm long; *bracts* lacking or occasionally bracted at base; *calyx* in fruit, 4-10(12) mm long, lanceolate, ascending, the segments linear-lanceolate, connivent with slender recurving tips, midrib thickened and hirsute, margins villous-setose; *pedicels* obscure about 0.5 mm long; *corolla* minute, 1-2 mm broad; *style* subequal to nutlets or a trifle shorter; *gynobase* linear about three-fourths length of nutlets; *nutlets* 4, homomorphous, lanceolate, 2-2.9 mm long, the margins obtuse, the surface mostly verrucose or somewhat muriculate near the tip, scar narrowly open and linear to nearly closed, but always with a small areola near the base.

Dry bajadas, washes, and open hillsides mainly in the *Larrea* community. The stems often supported by other vegetation. Southeastern California, northern Baja California, and eastward through Nevada to south-

western Utah and Arizona. March to May.

25. *Cryptantha gracilis* Osterh.

C. gracilis Osterh. Bull. Torrey Club 30: 236. 1903. (*Osterhout* 2589, Glenwood Springs, Garfield Co., Colorado)

C. hillmannii Nels. & Kenn. Proc. Biol. Soc. Wash. 19: 257. 1906. *C. gracilis* var. *hillmannii* Munz & Johnst. Bull. Torrey Club 49: 39. 1922. (*Hillman*, Huffaken Ranch near Reno, Nevada)

Slender erect annual herbs; *stems* 1-several, sparsely branched from the base and above, 1-2(4) dm tall, densely short setose; *leaves* mostly basal, scattered above, linear-oblong, to narrowly oblanceolate, 1-3 cm long, 1-2(3) mm wide, rounded or obtuse, setose or weakly hispid, inconspicuously pustulate; *inflorescence* open, the spikes solitary or geminate, usually glomerate, 1-2 cm long; *bracts* lacking; *calyx* in fruit 2-3 mm long, ovate, spreading, early deciduous, the segments lanceolate, midrib slightly thickened and inconspicuously setose, the margins densely setose-villous, often tawny; *pedicels* lacking; *corolla* minute, less than 1 mm broad; *style* two-thirds to three-fourths length of *nutlet*; *gynobase* about half height of *nutlet*; *nutlets* 1 or rarely 2 or 3, homomorphous, lanceolate, 1.5-2 mm long, margins mostly rounded, surface smooth and shiny, scar linear very narrowly open at least at the base.

Dry slopes and open areas in the upper Transition Zone. Southern Idaho south through Nevada to Inyo County, California, and east to western Colorado, and northern Arizona. April to July.

C. gracilis enters our area from the north, and is found only on some of the higher ranges in the Mohave Desert (Charleston Mountains and the Virgin Mountains). The species never truly grows on the dry desert lowlands.

26. *Cryptantha mohavensis* E. L. Greene

Krynitzkia mohavensis E. L. Greene, Bull. Calif. Acad. Sci. 1: 207. 1885. *C. mohavensis* E. L. Greene, Pittonia 1: 120. 1887. (*Curran*, Mohave Desert, California, 1884)

C. fallax E. L. Greene, Pittonia 5: 54. 1902. (*E. L. Greene*, mountains above Tehachapi, California, 22 June 1889)

Usually erect annual herbs; *stems* many branched, 1-4 dm tall, short-hispid to hispid-strigose; *leaves* linear to linear-lanceolate, 1-4 cm long, 1-3 mm broad, strigose or appressed setose, minutely and densely pustulate, obtuse; *inflorescence* crowded, the spikes

ternate or geminate, usually dense, 2-6 cm long; *bracts* lacking; *calyx* in fruit 3-5 mm long, oblong-ovate, ascending, deciduous, the segments lanceolate, connivent, midrib moderately thickened and often sparsely hirsute, margins commonly silky-strigose; *pedicels* obscure, ca. 0.5 mm long; *corolla* conspicuous 4-7 mm broad; *style* evidently surpassing *nutlets*; *gynobase* columnar subulate, three-fourths height of *nutlet*; *nutlets* 4, homomorphous, lance-ovate to lance-oblong, 2-2.5 mm long, margins angled and obtuse near apex, surface smooth and shiny, rarely granulate, the dorsal side flat or low convex, scar closed above but opening to form a small triangular areola at the base.

Dry sandy soils. Southeastern and southern California from Inyo and Kern counties southward to the San Gabriel Mountains and Sierra Libre. May to June.

The species just enters our flora along the western boundary of the foothills of the Sierra Nevada near Bishop south to the town of Mohave, California.

27. *Cryptantha fendleri* (A. Gray) Greene

Krynitzkia fendleri A. Gray, Proc. Amer. Acad. Arts 20: 268. 1885. *C. fendleri* Greene, Pittonia 1: 120. 1887. (*Fendler*, without locality, New Mexico, 1847)

C. ramulosissima A. Nels. Erythra 7: 68. 1899. (*Nelson* 5275, Laramie, Wyoming)

C. wyomingensis Gandoger, Bull. Soc. Bot. Fr. 65: 62. 1918. (*Nelson* 1523, Cummins, Wyoming)

Erect annual herbs; *stems* solitary with many divaricate or ascending lateral branches, 1-5 dm tall, densely spreading hispid; *leaves* narrowly oblanceolate, acute to nearly obtuse, 1-5 cm long, (1)2-4 mm broad, hispid, pustulate on the dorsal surface, much less so above; *inflorescence* broad, the spikes solitary or geminate 2-13 cm long, loosely flowered; *bracts* lacking or rarely 1 or 2 near the base; *calyx* in fruit 3-6(7.5) mm long, oblong-lanceolate, ascending the segments linear to lance-linear, slightly connivent with the tips slightly spreading, midrib thickened and hirsute, margins strigose; *pedicels* about 0.5 mm long, obscure; *corolla* inconspicuous, about 1 mm broad; *style* subequal to or slightly exceeding the *nutlets*; *gynobase* subulate, about two-thirds height of *nutlets*; *nutlets* 4, or sometimes fewer by abortion, homomorphous, lanceolate, the tips acuminate, 1.5-2 mm long, margins obtuse or

rounded, surface smooth and usually shiny, scar closed or slightly open above, below forming a triangular areola.

Open, exposed, usually sandy sites in the *Artemisia* and *Juniperus* associations, 3,500–7,000 feet elevation. Southeastern Washington and northeastern Oregon east to southern Alberta and Saskatchewan to eastern Nebraska, northern New Mexico, and Arizona. June to August.

28. *Cryptantha flava* (A. Nels.) Payson

Oreocarya flava A. Nels. Bull. Torrey Club 25: 202. 1898. *C. flava* Payson, Ann. Mo. Bot. Gard. 14: 259. 1927. (*A. Nelsoni* 3074, point of rocks, Sweetwater County, Wyoming, 1 June 1897)

O. lutescens E. L. Greene, Pittonia 4: 93. 1899. *C. confertiflora* var. *lutescens* Brand. Pflanzenr. IV. (Heft. 97) 252: 90. 1931. (*C. F. Baker*, hills about Aztec, New Mexico, 25 April 1899)

Perennial herbs; *stems* many from a multiple caudex, 1.3–4 dm tall, densely long white-hairy at the base, becoming setose and strigose upward; *leaves* narrowly oblanceolate to nearly linear, acute, 2–9 cm long, 3–8 mm wide, dorsal surface strigose and appressed setose with pustulate hairs, ventral surface almost uniformly strigose, and with the pustules less conspicuous; *inflorescence* narrow to somewhat open, 0.5–2.5 dm long, conspicuously yellow setose; *bracts* inconspicuous; *pedicels* 3–5 mm long in fruit; *calyx* 8–10 mm long in anthesis, in fruit becoming 9–12 mm long, the segments linear, densely setose, with yellowish hairs; *corolla* yellow, the tube 9–12 mm long, crests at base of tube absent or nearly so, fornicies yellow, truncate, emarginate, 1–1.5 mm long, limb 8–10 mm broad; *style* exceeding mature fruit 3–7 mm (heterostyled); *nutlets* lanceolate, 3.4–4 mm long, 1.9–2.2 mm wide, 1 or 2 usually maturing, the margins acute, in contact when more than 1 nutlet matures, both surfaces of nutlet smooth and glossy, scar straight, closed, elevated margin lacking.

Dry sandy soil often in dune areas, 4,000–7,000 feet elevation. Southwestern Wyoming, south through eastern Utah and western Colorado into northeastern Arizona and northwestern New Mexico. April to August.

29. *Cryptantha confertiflora* (Greene) Payson

Krynitzkia leucophava var. *alata* M. E. Jones, Proc. Calif. Acad. Sci. 5: 710. 1895. *Oreocarya alata* A. Nels. Coulter and Nelson, Man. Cent. Rocky

Mts. 417. 1909. (*M. E. Jones* 5144, on sandstone cliffs, Silver Reef, Utah, 3 May 1894)

Oreocarya confertiflora E. L. Greene, Pittonia 3: 112. 1896. (*S. B. Parish* 1316, Cushenberry Springs on the north side of the San Bernardino Mountains, San Bernardino County, California, 1882)

O. lutea E. L. Greene, Muhlenbergia 2: 240. 1906. name only. Feddes Rept. Spec. Nov. Regni. Veg. 19: 72. 1923. description. (*A. A. Heller* 8211, White Mountains, Inyo County, California, 9 May 1906)

Perennial herbs; *stems* 1–7, slender, 1.7–4.3 dm tall, tomentose at base, strigose and setose upward; *leaves* linear to oblanceolate, 3–12 cm long, 2–10(16) mm wide, acute, dorsal surface densely strigose and appressed setose with pustulate bases, ventral surface uniformly strigose and with few or no pustules; *inflorescence* subcapitate, 0.3–2 dm long, strigose, and with flattened, twisted, setose hairs; *bracts* inconspicuous; *calyx* in anthesis 6–8 mm long, in fruit becoming 10–14 mm long, the segments linear-lanceolate, strigose and spreading setose; *corolla* yellow, the tube 9–13 mm long, fornicies broad, emarginate, about 1 mm long, crest at base of tube evident or sometimes lacking, limb 8–10 mm wide; *heterostyled*; *nutlets* ovate or triangular-ovate, 3.5–4 mm long, 2.5–3 mm wide, usually all four maturing, margins narrowly winged, in contact, both surfaces smooth and glossy, scar straight, closed, and lacking an elevated margin.

Dry exposed sites on a wide variety of soil types. Southeastern California, eastward through southern Nevada into northern Arizona and southern Utah. April to July.

A tall handsome plant closely related to *C. flava* but having nearly capitate inflorescences and broadly ovate nutlets. The yellow flowers also tend to be lighter in color or a washed out yellow.

30. *Cryptantha capitata* (Eastw.) I. M. Johnston

Oreocarya capitata East. Leaflets W. Bot. 1: 9. 1937. *C. capitata* I. M. Johnston, J. Arnold Arbor 21: 66. 1940. (*A. Eastwood* 5969, Hermit Trail on the south rim of the Grand Canyon, Coconino County, Arizona, 9 April 1917)

Erect perennial herbs; *stems* weak, 1–several, 1.5–2.7 dm tall, appressed setose; *leaves* linear or narrowly oblanceolate, 3–8 cm long, 3–5 mm wide, dorsal surface appressed setose-pustulate, ventral surface uniformly stri-

gose and without pustules; *inflorescence* capitate, or with one or two glomerules below the terminal cluster, 0.1–0.4(7) dm long, spreading white-setose; *calyx* 7–9 mm long in anthesis, in fruit becoming 11–16 mm long, the segments linear-lanceolate, conspicuously setose-pustulate; *corolla* white, the tube 9–12 mm long, fornicies yellow, emarginate, about 1 mm long, papillose, crests at base of tube conspicuous, limb 6–8 mm wide; *style* exceeding mature fruit 4–5 mm; *nutlets* lanceolate, 4–5 mm long, 2–3 mm wide, two to four usually maturing, the margins in contact, knifelike, both surfaces glossy-smooth, scar closed, straight, and without an elevated margin.

Open or exposed somewhat sandy soils in the Transition Zone, 6,500 to 8,500 feet elevation. South central Utah and north central Arizona in the Colorado River drainage basin. April to July.

In our area this species is restricted to the Grand Canyon National Park along the Kaibab and Hermit trails, both on the north and south rims.

31. *Cryptantha fulvocanescens* (S. Wats.) Payson

Eritrichium glomeratum var. *fulvocanescens* S. Wats. Bot. King Exp. 243. 1871. *E. fulvocanescens* A. Gray, Proc. Amer. Acad. Arts 10: 61, 1875. *Krynitzkia fulvocanescens* A. Gray, Proc. Amer. Acad. Arts 20: 280. 1885. *Orcocarya fulvocanescens* E. L. Greene, Pittonia 1: 58. 1887. *C. fulvocanescens* Payson, Ann. Mo. Bot. Gard. 14: 319. 1927. (Fendler 632, near Santa Fe, Santa Fe County, New Mexico, 1847)

Krynitzkia echinoides M. E. Jones, Proc. Calif. Acad. Sci. 5: 709. 1895. *Orcocarya echinoides* Macbr. Contr. Gray Herb. 48: 31. 1916. as to synonymy, not as to specimens cited. *C. ech-*

inoides Payson, Ann. Mo. Bot. Gard. 14: 321. 1927. *C. fulvocanescens* var. *echinoides* Higgins, Great Basin Nat. 29: 30. 1969. (M. E. Jones 5297, Pahrria Canyon, Kane County, Utah, 26 May 1894)

Densely caespitose perennials from a strongly lignified taproot; *stems* many from a multiple caudex, 0.8–3 dm tall, white hairy at the base, setose-hirsute upward; *leaves* spatulate or oblanceolate, acute to obtuse, 1.5–7 cm long, 4–12 mm wide, uniformly strigose, pustules mostly confined to the dorsal surface; *inflorescence* narrow or somewhat open at maturity, 0.3–1.9 dm long, white or yellowish setose-hispid; *bracts* inconspicuous; *pedicels* 2–10 mm long; *calyx* 4–6 mm long in anthesis, in fruit becoming 9–13 mm long, the segments linear, densely white or yellowish setose-hispid; *corolla* white, the tube 7–11 mm long, fornicies yellow, emarginate or rounded, 0.7–1.3 mm long, crests at base of tube evident or lacking, limb 7–9 mm wide; *style* exceeding mature fruit 3–7 mm; *nutlets* lance-ovate, 3.5–4.5 mm long, 2–3 mm wide, one or two usually maturing, the margins acute to obtuse, in contact when more than one nutlet matures, both surfaces densely and uniformly muricate, scar open or nearly closed, elevated margin lacking.

Dry, sandy to clay soils on exposed areas in the *Artemisia* or *Juniperus-Pinus* association, 4,000 to 7,500 feet elevation. Central Utah and north central Arizona east to western Colorado and central New Mexico, with an isolated population at White Sands National Monument. April to August.

Two rather distinct varieties occur within our area and may be separated by the following key:

1. Murications on the nutlet rounded; corolla 9–13 mm long; inflorescence narrow, white setose at maturity; usually growing on sandy soils var. *fulvocanescens*
- Murications on the nutlet with one or two setose projections; corolla 7–9 mm long; inflorescence broader and usually yellowish setose-hispid at maturity; usually growing on clay soils var. *echinoides* (Jones) Higgins

The variety *echinoides* is limited in our area to north central Arizona and north-eastern New Mexico.

32. *Cryptantha oblata* (M. E. Jones) Payson

Krynitzkia oblata M. E. Jones, Contr. W. Bot. 13: 4. 1910. *Orcocarya oblata* Macbr. Proc. Amer. Acad. Arts 51: 548. 1916. *Hemisphaerocarya ob-*

lata Brand, Feddes Repert. Spec. Nov. Regni Veg. 24: 61. 1927. *C. oblata* Payson, Ann. Mo. Bot. Gard. 14: 254. 1927. (M. E. Jones 3579, El Paso, Texas, 23 April 1884)

O. hispidissima Wootton & Standl. Contr. U. S. Natl. Herb. 19: 545. 1915. not *O. hispidissima* (Torr.) Rydb. (Wright 1566, near El Paso and Dona Ana, March to April)

Perennial or biennial herb; *stems* several, 1–3.5 dm tall, retrorsely setose and spreading hirsute; *leaves* oblanceolate, acute, 3–10 cm long, 4–14 mm wide, coarsely strigose and setose dorsally with conspicuous pustules, ventral surface weakly strigose-setose, and with fewer pustulate hairs, the petioles ciliate-margined; *inflorescence* somewhat open, especially in age, 0.3–2 dm long, setose-hirsute; *calyx* 5–7 mm long in anthesis, becoming 8–10 mm long in fruit, the segments linear-lanceolate, densely setose-hirsute; *corolla* white, tube 7–10 mm long, crests at base of tube lacking, fornicies yellow, broad, papillose, limb 8–12 mm wide; *style* 3–5 mm longer than mature fruit; *nutlets* ovoid, usually all four maturing, the margins narrowly separated, acute, 2.5–3 mm long, 2–2.5 mm wide, dorsal surface rugose-tuberculate, ventral surface smooth or slightly uneven, scar closed, straight, and without an elevated margin.

Sandy or gravelly to rocky hillsides mostly on gypsum soils, 1,000 to 5,000 feet elevation. South central New Mexico south through Trans-Pecos Texas into northern Mexico. March to September.

This species is only one of the many gypsumophilous plants that occur in the southeastern part of our area.

33. *Cryptantha paysonii* (Macbr.) I. M. Johnston

Oreocarya paysonii Macbr. Contr. Gray Herb. 48: 36. 1916. *Hemisphaerocarya paysonii* Brand. Feddes Repert. Spec. Nov. Regni. Veg. 24: 61. 1927. *C. paysonii* I. M. Johnston. Wrightia 2: 160. 1961. (*O. B. Metcalfe* 1576, limestone hills at Berendo Creek, Sierra County, New Mexico, 12 May 1905)

Caespitose perennials; *stems* erect, stout, (0.5)1.6–2.9 dm tall, strigose and more or less spreading setose; *leaves* oblanceolate, obtuse to acute, 3–9 cm long, 5–15 mm wide, dorsal surface finely strigose or subtomentose, also setose with pustulate hairs, ventral surface similar but with fewer pustulate hairs; *inflorescence* subcapitate, consisting of four to six compact cymules, 0.5–1.2 dm long, setose; *calyx* 7–9 mm long in anthesis, becoming 9–10 mm long in fruit, the segments linear-lanceolate, setose; *corolla* white to yellowish tinged, the tube 12–14 mm long, crests at base of tube lacking, fornicies yellow, rounded, densely papillose, 0.5–1 mm long, limb 10–13 mm wide; *heterostyled*; *nutlets*

ovate, 2.7–3 mm long, 2–2.5 mm wide, usually all four nutlets maturing, margins narrowly winged, in contact, both surfaces finely rugulose or finely tuberculate, scar closed, straight, lacking an elevated margin.

Gravelly or rocky hillsides mostly on gypsum or limestone soils, 4,000–7,500 feet elevation. Southeastern New Mexico and Trans-Pecos Texas in Culberson County. April to June.

34. *Cryptantha paradoxa* (A. Nels.) Payson

Oreocarya paradoxa A. Nels. Bot. Gaz. 56: 69. 1913. *C. paradoxa* Payson, Ann. Mo. Bot. Gard. 14: 330. 1927. (*E. P. Walker* 91, dry gypsum hills in Paradox Valley, Montrose County, Colorado, 17 June 1912)

O. gypsophila Payson, Bot. Gaz. 60: 380. 1915. (*Payson* 458, dry gypsum hills in Paradox Valley, Colorado, 18 June 1914)

Small perennial herbs; *stems* 1–several, slender, 0.4–1.2 dm tall, subtomentose near the base, weakly setose above; *leaves* oblanceolate to spatulate, usually folded, obtuse, 1.5–4 cm long, 2–4(7) mm wide, dorsal surface with appressed setose-pustulate hairs, ventral surface uniformly strigose and without pustulate hairs, the petioles ciliate-margined; *inflorescence* subcapitate, 0.1–0.4 dm long, setose; *bracts* inconspicuous; *calyx* in anthesis 5–6 mm long, in fruit becoming 6–8 mm long, the segments linear-lanceolate, weakly setose; *corolla* white with a yellow tube 10–12 mm long, crests at base of tube lacking, fornicies yellow, broad, slightly emarginate, papillose, 0.5 mm long, limb 10–12 mm wide; *style* exceeding mature fruit 4–9 mm; *nutlets* lanceolate, turgid, 2–3 mm long, 1.3–1.6 mm wide, all four usually maturing, margins acute to obtuse, not in contact, dorsal surface densely tuberculate and conspicuously rugose, ventral surface tuberculate, also somewhat rugulose, scar open, constricted below the middle, the margin elevated.

Dry, sandy, gravelly, or clay soils, 4,000 to 7,500 feet elevation. Emery County, Utah, western Colorado, and San Juan County, New Mexico. May to June.

In our area known only from one collection by Duane Atwood 2527, 12 miles west of Shiprock on Hwy 504, 15 May 1970.

35. *Cryptantha bakeri* (E. L. Greene) Payson

Oreocarya bakeri E. L. Greene. Pittonia 4: 92. 1899. *C. bakeri* Payson, Ann. Mo. Bot. Gard. 14: 331. 1927. (*Baker, Earle, and Tracy* 827, Mancos

River sage plains in southern Colorado, 8 July 1898)

O. culophus Rydb. Bull. Torrey Club 31: 637. 1904. (Crandall, Delores, Colorado, 1892)

Biennial or short-lived perennials; *stems* stout, 1–3 dm tall, spreading setose-hirsute; *leaves* oblanceolate, obtuse, mostly basal, 3–6 cm long, 5–12 mm wide, dorsal surface strigose and spreading setose, pustulate, ventral surface uniformly strigose and with few or no pustulate hairs; *inflorescence* narrow, 0.6–2.5 dm long, setose-hirsute; *bracts* evident, slightly surpassing the individual cymes; *calyx* in anthesis 3.5–4 mm long, in fruit becoming 6–8 mm long, the segments broadly lanceolate or ovate, conspicuously setose; *corolla* white, the tube 4–6 mm long, crests at base of tube lacking, fornices yellow, emarginate, 1–1.5 mm long, limb 6–8 mm wide; *style* exceeding mature fruit 1–2 mm; *nutlets* ovate-lanceolate, 2.5–3 mm long, 1.5–2 mm wide, three to four usually maturing, margins obtuse, nearly in contact, dorsal surface deeply and sharply rugose, ventral surface tuberculate and short rugose, scar closed, surrounded by a definitely elevated white margin.

Dry sandy or clay soils in *Pinyon-Juniper* community 4,000 to 8,000 feet elevation. Southeastern Utah, northeastern Arizona in Apache and Navajo counties, and Southwestern Colorado. May to August.

A species closely allied with *C. flavoculata* but having a shorter style and corolla, and the nutlet scar tightly closed.

36. *Cryptantha flavoculata* (A. Nels.) Payson

Oreocarya flavoculata A. Nels. Erythea 7: 66. 1899.

C. flavoculata Payson, Ann. Mo. Bot. Gard. 14: 334. 1927. (A. Nelson 4572, Piedmont, Wyoming, 7 June 1898)

O. flavoculata spatulata A. Nels. Erythea 7: 67. 1899. (A. Nelson 2977, gravelly hilltops near Evanston, Wyoming, 29 May 1897)

O. cristata Eastw. Bull. Torrey Club 30: 244. 1903. (Eastwood, Grand Junction, Colorado, 17 May 1893)

O. shockleyi Eastw. Bull. Torrey Club 30: 245. 1903. (Shockley 244, Miller Mountain, Esmeralda County, Nevada)

O. eastwoodae Nels. & Kenn. Muhlenbergia 3: 141. 1908. (Kennedy & Goodling 146, Mormon Mountains, Lincoln County, Nevada)

Caespitose perennial herbs; *stems* 1–several, slender, 1–3.7 dm tall, strigose and spreading setose with slender bristles; *leaves* linear-oblanceolate to spatulate, obtuse or

sometimes acute, 3–11 cm long, 3–15 mm wide, densely strigose and weakly setose, dorsal surface conspicuously pustulate, ventral surface with few pustules and sometimes silky-strigose; *inflorescence* narrow, or sometimes slightly open and lax, 0.5–3 dm long; *bracts* evident but not conspicuous; *calyx* 5–6 mm long in anthesis, in fruit becoming 8–10 mm long, the segments lanceolate to ovate; *corolla* white or pale yellow, the tube usually yellow, 7–10 mm long, crests at base of tube lacking, fornices yellow, minutely papillose, 1–2 mm long, limb 8–12 mm wide; *style* exceeding mature fruit 4–8 mm (heterostyled); *nutlets* lanceolate to lance-ovate, 2.5–3.5 mm long, 1.8–2 mm wide, usually all four maturing, margins obtuse, in contact or slightly separated, dorsal surface muricate, tuberculate, and with conspicuous ridges, sometimes nearly foveolate, ventral surface tuberculate, rarely with ridges, scar open, constricted near the middle and surrounded by a high, elevated margin.

On a wide variety of soils mostly in the *Pinyon-Juniper* community, but also occurring in the *Artemisia* and the *Spruce-Fir* communities, 3,000–8,500 feet elevation. East central California eastward through Nevada and Utah into southwestern Wyoming, western Colorado, and northern Arizona. April to July.

37. *Cryptantha tenuis* (Eastw.) Payson

Oreocarya tenuis Eastw. Bull. Torrey Club 30: 244.

1903. *C. tenuis* Payson, Ann. Mo. Bot. Gard. 14: 327. 1927. (A. Eastwood, near Moab, in Court House Wash, Grand County, Utah, 25 May 1892)

Caespitose perennial herbs; *stems* slender, 1–many, 1.3–2.5 dm tall, strigose and weakly spreading setose; *leaves* linear-spatulate, mostly basal, obtuse, 2–5 cm long, 3–6 mm wide, dorsal surface strigose and weakly spreading setose, evidently pustulate, ventral surface uniformly strigose and without pustules; *inflorescence* narrow, interrupted, 0.6–1.4 cm long, weakly setose; *bracts* inconspicuous; *calyx* 4.5–6 mm long in anthesis, in fruit becoming 7–9 mm long, the segments linear-lanceolate, white-setose; *corolla* white, somewhat campanulate, the tube 5.5–7 mm long, crests at base of tube lacking or sometimes evident, fornices yellow, broad, emarginate, papillose, limb 5–8 mm wide; *style* ex-

ceeding mature fruit 3-4 mm; *nutlets* lanceolate, 3-4 mm long, 1.8-2 mm wide, all four usually maturing, margins acute, nearly in contact, dorsal surface carinate, sharply and deeply rugose, ventral surface rugose, scar open, constricted above the base, and with an elevated margin.

Dry, sandy, or clayey exposed slopes and benches, 2,500 to 5,500 feet elevation. Southeastern Utah in Emery, Grand, Wayne, and San Juan counties. The species undoubtedly also occurs in northeastern Arizona, because several collections from San Juan County, Utah, have been made within less than a mile of the Arizona border and may have been within Arizona; it would be very hard to tell exactly where the boundary is in this remote area. April to July.

38. *Cryptantha jamesii* (Torr.) Payson

Eritrichium jamesii Torr. in Marcy, Expl. Red River 262. 1854. *Krynitzkia jamesii* A. Gray, Proc. Amer. Acad. Arts 20: 278. 1885 in part. (*James*, barren deserts high upon the Platte)

E. multicaule Torr. in Marcy, Expl. Red River 262. 1854. *Oreocarya multicaulis* E. L. Greene, Pittonia 3: 114. 1896. *O. suffruticosa* var. *multicaulis* Payson, Univ. Wyo. Pub. Bot. 1: 171. 1926. *Hemisphaerocarya suffruticosa* var. *multicaulis* Brand, Feddes Repert. Spec. Nov. Regni. Veg. 24: 60. 1927. *C. jamesii* var. *multicaulis* Payson, Ann. Mo. Bot. Gard. 14: 244. 1927. (*Fendler* 636, near Santa Fe, New Mexico, 1847) = var. *multicaulis*.

O. abortiva E. L. Greene, Pittonia 3: 114. 1896. *Krynitzkia multicaulis* var. *abortiva* M. E. Jones, Contr. W. Bot. 13: 5. 1910. *O. suffruticosa* var. *abortiva* Macbr. Proc. Amer. Acad. Arts 51: 547. 1916. *Hemisphaerocarya abortiva* Brand, Feddes Repert. Spec. Nov. Regni. Veg. 24: 61. 1927. *C. jamesii* var. *abortiva* Payson, Ann. Mo. Bot. Gard. 14: 250. 1927. (*S. B. Parish* 3694, Bear Valley, San Bernardino Mountains, California, 16-20 June 1895) = var. *abortiva*.

O. cinerea E. L. Greene, Pittonia 3: 113. 1896. *O. multicaulis* var. *cinerea* Macbr. Proc. Amer. Acad. Arts 51: 54. 1916. *O. suffruticosa* var. *cinerea* Payson, Univ. Wyo. Publ. Bot. 1: 171. 1926. *Hemisphaerocarya cinerea* Brand, Feddes Repert. Spec. Nov. Regni. Veg. 24: 61. 1927. *C. jamesii* var. *cinerea* Payson, Ann. Mo. Bot. Gard. 14: 246. 1927. (*E. L. Greene*, southern Colorado, on the plains near Pueblo, 1873) = var. *setosa*.

O. disticha Eastw. Bull. Torrey Club 30: 238. 1903. *C. jamesii* var. *disticha* Payson, Ann. Mo. Bot. Gard. 14: 248. 1927. (*A. Eastwood* 90, on Bartons Range, San Juan County, Utah, 13 July 1895) = var. *disticha*.

Krynitzkia multicaulis var. *setosa* M. E. Jones, Contr. W. Bot. 13: 4. 1910. *Hemisphaerocarya*

suffruticosa var. *setosa* Brand, Feddes Repert. Spec. Nov. Regni. Veg. 24: 60. 1927. *C. jamesii* var. *setosa* I. M. Johnst. ex Tidestrom, Proc. Biol. Soc. Wash. 48: 42. 1935. (*M. E. Jones*, near Fort Cove, Utah, 27 June 1901)

O. pustulosa Rydb. Bull. Torrey Club 40: 480. 1913. *C. pustulosa* Payson, Ann. Mo. Bot. Gard. 14: 252. 1927. *H. suffruticosa* var. *pustulosa* Brand, Feddes Repert. Spec. Nov. Regni. Veg. 24: 60. 1927. *C. jamesii* var. *pustulosa* Harrington, Man. Pl. Colorado 466, 641. 1954. (*Rydberg & Garrett* 9320, Hammond Canyon on the Elk Mountains, San Juan County, Utah, 31 July 1911) = var. *pustulosa*

O. multicaulis var. *laxa* Macbr. Contr. Gray Herb. 48: 35. 1916. *H. laxa* Brand, Feddes Repert. Spec. Nov. Regni. Veg. 24: 60. 1927. *C. jamesii* var. *laxa* Payson, Ann. Mo. Bot. Gard. 14: 246. 1927. (*C. G. Pringle* 776, on sand hills near Paso del Norte, Chihuahua, Mexico, 20 September 1886) = var. *laxa*.

Erect to caespitose perennials; *stems* 1-many, 1-6 dm tall, glabrous to evidently hirsute; *leaves* linear to broadly oblanceolate, obtuse to acute, 2-15 cm long, 2-15 mm wide, glabrous to hirsute, usually pustulate dorsally, ventral surface lacking pustules or the pustules very inconspicuous; *inflorescence* open, the cymules usually elongating, tomentose to setose-hirsute; *bracts* inconspicuous to very evident; *calyx* in anthesis 3-4 mm long, in fruit becoming 5-7 mm long, the segments ovate-lanceolate, subtomentose to setose-hirsute or sometime nearly glabrous; *corolla* white, the tube 2.5-3 mm long, crests at base of tube conspicuous, fornice light-yellow, emarginate, 0.5-1 mm long, limb 5-8 broad; *style* exceeding mature fruit 1-3 mm; *fruit* oblate-ovoid; *nutlets* ovate-lanceolate, 1-4 maturing, 2-2.5 mm long, 1.5-2 mm wide, the margins not in contact, acute, both surfaces smooth and glossy, scar straight, closed, extending from the base to near the apex, elevated margin lacking.

In a wide variety of habitats and on very sandy to extremely gumbo clays, 2,000 to 10,500 feet elevation. Southeastern California eastward through southern Nevada and Utah into Wyoming, South Dakota, southward through the high plains into northern Mexico, also northern Arizona and most of New Mexico. April to October.

Cryptantha jamesii is a wide-ranging heteromorphic species with a number of diverse growth forms. These growth forms correlated with soil types and altitudinal differences form the basis for the various varieties.

1. Ventral surface of the leaves glabrous, the petioles not ciliate margined, or tufted at the base of the plant; in our area limited to northeastern Arizona and northwestern New Mexico var. *pustulosa* (Rydb.) Harrington
- Ventral surface of leaves strigose or setose, the petioles ciliate margined, leaves usually tufted at the base of plant 2
- 2(1). Stems simple, not branched above the base 3
- Stems branched from the base as well as above 5
- 3(2). Stems 1–4.4 dm long, usually twice as long as the basal tuft of leaves; wide-spread variety throughout the higher elevations in Arizona and New Mexico of our area var. *multicaulis* (Torr.) Payson
- Stems 0.2–0.9 dm long, usually not exceeding the basal tuft of leaves 4
- 4(3). Flora bracts exceeding the cymules; stems low, decumbent; mountains of southern California and Nevada var. *abortiva* (Greene) Payson
- Flora bracts not exceeding the cymules; stems erect or nearly so; common on *Artemisia* flats and in the Pinyon-Juniper community, in our area confined to northern Arizona and New Mexico var. *setosa* (Jones) Johnst. ex Tidestr.
- 5(2). Stems decumbent or ascending; plants of the great plains var. *jamesii*
- Stems erect 6
- 6(5). Leaves linear; cymules 8 cm long or longer, very lax; in our area confined to sand hills in the vicinity of Las Cruces, New Mexico var. *laxa* (Macbr.) Payson
- Leaves oblanceolate, cymules usually shorter than 8 cm long and more congested; in our area limited to northern Arizona and northwestern New Mexico on sandy dune areas var. *disticha* (Eastw.) Payson

39. *Cryptantha atwoodii* Higgins

C. atwoodii Higgins. Southw. Naturalist 19: (2) 127–130. 1974. (*D. Atwood* 2624, 7 miles north of Junction Hwy 89/164 on Hwy 89, Coconino County, Arizona, 20 May 1970)

Biennial or short-lived perennial herbs; stems several, arising from the branched caudex, 0.5–3 dm tall, spreading setose with slender somewhat stiffened hairs; leaves oblanceolate, folded, obtuse, 1–4 cm long, 2–6 mm wide, setose on both surfaces, conspicuously pustulate on the dorsal side; inflorescence capitate or with several reduced clusters below the terminal cymule, 0.1–1.3 dm long; calyx 3–4 mm long in anthesis, in fruit becoming 5–7 mm long, the segments lanceolate, setose; corolla white, the tube 4–4.5 mm long, crests at base of tube lacking, fornices yellow, rounded, 0.5 mm long, limb 5–8 mm broad; style exceeding mature fruit 1.5–3 mm; fruit depressed globular; nutlets ovate, 1.9–2.5 mm long, 1.8–2 mm wide, usually all four maturing, margins acute, not in contact, both surfaces smooth and glossy, opaque, scar straight, closed, extending from the base to near the apex, elevated margin lacking.

Dry hillsides in shaley soil. A very narrow endemic from Coconino County, Arizona, all collections coming from the area about 7 miles south of the gap along Hwy 89. April to May.

The area in which this species grows is extremely overgrazed. It was noted that the sheep in the area also utilized this plant for food, although it is not very palatable; also the individual plants are extremely hard to find. *C. atwoodii* is one of those rare endemics that should be protected.

40. *Cryptantha palmeri* (A. Gray) Payson

Krynitzkia palmeri A. Gray. Proc. Amer. Acad. Arts 20: 278. 1885. *Oreocarya palmeri* Greene. Pittonia 1: 57. 1887. *Hemisphaerocarya palmeri* Brand, Feddes Repert. Spec. Nov. Regni. Veg. 24: 61. 1927. (*Palmer* 595, 40 miles south of Saltillo, Coahuila, Mexico, March 1880)

C. coryi I. M. Johnst. J. Arnold Arbor 20: 396. 1939. (*V. L. Cory*, s.n., about 2 miles west of Longfellow, Pecos County, Texas, 15 April 1936)

Biennial or short-lived perennials; stems 1–several, 1.7–4 dm tall, spreading setose or hirsute; leaves linear-lanceolate, acute, 3–10(16) cm long, 4–10 mm wide, strigose and subtomentose, pustulate hairs con-

spicuous on the dorsal surface, fewer and not evident on the ventral surface; *inflorescence* broad topped due to the elongation of the cymules in age, 0.3–2.7 dm long, setose; *bracts* inconspicuous; *calyx* 4–6 mm long in anthesis, in fruit becoming 7–10 mm long, the segments lanceolate, setose or weakly hispid; *corolla* white, the tube 4–6 mm long, crests at base of tube lacking, fornices yellow, rounded, papillose, 0.5–1 mm long, limb 7–9 mm wide; *style* exceeding mature fruit 2–3.5 mm; *nutlets* ovate, 2.5–2.8 mm long, 2–2.7 mm wide, the margins not in contact, acute, both surfaces of the nutlet smooth and glossy, scar tightly closed and without an elevated margin.

Gravelly to rock hillsides on gypsum, 1,000–4,000 feet elevation. Southeastern New Mexico, western Texas, and northern Mexico in the states of Nuevo Leon and Coahuila. April to July.

A Chihuahuan Desert species that just enters our area in southeastern New Mexico. It is found almost exclusively on gypsum or limestone soils.

41. *Cryptantha setosissima* (A. Gray) Payson
Eritrichium setosissima A. Gray, Proc. Amer. Acad. Arts 12: 80. 1877. *Krynitzkia setosissima* A. Gray, Proc. Amer. Acad. Arts 20: 276. 1885. *O. setosissima* E. L. Greene, Pittonia 1: 58. 1887. (L. F. Ward 646, at Fish Lake, Sevier County, Utah, 25 August 1875)

Biennial or short-lived robust perennial herbs; *stems* 1–3, erect, 3–10 dm tall, hirsute; *leaves* clustered at the base, reduced upward, oblanceolate, 3–13 cm long, 5–15 mm wide, setose, with some finer twisted pubescence beneath, pustulate hairs numerous on both surfaces; *inflorescence* broad topped due to the elongation of the scorpioid racemes, 1–5 dm long; *calyx* 4–6 mm long in anthesis, in fruit becoming 9–11 mm long, the segments broadly lanceolate or ovate, setose; *corolla* white, the tube 3–5 mm long, constricted above the ovary by the conspicuous ring of crests, fornices yellow, emarginate, about 0.5 mm long, limb 7–9 mm broad; *style* exceeding mature fruit 1–2 mm; *nutlets* ovate, 5–6 mm long, 3.5–4.5 mm wide, papery, with a broad winged margin, dorsal surface muricate and inconspicuously rugose or tuberculate, ventral surface smooth or nearly so, scar straight, narrow, slightly open, elevated margin lacking.

Gravelly to sandy soils in the *Pinyon-Juniper* association or the *Spruce-Fir* association, 6,000 to 11,000 feet elevation. Nye County, Nevada, eastward to central Utah and south-eastward in the mountainous areas of Arizona to Greenlee County.

This is one of the most distinctive species in the entire genus, with its stout, strict, solitary stems, and its broadly winged nutlets.

42. *Cryptantha thyriflora* (E. L. Greene) Payson

Eritrichium glomeratum var. *hispidissimum* Torr. Bot. Mex. Bound. 140. 1859 in part. *O. hispidissima* Rydb. Bull. Torrey Club 33: 150. 1906. (Type not given)

Orocarya thyriflora E. L. Greene, Pittonia 3: 111. 1896. *C. thyriflora* Payson, Ann. Mo. Bot. Gard. 14: 283. 1927. (E. L. Greene, Cheyenne, Wyoming, 6 July 1892)

O. urticacea Wooton & Standl. Contr. U. S. Natl. Herb. 16: 166. 1913. (A. A. & E. G. Heller 3731, Canyoncito, Santa Fe County, New Mexico, 18 June 1897)

O. monosperma Osterh. Bull. Torrey Club 46: 55. 1919. (Osterhout 5754, Trinidad, Las Animas County, Colorado, 20 July 1918)

Short-lived perennials or sometimes biennial; *stems* stout, 1–several, arising from the base, 1.7–4 dm tall, very hispid; *leaves* oblanceolate, obtuse, 5–12 cm long, 5–14 mm wide, spreading setose or hispid, pustulate on both surfaces; *inflorescence* very broad 1–3 cm long, 0.6–2.5 dm wide, setose or hispid; *bracts* 2–3 cm long, but hidden by the elongate cymules; *calyx* in anthesis 3–4 mm long, in fruit becoming 6–9 mm long, the segments linear, setose; *corolla* white, the tube 3–4 mm long, crests at base of tube conspicuous, fornices yellow, emarginate, papillose, about 0.5 mm long, limb 5–8 mm wide; *style* exceeding mature fruit 1–1.5 mm; *nutlets* ovate to ovate-lanceolate, 2.5–3.5 mm long, 1.5–2 mm wide, usually 2 to 4 maturing, acute, margins in contact, dorsal surface low rugulose and tuberculate, sometimes with murications between the rugae, ventral surface similar but with fewer ridges or sometimes almost smooth, scar subulate, the margin not elevated.

Plains, foothills, and mountain slopes, 4,500–9,600 feet elevation. Southeastern Wyoming and western Nebraska, south through the eastern two thirds of Colorado into northeastern New Mexico and the Oklahoma Panhandle. May to September.

This is a very striking and handsome plant, especially when in full flower. The very broad and rounded inflorescence easily separates this species from others in the genus. In our area restricted to the northeast quarter of New Mexico.

43. *Cryptantha osterhoutii* (Payson) Payson
Oreocarya osterhoutii Payson, Univ. Wyó. Publ. Bot. 1: 167. 1926. *C. osterhoutii* Payson, Ann. Mo. Bot. Gard. 14: 329. 1927. (*G. E. Osterhout 6138*, Monument Park, near Grand Junction, Mesa County, Colorado, 3 June 1921)

Densely caespitose perennials; *stems* slender, many arising from the densely branched multiple caudex, 0.7–1.2 dm tall, strigose and spreading setose; *leaves* spatulate to oblanceolate, obtuse, 1–3 cm long, 3–8 mm wide, dorsal surface strigose and appressed setose, pustulate, ventral surface strigose, the pustules mostly lacking; *inflorescence* open, 0.3–0.8 dm long, weakly white-setose; *bracts* inconspicuous; *calyx* in anthesis 2.5–4 mm long, in fruit becoming 5–6.5 mm long, the segments lanceolate, strigose and spreading setose; *corolla* white, the tube 2–3 mm long, crests at base of tube usually evident but poorly developed, fornicies yellow, broad, emarginate, papillose, about 0.5 mm long, limb 5–7 mm wide; *style* exceeding mature fruit 0.2–0.7 mm; *nutlets* lanceolate, 2.7–3.2 mm long, 1.8–2.2 mm wide, usually less than four maturing, margins obtuse, not in contact, dorsal surface carinate, sharply tuberculate and rugose, ventral surface sharply tuberculate, scar open, constricted above the base, elevated margin evident but not conspicuous.

Sandy benches and rocky hillsides, 2,500–6,000 feet elevation. Southeastern Utah, and just into northeastern Arizona and Mesa County, Colorado. May to June.

A striking little plant that reaches its greatest concentration in the Canyonlands National Park area of southeastern Utah.

44. *Cryptantha insolita* (Macbr.) Payson
Oreocarya insolita Macbr. Contr. Gray Herb. 48: 28. 1916. *C. insolita* Payson, Ann. Mo. Bot. Gard. 14: 273. 1927. (*L. N. Gooding 2286*, Las Vegas, Clark County, Nevada, 4 May 1905)

Biennial or short-lived perennial from a slender taproot; *stems* 1–several, 3–4 dm tall, strigose and abundantly setose; *leaves* spatulate, mostly basal, obtuse, 3–5 cm long, 5–14 mm wide, dorsal surface subtomentose and

sparsely appressed setose pustulate, ventral surface similar but the setae smaller and fewer, pustules few and inconspicuous, petioles long-hairy at the base; *inflorescence* open, 0.7–1.4 dm long, cymes few, much elongating, weakly setose; *bracts* inconspicuous; *calyx* in anthesis 3.5–4.5 mm long, in fruit becoming 7–9 mm long, the segments linear lanceolate, densely hirsute; *corolla* white, the tube 3–4 mm long, crests at base of tube well developed, fornicies yellow, slightly emarginate, papillose, 0.5–1 mm long, limb 6–8 mm wide; *style* exceeding mature fruit 1–1.5 mm; *nutlets* ovate to lanceolate, 3.7–4 mm long, one to four maturing, the margins acute, in contact or nearly so, dorsal surface carinate, tuberculate, granulo-muricate and sometimes slightly rugose, ventral surface tuberculate and somewhat rugulose, scar narrow but open, the margin showing some tendency to become elevated.

Alkaline flats and rolling hills, 1,900–2,500 feet elevation. Known only from the region of Las Vegas, Nevada. April to June.

A rare endemic that may no longer exist because of the urbanization of the area of Las Vegas. The two known collections were labeled Las Vegas, so may have occurred in what is now the city or could possibly exist in outlying regions near the town.

45. *Cryptantha virginensis* (M. E. Jones) Payson
Krynitzkia glomerata var. *virginensis* M. E. Jones, Contr. W. Bot. 13: 5. 1910. *Oreocarya virginensis* Macbr. Proc. Amer. Acad. Arts 51: 547. 1916. *C. virginensis* Payson, Ann. Mo. Bot. Gard. 14: 274. 1927. (*M. E. Jones 5195a*, Laverkin, Washington County, Utah, 8 May 1894)

Biennial herbs; *stems* 1–several, from a stout taproot, 1.5–3(4) dm tall, setose-hirsute with spreading bristles; *leaves* oblanceolate to spatulate, obtuse, 3–10(12) cm long, 5–15 mm wide, dorsal surface sparsely setose, pustulate, also with some fine tangled pubescence beneath, ventral surface subtomentose and weakly appressed setose, with only a few pustulate hairs; *inflorescence* a broad thyrus with the many individual cymes much elongating, 0.5–3 dm long; *bracts* conspicuous; *calyx* in anthesis 3–4 mm long, in fruit becoming 7–11 mm long, the segments linear-lanceolate, hirsute; *corolla* white, the tube 3–4 mm long, crests at base of tube conspicuous, fornicies yellow, emarginate

nate, papillose, about 1 mm long, limb 7-9 mm wide; *style* exceeding mature fruit 1-1.5 mm; *nutlets* ovate, 3.3-4.5 mm long, 2.4-2.6 mm broad, usually only one or two nutlets maturing, margins in contact, acute, dorsal surface with a distinct ridge, the surface tuberculate and usually rugulose, ventral surface very uneven with indeterminate rugae and tubercles, scar open and triangular, with an elevated margin.

Gravelly to clay soils mostly in the lower sonoran zone, 2,000-8,000 feet elevation. Southeastern California in Inyo and San Bernardino counties, eastward through southern Nevada into Washington County, Utah, and southward into Mohave and Coconino counties of Arizona. March to July.

Unlike most of the species of *Cryptantha*, this showy plant has very fragrant flowers.

46. *Cryptantha hoffmannii* I. M. Johnston.

C. hoffmannii I. M. Johnston. Contr. Arnold Arbor. 3: 90. 1932. *Oreocarya hoffmannii* Abrams, Ill. Fl. Pacif. States 3: 600. 1951. (*R. Hoffman* 78, rocky open slopes of Westguard Pass, Inyo County, California, 11 July 1930)

Biennial herbs; *stems* 1-several, 1.7-3(4) dm tall, conspicuously hirsute; *leaves* spatulate, crowded at the base, reduced upward, 2-5 cm long, 5-12 mm wide, spreading setose-hirsute, pustulate on both surfaces, but more so dorsally; *inflorescence* broad topped, interrupted, 1-2.8 dm long; *bracts* evident but not inconspicuous; *calyx* in anthesis 3-5 mm long, in fruit becoming 5-8 mm long, the segments lanceolate, hirsute-hispid; *corolla* white, the tube 3-4 mm long, crests at base of tube evident, fornicies yellow, rounded, 0.5 mm long, papillose, limb 5-7 mm wide; *style* exceeding mature fruit 0.2-0.8 mm; *nutlets* ovate, 3-3.5 mm long, 2-2.5 mm wide, 2-4 nutlets maturing, the margins in contact, acute, both surfaces irregularly low rugose and minutely tuberculate, the dorsal with a low inconspicuous crest, scar open, triangular, with an elevated margin.

Gravelly soils in the *Pinyon-Juniper* association to the upper transition zone, 7,000-9,000 feet elevation. Southeastern California in Inyo County and just across the border into Nevada, mostly confined to the area of Westguard Pass. June to July.

48. *Cryptantha abata* I. M. Johnston

Krymitzka depressa M. E. Jones, Contr. W. Bot. 13: 5. 1910. not *C. depressa* A. Nels. Bot. Gaz.

34: 29. 1902. *Oreocarya depressa* Macbr. Contr. Gray Herb. 48: 32. 1916. *C. modesta* Payson, Ann. Mo. Bot. Gard. 14: 278. 1927. not *C. modesta* Brand. Feddes Report. Spec. Nov. Regni. Veg. 24: 48. 1924. *C. abata* I. M. Johnston. J. Arnold Arbor. 24: 240. 1928. (*M. E. Jones* 6692, Aunni, Nevada, 20 June 1893)

Long-lived perennial caespitose herbs; *stems* many, 0.5-1.8 dm tall, strigose and weakly setose; *leaves* oblanceolate to spatulate, obtuse, strigose, setose, and subtomentose, the petioles ciliate margined; *inflorescence* narrow, short, 0.2-0.8 dm long; *calyx* in anthesis 2.5-4 mm long, in fruit becoming 5-8 mm long, setose; *corolla* white, the tube 3-4 mm long, crests at base of tube conspicuous, fornicies yellow, rounded, papillose, about 0.5 mm long, limb 7-8 mm wide; *style* exceeding mature fruit 0.5-1 mm; *nutlets* in contact, obtuse to acute, dorsal surface carinate, tuberculate, muricate and sometimes with low inconspicuous ridges, ventral surface deeply and irregularly rugose, scar open, triangular, surrounded by a slightly elevated margin.

Sandy to gravelly soils in the *Artemisia* and *Pinyon-Juniper* association, 4,000-9,000 feet elevation. Extreme eastern Nevada, south and western Utah, and Mohave County, Arizona. April to July.

Cryptantha abata is a tufted, often mat-forming plant. It is extremely rare in our flora but becomes very common at moderate elevations in Garfield and Piute counties, Utah.

49. *Cryptantha humilis* (A. Gray) Payson

Etrichium glomeratum var. *humile* A. Gray, Proc. Amer. Acad. Arts 10: 61. 1875. *Oreocarya humilis* Payson, Ann. Mo. Bot. Gard. 14: 278. 1927. (*Bolander*, Summit Station, Donner Pass, Nevada County, California, 1871)
C. nana var. *ovina* Payson, Ann. Mo. Bot. Gard. 14: 314. 1927. *C. humilis* var. *ovina* Higgins, Brigham Young Univ. Sci. Bull. 13: no. 4. 37. 1971. (*G. H. Bentley*, vicinity of Currant, Nye County, Nevada, June 1916)

Short-lived perennial herbs; *stems* many, 0.5-3 dm tall, strigose to spreading setose-hirsute; *leaves* oblanceolate to spatulate, 1-6 cm long, 2-12 cm wide, strigose, setose, or subtomentose, pustulate on both surfaces; *inflorescence* narrowly cylindrical to open and lax, 0.2-1.8 cm long, tomentose to conspicuously setose; *bracts* inconspicuous; *calyx* in anthesis 2.5-4.5 mm long, in fruit becom-

ing 6–13 mm long, setose or tomentose; *corolla* white, the tube 2.5–4.5 mm long, crests at base of tube conspicuous to nearly obsolete, fornicies yellow, more or less papillose, rounded, about 0.5 mm long, limb 7–10 mm broad; *style* shorter than to exceeding mature fruit 2.5 mm; *nutlets* lanceolate to ovate-lanceolate, 3–4.5 mm long, 1.8–3.2 mm wide, 1 to 4 of them maturing, margins in contact, acute to obtuse, dorsal surface muriccate, tuberculate, or somewhat rugulose, ventral surface indistinctly muriccate or tuberculate, scar open, triangular, margin not elevated.

Mostly sandy or gravelly slopes, road cuts, and talus slopes of the higher mountains, 3,500–12,000 feet elevation. Sierra Nevada of California eastward to southeastern Oregon, southern Idaho to western Colorado and extreme northwestern Arizona. April to August.

Cryptantha humilis is a common member of the Great Basin flora, but enters our area only in southern Nevada and extreme northwestern Arizona. There are 5 varieties in the species complex, with only variety *ovina* (Payson) Higgins entering our area.

14. PLAGIOBOTHRYS F. & M.

Annual or perennial herbs; *stems* prostrate to erect, weak to somewhat robust, usually with slender appressed hairs, but at times setose though not pungently so; lower *leaves* opposite, alternate, or rosulate and crowded;

flowers borne in slender racemes or spikes, occasionally glomerate, frequently bracted; *calyx* cleft to near the base, sometimes accrescent; *corolla* white, the tube short and included in the calyx, the fornicies usually prominent and often yellow; *stamens* included, the filaments short; *nutlets* 4, or 1–3 by abortion, erect or incurved, roughened or rarely smooth, tending to be keeled on the back, and with a well-developed ventral keel extending from the tip to the middle or to the base, scar usually elevated and caruncle-like, mostly small, lateral to basal, placed at the base of the ventral keel; *gynobase* short and broad.

About 65 species native to western North America and South America with about 3 outlying species in Australia. (Name from the Greek, plagios, placed sideways, and bothros, pit or excavation, referring to the position of the nutlet scar.)

References

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- Piper, C. V. A study of *Allocarya*. Contr. U.S. Nat. Herb. 79–113. 1920.

- | | | |
|-------|--|-----------------------|
| 1. | Leaves all alternate, scar lateral, near middle of nutlet | 2 |
| – | Leaves opposite at least below; scar lateral, oblique or basal | 9 |
| 2(1). | Caruncle of nutlet elongate, extending along crest of the ventral keel; nutlets trigonous | 3 |
| – | Caruncle round or nearly so, at or below end of ventral keel | 4 |
| 3(2). | Corolla 4–7 mm broad; nutlets irregularly rugose | 1. <i>P. kingii</i> |
| – | Corolla 1–2.5 mm broad; nutlets conspicuously tessellate | 2. <i>P. jonesii</i> |
| 4(2). | Caruncle weakly developed, borne at tip of a short or conspicuous stipe; lowest leaves not in a rosette | 5 |
| – | Caruncle well developed, sessile on the nutlet; lowest leaves mostly in a rosette | 6 |
| 5(4). | Stipe of nutlet elongate, about equalling the body in length; nutlets commonly united in pairs, plants of south and west Arizona | 3. <i>P. pringlei</i> |
| – | Stipe of nutlet very short; nutlets distinct; plants mostly Californian | 4. <i>P. collinus</i> |

- 6(4). Calyx circumscissile in fruit, less than 4 mm long; lobes usually connivent over fruit; nutlets usually only 1 or 2 7
 — Calyx not circumscissile, or, if so, the strongly accrescent calyx over 4 mm long; calyx lobes erect or spreading; nutlets usually 4 8
- 7(6). Inflorescence a long, simple bracted raceme; nutlets highly incurved in lateral view, 1–2.5 mm long; corolla 2–3 mm broad 5. *P. arizonicus*
 — Inflorescence forked, bracted only at base if at all; nutlets low and flattened in lateral view 2–3 mm long; corolla 3–99 mm broad *P. nothofolius*
- 8(6). Transverse dorsal crests of nutlets very narrow and sharp, enclosing polygonal granulate areolas 7. *P. canescens*
 — Transverse dorsal crests of nutlets very low and broad, separated only by low lineate ridges 8. *P. tenellus*
- 9(1). Stems strigose or appressed hispidulous 10
 — Stems with distinctly spreading hairs; Mohave Desert of California 12. *P. parishii*
- 10(9). Scar nearly basal; calyx lobes becoming elongate and thickened, tending all to be directed toward the same side of the fruit; plants mostly prostrate 9. *P. leptocladius*
 — Scar lateral or basilateral, calyx lobes neither elongate nor much thickened, symmetrically disposed; plants prostrate to ascending or erect 11
- 11(10). Nutlets ovate to lanceolate; the evident scar mostly lateral but occasionally basilateral; plants west of continental divide 10. *P. scouleri*
 — Nutlets narrowly lanceolate to lance-linear, scar basilateral, small; plants east of the continental divide 11. *P. scopulorum*

1. **Plagiobothrys kingii** (S. Wats.) A. Gray
Eritrichium kingii S. Wats. Bot. Kings Exp. 243. 1871. *Plagiobothrys kingii* A. Gray, Proc. Amer. Acad. Arts 20: 281. 1885. *Sonnea kingii* E. L. Greene, Pittonia 1: 23. 1887. (S. Watson 554, eastern side of the Sierra Nevada at Truckee Pass, California)

Stems erect, 1–several, 1–4 dm tall, hirsute, also villous-setose; *leaves* at base of plant narrowly oblanceolate, the cauline lance-linear, 2–6 cm long, hirsute to hispid, with spreading or ascending bristles; *inflorescence* cymose, the cymes dense in early flower, scorpioid, elongating in fruit and more laxly flowered; *bracts* evident at least on part of the inflorescence or flowers; *calyx* 5–6 mm long in fruit, the segments lanceolate, very hirsute-hispid; *corolla* 4–7 mm broad; *nutlets* 4, cuneate-ovoid, 2.5–3 mm long, acute and incurved at the apex, dorsal surface with a low median ridge and similar lateral keels on the edges, the whole irregularly rugose with broad papillate areolas; *scar* elongate, keel-like and medial.

Dry sandy to gravelly bajadas and valleys at 4,000–7,000 feet elevation. Southeastern

Oregon, extreme eastern California, Nevada, and extreme western Utah. May to June.

Our plant is variety *kingii* and just enters the flora in southern Nevada. Variety *harknessii* (E. L. Greene) Jepson is a more northerly ranging form from northern Nevada and California into southeastern Oregon. The cymes on this phase are more congested and usually do not become as elongate.

2. **Plagiobothrys jonesii** A. Gray
Plagiobothrys jonesii A. Gray, Synop. Fl. N. Amer. 2: 430. 1886. *Sonnea jonesii* E. L. Greene, Pittonia 1: 23. 1887. (M. E. Jones, southeastern California on the Colorado near the Needles, 5 May 1884)

Stems erect, simple, widely branched with spreading or ascending branches, 1–3(4) dm tall, conspicuously hispid and villous-setose, the hairs pustulate; *leaves* oblanceolate to linear at the base 2–6 cm long, the cauline lanceolate, conspicuously spreading hirsute, the hairs with pustulate bases; *inflorescence* congested when immature, the scorpioid cymes only slightly elongating at maturity 1.5–4(7) cm long, some of the lower leaves also with axillary flowers; *bracts* lacking; *calyx* 6–10 mm long in fruit, the segments lin-

ear-subulate, spreading hirsute; *corolla* 1–2 mm broad; *nutlets* 2 or 3, incurved, 4 angled by the dorsal and ventral keels and the lateral ridges, 2.5–3.5 mm long, apex acute, the keel and lateral angles tuberculate, the surface between tessellate; *scar* narrow, merging into the keel above and with a diverging lateral ridge extending to either side.

Gravelly wash bottoms, rocky ridges, and desert bajadas below 5,800 feet elevation. Southern California eastward to southern Nevada, southwestern Utah, and western Arizona, south into Sonora, Mexico. March to May.

Plagiobothrys jonesii differs from all other members of the genus in that it resembles a *Cryptantha* in habit and an *Amsinckia* in nutlet characteristics.

3. *Plagiobothrys pringlei* E. L. Greene

Echidiocarya arizonica A. Gray in Bentham & Hooker's Gen. Pl. 2: 854. 1876; Proc. Amer. Acad. Arts 11: 89. 1876. non *P. arizonicus* (A. Gray) Greene. *Plagiobothrys pringlei* E. L. Greene, Pittonia 1: 21. 1887. (Dr. Smart, Verde Mesa, Arizona)

Stems several to many, branched from near the base, prostrate or decumbent to nearly erect, slender, 1–4 dm long, spreading setose with fine short hairs; *leaves* numerous below, gradually reduced above, narrowly oblanceolate to linear, 2–4(6) cm long, 2–5 mm broad, obtuse to acute at apex, appressed strigose or canescent to conspicuously setose; *inflorescence* an elongate spike, floriferous to near the base of the stem; *bracts* conspicuous, 1–2 cm long; *calyx* 3–4.5 mm long in fruit, the segments linear-lanceolate, canescent; *corolla* 2–3 mm broad, inconspicuous; *nutlets* 4, those near the base of stem commonly joined in pairs, the upper separate, ovate, acute at apex, 1.8–2 mm long, dorsal keel evident near the apex but fading to distinct tuberculations below, the surface also rugulose with short ridges; *scar* elevated on a prominent stipe at least 1.3 mm long, and usually as long as the nutlet.

On sandy or gravelly desert flats and bajadas. Common in Cochise, Maricopa, Pima, and Pinal counties of Arizona, and northern Sonora, Mexico. March to April.

4. *Plagiobothrys collinus* (Ph.) I. M. Johnston

Plagiobothrys californicus var. *fulvescens* I. M. Johnston. Contr. Gray Herb. 68: 74. 1923. *Allocaryastrum ursinum* var. *fulvescens* Brand, Pflanzenz. IV 252: 101. 1931. *Echidiocarya californica*

subsp. *fulvescens* L. Abrams. Ill. Fl. Pacific States 3: 571. 1951. *P. collinus* var. *fulvescens* Higgins Great Basin Nat. 34(2):165. 1974. (T. S. Brandegee, Santa Barbara, California, 1881)

P. micranthus A. Nels. Amer. J. Bot. 25: 115. 1938. (A. Nelson 10232, Prescott, Arizona, moist creek banks, 28 April 1925)

Stems slender, elongate, prostrate or decumbent, 1–4 dm long, hispidulous; *leaves* oblanceolate, obtusish to acutish, 1–3 cm long, 3–5 mm broad, hirsute; *inflorescence* an elongate spike, remotely flowered and very slender; *bracts* lacking above the middle of inflorescence; *calyx* 2.8–3.2 mm long in fruit, the segments linear-lanceolate, hispidulous; *corolla* 2–2.5 mm broad; *nutlets* 4, ovoid, 1.5 mm long, dorsal keel thin above, reduced to a mere line and fading out about middle of nutlet, irregularly rugose, also muriculate; *scar* on a short stipe near base of nutlet.

Dry, open flats, mesas, and valleys, ascending to moderate elevations in the foothills. Southern California, northern Baja California, Mexico, eastward to westward Arizona and Sonora, Mexico, and in Chile of South America. February to May.

P. collinus is divided into five rather distinct varieties in western North and South America. The only phase that enters our area is variety *fulvescens*, with its elongate laxly flowered spikes and harsher, more penetrating pubescence.

5. *Plagiobothrys arizonicus* (A. Gray) E. L. Greene

Eitrichium canescens var. *arizonicum* A. Gray. Proc. Amer. Acad. Arts 17: 227. 1882. *Plagiobothrys arizonicus* E. L. Greene ex A. Gray, Proc. Amer. Acad. Arts 20: 264. 1885. (C. G. Pringle 364, near Camp Lowell, Arizona, 9 April 1881)

Stems loosely ascending to erect, usually branched below the middle, 1–4(5) dm tall, hirsute-hispid, also somewhat villous, the basal part of the stem and the root highly charged with a purple dye; *leaves* linear-oblanceolate, 1.5–5(6) cm long, 2–6(10) mm broad, hirsute, with pustulate hairs, the midvein and its branches strong dye stained; *inflorescence* spikelike, elongate, and remotely flowered, 3–15 cm long; *bracts* mostly lacking on all flowers but with several scattered along the spikes; *calyx* 3–3.5 mm long in fruit, lobed to about the middle, circumscissile, the segments connivent and narrowly lanceolate, hirsute and somewhat villous; *corolla* 2–2.5 mm broad; *nutlets* 1–4, commonly

2, ovoid, abruptly acute at apex, the dorsal surface with rectangular smooth areolae marked off by narrow tuberculate ridges and rugae; *scar* median in a sunken area at base of keel.

Dry desert slopes and mesas, often near the base of rocky outcrops, extending to moderate elevations in the mountains 7,000 feet. Western edge of the San Joaquin Valley, California, eastward through southern Nevada to southern Utah, New Mexico, and south into Sonora, Mexico. March to May.

6. *Plagiobothrys nothofulvus* (A. Gray) A. Gray

Eritrichium nothofulvum A. Gray, Proc. Amer. Acad. Arts 17: 227. 1882. *Plagiobothrys nothofulvus* A. Gray, Proc. Amer. Acad. Arts 20: 285. 1885. (Douglas, California)

Stems 1-several, simple or more often ascendingly branched from the base, 1.5-5(6) dm tall, villous-hispidulous with spreading hairs, base of plant often slightly dye stained; *leaves* at base oblanceolate 3-10 cm long, 5-20 mm broad, acute at apex, sparsely villous-setose, cauline leaves few, linear-lanceolate to lanceolate; *inflorescence* elongate, loosely flowered, racemes often paired, 5-15(20) cm long; *bracts* lacking; *calyx* 2-3 mm long in fruit, lobed to about the middle, circumscribed, the segments narrowly lanceolate, fulvous-hirsute; *corolla* 6-9 mm broad, showy; *nutlets* 1 to 4, 2-3 mm long, round-ovoid, abruptly constricted to an acute apex, loosely rugulose-reticulate and somewhat granular tuberculate; *scar* annular, median at the base of the narrow ventral keel.

Open grassy slopes, fields, and roadsides, mostly below 2,500 feet elevation. Southern Washington along the Columbia River, south through Oregon and California on the west slope of the Sierra Nevada to the Coastal Ranges to northern Baja California, Mexico, occasionally at the desert edge in eastern Kern County, California. March to May.

Plagiobothrys nothofulvus just enters our flora along the extreme western boundary in California.

7. *Plagiobothrys canescens* Benth.

Plagiobothrys canescens Benth. pl. Hartweg. 326. 1849. *Eritrichium canescens* A. Gray, Proc. Amer. Acad. Arts 10: 57. 1874. (Hartweg, Sacramento Valley, California)

P. microcarpa E. L. Greene, Pittonia 1: 21. 1887. (Mrs. R. M. Austin, Butte County, California, May 1883)

P. canescens var. *apertus* E. L. Greene, Pittonia 1: 21. 1887. (E.L. Greene, plains of the upper San Joaquin, 1884)

Stems many, branched from the base, decumbent or prostrate, rarely erect, 1-4(6) dm long, villous or finely hispidulous; *leaves* linear to linear-oblongate, 1.5-5 cm long, 2-7 mm broad, the cauline well developed; *inflorescence* elongate and loosely flowered in age, 5-25 cm long; *bracts* conspicuous and well developed, 1-2 cm long; *calyx* in fruit 4-6 mm long, the segments lanceolate, densely rufous-villous-tomentose; *corolla* 2.7-3.5 mm broad; *nutlets* mostly 4, round-ovoid, abruptly constricted to the narrow acute apex, strongly incurved, obscurely tuberculate, but with conspicuous transverse rugae forming rectangular papillate intervals; *scar* median, annular, slightly raised.

Gravelly to clayey slopes, plains, and grassy hillsides, also alkaline flats, mostly below 4,500 feet elevation. Nearly throughout the length of California, mostly west of the Sierra Nevada, entering the Mohave Desert in Inyo, Kern, and San Bernardino counties. March to May.

8. *Plagiobothrys tenellus* (Nutt.) A. Gray

Myosotis tenella Nutt. ex Hook. J. Bot. Kew Gard. Misc. 3: 295. 1851. *Eritrichium tenellum* A. Gray, Proc. Amer. Acad. Arts 10: 57. 1874. (Geyer, "mountains along the Coeur d'Alene River," Idaho)

Stems 1-several, slender, erect or ascending, 1-3 dm tall, soft-villous; *leaves* mostly basal, rosettelike, lance-oblong to lance-elliptic, 1-4 cm long, 2-8 mm broad, sessile, cauline leaves few, ovate to lanceolate, shorter than the basal ones; *inflorescence* open, loosely flowered, tending to elongate in age, slender, 4-15 cm long; *bracts* evident only near the base; *calyx* in fruit 3-5 mm long, the segments ovate-lanceolate, short villous, whitish or fulvous; *corolla* 2-3 mm broad; *nutlets* usually 4, 1.5-2.5 mm long, thick cruciform, usually light colored, sharply ridged dorsally and on the edges, tuberculate on the ridges, smooth and shiny between the ridges; *scar* small, set just below middle of nutlet at end of keel.

Grassy, sandy, or gravelly slopes, hillsides, and dry open areas below 5,000 feet elevation. Common from California to British Columbia and Idaho, becoming rather rare in Utah and Nevada, and with several highly

scattered locations in Graham, Gila, Maricopa, Pinal, and Pima counties of Arizona. March to June.

9. *Plagiobothrys leptocladus* (E. L. Greene)

I. M. Johnston

Eritrichium californicum var. *subglochidiatum* A. Gray, Bot. Calif. 1: 526. 1876. *Krynitzkia californica* var. *subglochidiata* A. Gray, Proc. Amer. Acad. Arts 20: 266. 1885. *Allocarya californica* var. *subglochidiata* Jepson, Fl. W. Middle Calif. 443. 1901. *Allocarya subglochidiata* Piper, Contr. U. S. Natl. Herb. 11: 485. 1906. (S. Watson 551, Clover Mountains, Elko County, Nevada, Lectotype by Johnston)

Allocarya leptoclada E. L. Greene, Pittonia 3: 109. 1896. *Plagiobothrys leptocladus* I. M. Johnston, Contr. Arnold Arbor. 3: 38. 1932. (E. L. Greene, Pine Creek, Eureka County, Nevada, 20 July 1896)

Stems prostrate, 1–3(7) dm long, somewhat succulent, sparsely strigose to subglabrous; *leaves* linear or linear-oblancoelate, 3–8 cm long, 2–5 mm broad, 1 or more pair near the base opposite, dorsal surface sparsely strigose-pustulate, subglabrous above; *inflorescence* spikelike, elongate, loosely flowered to near base of plant, the spikes somewhat unilateral; *bracts* evident at least below; *calyx* very accrescent, in fruit becoming 4–8 mm long, the segments linear, slightly thickened and succulent, all tending to be directed toward the same side of the fruit; *corolla* minute, 1–2 mm broad; *nutlets* 1–4, lanceolate, 1.5–2.5 mm long, dorsal surface rugose-tuberculate, granulate, or penicillate-hairy, ventral surface angulate, keeled the entire length; *scar* basal or nearly so, not surrounded by a ridge.

Moist depressions of clay flats, usually in alkaline soils. Oregon south to northern Baja California, Mexico, eastward to western Wyoming and northern Utah, entering the desert edge in Kern and San Bernardino counties of California. April to July.

In northern Utah *P. leptocladus* often forms prostrate mats a meter or more in diameter from a single plant, but this is relatively rare throughout most of its range.

10. *Plagiobothrys scouleri* (H. & A.) I. M. Johnston

Allocarya cusickii E. L. Greene, Pittonia 1: 17. 1887. *Plagiobothrys cusickii* I. M. Johnston, Contr. Arnold Arbor. 3: 63. 1932. (W. C. Cusick, Union County, Oregon, in 1883) = var. *cusickii*

A. *hispidula* E. L. Greene, Pittonia 1: 17. 1887. *Plagiobothrys hispidulus* I. M. Johnston, Contr. Arnold Arbor. 3: 71. 1932. (S. B. Parish 1470, Bear Lake, San Bernardino Mountains, California) = var. *penicillatus*

A. *penicillata* E. L. Greene, Pittonia 1: 18. 1887. A. *hispidula* var. *penicillata* Jepson, Man. Fl. Pl. Calif. 853. 1925. (E. L. Greene, Donner Lake in the Sierra Nevada, California, August 1883)

A. *cognata*, E. L. Greene, Pittonia 4: 235. 1901. *Plagiobothrys cognatus* I. M. Johnston, Contr. Arnold Arbor. 3: 59. 1932. (Mulford 147, in part, Cache Valley, Utah, 17 June 1898) = var. *penicillatus*

Stems prostrate or ascending, several to many, 2–1.5 dm long, strigose; *leaves* essentially all canline, linear, 1.5–6.5 cm long, 2–5 mm broad, the lowermost opposite, the others alternate, sparsely to densely strigose; *inflorescence* and elongate, loosely flowered raceme or spike that is floriferous to near base of plant; *bracts* evident at least below; *calyx* 2–3.5 mm long in fruit, the segments linear-lanceolate, hispidulose; *corolla* inconspicuous, 2–4 mm broad; *nutlets* usually 4, ovate, to lance-ovate, 1.5–2 mm long, rugose and tuberculate to nearly smooth, with or without penicillate bristles; *scar* small lateral to basilateral.

Moist areas along roadsides, open mountain meadow depressions and along slow-moving stream banks, 4,000–10,500 feet elevation. Alaska, south through British Columbia and Saskatchewan, to California, Arizona, and New Mexico. May to August.

P. scouleri is a highly variable and complex species, probably due to the fact that many incipient species are in the process of being evolved. The species and its varieties are centered somewhat to the northwest of our flora; however two varieties, which are separated by the following key, enter our area.

1. Nutlets smooth, glossy; stems and leaves sparsely strigose to glabrous; southern Nevada in Clark County in our flora var. *cusickii* (Greene) Higgins
- Nutlets rugulose or tuberculate, dull, often penicillate bristly; stems and leaves abundantly strigose or hispidulous, Arizona and New Mexico in our flora var. *penicillatus* (Greene) Cronquist

11. *Plagiobothrys scopulorum* (E. L. Greene)

I. M. Johnston

Allocarya scopulorum E. L. Greene, Pittonia 1: 16. 1887. *Plagiobothrys scopulorum* I. M. Johnst. Contr. Gray Herb 68: 79. 1923. (E. L. Greene, Denver, Colorado, 15 June 1870)

Stems mostly ascending but occasionally prostrate, 5–25 cm tall, branched from near the base, strigose; *leaves* linear, strigose, 1–5 cm long, 1–4 mm broad; *inflorescence* loosely flowered, floriferous to near base of plant; *bracts* evident, mostly near the base; *calyx* 2.5–3.5 mm long in fruit, the segments lance-linear, not accrescent, strigose-hispidulous; *corolla* inconspicuous, 1–2 mm broad; *nutlets* 4, 1.5–2 mm long, lanceolate, rugulose and tuberculate, the ridges rather inconspicuous; *scar* basilateral to nearly basal, small.

Moist areas at roadsides and depressions in the prairie sod to moderate elevations in the mountains. Mostly east of the Continental Divide from Saskatchewan south through much of the northern prairie to Nebraska, the Dakotas, and northern New Mexico. July to September.

The fruit of *P. scopulorum* is very similar to that of *P. leptocladus*, but the habit, indument, and calyx are entirely different, and more like that of *P. scouleri*. These differences correlated with geography distinguished this plant as being at least somewhat different.

12. *Plagiobothrys parishii* I. M. Johnston

Entrichium cooperi A. Gray, Proc. Amer. Acad. Arts 19: 89. 1883. *Krynitzkia cooperi* A. Gray, Proc. Amer. Acad. Arts 20: 267. 1885. *Allocarya cooperi* E. L. Greene, Pittonia 1: 19. 1887. non *P. cooperi* A. Gray. *Plagiobothrys parishii* I. M. Johnst. Contr. Gray Herb. 68: 78. 1923. (*Dr. Cooper*, Mohave Desert, southeastern California, at Camp Cady, 1860–61)

Stems diffusely branched from near the base, erect or ascending, 0.5–3 dm tall, hirsute with short, stout, spreading bristles; *leaves* linear or the upper oblong, hispidulous and with pustules on the dorsal surface, 1–5 cm long, 2–4 mm wide; *inflorescence* in age becoming loose and slender, 3–10 cm long; *bracts* few, near the base; *calyx* 2–3 mm long in fruit, early deciduous, the segments oblong to lanceolate, hispidulous; *corolla* 3–5(6) mm broad, white with a yellow throat; *nutlets* ovate to lance-ovoid, more or less slightly heteromorphic with the axil nutlet slightly larger, plumper, and with a triangular-ovate

scar, the others with a sublinear scar, apex on both nutlets acute, dorsal surface keeled at apex only, strongly rugose with transverse ridges.

Wet alkaline soil around desert springs, 2,500–4,500 feet elevation. Southeastern California in Inyo, Mono, and San Bernardino counties. April to June.

Plagiobothrys parishii is a rather narrow endemic of the Mohave Desert, having been collected in a few scattered stations, but is quite common about Rabbit Springs in San Bernardino County.

15. *MERTENSIA* Roth.

Plants perennial herbs from fleshy fusiform, rhizomelike or cornlike roots; *stems* erect or ascending, glabrous to somewhat pubescent 3–17 dm tall, unbranched below the inflorescence; *leaves* entire, linear to cordate, sessile or petiolate, alternate; *inflorescence* lax or congested, ebracteate, unilateral, modified scorpioid cyme, or becoming paniced in age; *calyx* 5-parted, occasionally campanulate, often accrescent; *corolla* tubular, campanulate, with or rarely without fornicies in the throat, blue, occasionally white or pink; *filaments* attached below the throat; *anthers* exerted or included; *style* shorter or longer than the corolla; *ovary* 2 celled; *nutlets* 4, or by abortion fewer, attached laterally to the gynobase at or below the middle, generally rugose.

A genus of about 35 species of Eurasia and North America, mainly in the western half. (Named for F. C. Mertens, 1764–1831, German botanist.)

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- Macbride, J. F. The True Mertensias of western North America. Contr. Gray Herb. n.s. 48: 1–20. 1916.
- Williams, L. O. A Monograph of the Genus *Mertensia* in North America. Ann. Mo. Bot. Gard. 24: 17–159. 1937.

1. Plants relatively tall and robust (4–15 dm tall when fully developed), with evident lateral veins in the cauline leaves; flowering in late spring and summer 2
- Plants smaller, seldom as much as 4 dm tall, usually without evident lateral veins in the cauline leaves; blooming as soon as snow and temperature permit ..
..... 3
- 2(1). Leaves strigillose on the upper surface; calyx-lobes acute 1. *M. franciscana*
- Leaves glabrous or somewhat papillose above, not hairy; calyx-lobes rather obtuse, ciliate on the margins 2. *M. ciliata*
- 3(1). Filaments narrower and much shorter than the anthers, the base of the anthers not elevated beyond the fornicies; alpine plants 3. *M. alpina*
- Filaments longer and more conspicuous, broad and flattened; base of anthers elevated well above the fornicies; plants alpine or not 4
- 4(3). Nutlets without an elevated margin or border; plants not of Arizona
..... 4. *M. lanceolata*
- Nutlets with the margin elevated, forming a definite border; plants of northern Arizona 5. *M. macdougalii*

1. *Mertensia franciscana* A. A. Heller

Mertensia franciscana A. A. Heller. Bull. Torrey Club 26: 549. 1899. (*D. T. Macdougall* 232, vicinity of Flagstaff, 7,000 feet, 15 July 1898)

M. pratensis A. A. Heller Ibid. 550. 1899. (*Heller & Heller* 3641, Santa Fe Canyon, 9 miles east of Santa Fe, 2 June 1897)

M. alba Rydb. Bull. Torrey Club 31: 638. 1904. *M. pratensis* f. *alba* J. F. Macbride, Contr. Gray Herb. 48: 8. 1916. (*Baker, Earle, & Tracy* 825, La Plata River, 10,500 feet, 13 July 1898)

M. grandis Woot. & Standl. Contr. U. S. Natl. Herb. 16: 165. 1913. (*O. B. Metcalfe* 1319, south end of the Black Range, Hillsboro Peak, Grant County, New Mexico, 11 September 1904)

Stems erect or ascending (1)3–10 dm tall, glabrous; *leaves* at base oblong-elliptic to elliptic 6–20 cm long, 1–3.5(4.5) cm broad, base acute-attenuate to subcordate, apex acuminate to acute, upper surface, very short strigillose, lower surface glabrous; *petioles* longer or shorter than the blade, cauline leaves elliptic to lance-ovate, 4–14 cm long, 1–3(6) cm broad, becoming sessile toward the inflorescence; *inflorescence* paniculate; *bracts* lacking; *calyx* 2.5–5 mm long, the segments linear to lanceolate, acute, divided nearly to the base, glabrous or pubescent on the back, conspicuously ciliate on the margins; *pedicels* 1–20 mm long, strigose; *corolla* tube 5–9 mm long, glabrous or pubescent within, limb 4–9 mm broad, moderately expanded, fornicies prominent, usually pubescent; *anthers* 2.5–3 mm long, longer than the filaments; *style* 9–20 mm long; *nutlets* rugose and papillate.

Stream banks, moist meadows, and open-

ings in pine forests, 6,000–11,000 feet elevation. Eastern Nevada and Arizona, eastward to Colorado and New Mexico. June to August.

This is by far the most common bluebell in our area, it is very common throughout the mountainous areas of New Mexico and Arizona.

2. *Mertensia ciliata* (Torr.) G. Don

Pulmonaria ciliata Torr. Annals Lyceum N. Y. 2: 224. 1827. *Mertensia ciliata* G. Don, Gen. Syst. 4: 372. 1837. (*James*, Rocky Mountains of Colorado)

Mertensia picta Rydb. Bull. Torrey Club 31: 638. 1904. (*G. E. Osterhout* 2533, Estes Park, Larimer County, Colorado, 20 July 1903)

Stems many from the branched caudex, 1.5–15 dm tall, glabrous; *leaves* variable, at the base of the plant oblong to ovate or lance-subcordate, 4–15 cm long, 2–6(10) cm broad, ciliate on the margins, glabrous or papillate on the surfaces, petioles longer or shorter than the blades, cauline leaves lanceolate to ovate, acute, acuminate or obtuse at apex, attenuate to subcordate at base, mostly sessile; *inflorescence* paniculate; *bracts* lacking; *calyx* 1.5–3 mm long, the segments oblong to nearly lanceolate, obtuse or rounded at the apex, not accrescent, glabrous on the back, the margins ciliate; *pedicels* 1–10 mm long, glabrous or with a few strigose hairs; *corolla* tube 4–6(8) mm long, the limb 4–10(15) mm broad, moderately expanded, fornicies evident, glabrous to pubescent; *anthers* 1–2.5 mm long, as long as or shorter and narrower than the expanded part

of the filaments; *style* about as long as corolla or exceeding it; *nutlets* rugose or papillate. *N* = 12, 24.

Stream banks, wet meadows, and moist hillsides up to 12,000 feet elevation. Mountains of Montana and eastern Oregon, south-eastward to Utah, Wyoming, Colorado, and northern New Mexico. July to September.

Mertensia ciliata resembles *M. franciscana* in general aspect but is easily separated from the latter by its glabrous leaves and stems and the small obtuse calyx segments. This plant only enters our flora in the higher elevations in northern New Mexico.

3. *Mertensia alpina* (Torr.) G. Don

Pulmonaria alpina Torr. Annals Lyceum N. Y. 2: 224. 1828. *Mertensia alpina* G. Don, Gen. Hist. 4: 372. 1838. *Cerinthodes alpinum* Kuntze, Rev. Gen. Pl. 2: 436. 1891. (James, Rocky Mountains)

Mertensia obtusiloba Rydb. Bull. Torrey Club 28: 32. 1901. *M. brevistyla* var. *obtusiloba* A. Nels. Man. Rocky Mt. Bot. 421. 1909. (F. Clements, Pikes Peak, Colorado, 1900)

Stems 1-numerous, glabrous, erect or ascending, 0.5-2(3) dm tall; *leaves* at base of plant linear-lanceolate to oblong or elliptic, 1-5(7) cm long, 0.7-1.5(2) cm broad, strigose above, glabrous beneath, the winged petiole shorter than the blade, cauline leaves lanceolate to elliptic, sessile, 1-6 cm long, 0.3-1.8 cm broad; *inflorescence* compact, or slightly paniced in age; *bracts* lacking; *calyx* 2-3(5) mm long in fruit, divided to near the base, the segments linear-lanceolate to oblong, obtuse to acute at the apex, ciliate; *pedicels* 1-10 mm long, strigose to glabrous; *corolla* tube 3-6(11) mm long, glabrous within, limb widely spreading (5)7-10(11) mm wide; *fores* prominent, nearly closing the throat; *anthers* about 1-1.3 mm long, usually longer than the filaments, inserted in the tube and not projecting beyond it; *style* short, about equalling the calyx; *nutlets* rugose, about 2 mm long.

Above timberline, in the high mountains on open dry meadows and slopes. South-western Montana and adjacent Idaho, south to Colorado and northern New Mexico. July and August.

4. *Mertensia lanceolata* (Pursh) A. DC.

Pulmonaria lanceolata Pursh, Fl. Amer. Sept. 2: 729. 1814. *Casselia lanceolata* Dumort. Com. Bot. 24. 1822. *Cerinthodes lanceolatum* Kuntze, Rev. Gen. Pl. 2: 436. 1891. (Bradbury, in upper Louisiana, 18 June 1811)

P. marginata Nutt. Gen. 1: 115. 1818. *Lithospermum marginatum* Spreng, Syst. 1: 547. 1825. *Mertensia marginata* G. Don, Gen. Hist. 4: 319. 1838. (Nuttall, Missouri)

Mertensia fendleri A. Gray, Amer. J. Arts Sci. 34: 339. 1862. *Mertensia lanceolata* var. *fendleri* A. Gray, Proc. Amer. Acad. Arts 10: 53. 1875. (*Fendler* 625, Santa Fe creek bottom, 1847)

Mertensia viridis A. Nels. Bull. Torrey Club 26: 244. 1899. *Mertensia lanceolata* var. *viridis* A. Nels. First Report Fl. Wyoming 158. 1896. (A. Nelson 1608, Laramie Peak, 6 August 1895)

M. bakeri E. L. Greene, Pittonia 4: 90. 1899. (*Baker, Earle, & Tracy* 576, Hayden Peak, Colorado, 13,000 feet, 14 July 1898)

M. cynoglossoides E. L. Greene, Pl. Baker. 3: 19. 1901. *M. viridis* var. *cynoglossoides* Macbr. Contr. Gray Herb. 48: 13. 1916. (*Baker* 191, Black Canyon, Colorado, 20 June 1901)

M. caelestina Nels. & Ckll. Proc. Biol. Soc. Wash. 16: 46. 1903. *M. viridis* var. *caelestina* Williams, Ann. Mo. Bot. Gard. 24: 114. 1937. (*Cockrell* 40, Truchas Peak, New Mexico, in 1902)

M. amplifolia Woot. & Standl. Contr. U. S. Natl. Herb. 16: 165. 1913. (*Vasey, Glorietta, New Mexico, June 1881*)

M. fendleri var. *pubens* Macbr. Contr. Gray Herb. 48: 14. 1916. *M. lanceolata* var. *pubens* Williams, Ann. Mo. Bot. Gard. 24: 98. 1937. (*Standley* 4023, Winsor's Ranch, along the Pecos River, 29 June 1908)

Stems 1-many, 1-4.5 dm tall, erect or ascending, canescent to glabrous; *leaves* at base of plant ovate to elliptic or oblanceolate, 1.5-14 cm long, 0.3-3.5 cm broad, glabrous to densely canescent on both surfaces, sessile or with the petioles longer than the blade, cauline leaves only moderately reduced toward the inflorescence, mostly sessile; *inflorescence* congested to loosely paniculate, especially in age; *bracts* only near the base; *calyx* 2-5(8) mm long in fruit, divided to below the middle and mostly to near the base, the segments lanceolate to ovate-triangular, glabrous to strigose; *pedicels* 1-15 mm long, strigose to glabrous; *corolla* tube 3-7 mm long, with a ring of dense hairs near the base, the limb 3-9 mm broad, moderately expanded; *fores* conspicuous, glabrous to pubescent; *anthers* 1-2 mm long, well exerted from the tube; *style* shorter or longer than the corolla tube; *nutlets* 2-3 mm long, rugose.

Moderately moist to dry open slopes and ridges in the mountains, 6,000-11,000 feet elevation. Saskatchewan, Montana, and North Dakota, south through Colorado, Utah, and Wyoming into northern New Mexico.

June to September.

Mertensia lanceolata is a poorly defined species. *Mertensia bakeri* and *M. viridis* seem to be only ecotypes of the larger, more wide-ranging *M. lanceolata*. There are no clearly defined morphological differences that can be correlated with geography to aid in the separation of species. There may be enough variation in this heterogeneous mixture, here called *lanceolata* to warrant a variety or two, but none are here proposed.

5. *Mertensia macdougallii* A. A. Heller

Mertensia macdougallii A. A. Heller. Bull. Torrey Club 26: 550. 1899. (*MacDougal* 95, near Mormon Lake, south of Flagstaff, Arizona, 12 June 1898)

Stems ascending, 1-several, 0.8-2.5 dm tall, glabrous; *leaves* at base oblong-oval to obovate, petiolate, 2-5 cm long, 1-2.8(4) cm broad, glabrous, pustulate, the cauline leaves, sessile, oblong-lanceolate to ovate, 2-4 cm long, 0.5-2 cm broad; *inflorescence* a modified dense scorpioid cyme, not much elongating in age; *bracts* lacking; *calyx* in anthesis 5-6 mm long, in fruit becoming 7-10 mm long, divided to below the middle, the segments lance-oblong, ciliate; *pedicels* 1-10 mm long, glabrous; *corolla* tube 8-9 mm long, glabrous within, the limb 5-6 mm broad, moderately expanded; *fores* conspicuous, glabrous; *anthers* 2.5-3 mm long, subequal to the filaments; *style* usually exceeding the corolla; *nutlets* rugose, inner surface slightly concave, the margin forming a collar.

Moist rich soil at medium elevations, 6,000-9,000 feet. Coconino and Yavapai counties, Arizona.

16. ERITRICHIMUM Schrad.

Depressed-pulvinate perennial plants; *stems* 2-10 cm tall, or sometimes acaulescent; *leaves* small, usually densely hairy, crowded on the numerous short shoots or a base of the elongate stem; *inflorescence* a false raceme or spike terminating the short stem, naked or leafy bracteate; *pedicels* erect; *calyx* cleft nearly to the base; *corolla* blue, rarely white, often with a yellow eye, salverform, with a short, narrow tube; *fores* well developed; *filaments* attached well down in the corolla tube; *anthers* included; *ovary* 4

lobed; *stigma* 1; *nutlets* 1-4, smooth, attached basilaterally to the low stout gyno-base, the apex obliquely truncate, this portion surrounded by an entire or toothed margin.

A genus of about 4 species of Eurasia and western North America. (From the Greek erion, wool and trichos, hair, referring to the wooly pubescence of *E. nanum*, the original species.)

Reference

Wight, William R. The genus *Eritrichium* in North America. Bull. Torrey Club 29: 407-14. 1902.

1. *Eritrichium nanum* (Vill.) Schrad.

Mysotis nana Vill. Prosp. 21. 1779. *Eritrichium nanum* Schrad. Asperif. 16. 1820. *Omphalodes nana* A. Gray. Proc. Amer. Acad. Arts 20: 263. 1885. *Lappula nana* Car. in Parl. & Car. Fl. Ital. 6: 861. 1886. (Presumably from the Alps)

Eritrichium arctioides var. *elongatum* Rydb. Mem. N.Y. Bot. Gard. 1: 327. 1900. *E. elongatum* Wight, Bull. Torrey Club. 29: 408. 1902. *E. nanum* var. *elongatum* Cronq. Vasc. Pl. Pacif. N. W. 4: 203. 1959. (Rydberg & Bessey 4891. Spanish Basin, Montana, 26 June 897) = var. *elongatum*.

Eritrichium argenteum Wight, Bull. Torrey Club. 29: 411. 1902. *E. elongatum* var. *argenteum* I. M. Johnston. Contr. Gray Herb. 70: 53. 1924. *E. nanum* ssp. *villosum* var. *villosum* f. *argenteum* Brand, Pflanzenr. IV 252 (Heft. 97): 191. 1931. (Crandall & Concan 361, northwest of Como, Colorado, 31 July 1895) = var. *elongatum*.

Pulvinate-caespitose, long-lived perennials; *stems* acaulescent or caulescent with short, slender, erect stems, 0.1-0.7(1) dm tall, villous to densely strigose; *leaves* oblanceolate to oblong or narrowly ovate, 5-10 mm long, 1-2(3) mm broad, villous to loosely strigose; *inflorescence* compact when sessile among the leaves or racemelike when borne on a leafy flowering branch, capitate; *calyx* 1.8-2.3 mm long in fruit, linear, villous or silky strigose; *corolla* tube short, 2-2.5 mm long, yellowish, the limb blue rarely white 4-8 mm broad; *fores* prominent, papillose; *nutlets* 1-4, glabrous, somewhat asymmetrical, margined, with an entire or toothed margin.

Open rocky slopes, dry meadows, and on tundra at high elevations in the mountains, 10,000-14,000 feet elevation. Irregularly from the Alps of Europe, across Asia to

Alaska and south in the Rocky Mountains to northern New Mexico. June to August.

Eritrichium as here considered is a highly variable and widespread circumboreal species, with several varieties. In our flora only variety *elongatum* occurs and is limited to only the highest mountain peaks in northern New Mexico.

17. LAPPULA Gilib.

Stickseed

Annual or biennial herbs; *stems* ascending or erect; *leaves* alternate, entire, narrow, firm, and veinless; *inflorescence* terminal, the flowers borne in a sympodial, branched cyme; *calyx* 5-parted, nearly to the base, accrescent; *pedicels* usually erect, short; *corolla* blue or white, rather inconspicuous, more or

1. Nutlets with 2 rows of slender marginal prickles that are not confluent at base; corolla about 3 mm broad 1. *L. echinata*
 — Nutlets with a single row of marginal prickles that are more or less confluent at the base; corolla 2 mm or less broad 2. *L. redowskii*

1. *Lappula echinata* Gilib

Myosotis lappula L. Sp. Pl. 131. 1753. *Lappula myosotis* Moench. Meth. 417. 1794. *Echinosperrum lappula* Lehm. Asperif. 121. 1818. *Lappula lappula* Karst. Deuts. Fl. 979. 1882. (*Europe*)

Lappula echinata Gilib. Fl. Lithu. 1: 25. 1781. (*Europe*)

Echinosperrum fremontii Torr. Pacif. R. R. Reports 12: 46. 1860. *Lappula fremontii* E. L. Greene, Pittonia 4: 96. 1899. (*Fremont S44*, Pass Creek, near southern end of the Sierra Nevada)

Stems simple to freely branched, 1.5–8 dm tall, villous-hirsute; *leaves* linear to linear-lanceolate or lanceolate, acute or obtuse, narrowed to a sessile base, 2–5 cm long, 2–7 mm broad, hispidulous; *calyx* 2.5–3(4) mm long in fruit, the segments linear, appressed hispidulous; *pedicels* 1–3 mm long, erect; *corolla* bright blue, 2–4 mm broad; *nutlets* 3–4 mm long, sharply verrucose or muricate dorsally, with 2 marginal rows of long, slender bristles that are distinct to near the base, these sometimes irregularly distributed over the back.

Dry plains, hillsides, roadsides and waste places, also cultivated ground. Native to Eurasia, but widespread as a weed in northern United States and Canada. June to August.

L. echinata is rare in our flora, known only

less funnellform, with conspicuous fornicies; *stamens* included; variously inserted; *style* included; *nutlets* 4, ovoid to oblong, trigonous or flattened, with 1–3 rows of cylindrical, conical or flattened spines or glochidia on the sides, or on the cupulate border, attached to the elongate gynobase only part of their length.

A genus of about 10 species of wide distribution in the northern hemisphere (diminutive of the Latin *lappa*, a bur.)

Reference

Johnston, I. M. Studies in the Boraginaceae.

A synopsis of the American native and immigrant borages of the subfamily Boraginoidae. Contr. Gray Herb. 70: 47–51. 1924.

from Schultz Pass, Coconino County, Arizona (*Whitting 1173B*).

2. *Lappula redowskii* (Hornem.) E. L. Greene

Myosotis redowskii Hornem. Hort. Bot. Hafn. 1: 174. 1813. *Echinosperrum redowskii* Lehm. Asperif. 127. 1818. (*Russia*)

Echinosperrum texanum Scheele, Linnea 25: 260. 1852. *Lappula texana* Britt. Mem. Torrey Club. 5: 273. 1894. *L. redowskii* var. *texana* Brand, Pflanzenr. IV 252 (Heft. 97): 150. 1931. (*Roemer*, San Antonio, Texas) = var. *cupulata*

Echinosperrum redowskii var. *occidentale* S. Wats. Bot. King Exp. 246. 1871. *Lappula redowskii* var. *occidentale* Rydb. Contr. U. S. Natl. Herb. 3: 170. 1895. *L. occidentalis* E. L. Greene, Pittonia 4: 97. 1899. *E. occidentale* K. Schum. Just. Bot. Jahresb. 27: 522. 1901. (S. Watson 861, from the Sierra's to the Wasatch) = var. *redowskii*

Echinosperrum redowskii var. *cupulatum* A. Gray, Bot. Calif. 1: 530. 1876. *Lappula cupulata* Rydb. Bull. Torrey Club 28: 31. 1901. *Echinosperrum cupulatum* K. Schum. Just. Bot. Jahresb. 29: 564. 1903. *L. redowskii* var. *cupulata* M. E. Jones, Bull. Univ. Mont. Biol. 15: 44. 1910. (S. Watson 862, Trinity Mountains, Nevada)

Lappula desertorum E. L. Greene, Pittonia 4: 95. 1899. *Echinosperrum desertorum* K. Schum. Just. Bot. Jahresb. 27: 522. 1901. *L. redowskii* var. *desertorum* I. M. Johnst. Contr. Arnold Arb. 3: 93. 1932. (*E. L. Greene*, near Holborn, Nevada, 16 July 1896)

Lappula heterosperma E. L. Greene, Pittonia 4: 94. 1899. *L. texana* var. *heterosperma* Nels. & Macbr. Bot. Gaz. 61: 41. 1916. (Baker, Earle, & Tracy 826, from near Mancos, in southwestern Colorado) = var. *cupulata*

Lappula coronata E. L. Greene, Pittonia 4: 94. 1899. *Echinosperrum coronatum* K. Schum. Just. Bot. Jahresh. 27: 522. 1901. *L. texana* var. *coronata* Nels. & Macbr. Bot. Gaz. 61: 41. 1916. (C. G. Pringle, mesas near Tucson, Arizona, 18 April 1884) = var. *cupulata*

L. leucotricha Rydb. Bull. Torrey Club. 36: 676. 1909. (Toumey, near Tucson, Arizona, 20 April 1894)

Stems usually simple, or with several minor stems arising from the base of the major stem, or bushy branched from the base, 1–5 dm tall, cinereous hispid-villous; *leaves* narrowly oblanceolate to spatulate, the basal ones 1.5–5(8) cm long, 3–8 mm broad, rosettelike, the cauline leaves gradually reduced in size upward; *inflorescence* cymose, the individual racemes terminating the stems and branches; *bracts* conspicuous, subtending each flower; *calyx* in fruit 3–5 mm long, the segments linear or linear-lanceolate, strigose; *pedicels* erect or ascending 1–3 mm long; *corolla* blue or whitish, 1–2 mm broad; *nutlets* 2–3 mm long, muricate dorsally, with a single row of nearly distinct prickles, or sometimes with a greatly swollen cupulate border.

A weed in dry, usually disturbed areas along roadsides, abandoned fields and waste places. Eurasia and western North America. March to July.

Lappula redowskii is a widespread and variable species. Many names have been placed on the various forms that occur throughout the range of the species. The most distinct of these forms has been called *L. texana*, and, if it weren't for the many intermediate characteristics between it and the typical *L. redowskii*, it could easily be maintained as a distinct species. It is the many named and nameless forms that occur between these two

extremes that have produced the abundant synonymy.

18. HACKELIA Opiz.

Stickseed

Ascending or erect biennial or perennial herbs; *leaves* alternate, broad and veiny; *flowers* in naked or only basally bracteate scorpioid cymes paniculately disposed; *calyx* cut to the base into spreading ovate to oblong or lanceolate lobes; *pedicels* slender, recurving in fruit; *corolla* white or blue, with a short or elongated tube, and an evidently 5-lobed limb, the lobes rounded and connate less than one-third their length; *fornices* well developed; *stamens* included, affixed at middle of tube; *filaments* slender, short; *anthers* oblong to elliptic; *style* slender, scarcely if at all surpassing the nutlets; *stigma* capitate; *nutlets* 4, erect, ovate to lanceolate, attached ventrally to the pyramidal gynobase by a broad medial or submedial areola, the margin with subulate glochidiate prickles which are frequently confluent at the base, the back smooth or with glochidiate appendages.

A genus containing about 45 species, centering in western North America with outlying species in South America and Eurasia.

References

- Gentry, J. L. 1974. Studies in the genus *Hackelia* (Boraginaceae) in the western United States and Mexico. Southwestern Nat. 19:139–146.
- Gentry, J. L. and R. L. Carr. 1976. A revision of the genus *Hackelia* (Boraginaceae). Mem. New York Bot. Gard. vol. 26, no. 1.

- | | | |
|-------|--|------------------------|
| 1. | Corolla limb white to ochroleucous to greenish tinged | 1. <i>H. ursina</i> |
| – | Corolla limb blue or occasionally violet blue or pink | 2 |
| 2(1). | Intramarginal prickles absent on all nutlets (or rarely present on <i>H. floribunda</i> and then only on less than half the nutlets) | 3 |
| – | Intermarginal prickles present on all nutlets | 4. <i>H. pinetorum</i> |
| 3(2). | Corolla limb inconspicuous, only 1.5–2.5 mm wide, calyx segments ca. 1 mm long | 2. <i>H. besseyi</i> |

- Corolla limb broader, mostly 4–8 mm wide; calyx segments mostly 1.5 mm long or more 4
- 4(3). Cymes conspicuously bracteate throughout; cauline leaves long ciliate; stems generally stiffly hirsute 3. *H. hirsuta*
- Cymes bracteate, if at all, only at the base; cauline leaves not long ciliate; stems with appressed hairs 5
- 5(4). Fornices curved inward at the tips, about twice as long as broad; principal marginal prickles of all mature nutlets less than 2 mm long; inflorescence open and spreading, the branches few; plants slender 4. *H. pinetorum*
- Fornices relatively straight, not curving inward at the tip, about as broad as long; principal marginal prickles more than 2 mm long; inflorescence mostly elongate and narrow 5. *H. floribunda*

1. **Hackelia ursina** (Greene ex A. Gray) I. M. Johnston

Echinosperruan ursinum Greene ex A. Gray, Proc. Amer. Acad. Arts 17: 224. 1882. *Lappula ursina* E. L. Greene, Pittonia 2: 182. 1891. *Hackelia ursina* I. M. Johnston. Contr. Gray Herb. 68: 46. 1923. (*E. L. Greene*, on gravel beds of Bear Canyon in the Bear Mountains, New Mexico, 4 October 1880)

Lappula leucantha E. L. Greene, Leaflet Bot. Observ. Crit. 1: 152. 1905. (*O. B. Metcalfe* 1475, Shady Canyon of Iron Creek, Black Range, Grant County, New Mexico, 11 October 1904) = var. *ursina*

L. pustulata Macbride, Contr. Gray. Herb. 48: 39. 1916. *Hackelia ursina* var. *pustulata* J. L. Gentry, Southwestern Naturalist 19(2):144. 1974. (*C. G. Pringle* 563, hills west of Chihuahua, Mexico, 23 October 1885)

L. heliocarpa Brand, Feddes Repert. Spec. Nov. Regni. Veg. 18: 310. 1922. *Hackelia heliocarpa* Brand, Pflanzenr. IV 252 (Heft. 97) 120. 1931. (*C. G. Pringle* 2004, Canyon below Cusihiiriachic, Chihuahua, Mexico, 21 September 1888) = var. *pustulata*

Hackelia ursina var. *diaboli* J. L. Gentry, Southwestern Naturalist 19(2):143. 1974. (*G. J. Harrison* 1880, Devil's Canyon, Pinal County, Arizona 16 May 1926) = var. *diaboli*

Stems erect, 1–several, sometimes branched near the base, 3–14 dm tall, hispid or hirsute with spreading bristles or often appressed strigose also, especially above; **leaves** at the base of plant oblanceolate, long petiol-

ate, obtuse, 2.5–14 cm long, 5–15 mm broad, hispid-hirsute, pustulate, the cauline leaves gradually reduced above, oblanceolate to narrowly ovate, broader than the basal ones; **inflorescence** open and spreading; **bracts** evident throughout the cymes; **calyx** 1.5–3.5 mm long in fruit, the segments oblong to lanceolate, hispid; **pedicels** 1.5–10 mm long; **corolla** white or tinged with yellow, the tube 1.5–2.5 mm long, the limb 5–11 mm wide; **fornices** evident, papillate; **style** 0.8–1.8 mm long, longer than nutlet; **nutlets** 2–3 mm long, ovate to lanceolate, intermarginal prickles present or lacking, marginal prickles 7–11 on each side, slightly connate at the base or fused for half their length into a cupulate wing, dorsal surface muricate-hispidulous to nearly smooth.

Gravelly creek beds, rocky terraces, canyons, and talus slopes or moist areas, 3,500–8,500 feet elevation, mostly in the oak, juniper, or pinus communities. Southern Arizona, New Mexico, and northern Mexico. May to August.

Our plants of *H. ursina*, as here described, are the only white-flowered species and can be separated into three varieties by the following key:

- 1. Nutlets 2–2.5 mm long, with marginal prickles 1–2 mm long; flowering July and August; Pinal Mountains, Arizona, and western New Mexico to northern Mexico 2
- Nutlets 2.5–3.5 mm long, with marginal prickles 2–3 mm long; flowering in May; rare in Devil's Canyon, Pinal County, Arizona var. *diaboli* J. L. Gentry

- 2(1). Corolla limb 5–7.5 mm broad; pedicels rarely more than 2.5 mm at anthesis; southwestern New Mexico var. *ursina*
- Corolla limb 7.5–10 mm broad; pedicels mostly more than 3 mm at anthesis; Pinal Mountains, Arizona, and northern Mexico var. *pustulata* (Macbr.) J. L. Gentry

2. *Hackelia besseyi* (Rydb.) J. L. Gentry

Lappula besseyi Rydb. Bull. Torrey Club 31: 636.

1904. *H. leptophylla* var. *besseyi* Brand, Pflanzenz. IV 252 (Hft. 97): 127. 1931. *H. besseyi* Gentry, Southwestern Naturalist 19(2):139. 1974. (C. E. Bessey, mouth of Cheyenne Canyon, Colorado, 25 July 1895)

L. grisea Woot. & Standl. Contr. U. S. Natl. Herb. 16: 164. 1913. *H. grisea* I. M. Johnston, J. Arnold Arbor. 16: 194. 1935. (E. O. Wooton, James Canyon, Sacramento Mountains, New Mexico, 6 August 1905)

Stems erect, solitary, 3–11 dm tall, canescent with strigose or villous-hirsute hairs; leaves at base of plant oblanceolate, 2–9 cm long, (7)10–17 mm broad, obtuse, strigose to hirsute-hispid, pustulate, cauline leaves gradually reduced above 2–13 cm long, 5–10(12) mm broad; inflorescence open and spreading; bracts evident only near base of cyme; calyx 1–1.5 mm long in fruit, the segments lance-ovate; pedicels in fruit 3–5 mm long; corolla tube 0.8–0.9 mm long, limb 1.5–2.5 mm broad, blue; fornicies evident, papillate; style shorter than nutlet; nutlets 2–2.5 mm long, ovate to ovate-lanceolate, intramarginal prickles lacking, marginal prickles 8–13 on each side, distinct or slightly connate, a long and short prickle alternating, dorsal surface muricate-hispidulous.

In the foothills, extending to moderate elevations in the mountains, 6,000–9,000 feet, in association with Pinyon-Juniper and Fir-Pine stands. El Paso County, Colorado, south through New Mexico to Trans-Pecos Texas. July to September.

The very small corollas, with ascending lobes, easily distinguish this plant from all other members of *Hackelia* in North America.

3. *Hackelia hirsuta* (Woot. & Standl.) I. M. Johnston

Lappula hirsuta Woot. & Standl. Contr. U. S. Natl. Herb. 16: 164. 1913. *H. hirsuta* I. M. Johnston, Contr. Gray Herb. 68: 46. 1923. (G. Heller 3793, 9 miles east of Santa Fe, New Mexico, 2 July 1897)

Stems 1 or few, often bluish tinged at the base, erect, or widely branched from the base

and throughout, 1–8 dm tall, spreading hispid below, hirsute to strigose above; leaves at base of plant oblanceolate, acute, petiolate, withering early, 2–7 cm long, 5–10 mm broad, villous-strigose to hirsute, ciliate on the petioles, moderately pustulate, cauline leaves oblanceolate to linear-oblong, 3–10 cm long, 5–12 mm wide, ciliate; inflorescence open, widely spreading; bracts 3–10 mm long, evident throughout; calyx 2–3 mm long in fruit, the segments oblong to lanceolate; pedicels 5–10 mm long in fruit; corolla blue with a white eye, the tube 1.5–2 mm long, limb 4–8 mm broad; fornicies evident, papillate; style 0.6–1.1 mm long, shorter than nutlet; nutlets 2.5–3.5 mm long, ovate-lanceolate, intramarginal prickles absent, marginal prickles 4–7 on each side, slightly connate or distinct at the base, dorsal surface muricate-hispidulous.

On dry, open hillsides or shale roadcuts, in oak canyons or coniferous forests, or rarely moist areas, 6,000–10,000 feet elevation. Endemic to north central New Mexico.

A striking and very distinct species due to the spreading branches and the conspicuously hirsute-hispid stems and leaves.

4. *Hackelia pinetorum* (Greene ex A. Gray)

I. M. Johnston

Echinosperrum pinetorum Greene ex A. Gray, Proc. Amer. Acad. Arts 17: 224. 1882. *Lappula pinetorum* I. M. Johnston, Contr. Gray Herb. 68: 45. 1923. *H. floribunda* var. *pinetorum* Brand, Pflanzenz. IV 252 (Hft. 97): 127. 1931. (E. L. Greene, Pinos Altos Mountains, New Mexico, July and September 1880) = var. *pinetorum*

H. pinetorum var. *jonesii* J. L. Gentry, Southwestern Naturalist 19(2):142. 1974. (M. E. Jones, Soldier Canyon, Sierra Madre, Chihuahua, Mexico, 16 September 1903) = var. *jonesii*

Stems 1 or few, erect, 3–8 dm tall, grayish hirsute below, becoming strigose above; leaves at base of plant withering early, elliptic to oblong or oblanceolate, obtuse, petiolate, 3–8.5 cm long, 10–20 mm broad, hirsute to hispidulous, cauline leaves reduced upward, 3–12 cm long, 8–25 mm broad; inflorescence open and spreading; bracts lack-

ing or 1-2 at the base; *calyx* 1.5-2 mm long in fruit, the segments lanceolate to oblong; *pedicels* 2-5 mm long in fruit; *corolla* pale blue, tube 1.3-1.6 mm long, the limb 4-7 mm broad; *style* not exceeding nutlet; *nutlets* 2-3 mm long, lanceolate to lance-ovate, intramarginal prickles small, 1-3 or absent, marginal prickles 4-7 on each side, distinct or slightly connate at the base, less than 2 mm long, dorsal surface muricate hispidulous.

Moist, shaded places in Douglas-fir or oak woods or pine woodlands at elevations 6,000-9,000 feet. Coconino County, Arizona, south to southeastern Arizona to southern New Mexico and Trans-Pecos Texas, south into Chihuahua, Sierra Madre, Occidentale, Mexico. June to August.

The northern phase of *H. pinetorum* is the most common and is var. *pinetorum*. The southern element has been called var. *jonesii* and enters our flora only in the Organ Mountains of southern New Mexico. It is distinguished from the typical plant by the absence of intramarginal prickles; however, there is some introgression between the two varieties in the Organ Mountains.

5. **Hackelia floribunda** (Lehm.) I. M. Johnston

Echinospermum floribundum Lehm. Stirip. Pug. 2: 24. 1830. *E. deflexum* var. *floribundum* S. Wats. Bot. King Exp. 245. 1871. *Lappula floribunda* E. L. Greene, Pittonia 2: 182. 1891. *H. floribunda* I. M. Johnston. Contr. Gray Herb. 68: 46. 1923. (Drummond, Saskatchewan)

Lappula leptophylla Rydb. Mem. New York Bot. Gard. 1: 329. 1900. *H. leptophylla* I. M. Johnston. Contr. Gray Herb. 68: 46. 1923. (Several specimens cited from Montana and Wyoming)

Stems stout, erect, 5-12(14) dm tall, reflexed or spreading hirsute or strigose below;

leaves at base of plant withering early, oblanceolate to elliptic-oblong, 4-20 cm long, 5-20(25) mm broad, petiolate, apex obtuse to acute, hirsutulous-appressed, cauline leaves sessile, gradually reduced upward; *inflorescence* elongate, rather narrow with strongly ascending, many-flowered branches; *bracts* lacking or 1-2 at base of cymes; *calyx* in fruit 2-3(3.5) mm long, the segments oblong to lance-oblong, hirsute; *pedicels* 1-3.5 mm long at anthesis, in fruit becoming 4-7(10) mm long; *corolla* blue or rarely whitish, the tube 1-2 mm long, the limb 4-7 mm broad; *fores* small, obscurely papillate; *style* shorter than nutlets; *nutlets* 3-5 mm long, ovate or ovate-lanceolate, intramarginal prickles lacking or rarely present on a few of the nutlets of the inflorescence, marginal prickles 5-8 on each side, distinct or slightly connate, or sometimes fused for half their length, 1.5-3 mm long, dorsal surface with a faint median ridge, muriculate-hirsutulous.

Moist to moderately dry places in the mountains or foothills, or along stream banks, associated with oak, aspen, and evergreen forests 4,000-10,500 feet elevation. British Columbia, Alberta, and Saskatchewan, south to Nevada, Arizona, and New Mexico. Disjunct to Durango, Mexico, less often in Washington, Oregon, and California. July to August.

There is some variation within *H. floribunda*, such as the fusion of marginal prickles or not, and the presence or absence of intramarginal prickles. These phases in the past have been called *H. leptophylla*; however, they seem to be wholly arbitrary and not worthy of any taxonomic recognition.