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Editor
Harold W. Rickett

**A Monograph on the
Genus Downingia**

By
ROGERS McVAUGH

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A Monograph on the Genus *Downingia*

ROGERS McVAUGH

(WITH SIXTEEN FIGURES AND ELEVEN MAPS)

INTRODUCTION

The genus *Downingia* (Campanulaceae—Lobelioideae) is a very natural and well-defined group, made up of about 13 species. All the species occur in western United States, with the greatest concentration of species in California. A single species, *D. pusilla*, occurs both in California and Chile. All the downingias are annuals of like appearance, the vegetative characters of the several species being so nearly identical that they are scarcely to be relied upon as means of identification. With some minor exceptions, the important taxonomic characters of the genus are localized in the flowers and fruits. The flowers are commonly blue or purplish, varying to white or pink in some individuals, and are similar in size, markings, and conformation in all the species, so that in a few cases only can gross morphological characters be used to distinguish single species. The fruit in all the species is an elongated capsule, sessile in the axil of a leafy bract and dehiscent at maturity by long slits on the sides.

The superficial resemblances found in all the species make it necessary for the taxonomist to treat the genus exactly as if it were a genus of grasses or of the Compositae, where the distinguishing features are often technical ones and equally often invisible to the unaided eye. In *Downingia*, even though a single flower may be as much as 3.5 centimeters in length, it is often necessary to examine a specimen with a magnification of 10 or 15 diameters before a positive identification can be made.

The corolla of *Downingia*, while in general essentially like that of the majority of the members of the Lobelioideae, has several specialized features which have been much relied upon as means of identification. The "lower lip," as in the flower of *Lobelia* and other genera, is three-lobed and flattened; it may be strongly reflexed or not at all so. At the base of the lip may be found one or more dark purplish spots, in combination with patches or blotches of white or yellow or both. Short horn-like processes are sometimes produced at the base of the lower lip. The sinuses between the "upper" and "lower" lips of the corolla are of different depths in the different species, and some stress has been placed upon the depth of these sinuses in relation to the plane of the reflexed lower lip. The two lobes of the corolla which form the "upper lip" are variously erect, recurved, crossed one upon another, or curled into a ring.

Features of the kind just mentioned are evident in the fresh flower, but are hard to distinguish in herbarium specimens, except after prolonged

study. Flower-color is usually imperfectly or not at all preserved in the herbarium, while such features as the degree of flexion of the lip of the corolla or the direction of the lobes of the "upper lip" are often totally obscured in a pressed flower. The most recent student of the genus, Dr. Robert F. Hoover, has already pointed out¹ that collectors of these plants should study the fresh flowers and make ample notes on the color and conformation of the corollas.

Study of a large series of herbarium specimens, however, brings out the fact that certain morphological characters of these plants are not obscured by drying and are therefore ordinarily available to the student. It has proven quite feasible to separate the several species by means of characters which are discernible even in imperfectly prepared specimens. This does not in the slightest degree detract from the importance of information concerning the fresh flowers; all herbaria at present are suffering from a deplorable lack of just such information.

The genus *Downingia* was established by John Torrey in 1856, and dedicated by him to Andrew Jackson Downing, a horticulturist of Newburgh, New York. Torrey proposed this name to replace *Clintonia* of Lindley, which was antedated by *Clintonia* of Rafinesque. There were already three published names for the genus when Torrey proposed *Downingia*, and his name has been conserved by international agreement. Torrey was aware that *Wittia* had been proposed as a name by Kunth in 1850, but rejected it because he considered it unsuitable to dedicate more than one genus to a single man (De Witt Clinton). Two earlier names proposed by Rafinesque (*Bolelia*, 1832, and *Gynampsis*, 1833) were disregarded by Torrey and may have been unknown to him.

The first downingias made known to science were grown from seeds collected by David Douglas in what is now Oregon. The original species, *D. elegans*, was described by Lindley in 1829 (as *Clintonia elegans*), and a second species, *Clintonia pulchella*, was described by Lindley in 1836, from plants grown from seeds collected in California by Douglas in 1833. Until the year 1886 all collections of Californian or other North American downingias were referred to one of these two species.

In 1886 Asa Gray described a third North American species, and in the same year Edward Lee Greene, the first real student of these plants in the field, described a fourth species. Between 1886 and 1895 Greene proposed 8 new species of *Downingia*, all except one of which appear to be perfectly distinct species. Since Greene's time but one valid species has been discovered in California, and but two elsewhere.

¹ A provisional key to the species of *Downingia* known in California. Leaflet West. Bot. 2: 33-35. Aug. 1937.

The next student of the genus, Professor W. L. Jepson, published in 1922² a revision of the Californian species. He recognized 7 species, reducing *D. insignis* Greene to synonymy under *D. elegans*, *D. montana* to a variety of *D. bicornuta*, and *D. tricolor* to synonymy under *D. concolor*. Essentially the same treatment was employed in Jepson's *California Manual* published three years later.³

In 1937 Dr. Robert F. Hoover, one of Professor Jepson's students, published a key⁴ to the species of *Downingia* known to him from the state of California. He included a total of 13 species. He was in agreement with Jepson on the status of *D. insignis* and *D. tricolor*, but accorded specific rank to *D. montana*. His list also included *D. laeta* Greene, which was not known to Jepson from the state, as well as *D. pallida* Hoover, *D. bella* Hoover, *D. immaculata* Munz & Johnston, and *D. mirabilis* J. T. Howell, all of which had been published after the preparation of Jepson's treatment.

The present monograph recognizes 13 species in the genus, all of which occur in California and 6 of which are apparently endemic to that state. The range of the genus as a whole is from southwestern Saskatchewan to west-central Washington, south to central Utah, western Nevada, and southern California, with a single species common to California and Chile. Specific limits as interpreted by the present writer agree fairly well with those of Jepson and Hoover; the principal exceptions are noted in the text below.

Morphological specialization in *Downingia* is considerable. Evidence from species of other genera of Lobelioideae, native to ancient or long-isolated areas like the West Indies, indicates that the method of dehiscence of the capsule is an advanced one for the family. That the genus *Downingia* is in a state of flux, from the point of view of evolution, is indicated by the presence of both unilocular and bilocular ovaries in the same genus. Other non-primitive characters of the genus are the annual duration of all the species, the reduced foliage leaves and the assumption of much of the photosynthetic activity by the bracts, the sessile ovary, and the lack of bracteoles of the pedicel. As noted above, the corolla in many of the species is highly evolved, both in color-pattern and in conformation. The seeds of *Downingia* are unique in being fusiform and apiculate; the seeds of many of the supposedly primitive members of the subfamily Lobelioideae are variously sculptured and pitted, and vary from globose to bluntly ellipsoid. Additional evidence of a recent development of the genus is fur-

² Revision of the California species of the genus *Downingia* Torr. *Madroño* 1: 98-102. 1922.

³ A Manual of the Flowering Plants of California, Berkeley, 1923-1925.

⁴ Leaflet. West. Bot. 2: 33-35. Au 1937.

nished by geographical distribution of some of the species, which are wholly confined to the great interior valley of California; this region has suffered submergence relatively recently, geologically speaking, so that the components of its flora must be recent introductions or recent developments. Such a species as *Downingia ornatissima*, which is seemingly wholly confined to the Great Valley, with no very evident connections inside the genus, and with a highly evolved corolla as well (even for *Downingia*, where such a corolla is the general rule), is apparently of relatively modern origin.

The corolla of *Downingia* resembles, in essentials, that of the other genera of the Lobelioideae. In certain species the corolla is almost indistinguishable from that of *Porterella carnosula* (which, indeed, is apparently identical with *Downingia* in vegetative and other characters except for its pedicellate, apically dehiscent capsule). So far as can be ascertained at the present time, the genus *Downingia* may be assumed to have arisen from an ancestor very similar to or identical with that of *Porterella*. *Porterella* in its turn has apparently been derived from a "*Laurentia*"-like ancestor, a complex which may have contributed to some of the small blue-flowered species which we now divide among several genera, including *Diastatea*, "*Laurentia*" (*Lobelia*, sect. *Isotoma*), and *Lobelia*.

The changes brought about by the evolutionary process are assumed to be roughly as follows:

1. Assumption of a semi-aquatic habitat.
2. Assumption of an annual duration by all species.
3. Reduction of vegetative (foliar) tissue to a minimum.
4. Disappearance of pedicel and accompanying bracteoles.
5. Lengthening of the ovary and change from apical to lateral dehiscence.
6. Development of fusiform, apiculate seeds.

Subsequent changes in certain of the species are thought to be as follows:

7. Development of a unilocular ovary through abortion.
8. Development of highly specialized patterns of color and conformation in the corolla.

The process outlined above may, on the other hand, be far too simple. The most important single bit of evidence upon which the above assumptions are based is the strong resemblance between *Downingia* and *Porterella*, added to the technical similarities between *Porterella* and *Lobelia*, sect. *Isotoma*. Such resemblances, while highly useful to the taxonomist, must not to be leaned upon too heavily. The transition from apical to lateral dehiscence of the capsule appears in this case to be a considerable one. The valves in *Downingia* vary from 3 to 5 in number, while in the genera with apical dehiscence they are almost invariably two. Further-

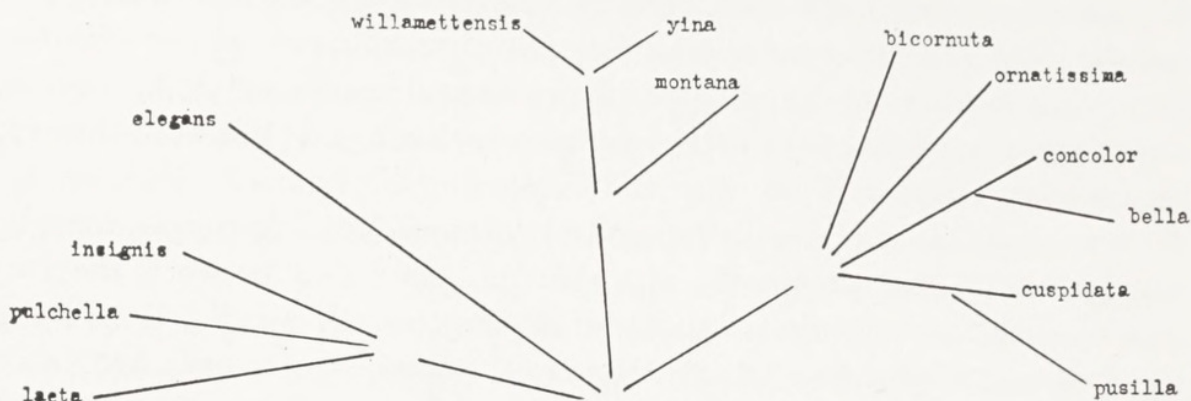
more, the character of lateral dehiscence of the capsule is not peculiar to *Downingia*, but is shared with the monotypic genus *Cyphocarpus*, which is a Chilean endemic, and with certain Australian species now referred to *Lobelia*. *Cyphocarpus* is peculiar among plants of campanulaceous affinities in having a truly lobeliaceous corolla, a capsule essentially like that of *Downingia*, but stamens entirely free from each other. It has been thrown, for lack of a better place, into the "Cyphiaceae" by most authors. Its presence in Chile, along with that of a true species of *Downingia*, may be suggestive of some previously unsuspected connection between the two genera. The single Chilean species of *Downingia*, *D. pusilla*, is but one member of the puzzling group of species common to temperate North America and temperate South America; the presence of representatives of otherwise strictly North American genera in southern South America is unexplained as yet, although a widely recognized phenomenon. It is indeed possible that *Downingia* has developed from some ancestral type, quite unlike *Lobelia*, from which ancestor cyphioid genera like *Cyphocarpus* may have come as well.

Whatever the source of the immediate forerunner of the modern genus *Downingia*, the putative characteristics of such a primitive *Downingia* are as follows:

1. A bilocular capsule with tough walls, these tardily dehiscent even at maturity.
2. A corolla very like that of *Downingia montana*, with relatively long and slender tube, reflexed lower lip and pronounced inequality between the lobes of the upper and lower lips. This corolla is assumed to have been almost without the peculiar folds and protuberances so noticeable in some of the present species. The purple coloration at the base of the lower lip is assumed to be a primitive character in the genus, since it is persistent in most of the species.
3. Seeds untwisted, with faint lines.

A plant like that described above appears to be most closely akin to the genus *Lobelia*, and presumably subsequent evolution of *Downingia* has been away from this type. A few species have developed the unilocular condition, while others have lost the purple coloration of the corolla-lip, and have developed peculiar features of the corolla not found elsewhere. The capsule in some species has apparently become progressively more delicate and hyaline divisions have been developed between the valves, the valves then separating at maturity. In a few species the upper lobes of the corolla have become almost as large as the lower. Additional changes are found in the seeds, which in most species have lost the surface markings and become perfectly smooth and shining; in two species the seeds are characteristically twisted, with the surface markings oblique; this is apparently an evolutionary advance.

The accompanying scheme shows graphically the supposed interrelationships of the species.



METHODS

The conclusions reached by the writer in the present paper are based upon herbarium study of approximately 1500 specimens of *Downingia*, comprising roughly 700 different collections. A record was kept for each specimen examined, the following data being recorded:

- Height of plant (range of variation if possible).
Length of inflorescence, measured from lowest flower-bract to top of plant.
Number of flowers (range of variation, if possible).
Size of leaves (if present).
Presence and extent of pubescence.
Size of flower-bracts (length, and breadth at widest part).
Diameter and length of mature capsule, if available.
Character of capsule-wall (tough, fragile with hyaline divisions, etc.).
Length of calyx-lobes (including range of variation).
Length of corolla when straightened out (often estimated, owing to the imperfect preservation of the corolla when pressed).
Dimensions of corolla-lobes.
Length of corolla-tube, measured (1) from summit of hypanthium to the lowest point of the lateral sinus and (2) from summit of hypanthium to lowest point of dorsal sinus.
Length of the filament-tube, measured from the summit of the corolla-tube to the base of the anther-tube.
Length of the anther-tube.
Additional features have been noted for certain species, as, for example, the length of the twisted appendage of the anther-tube in *D. bicornuta*.

It was not practicable to secure all the above data for every specimen examined; a plant with immature fruits, for example, furnishes no information about the capsule or the seeds. A very old fruiting specimen may be wholly without remains of the corolla; again, a scanty herbarium specimen may bear so few flowers that it is difficult to make dissections without dam-

aging the specimen. As in all the members of the Lobelioideae, however, pressed specimens of *Downingia* usually have all the above parts well-preserved except the corolla-lobes. In almost any specimen, no matter how poorly prepared, it is possible to measure the corolla-tube, the filament-tube, and the anther-tube with very little error. The corolla-lobes, on the other hand, are not available for study on more than about 25 per cent of the flowers.

The measurements given below, in the descriptions of the several species, are derived from those obtained as described above. Where a measurement is given as "(2.5) 4.0—6.0 (7.5)" it indicates that the principal range of variation is from 4 to 6, with rather an abrupt change of frequency of occurrence at those points, but with occasional extreme individuals varying as far as 2.5 or 7.5. The stated limits of variation of each character are derived from the measurements of roughly 90 per cent of the whole number of specimens examined, with the exception of the corolla-lobes, as stated above, the capsule, which is present in roughly half the plants seen, and the leaves, which are often absent at flowering time.

The specimens were examined with the aid of a binocular dissecting microscope, with available magnification of 7, 15, and 20 diameters.

Examination of any series of measurements similar to the above usually shows, sometimes in very startling fashion, simple and positive ways of separating species which have previously been confused. It is, or should be, axiomatic that while any two unrelated species may appear to be alike in any single character, the probability of such similarity decreases very rapidly when one increases the number of characters under consideration. To state this simply in another way, we may assume that any two species, if actually distinct, will differ from each other not in a single character, but in many characters, except in the relatively rare cases where the difference between species lies in a single gene. We may, accordingly, expect to find certain sets of characters, even in related species, where there is no overlapping of measurements and little possibility of confusion of different species.

The large-flowered species, *Downingia insignis* Greene, may be used as a case in point. The flowers are superficially very similar to those of *D. elegans*, both species having a long-exserted and strongly recurved anther-tube and a broad campanulate corolla-tube without a reflexed lower lip. On the basis of this superficial similarity, *D. insignis* has been merged with *D. elegans* by almost all Californian botanists. When the measurements of all the supposed *D. elegans* are plotted graphically some discrepancies are at once apparent. The curve for length of corolla-tube, for example, is plainly bimodal, with one region of greatest frequency between 3.5 and

5.0 mm., and a second between 2.0 and 3.2 mm. When all the specimens having the longer corolla-tube are segregated from the others, they are found to constitute a perfectly distinct group, differing from *Downingia elegans* in geographical range, time of flowering, number of loculi in the ovary and method of placentation, size and toughness of capsule, shape and surface-markings of anthers, color-pattern of corolla, and general aspect of plant-body. The single character of length of corolla-tube having served as a clue to the identity of *D. insignis*, the species was then easily shown to be abundantly distinct.

The above arguments may be taken to apply equally well to qualitative data as to quantitative. In certain groups of plants it is often impossible to obtain enough material of flowers and fruits to enable the taxonomist to carry out a program like that outlined above. When abundant flowering and fruiting material is available, however, such a course seems to be the logical one. The principal difficulty is the determination of the most dependable characters in a given group; that is, the characters with a relatively small range of variation. In the Campanulaceae, for example, little importance may be attached to the size of the plant itself; *Specularia perfoliata* or *Lobelia inflata* may produce perfect flowers and fruit when growing under adverse conditions so that the plants are not more than one or two centimeters in height, while the same species under favorable conditions may attain many times this height. As in most other plant-families, the principal diagnostic characters of the Campanulaceae are to be found in the flowers and fruits, but some characters of flower and fruit are much more dependable than others. In general too much stress should not be placed upon the size and shape of the corolla-lobes, as these appear to vary considerably with differences in habitat of the plant. Length of the corolla-tube, at least in the Lobelioideae, appears to vary within quite definite limits, as does that of the filament-tube and that of the anther-tube.

DELIMITATION OF SPECIES

Specific limits, according to the writer's concept, are determined through consideration of the following:

1. *Morphology*. As has been stated above, each true species may be expected to differ from all others by several or many characters; the apparent absence of such distinctive features is often due to inadequate examination of the available material. Logically the writer would consider a difference of but few genetic characters sufficient to establish the identity of a species. In practice, however, such a case is rarely found, or, if present, usually goes undetected. Ordinarily, in nature, a species may be defined as that population which, while perhaps indistinguishable from other populations

in many of its features, differs significantly from them, without intermediate states, in several ways.

Subspecific limits are determined in a similar fashion. The terms employed here, namely "variety" and "form," are used as follows:

A variety is defined as that population within a species which differs in one or more ways from the remainder of the species, the differences being more or less strongly linked with differences in geographical distribution. The writer has never studied a variety which was not partially segregated geographically from the other varieties of the species. A variety is connected by intermediates, these usually numerous, to the other variety or varieties, and their ranges are ordinarily adjoining or overlapping.

A form is defined as a variant differing from the rest of the species by (usually) a single trivial character. A form is understood to be without geographical significance.

2. *Areal distribution*. Wholly disjunct ranges of two supposed entities, while strongly indicative of specific differences between the two, are nevertheless not conclusive, and evidence from distribution must be used in conjunction with that from morphology.

SYSTEMATIC TREATMENT

DOWNINGIA Torrey, Pacific Rail. Rep. 4⁵: 116. 1856, nomen conservandum.

Clintonia Dougl., ex Lindl., Bot. Reg. 15: t.1241. 1829, non *Clintonia* Raf., 1818.

Bolelia Raf., Atl. Jour. 120. 1832.

Gynampsis Raf., Herb. Raf. 48. 1833; Fl. Tellur. 3: 5. 1837.

Wittia Kunth, Abh. Akad. Berlin 1848: 32. 1850.

Soft-stemmed annual herbs, simple or somewhat branched, erect or decumbent, sometimes rooting at the lower nodes, often corky-parenchymatous below. Vegetative parts wholly glabrous, or rarely the upper part of the stem or the calyx-lobes scabrous-ciliate; ovary and capsule often minutely scabrous. Leaves cauline, numerous, much smaller than the flower-bracts, soon deciduous and often not functional at flowering time, lanceolate to subulate or the uppermost broader, sessile, entire or rarely with a few minute teeth, the upper usually obtuse, the lower acute to acuminate or awn-pointed.

Inflorescence a simple raceme, the terminal flowers often aborting and overtopped by the earlier developing ones. Flowers perfect, 5-merous (except for the gynoeceum, in which the placentae are 2, the loculi one or 2 and the valves 3-5), sessile in the axils of foliaceous bracts but appearing long-stalked because of the great elongation of the ovary. Flowers inverted in anthesis by the twisting of the capsule, the (apparently) lower lip of the corolla being morphologically the upper one, and the (apparently) upper lip being actually the lower. Corolla blue, occasionally varying to pink or white, usually with a symmetrical white or yellow blotch on the lower lip. Corolla-tube entire, neither fenestrate nor cleft to the base between the two smaller corolla-lobes. Limb more or less strongly bilabiate, the 2 lobes of the one lip (the "upper") mostly smaller and

narrower than the 3 prominently fused lobes of the other; lower lip often furnished with folds and ridges or nipples at the basal angle.

Stamens syngenesious and monadelphous, with the general characters of the subfamily. Two smaller anthers each with a terminal tuft of bristles and usually with a terminal hornlike process as well. Ovary wholly inferior, topped by the free calyx-lobes. Calyx lobes normally entire except for a minute tooth on each edge near base; three upper lobes (those alternating with the two narrower lobes of the corolla) usually longer than the other two. Ovary linear to fusiform, 10—75 times as long as wide when mature, opening elastically by 3—5 longitudinal slits in the wall, the slits extending nearly the entire length of the capsule. Ovary and capsule unilocular, with 2 parietal placentae extending the length of the loculus, or bilocular, with the 2 placentae extending the length of the two faces of the delicate longitudinal central septum. Ovules and seeds many, the mature seeds fusiform, apiculate, light brown with darker tips, smooth and polished or with faint longitudinal cellular lines and but slightly lustrous.

TYPE SPECIES: *Downingia elegans* (Dougl. ex Lindl.) Torr.⁵

The collections in herbaria have been made available to the writer through the generous cooperation of the persons in charge. It is a pleasure to acknowledge the kindness of these botanical friends, without whose aid the completion of this study would have been impossible. In citing specimens from the several herbaria, the following abbreviations are used: The Academy of Natural Sciences of Philadelphia (ANS); the California Academy of Sciences (CalAc); Catholic University of America (Cath); Herbarium of E. L. Greene, University of Notre Dame (ELG); Field Museum of Natural History (F); Forest Service, United States Department of Agriculture (FS); Gray Herbarium, Harvard University (G); University of Idaho, Pocatello (Id); Montana State University (Mont); The National Arboretum, Washington, D. C. (USNA); New York Botanical Garden (NB); National Museum of Canada (O); University of Oregon (Ore); Pomona College (P); Rocky Mountain Herbarium, University of Wyoming (R); Stanford University (S); University of California at Berkeley (UC); United States National Herbarium (US); Willamette University (WU).

In the following discussion, certain special terms are used as follows:

Lower lip: The three-lobed lip of the corolla, actually originating next to the inflorescence-axis but twisted away from the axis in anthesis so that the rest of the corolla is between it and the stem.

Upper lip: The two-lobed lip of the corolla, actually the lower or outer

⁵ Some authors have regarded *Downingia pulchella* as the type species of the genus, but such a course appears illogical. Torrey proposed *Downingia* as a name to replace the illegitimate *Clintonia* of Lindley, and at the same time (1856) transferred *Clintonia pulchella* to *Downingia*. *Clintonia elegans* was not transferred to *Downingia* until 1874, but it was the original species of Lindley's genus *Clintonia*, antedating *C. pulchella* by 7 years, and must therefore be regarded as the type species of *Downingia*.

lip but through inversion of the flower becoming apparently the upper or inner one.

Filament-tube: The united filaments, measured from the summit of the ovary (the base of the calyx-lobes) to the base of the anther-tube.

Corolla: Measurements of corolla apply to length from base (at summit of ovary) to tip of the longest lobes.

Corolla-tube: the sympetalous part of the corolla, its length measured either to the *lateral sinuses* (from the summit of the ovary to the deepest point of the sinus between the upper and lower lips) or to the *dorsal sinus* (from the summit of the ovary to the deepest point of the sinus between the two narrow lobes of the corolla, that is, those of the upper lip).

ANALYTICAL KEY TO THE SPECIES

1. Corolla 2.0—7.0 mm. long, not at all or scarcely exceeding the calyx-lobes; lower lip ascending, never sharply reflexed; filament-tube 1.0—2.8 mm. long; anther-tube not incurved, its long axis nearly or quite parallel with that of the filament-tube (see figures 7–9, p. 17).....2
2. Corolla 2.0—4.0 mm. long; filament-tube 1.0—1.8 mm. long; anther-tube 0.6—1.1 mm. long; seeds appearing as if twisted, the very fine cellular lines of the surface running obliquely to the long axis of the seed, at least in part.....*D. pusilla* (p. 35)
2. Corolla 4.0—7.0 mm. long; filament-tube 1.8—2.8 mm. long; anther-tube 1.3—2.2 mm. long; seeds not appearing twisted.....*D. laeta* (p. 43)
1. Corolla 5.0—20.0 mm. long, usually much exceeding the calyx-lobes; lower lip of corolla sharply reflexed or the anther-tube sharply incurved and standing almost at right angles to the filament tube.....3
3. Anther tube strongly incurved, usually standing almost at right angles to the filament tube; lower lip of corolla not sharply reflexed nor forming a sharp angle with the corolla-tube; corolla-tube broadly funnel-form or campanulate, the lateral sinuses conspicuously deeper than the dorsal one so that the two upper corolla-lobes form a distinct cleft upper lip (see figures 1, 2).....4
4. Ovary and capsule bilocular, the ovules attached to the two faces of a longitudinal septum;⁶ anther-tube relatively short and thick, 2.4—3.5 mm. long, 1.0—1.3 mm. in diameter, nearly uniformly dirty-white in color; anthers minutely granular-roughened over the whole surface; flowering season from March to mid-June. .*D. insignis* (p. 40)
4. Ovary and capsule unilocular, the ovules attached to the ovary wall along two longitudinal lines;⁶ anther-tube relatively slender, 2.0—4.0 mm. long, 0.6—1.0 mm. in diameter, pale bluish-gray (when dry) with pale gray or white connectives forming longitudinal stripes; anthers smooth and glabrous or sparsely pilose, never granular-roughened, flowering season from June to September.....*D. elegans* (p. 50)
3. Anther-tube not at all or very slightly incurved; lower lip of corolla reflexed, forming a sharp angle with the corolla-tube (see figures 3, 11).....5
5. Pair of bristles at apex of anther-tube usually tightly twisted together, forming an appendage 0.6—2.7 mm. in length; corolla-tube prominently bearded within on lower side; base of lower lip with dark purple nipple-like projections (figures 4–6).....*D. bicornuta* (p. 27)
5. Pair of bristles at apex of anther-tube, if present, never twisted together; corolla-tube glabrous within or, in *D. ornatissima*, sparsely pilose; base of lower lip without purple

⁶ This is readily discernible, even in immature fruits, if the calyx and ovary-wall be slit longitudinally by the point of a needle, under a dissecting lens.

- nipple-like projections 6
6. Anther-tube 2.6—3.5 mm. long, rarely less, usually gradually narrowed and pointed at tip; filament-tube exceeding the corolla-tube so that the anther-tube is prominently exerted (filament-tube usually 3.0—4.5 mm. long, mostly 1.5—2.0 times the length of the corolla-tube measured at the lateral sinuses); lower lip of corolla with three purple spots at base (figure 10)..... *D. pulchella* (p. 37)
6. Anther-tube 1.4—2.5 (rarely 3.0) mm. long, cylindric, the tip blunt or rounded, if pointed very abruptly so; filament-tube about equalling or somewhat exceeding the corolla-tube, never more than 1.5 times as long as the corolla tube measured at the lateral sinuses..... 7
7. Dorsal sinus of the corolla produced backward and outward into a short hornlike process with upcurved tip (this may be small or absent in individual plants); corolla-tube sparsely pilose within; anther-tube wholly exerted, often for a distance of 1.0—2.0 mm., the filament-tube plainly exceeding the corolla-tube as measured on dorsal side (figure 3)..... *D. ornatissima* (p. 22)
7. Dorsal sinus of the corolla without projecting fold or horn; corolla glabrous within; base of the anther-tube normally included, the filament-tube equalling or shorter than the corolla-tube measured on dorsal side..... 8
8. Ovary and capsule bilocular, the ovules attached to the two faces of a longitudinal septum..... 9
9. Seeds not appearing as if twisted, the markings, if any, paralleling the long axis of the seed; lower lip of corolla with one or more purple spots at base..... 10
10. Two upper corolla-lobes minutely ciliate-scabrous on margins near tip (this plainly visible when magnified about 15 \times); lower lip of corolla with large purple spot at base, the purple color covering the low ridges at basal angle of lip (figures 12, 13)..... *D. concolor* (p. 18)
10. Two upper corolla-lobes smooth on margins; corolla with three or two purple spots at base of lower lip (at mouth of tube)..... *D. bella* (p. 21)
9. Seeds appearing as if twisted, the very fine cellular coat marked by minute lines running obliquely to the long axis of the seed; base of lower lip of corolla yellow, without purple areas (figure 16)..... *D. cuspidata* (p. 30)
8. Ovary and capsule unilocular, the ovules attached to the ovary wall along two longitudinal lines..... 11
11. Three larger anthers usually abundantly pilose near tip, with an additional tuft of minute bristles at the extreme tip; seeds dull or scarcely lustrous, with faint but plainly visible longitudinal lines (magnification ca. 15 \times); lower lip of corolla with three purple grooves alternating with three purple ridges at base; range from Shasta County, California, south along the Sierra Nevada to Tuolumne County (figures 11, 15)..... *D. montana* (p. 45)
11. Three larger anthers glabrous or sparsely pilose near tip, the bristle-like tufts at the extreme tips usually reduced to minute serrulations; seeds smooth, shining, with no lines visible on the surface (magnification 15 \times); range from Humboldt County, California, north to Washington..... 12
12. Valves of the capsule separated by hyaline lines extending the length of the capsule, these visible as impressed lines even before maturity; mature capsule terete, linear or fusiform, broadest about the middle; plants 10 cm. high or less, diffusely branched from the base; range from northern Siskiyou County, California, to Klamath County, Oregon..... *D. yina* (p. 47)
12. Valves of the capsule usually invisible before splitting, with no impressed lines nor scarious divisions on calyx-tube; mature capsule subulate, broadest near base; plants up to 35 cm. high, usually erect; range from Humboldt County, California, north to Washington, mostly west of the Cascade Ranges..... *D. willamettensis* (p. 48)

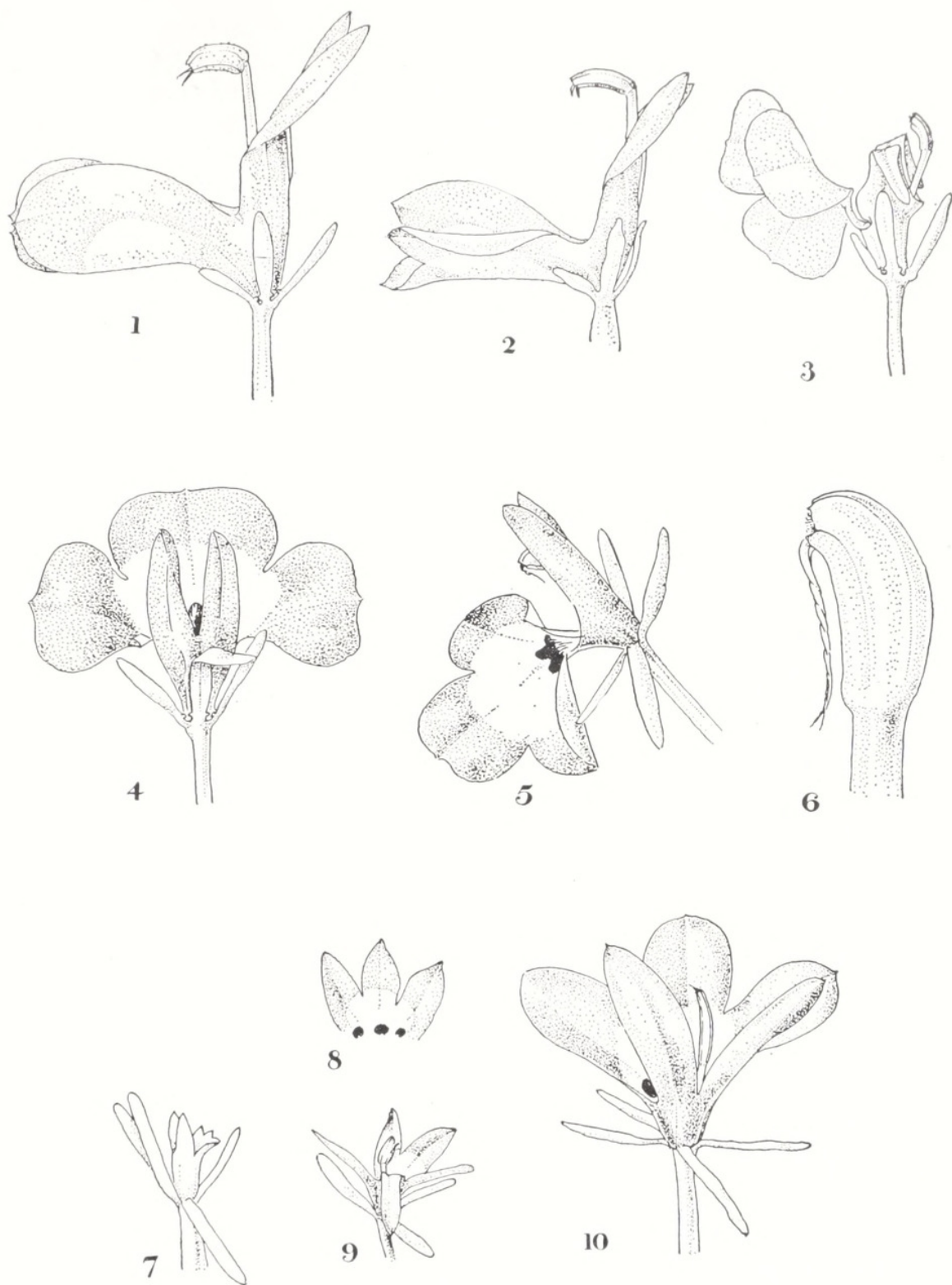


FIG. 1. Lateral view of flower of *Downingia insignis*, $\times 2.5$ (CalAc 174146). FIG. 2. Lateral view of flower of *Downingia elegans* var. *elegans*, $\times 2.5$ (Bracelin 695). FIG. 3. Lateral view of flower of *Downingia ornatissima* var. *ornatissima*, $\times 2.5$ (Eastwood 10185).

FIG. 4. Dorsal view of flower of *Downingia bicornuta* var. *bicornuta*, $\times 2.5$ (Hoover 1099). FIG. 5. Lateral view of flower of *Downingia bicornuta*, $\times 2.5$ (Stanford 937). FIG. 6. Lateral view of anther-tube of *Downingia bicornuta* var. *picta*, $\times 12.5$ (Hoover 1083).

FIG. 7. Lateral view of flower of *Downingia pusilla*, $\times 2.5$ (Heller & Brown 5362). FIG. 8. Portion of lower lip of corolla of *Downingia laeta*, $\times 2.5$. FIG. 9. Lateral view of flower of *Downingia laeta*, $\times 2.5$ (M. E. Jones, June 24, 1897; P). FIG. 10. Dorso-lateral view of flower of *Downingia pulchella*, $\times 2.5$ (Jepson, June 1896; G).

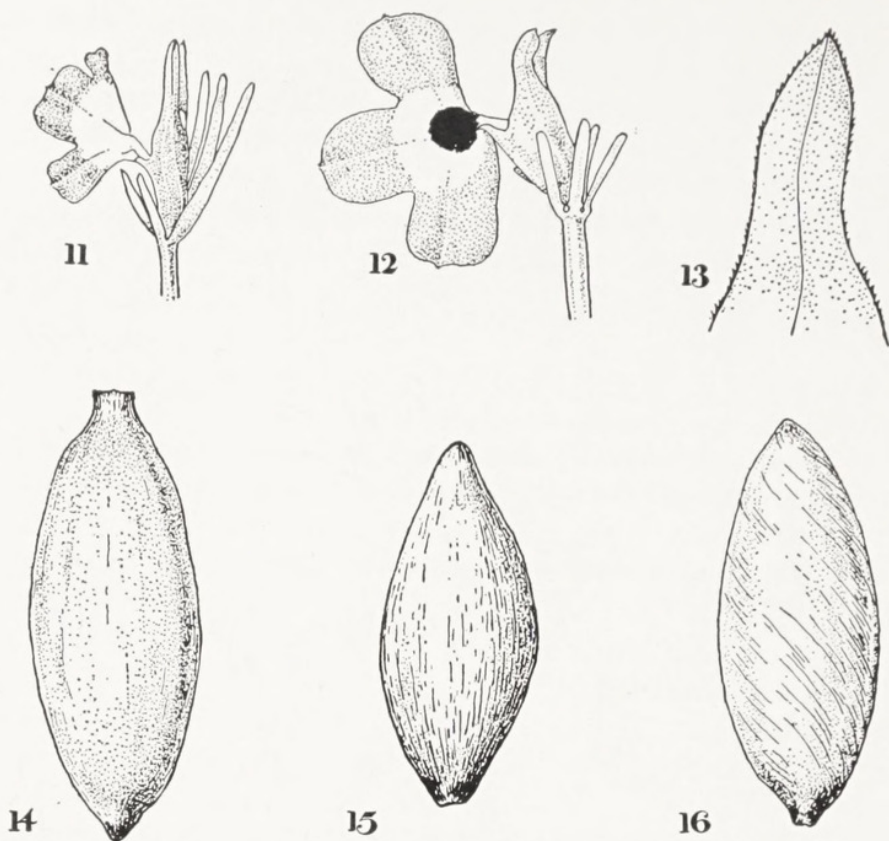


FIG. 11. Lateral view of flower of *Downingia montana*, $\times 2.5$ (Hoover 1203). FIG. 12. Lateral view of flower of *Downingia concolor* var. *tricolor* $\times 2.5$ (Heller & Brown 5631). FIG. 13. Tip of upper lobe of corolla of *Downingia concolor*, $\times 10$.

FIGS. 14–16. Seeds of *Downingia*, $\times 50$. FIG. 14. *Downingia elegans*. FIG. 15. *Downingia montana*. FIG. 16. *Downingia cuspidata*. No attempt is made to indicate color values, as seeds taken from dried material vary considerably in color. The color range is from a very dark brown to a light amber; the entire range may be seen in specimens of the same species. The reasons for the differences in pigmentation are not clear; apparently the stage of maturity of the seed is an important factor but not the only one.

The seed shown in figure 14 is the type found in most of the species. The surface is somewhat lustrous and practically unmarked. The body of the seed is terete, or very slightly angled; the ends are slightly constricted and darker in color than the body. The seed shown in figure 15 is very similar to that of figure 14 but the surface cells form a more distinct pattern which shows up as a series of faint but evident longitudinal lines. This pattern is best seen in *D. montana*, but a similar and less distinct pattern may sometimes be seen in the other species. The type of seed shown in figure 16 is peculiar to *D. cuspidata* and *D. pusilla*.

Thanks are due to Mr. B. Y. Morrison, of the Division of Plant Exploration and Introduction, who made the seed drawings reproduced above.

1. DOWNINGIA CONCOLOR Greene, Bull. Calif. Acad. 2: 153. 1886.

Plants few—20 (33) cm. high, glabrous except for the hypanthium, which is mostly somewhat scabrous but sometimes glabrous. Leaves 0.4—2.0 mm. wide by 5—18 mm. long. Inflorescence few—15 cm. long, loosely few—15-flowered. Flower-bracts elliptic to ovate, usually obtuse or at least blunt-tipped, 1.0—3.0 (4.0) mm. wide by 5—16 mm. long, usually 3—6 (10) times as long as wide.

Ovary linear, in fruit unchanged in shape or becoming narrowly fusiform (rarely somewhat subulate); mature capsule 0.8—1.5 (2.0) mm. in diameter by (12) 30—50 (62) mm. long. Calyx-lobes elliptic to linear or oblanceolate, obtuse

or subacute, ascending or rotately spreading, subequal or the two lower ones distinctly shorter, 3—8 mm. long.

Corolla 7—13 mm. long, glabrous except for the two upper lobes, which are ciliate-scabrous on the margins near tips and sometimes on the inner surface near the tips. Color blue (or "deep blue"), the lower lip with a quadrate or two-lobed purple or red-purple ("velvety purple" according to Jepson) spot at the base of the central white area; the white may be much reduced or lacking, leaving the whole lip blue except for the purple spot at base. Base of the lower lip with two low ridges or nipple-like processes arising in the purple spot.

Corolla-tube (2.5) 3.0—4.0 (5.5) mm. long, narrowly funnel-shaped ("turbinate" according to Greene), the lateral sinuses usually cut well below the plane of the lower lip (sometimes as much as 1 mm.); lateral sinuses about as deep as or slightly deeper than the dorsal one; corolla-tube measured to dorsal sinus 3.0—4.5 (5.5) mm. long. Two upper corolla-lobes lanceolate or shortly ovate, mostly recurved and often appressed to the corolla-tube but sometimes erect or only slightly recurved; tip acute; lobes mostly 0.8—1.2 mm. wide by (2.5) 3.5—5.0 mm. long. Lobes of the lower lip rounded to truncate, oblong to obovate, usually mucronate.

Filament-tube (2.0) 2.5—4.0 (5.0) mm. long, glabrous, the filaments united their whole length or nearly so; base of anther-tube usually covered by dorsal side of corolla-tube (whole anther-tube sometimes included); anther-tube 1.8—2.3 (2.6) mm. long, the anthers glabrous or somewhat pubescent on the backs; all anthers minutely tufted at tips, the two shorter ones prominently so and each bearing a short hornlike process as well.

Seeds not twisted, the fine cellular markings running longitudinally. Placentae axile.

KEY TO THE VARIETIES

1. Mature capsule tough, firm-papery, tardily dehiscent, lacking hyaline divisions between the valves, mostly 30—50 mm. long; range from Lake County to Monterey County, California.....var. *tricolor*
1. Mature capsule soon dehiscent, the valves separated by delicate hyaline lines of tissue; capsule mostly 12—25 mm. long; known only from vicinity of Cuyamaca Lake, San Diego County, California.....var. *brevior*
- 1a. DOWNINGIA CONCOLOR var. TRICOLOR (Greene) Jepson, Fl. W. Mid. Calif. ed. 2. 402. 1911. *D. concolor* Greene, l.c. *Type locality*: "Wheat field near the village of Suisun" (Solano County, California). TYPE: *E. L. Greene*, May 2, 1886, No. 16108 of the Greene Herbarium.
D. tricolor Greene, Pittonia 2: 79. 1890. *Type locality*: "Fields of the lower Sacramento Valley near Elmira." TYPE: "Near Elmira," *E. L. Greene*, May 1890, No. 16111 of the Greene Herbarium.
Bolelia concolor Greene, Pittonia 2: 127. 1890.
B. tricolor Greene, l.c.
B. concolor var. *tricolor* Jepson, Fl. W. Mid. Cal. ed. 1, 481. 1901.

Vernal pools, mud-flats, and margins of ponds; low elevations in the coastal regions of California from Lake County to Monterey County. Flower and fruit from April 1 to July 15; most collections have been made in May.

Specimens examined: CALIFORNIA: Near San Francisco, *Dr. A. Kellogg* in 1866 (US); Sacramento Valley, *E. L. Greene*, May 1890 (S, UC); road to Mt. Atlas, Napa Valley, *Belle R. Jackson*, May 29, 1938 (CalAc); without loc., *H. N. Bolander* 3985 (G). LAKE: Near Lakeport, *C. F. Baker* 3057 (ELG, F, G, NB, P, R, UC, US); Kelseyville, *M. S. Baker* 5917 (CalAc), 5918 (UC), 7508 (CalAc); 3 miles n. of Middletown, *C. B. Wolf* 1911 (S); 5 miles n.e. of Middletown, *L. R. Abrams* 12314 (S); n. of Middletown, *Eastwood and Howell* 5547 (CalAc). MONTEREY: Priest Valley, *A. Eastwood*, May 13, 1893 (CalAc); near Santa Rita, *E. K. Abbott*, May 1889 (CalAc). NAPA: Without loc., *Belle R. Jackson*, May 10, 1923 (CalAc). SAN BENITO: 2 miles n.e. of Hollister, *R. F. Hoover* 3487 (UC). SANTA CLARA: Morgan Hill, *M. S. Clemens*, April 1921 (NB); *J. T. Howell* 4750 (CalAc); between Gilroy and Morgan Hill, *L. R. Abrams* 5664 (S); between Morgan Hill and San Martin, *R. Bacigalupi*, May 12, 1923 (S); near Gilroy, *M. E. Lang*, 5/6/22 (S); Gilroy, *J. T. Howell* 5190 (CalAc, Cath, P); Mayfield, *S. H. Burnham*, May 22, 1895 (G); *W. R. Dudley*, May 2, 1893 (S) and May 3, 1896 (S); *L. R. Abrams*, May 1901 (P, S). SOLANO: Elmira, *C. F. Baker* 2895 (CalAc, ELG, G, NB, P, R, UC, US); Vanden, *Mrs. Brandegee*, April 1893 (S); Suisun, *E. L. Greene*, May 2, 1886 (CalAc, ELG (TYPE), F, NB, O, UC, US); May 3, 1886 (G); May 1890 (NB, Ore, UC); May 2, 1890 (ELG, UC); May 5, 1890 (NB, US); Suisun, *A. Eastwood* 10417 (CalAc); near Suisun, *Heller and Brown* 5592 (F, G, NB, P, R, S, US); Elmira, *E. L. Greene*, May 4, 1890 (S); near Elmira, *A. A. Heller* 14545 (US). SONOMA: Santa Rosa, *K. Brandegee*, without date (UC); *Heller & Brown* 5631 (F, G, P, NB, S, US); *A. Eastwood*, April 24, 1921 (CalAc, G, R); Mark West, *H. N. Bolander* 3895 (US); Elverano, *Michener & Bioletti*, May 30, 1892 (NB); Sebastopol, *J. T. Howell* 13017 (CalAc); 2 miles n. of Windsor, *Eastwood & Howell* 2508 (CalAc); near Windsor, *W. W. Carruth*, June 1901 (CalAc); near Healdsburg, *M. A. King*, May 1897 (UC); "Schellville," *Michener & Bioletti* 174, May 1891 (G); Shellville, *F. T. Bioletti*, May 1892 (ELG, UC); Sonoma, *F. T. Bioletti*, May 1891 (ELG, S, UC); "S(anta) R(osa)—Sebastopol Highway," *M. S. Baker* 2161b (S); "Laguna near Sta. Rosa Creek," *J. M. Bigelow*, May 1, 1854 (NB); without loc., *E. Samuels* 140 (US). TULARE: Deer Creek, *J. W. Congdon*, March 1881 (S).

lb. *DOWNINGIA CONCOLOR* var. **brevior** McVaugh, var. nov. A var. *tricolore* capsula brevior capsula lineis hyalinis dehiscente differt.

Type locality: Cuyamaca Lake, San Diego County, California. TYPE: *L. R. Abrams* 3851, in the herbarium of the New York Botanical Garden.

Muddy places, San Diego County, California. Known surely only from the vicinity of Cuyamaca Lake, at an elevation of about 1400 meters. Collected in flower and fruit from May to July.

Specimens examined: CALIFORNIA—SAN DIEGO: "Cuyamanca," *T. S. Brandegee*, June 3, 1896 (P, UC); Cuyamaca Valley, *S. B. & W. F. Parish* 394 (G); Cuyamaca Mt., *S. B. & W. F. Parish*, June 1880 (S); same loc., *S. B. & W. F. Parish* 398 (F); Cuyamaca Lake, *T. S. Brandegee*, July 16, 1906 (F, NB); Cuyamaca Lake, *L. R. Abrams* 3851 (CalAc, F, G, NB, P, S, UC, US);

Cuyamaca Lake, *P. A. Munz* 9785 (G, P, S, UC); Cuyamaca Lake, *M. E. Jones*, June 11, 1932 (UC) and May 30, 1926 (P, S); "in flumen prope San Diego," *M. F. Spencer* 1073, April 16, 1919 (UC); "in pools on the mesas," *M. F. Spencer* 1073, May 25, 1920 (P).

As stated above, this variety has been collected a number of times in the vicinity of Cuyamaca Lake, but no other locality is known to the writer, and *Munz*⁷ gives the single locality "Muddy shores of Cuyamaca Lake." The two *Spencer* collections just cited may have been collected elsewhere in San Diego County, but their exact origin is unknown.

The differences between var. *brevior* and the more widely distributed var. *tricolor* appear to be slight but constant. Vegetatively the two are indistinguishable, and the flowers of the two appear to be identical. The differences lie in the capsules, which in var. *tricolor* are ordinarily longer than those of var. *brevior* and much tougher when dry; they lack the evident hyaline lines, along which the capsules of var. *brevior* soon open.

2. DOWNINGIA BELLA Hoover, Leaflet West. Bot. 2: 2. 1937.

Type locality: "Near San Joaquin River southwest of Modesto" (Stanislaus County, California). *TYPE*: *R. F. Hoover* 837, April 1, 1936, in the herbarium of W. L. Jepson, not seen. Isotypes in the Gray Herbarium and in the herbaria of Stanford University, the University of California, and the California Academy of Sciences.

Plants few—17 cm. high, entirely glabrous or the capsule somewhat scabrous; stems fistulous, according to Hoover. Leaves 1.0—1.5 mm. wide by 5—12 mm. long. Inflorescence 6—8 cm. long, loosely 3—7-flowered. Flower-bracts oblong to elliptic, acute, or obtuse, 1.0—2.5 mm. wide, 7.0—18.0 mm. long, mostly 4—9 times as long as wide.

Ovary linear, in fruit probably more or less unchanged in shape (mature fruit not seen); nearly mature capsule about 1 mm. in diameter by 35—50 mm. in length, the lateral walls tough and tardily dehiscent, the divisions between the valves obscurely or not at all marked. Calyx-lobes linear or elliptic, ascending or rotately spreading, blunt-tipped, (2.0) 3.0—6.0 mm. long.

Corolla 10—12 mm. long, glabrous. Color deep bright blue, the lower lip with "central white area with yellow center" (Hoover, l.c.). Base of lower lip with two yellow ridges or projections, these alternating with three small purple spots or the central purple spot absent. Tube about the same color as the limb, or lighter just below the lower lip.

Corolla-tube 3.0—4.0 mm. long, narrowly funnelform or nearly cylindrical, the lateral sinuses cut about as deeply as the dorsal one and cut slightly below the plane of the lower lip. Two upper lobes lanceolate or nearly ovate, 1.3—2.0 mm. wide, 3.0—4.5 mm. long, acute, erect or somewhat recurved, but parallel with each other and with the corolla-tube, never curving to the side. Lower lip plane or essentially so, the lobes divergent, rounded or truncate, mucronate.

Filament-tube 2.7—3.5 mm. long, glabrous, the filaments united their

⁷ A Manual of Southern California Botany, 503. 1935.

whole length or nearly so; base of anther-tube covered by dorsal side of corolla-tube; anther-tube 1.6—2.4 mm. long.

Mature seeds not seen; markings of seeds longitudinal, the seeds not twisted; placentae axile.

Vernal pools of alkaline plains of the Great Valley of California, from Colusa County to Tulare County. Flower from about March 20 to May 15.

Specimens examined: CALIFORNIA—COLUSA: 4 miles e. of Williams, R. S. Ferris 499 (NB, S). MERCED: Merced, J. T. Howell 4168 (CalAc); 6 miles s. of Merced, R. F. Hoover 953 (CalAc); 2 miles s.e. of Athlone, R. F. Hoover 1754 (G). STANISLAUS: Near San Joaquin R., s.w. of Modesto, R. F. Hoover 563 (CalAc); R. F. Hoover 837 (CalAc, G, S, UC); 10 miles w. of Modesto, R. F. Hoover 386 (CalAc); R. F. Hoover 3079 (UC). TULARE: Pixley, A. Eastwood, April 3, 1917 (CalAc); 4 miles n. of Visalia, R. F. Hoover 921 (CalAc, UC); without loc. T. J. Patterson, May 28, 1886 (ELG).

The writer has seen but 11 collections of *Downingia bella*, all of which were made when the plants were in flower. In the absence of mature fruit and of more ample collections, it seems unwise to be dogmatic about the status of the plant in question, but it appears to be scarcely specifically distinct from *D. concolor*. In the material examined, the plants of *D. bella* average somewhat smaller than those of *D. concolor*, as do most of the flower-parts. These measurements are hardly significant, however, owing to the small amount of material examined. The only constant differences that the writer has been able to discover lie in the corolla; in *D. bella* the lower lip bears three purple spots instead of the one broad purple blotch of *D. concolor*. In addition, there is apparently no trace of ciliation on the upper corolla-lobes of *D. bella*. Hoover⁸ stresses the point that the stem of *D. bella* is "fistulous," while that of *D. concolor* is not. This the writer has been unable to check. As may be seen by reference to the map (map 4), the ranges of the two species do not overlap, so far as is known.

Although the differences between the two plants are very minor ones, lying principally in color-pattern and ciliation of the corolla, the best course for the present seems to be to regard them as distinct species. The writer has seen no intermediates between them, and any change in the status of either may await further field study.

3. DOWNINGIA ORNATISSIMA Greene, Pittonia 2: 80. 1890.

Plants few—20 (30) cm. high, entirely glabrous except for the hypanthium, which is usually scabrous. Leaves 0.5—2.0 mm. wide by 5.0—12.0 mm. long. Inflorescence few—12 (21) cm. long, loosely few—20-flowered. Flower-bracts lanceolate to elliptic or ovate, 1—4 (6) mm. wide by 6—12 (16) mm. long, usually 3—5 (10) times as long as wide, obtuse or acute.

Ovary linear, unchanged in fruit or becoming narrowly subulate, the ma-

⁸ Leaf. West. Bot. 2: 33–35. Au 1937.

ture capsule 0.5—1.5 mm. in diameter by 25—65 mm. in length, the lateral walls tough and not easily ruptured even when dry, with no evidence of scarios valves. Calyx-lobes linear to broadly elliptic, widest at or near the middle, all subequal in length or the two lower shorter, rounded to blunt or acute at tip, 1.7—6.0 (9.0) mm. long, erect or somewhat rotately spreading.

Corolla (7.0) 8.0—13.0 mm. long, the tube sparsely pilose within on lower side; corolla glabrous without. Lower lip bright or dark blue to pale lilac or nearly white, with squarish white center bearing two yellow or yellowish-green spots which contract into folds at the angle of the throat. Tube blue or lighter-colored.

Corolla-tube 2.5—4.0 (5.0) mm. long, narrowest at base and gradually wider to the apex, the lateral sinuses cut so deeply that the lower lip often appears hinged; dorsal sinus cut about as deeply as the lateral ones. Cleft (sinus) between the two upper lobes projected backward so as to appear like a short horn with upcurved tip; this horn-like projection may be very small or lacking; similar but smaller projections sometimes occur at the lateral sinuses. Two upper corolla-lobes lanceolate or narrowly triangular, somewhat enlarged at base, 2.5—6.0 mm. long, divergent, with the tip of each curled backward and outward into a ring, horizontally spreading with recurved tips, or ascending and appressed and only very slightly divergent. Lower lip plane or somewhat concave, the folds at base sometimes prominent and nipple-like, the lobes oblong, rounded or truncate, mucronulate.

Filament-tube 3.0—4.5 (6.0) mm. long, the filaments pubescent near base, connate nearly their whole length. Anther-tube 1.7—2.5 mm. long, wholly exerted, the base surpassing the dorsal sinus of the corolla by an appreciable amount, the distance usually 0.5—1.0 mm. (sometimes 2.5 mm.); anther-tube often bent abruptly downward; anthers all white-tufted at tips, the two shorter ones prominently so, each with a sharp horn-like process in addition; anthers glabrous or pubescent on the backs, the pubescence often with bulbous tips.

Seeds not twisted, the very fine lines longitudinal; placentae axile.

KEY TO THE VARIETIES

1. Two upper corolla-lobes glabrous within, divergent, with the tip of each curled outward and backward into a ring or at least strongly recurved.....var. *ornatissima*
1. Two upper corolla-lobes minutely pubescent within near tips, divergent.....var. *eximia*

3a. DOWNINGIA ORNATISSIMA var. **ornatissima** McVaugh, nom. nov.

D. ornatissima Greene, l.c. *Type locality*: "Fields of the lower Sacramento Valley near Elmira" (Solano County, California). *TYPE*: "Near Elmira," *E. L. Greene*, May 1890, No. 16100 of the Greene Herbarium.

Bolelia ornatissima Greene, *Pittonia* 2: 127. 1890.

Heavy clay soils, vernal pools and desiccating mud-flats, Sacramento Valley, California, south about to Merced County. Collected in flower from April 10 to May 30.

Specimens examined: CALIFORNIA: Knight's Ferry, Stanislaus, *J. M. Bigelow* (Whipple Exp., 1853–1854) (G); Stanislaus River, *J. M. Bigelow* (Whipple Exp., May 8, 1854) (NB); without loc., *J. M. Bigelow* (Whipple Exp., 1853–

1854) (US); without loc., *T. Hartweg* 1822 (G, NB). AMADOR: Ione, *H. Edwards*, May 1878 (NB). BUTTE: Without loc., *M. M. Miles* in 1886 (NB); 4 miles e. of Chico, *Heller* 13931 (US); near Butte City, *Heller & Brown* 5442 (F, G, NB, S, US); 8 miles n. of Oroville, *A. A. Heller* 11305 (CalAc, ELG, F, G, NB, S, UC, US); Berry Canon near Clear Creek, *Heller & Brown* 5549 (F, G, NB, P, R, S, US); near Clear Creek, *H. E. Brown* 188 (F, R, S, US); Butte Creek, *Mrs. R. M. Austin* 1905, Apr. 25, 1897 (NB, US); fields, *Mrs. C. C. Bruce* 1905, May 1898 (NB); Honcut, *L. S. Rose* 33188 (CalAc); Durham, *Mrs. J. H. Morrison*, May 1, 1932 (CalAc); "adobe swales and in water," *Mrs. R. M. Austin* 66 (UC). CALAVERAS: Near Jenny Lind, *E. E. Stanford* 972 (P, S, US). COLUSA: Near Colusa, *A. A. Heller* 13540 (F, NB, S, US). CONTRA COSTA: Near Antioch, *Mrs. Curran* in 1886 (ELG); 4 miles s. of Antioch, *Eastwood & Howell* 2153 (CalAc). GLENN: Willows, *A. Eastwood* 10185 (CalAc, G, US). MARIPOSA: 4.7 miles w.s.w. of Hill's Mine, *C. M. Belshaw* 1843 (FS). MERCED: Merced, *A. Eastwood* 4399 (CalAc, G, US); 8 miles n.e. of Merced, *J. T. Howell* 4201 (CalAc, Cath, F, NB, P, US) and 4214 (CalAc, NB); 2 miles n.e. of Planada, *R. F. Hoover* 2304 (UC); 7 miles s.e. of LeGrand, *R. F. Hoover* 1084 (S); 3 miles n. of Snelling, *R. F. Hoover* 961 (UC). PLACER: Auburn, *Mrs. Ames*, without date (F). SACRAMENTO: Rio Linda, *R. F. Hoover* 2206 (UC); 5 miles n.w. of Thornton, *R. F. Hoover* 2188 (S). SAN JOAQUIN: 7 miles s.w. of Stone Corral, Jackson Quad., *C. M. Belshaw* 1965 (UC); near Lockford, *W. P. Steinbeck*, May 9, 1923 (CalAc.) SOLANO: Vallejo, *E. L. Greene*, May 1874 (NB); near Little Oak, *W. L. Jepson*, May 2-6, 1891 (UC, US); Hartley's, *C. F. Baker* 2882 (CalAc, ELG, F, G, NB, O, P, R, UC, US); Vacaville, *C. F. Baker* 2917 (ELG, F, G, NB, P, R, UC, US); between Elmira and Cannon, *Mrs. K. Brandegee* 174 (F, G, NB, O, Ore, P, R, S, UC, US); Elmira, *C. F. Baker* 2901 (ELG, F, G, NB, P, UC, US); near Elmira, *A. A. Heller* 14547 (US); near Elmira, *W. L. Jepson*, May 30, 1891 (NB, UC, US); 1 mile n. of Elmira, *J. T. Howell* 5206 (CalAc); Elmira, *E. L. Greene*, May, 1890 (ELG, O, UC); near Elmira, *E. L. Greene*, May 2, 1890 (NB) and May 5, 1890 (NB, Ore, US); near Elmira, *E. L. Greene*, May, 1889 (ELG); near Suisun, *E. L. Greene*, May, 1890 (ELG, US); SUTTER; Pleasant Grove, *R. F. Hoover* 2221 (UC). TEHAMA: near Vina, *R. F. Hoover* 2252 (UC). TUOLUMNE: Without loc., *J. S. Congdon*, without date (NB). YOLO: Near Madison, *Heller & Brown* 5418 (F, G, NB, P, R, S, US); "By-Pass," *E. A. Wilkins*, April 28, 1932 (S, UC).

3b. *Downingia ornatissima* var. **eximia** (Hoover) McVaugh, comb. nov.

D. mirabilis J. T. Howell, Leaf. West. Bot. 1: 221. 1936. *Type locality*: "5 miles northeast of Merced, Merced Co., Calif." TYPE: *J. T. Howell* 4200, April 25, 1929, No. 232457 of the herbarium of the California Academy of Sciences.

D. mirabilis var. *eximia* Hoover, Leaf. West. Bot. 2: 6. 1937. *Type locality*: "3 miles west of Orange Cove, Fresno Co." (California). TYPE: *R. F. Hoover* 1000, April 28, 1936, in the herbarium of W. L. Jepson, not seen. Isotypes in the herbaria of the California Academy of Sciences, the University of California and Stanford University.

Habitat and flowering season of var. *ornatissima*. Range from Tulare

County, California, northward throughout the San Joaquin Valley and occasionally as far as Butte County.

Specimens examined: CALIFORNIA—CALAVERAS: Near Jenny Lind, *Constance & Morrison 2160* (R); CONTRA COSTA: 4 miles s. of Antioch, *Eastwood & Howell 2153* (F, NB). FRESNO: 3 miles w. of Orange Cove, *R. F. Hoover 1000* (CalAc, S, UC); near Pinedale, road to Friant, *R. F. Hoover 3459* (UC); 5 miles e. of Clovis, *R. F. Hoover 996* (CalAc). MADERA: Califa, *L. S. Rose 32205* (CalAc) and *32206* (Cath); 16 miles n. of Fresno (10 miles s. of Bates), *Keck & Stockwell 3336* (CalAc, S, UC); Berenda, *R. F. Hoover 906* (CalAc); 14 miles n.e. of Madera, *Eastwood & Howell 5341* (CalAc); Chowchilla, *J. T. Howell 13844* (CalAc); Daulton, *R. F. Hoover 3451* (UC); 6 miles e. of Madera, *A. G. Vestal*, April 24, 1927 (S); 6 miles n. of Madera, *L. R. Abrams 11638* (P, S); near Bellevue, *L. Constance 2197* (R). MERCED: 6 miles s.e. of LeGrand, *R. F. Hoover 1081* (CalAc, UC); Ryer, *R. F. Hoover 1074* (UC) and *2091* (G); 5 miles n.e. of Merced, *J. T. Howell 4200* (CalAc, Cath, F, NB, P, UC). SAN JOAQUIN: Peters, *E. E. Stanford 1029* (P); road to Stockton, 7 miles from Escalon, *J. T. Howell 4679* (CalAc, F); French Camp, *J. A. Sanford 155*, in 1890–91 (UC). STANISLAUS: 4 miles s. of Oakdale, *R. F. Hoover 488* (G); Turlock, *F. R. Fosberg*, April 6, 1927 (P); Turlock, *Miss Ellis*, May 1, 1886 (S); Turlock Reservoir, *L. S. Rose 37275* (CalAc, Cath, NB); Warnerville, *R. F. Hoover 1044* (CalAc, UC) and *1999* (UC); Hickman, *L. S. Rose 37271* (CalAc, F, US); 2 miles s. of Hickman, *R. F. Hoover 2085* (G, S, UC); Montpelier, *R. F. Hoover 585* (CalAc). TULARE: 1 mile e. of Orange Cove, *R. F. Hoover 1011* (G, UC); Woodlake, *R. F. Hoover 3481* (UC).

Downingia ornatissima, as here understood, is a distinct species not at all to be confused with any other in the genus. It forms a rather homogeneous unit ranging throughout the Great Valley of California at low altitudes. There is little variation within the species except in details of the conformation of the corolla. Individual plants in all parts of the range occasionally lack the tiny horn-like projection on the corolla-tube, and the two upper corolla-lobes vary in position to a considerable extent. Corolla-color is also variable, ranging from bright or dark blue to pale blue or nearly white. The two varieties proposed in this paper, while quite distinct in their most extreme forms, are scarcely separable in the lower San Joaquin Valley, and so must be regarded as rather formal varieties, and arbitrarily separated as such.

Downingia mirabilis was described by Howell from plants said to have "the upper frontal part of the corolla-tube rounded and dome-like, without that ridge and spur so prominent and distinctive in *D. ornatissima*," and "the folds and horn-like nipples in the angle of the throat . . . outward-curving and very much more elongate" (than in *D. ornatissima*). Examination of the type (*Howell 4200*) shows that while some of the plants have the corolla lacking the "spur," others are perfectly good specimens of *D. ornatissima*, including spur. Some of the corollas have the upper lobes re-

curved, while in other corollas they appear to have been erect and appressed. In the opinion of the present writer the variations discussed above are not of sufficient magnitude to warrant specific recognition for the plants in which they occur.

In the original description of *D. mirabilis* var. *eximia*, Hoover stated that the name applied solely to the plants with upper corolla-lobes erect and appressed, these having been found in the upper San Joaquin Valley. In establishing the plant of the entire San Joaquin Valley as a variety of *D. ornatissima* it becomes necessary to use Hoover's varietal name, while extending the morphological limits of the group of plants to which it applies.

There appear to be but two significant subspecific groups comprising the single species *D. ornatissima*. The one first described, that which occurs commonly in the Sacramento Valley, has the upper corolla-lobes glabrous within and almost invariably outwardly curled. At the other end of the range of the species, in the upper San Joaquin Valley, the upper corolla-lobes are plainly and often densely white-pubescent within, and, in addition, are more often erect and appressed or simply recurved. In the present treatment, segregation into varieties has depended for the most part upon the single character of the pubescence of the corolla-lobes; not only does the position of the corolla-lobes often become obscured in dried material, but also this character appears to be but slightly correlated with other features. As a result of such arbitrary segregation, a single collection will sometimes contain plants of both varieties; the writer has found this to be true to the greatest degree in collections from Merced and Stanislaus Counties.

Downingia ornatissima is rather difficult to separate from the other species of the genus by means of key-characters, especially when dry, as the flowers are of about the same size as those of several other species and flower-color is an unsatisfactory character for use except in fresh material. It is, however, one of the easiest species to recognize in the herbarium. The corolla-tube is almost invariably sparsely hairy within; the only other species with this feature is *D. bicornuta*, which may be distinguished at once by the twisted appendages at the apex of the anther-tube. *D. ornatissima* is, furthermore, easily recognized by means of the small conical projection at the summit of the corolla-tube; rarely indeed is a collection seen in which this feature is not found in any of the flowers. A third important diagnostic feature is the filament-tube, which is slightly curved backward and plainly longer than the dorsal side of the corolla-tube; such a filament-tube is not found in any species likely to be confused with *D. ornatissima*. Also pecul-

iar to this species are the bulbous-tipped hairs found on the backs of the anthers; these hairs are apparently unique in the genus.

4. *DOWNINGIA BICORNUTA* A. Gray, Syn. Fl. N. Am. 2¹ (suppl.): 395. 1886.

Plants few—25 (40) cm. high, entirely glabrous (hypanthium very rarely obscurely scabrous). Leaves 0.4—1.0 (2.0) mm. wide by (3.0) 6.0—15.0 (20.0) mm. long. Inflorescence few—12 (28) cm. long, loosely 1—10- (17-) flowered. Flower-bracts linear to broadly lanceolate, usually 5—10 times as long as wide, 1—3 (4) mm. wide, 5—15 (28) mm. long, obtuse or subacute.

Ovary linear, at maturity becoming linear to narrowly subulate, tapering very gradually from just above the base to the apex. Capsule with lateral walls thin but tough and not easily fractured; valves scarcely apparent even at maturity, or rarely conspicuous. Calyx-lobes linear or narrowly elliptic, rounded at tip or bluntly pointed, widest near the middle, usually plainly of two lengths, (2.5) 3.0—8.0 (13.0) mm. long, often rotate-spreading.

Corolla glabrous without, the tube densely white-bearded within on the lower side. Lower lip deep purplish-blue with a central area of white, yellow or yellowish-green, this central area marked with two yellow or green spots. Base of lower lip dark purple, with two ascending horns or nipples at the inner angle; lateral margins of the lower lip folded into two less prominent nipples, making four in all in a transverse line. Two upper lobes purplish-blue, slightly darker in color than the lower lip.

Corolla-tube broadly funnel-shaped, the lateral sinuses cut so deeply that the lower lip appears hinged; distance from summit of hypanthium to lateral sinuses slightly less than that to dorsal sinus. Two upper lobes ovate or triangular, acute, 1.0—1.3 mm. wide by 4.0—7.0 (8.5) mm. long. Lobes of the lower lip rounded or truncate, mucronulate. Filament-tube (2.3) 3.0—4.0 (4.8) mm. long; anther-tube (1.8) 2.0—2.5 (3.0) mm. long, usually partially included in the corolla-tube and often concealed by the two upper corolla-lobes.

Anthers minutely tufted at tip, smooth or sparsely bristly on the backs; two shorter anthers each with a recurved horn-like process from the apex, the processes tightly twisted together (rarely absent or not twisted).

Seeds not twisted, the markings very faint, longitudinal; placentation axile.

KEY TO THE VARIETIES

1. Twisted bristles at apex of anther-tube 0.6—1.5 mm. in length; corolla-tube (measured at lateral sinuses) 2.5—4.5 mm. long, blue, with purple veins var. *bicornuta*
1. Twisted bristles at apex of anther-tube 1.6—2.7 mm. in length; corolla-tube 1.5—2.6 mm. long, mostly with brownish-yellow spot on upper side. var. *picta*

4a. *DOWNINGIA BICORNUTA* var. ***bicornuta*** McVaugh, nom. nov.

D. bicornuta A. Gray, l.c. *Type locality*: "Northern part of California." TYPE: Chico, Butte County, California, Mrs. Bidwell in 1879, in the Gray Herbarium.

Bolelia bicornuta Greene, Pittonia 2: 127. 1890.

Downingia sikota Applegate, Contr. Dudley Herb. 1: 97. 1929. *Type locality*: "Swan Lake, Klamath Co., Oregon." TYPE: E. I. Applegate, July 24, 1904, No. 163278 of the herbarium of Stanford University. This number

(163278) was cited by Applegate in his original description, where the collector's number was given as 3170. No collector's number appears on the type.

Corolla 9.0—19.0 mm. long, the tube blue, with darker veins, the lower side lighter-colored, with two white or yellow longitudinal spots or streaks. Corolla-tube (2.5) 3.0—4.0 (4.5) mm. long. Mature capsule 1.0—2.0 mm. in diameter by 35—65 (90) mm. long. Two upper corolla-lobes divergent, erect or recurved. Lower lip usually plane or nearly so. Horn-like processes of the apex of the anther-tube 0.6—1.5 mm. long.

Drying soil of vernal pools, muddy soil of roadside pools, low land recently under water, moist depressions in clay soil in fields or in grasslands, wet banks of lakes and ponds. Southeastern Oregon and southwestern Idaho, south to northern and western Nevada, and Nevada and Stanislaus Counties, California. Often occurs at elevations of from 1200 to 1800 meters, and at lower elevations in the Sacramento Valley; rare in the San Joaquin Valley. Collected in flower and fruit from late April to early August.

Specimens examined: CALIFORNIA: Near Summit, *V. Rattan* 298, 1860–67 (US); Slippery Ford to Pyramid Peak, 7000 ft., *W. H. Brewer* 2132, Aug. 20, 1863 (US); "Valley of the Sacramento," *Dr. Stillman*, without date (NB); "collected in Sierra Nevada in 1863 by State Survey," No. 2132 (UC); "Geological Survey of California," *W. H. Brewer* in 1863 (G); "California," *Rev. Mr. Fitch*, in 1850 (NB); "Grove of large trees (*Sequoia gigantea*)," *J. Torrey* 279, in 1865 (NB). BUTTE: Chico Creek, *A. Gray*, Apr. 28, 1885 (F); near Nelson, *Heller & Brown* 5448 (F, G, NB, P, R, S, US); Nelson, *H. F. Copeland* 873 (P); Chico, *Bidwell* in 1879 (G, TYPE); Chico, *E. B. Copeland* 3176 (ELG, G, NB, P, R, UC, US), 3283 (ELG, P) 3284 (ELG, O, P, S, UC); near Chico, *Edw. Palmer* 2083 (NB, P, UC, US); near Chico, *E. L. Greene*, June 1882 (ELG); June 1889 (UC); June 1890 (UC); Chico-Oroville road, *A. A. Heller* 13935 (US); 5 miles from Chico on Oroville road, *A. A. Heller* 11316 (CalAc, ELG, F, G, NB, S, UC, US); 9 miles north of Chico, *A. A. Heller* 14363 (CalAc, Cath, F, G, NB, Ore, P, R, S, UC, US); Butte Creek, *Mrs. R. M. Austin* 1905, April 25, 1897 (NB); Butte, fields, *Mrs. C. C. Bruce* 1905, April 1897 (P); May 1898 (NB); without loc., *M. M. Miles*, in 1886 (NB). COLUSA: Near College City, *Heller & Brown* 5434 (F; a single plant on a sheet of *D. pulchella*). LASSEN: 10—15 miles w. of Amedee, *M. E. Jones*, June 24, 1897 (P, S, US); Honeylake Valley, *J. B. Davy* 3348 (UC); flat near Eagle Lake, *M. S. Baker*, July 21 (UC); Pine Creek, *M. S. Baker*, July 12 (UC). MODOC: Egg Lake, *M. S. Baker*, June 24, 1893 (UC); Rattlesnake Creek, near Alturas, *E. I. Applegate* 3028 (S) NEVADA: Truckee, *J. W. Stacey* 4 (CalAc). PLUMAS: Near Vinton, *Heller & Kennedy* 8675 (F, G, NB, S, US); near Lassen Buttes, *H. E. Brown* 615 (F, NB, R); $4\frac{3}{4}$ miles s.e. of East Butte, Sierra Co. (Sierraville Quad.), *E. Sawyer* 98 (UC). SHASTA: Goose Valley, *A. Eastwood* 745 (G, NB, US); *A. Eastwood* 978 (CalAc); Burney, *Ellsworth Bettal*, June 12, 1923 (CalAc). SIERRA: Sierra Valley, *J. G. Lemmon*, in June (F). STANISLAUS: Gobin Ranch,

13 miles e. of Waterford, *R. F. Hoover 1099* (CalAc). SUTTER: Edge of tule land, *E. B. Copeland 3285* (G, NB, US). TEHAMA: 10 miles e. of Red Bluff, *D. K. Gillespie 9272* (S).

NEVADA—ELKO: Deeth, *A. A. Heller 10555* (NB; a single plant on a sheet with *D. laeta*). WASHOE: Between Washoe and Franktown, *A. A. Heller 10596* (CalAc, F, G, NB, P, S, UC, US); Washoe, *C. L. Brown*, July 28, 1907 (CalAc); Lake Washoe, west of Carson City, *I. Tidestrom 10454* (Cath); Lake Washoe, *J. Torrey 279*, in 1865 (G, NB, US); "Truckee Meadows near Glendale," *W. W. Bailey 728*, July 1867 (G, NB, US); "5 miles south (= north) of Carson City on the Reno Road, *D. R. Goddard 1040* (UC).

IDAHO—ADA: Owyhee, *M. E. Jones 25531* (P, S).

OREGON: Shirk, *J. B. Leiberg 2583* (F, G, NB, Ore, P, UC, US); "P ranch," *Griffiths & Hunter 312* (NB, US). HARNEY: 1 mile e. of Burns, *J. W. Thompson 11975* (CalAc, G, P, US); Stein's Mt., Blitzen Valley, *P. Train*, without date (NB). KLAMATH: Lone Pine Ranch, Swan Lake, *E. I. Applegate 3171* (S) and *3173* (S); Brookside Ranch, Swan Lake Valley, *E. I. Applegate 3561* (S); Swan Lake Valley, *F. A. Walpole 2230* (US); Barkley Spring, Klamath Lake, *E. I. Applegate 5134* (S); Barkley Spring, *E. I. Applegate 3615* (S); Sprague River, near mouth Whiskey Creek, *E. I. Applegate 5914* (WU). MALHEUR: 1 mile n. of Sheaville, *P. Train*, July 7 (US). LAKE: Guano Ranch, *F. V. Coville 605* (US); near Adel, *M. E. Peck 19469* (WU); near Adel, *R. C. Andrews 500* (Ore). WASCO: The Dalles, *Davidson* (*M. E. Jones* herb.) (P).

The following specimens of *D. bicornuta* may be cited as intermediate between var. *picta* and var. *bicornuta*:

CALIFORNIA—MERCED: Ryer, *R. F. Hoover 2092* (G, S, UC). The corolla-tube is longer than usual in var. *picta*, and the twisted bristles of the anther-tube are shorter than is usual in this variety. SAN JOAQUIN: Near Stockton, *E. E. Stanford 188* (G, P, S). Corolla like that of typical *D. bicornuta*, but the tube as short in some plants as in var. *picta*, and the twisted bristles short for the variety. SHASTA: Redding, *W. W. Jones 297* (G); corolla and corolla-tube very short for the species, but the twisted bristles less than 1.0 mm. long. STANISLAUS: 4 miles s. of Oakdale, *R. F. Hoover 486* (UC); corolla almost large enough for typical *bicornuta*, but the bristles as much as 1.7 mm. long. TEHAMA: 5 miles s. of Cottonwood, *Eastwood & Howell 1844* (CalAc, P); *L. S. Rose 34244* (Cath, NB). In these collections the corolla-tube is much shorter than is usual in the typical plant.

4b. *DOWNINGIA BICORNUTA* var. *PICTA* Hoover, Leaf. West. Bot. 2: 4. 1937. *Type locality*: "7 miles southeast of LeGrand, Merced Co." (California).

TYPE: *R. F. Hoover 1083*, May 1, 1936, in the herbarium of W. L. Jepson, not seen. Isotypes in the Gray Herbarium and in the herbaria of the California Academy of Sciences, Stanford University and the University of California.

Flowers and fruit slightly smaller than in var. *bicornuta*. Corolla 7—10 mm. long. Corolla-tube (1.5) 2.0—2.6 mm. long. Mature capsule 0.5—1.5 mm. in diameter by 35—57 mm. long.

Corolla-tube with brownish-yellow spot on upper side; lower lip strongly concave; two upper lobes white or pale blue, often tipped with darker blue, not divergent but directed toward each other so that the tips cross, sharply

reflexed and appressed to the corolla-tube. Horn-like processes of the anther-tube 1.6—2.7 mm. long, often longer than the tube itself.

Habitat the same as that of var. *bicornuta*. Ranges through the Sacramento and San Joaquin Valleys, at low elevations, from Shasta County to Fresno County, California. Collected in flower and fruit from April 13 to May 27.

Specimens examined: CALIFORNIA: Mokelumne R., V. Rattan in 1884 (G). FRESNO: Near Pinedale, road to Friant, R. F. Hoover 3460 (UC). MERCED: Merced, A. Eastwood 4399 (US); Oakdale Rd., near Merced, J. T. Howell 2 (CalAc); 2 miles n. of Merced, R. F. Hoover 2104 (G); 7 miles n. of Merced, R. F. Hoover 2100 (G, UC); 6 miles n. of Merced, J. T. Howell 4204 (CalAc, Cath, F, NB, P, UC, US); 2 miles n.w. of Merced, J. T. Howell 4174 (CalAc, F, NB, P, US); 7 miles s.e. of LeGrand, R. F. Hoover 1083 (CalAc, G, S, UC); 2 miles n.e. of Planada, R. F. Hoover 2305 (UC); 6 miles s.w. of Hill's Mine, Indian Gulch Road, H. S. Yates 5087 (UC). SACRAMENTO: Rio Linda, R. F. Hoover 2200 (UC); Sacramento, E. Hannibal, April 28, 1918 (S); East Sacramento, F. Ramaley 11173 (UC). SAN JOAQUIN: Near Stockton, E. E. Stanford 937 (G, P, US); near Stockton, W. P. Steinbeck, April 1923 (CalAc); 2 miles s.s.w. of Wallace, R. D. Roseberry 167 (FS); 4 miles s. of Galt, D. K. and J. W. Gillespie 9234 (S, UC); 3 miles east of Clements, J. T. Howell 4711 (CalAc, F, P); Linden, F. W. Gunnison, May 1896 (UC). SHASTA: Near Redding, Mrs. C. A. Rose, May 1930 (CalAc). STANISLAUS: Between Oakdale and Waterford, C. Dudley in 1935 (CalAc); Turlock Reservoir, L. S. Rose 37274 (CalAc). SUTTER: Pleasant Grove, R. F. Hoover 1142 (G).

The varieties of *Downingia bicornuta* are well marked. Var. *picta* is wholly confined to the Great Valley of California, while all material from the region of the Sierra Nevada and eastward and northward may safely be referred to var. *bicornuta*. The latter extends sparingly into the Sacramento Valley (the type came from Chico, Butte County), and occasional intermediates are found in the region where either variety may be expected to grow. The descriptions of flower-color in *D. bicornuta*, found in the present paper, have been taken in part from Hoover.⁹ From his original description and from examination of herbarium material annotated by him, it would appear that the present interpretation of var. *picta* is a somewhat broader one than that originally intended. The present writer has been unable to check flower-color, except in especially well-prepared herbarium specimens; it may well transpire that the brownish-yellow spot on the corolla-tube, a character emphasized by Hoover for var. *picta*, is simply of local occurrence in the San Joaquin Valley. Whether or not this proves to be true, Hoover's name must be taken up for the variety of *D. bicornuta* with short corolla-tube and long twisted bristles.

⁹ New or imperfectly known Californian species of *Downingia*. Leaf. West. Bot. 2: 1-6. Ja 1937.

5. *DOWNINGIA CUSPIDATA* (Greene) Greene, ex Jepson, Fl. W. Mid. Calif., ed. 2. 403. 1911.

Bolelia cuspidata Greene, Erythea 3: 101. 1895. *Type locality*: "Grain field west of Yountville, Napa Co., Calif. . . . also in more slender form, with smaller and paler flowers, in Los Guilucos Valley, Sonoma Co., . . . F. T. Bioletti." *TYPE*: The specimen cited first, that said to have been collected at Yountville, Napa County, has not been located. It cannot be found in the Greene Herbarium (September, 1939). The *COTYPE*, collected by F. T. Bioletti, June 10, 1893, has been seen in the Gray Herbarium and in the herbaria of Stanford University and of the University of California.

Downingia pulchella var. *arcana* Jepson, Madrono 1: 100. 1922. *Type locality*: La Mesa, San Diego County, California. *TYPE*: W. L. Jepson 6678, presumably in the personal herbarium of Professor Jepson, not seen.

Downingia immaculata Munz & Johnston, Bull. Torrey Club 51: 300. 1924. *Type locality*: "South of Lake Elsinore, Riverside County, California." *TYPE*: P. A. Munz 5093, April 29, 1922, No. 13766 of the herbarium of Pomona College.

Downingia pallida Hoover, Leaf. West. Bot. 2: 1. 1937. *Type locality*: "Warnerville, Stanislaus Co." (California). *TYPE*: R. F. Hoover 1042, April 29, 1936, in the herbarium of W. L. Jepson, not seen. Isotypes seen in the herbaria of the California Academy of Sciences, Stanford University, and the University of California.

Plants few—25 (30) cm. high, entirely glabrous or the hypanthium sparsely scabrous, especially when young. Leaves 0.2—2.0 mm. wide, 3.0—13.0 mm. long. Inflorescence few—10 (17) cm. long, loosely 1—15- (25-) flowered. Flower-bracts linear to broadly elliptic or less often lanceolate, obtuse or subacute, 1—3 (4) mm. wide by 4—10 (13) mm. long, mostly about 3—5 times as long as wide.

Ovary linear, in fruit becoming fusiform; mature capsule (0.6) 1.0—1.6 (2.0) mm. in diameter by (15) 20—40 (55) mm. in length, the lateral walls tough but the valves easily separated and marked by conspicuous impressed lines or distinct hyaline slits, the lines or slits evident even in the young condition. Calyx-lobes elliptic to oblanceolate, obtuse or rounded, ascending, subequal in length, about 1.0 mm. wide or less, (1.3) 3.0—8.0 (11.0) mm. in length.

Corolla 7.0—15 mm. long, glabrous. Color bright or pale blue or lavender, sometimes white; lower lip with central white area, this with central or basal yellow spot or two more or less confluent such spots. Tube pale below base of lower lip but sometimes darker at base; two upper lobes often darker and with purplish veins.

Corolla-tube (2.3) 3.0—4.0 (5.2) mm. long, almost cylindrical but slightly expanded distally, the lateral sinuses usually slightly deeper than the dorsal one and cut very slightly (0.5 mm. or less) below the plane of the lower lip; tube measured to dorsal sinus 3.0—4.5 (5.0) mm. long. Two upper corolla-lobes ovate, acute, slightly divergent or recurved and overlapping in age, 1.0—2.5 mm. wide by (2.5) 3.0—6.0 (7.0) mm. long. Lower lip plane or nearly so, with two low inconspicuous yellow ridges at base, the lobes broadly ovate or oblong, mucronate, rounded to retuse or even obcordate.



MAP 1. Distribution of *Downingia ornatissima* var. *ornatissima* (circles) and var. *eximia* (triangles). MAP 2. Distribution of *Downingia bicornuta* var. *bicornuta* (circles) and var. *picta* (triangles). MAP 3. Distribution of *Downingia cuspidata*. MAP 4. Distribution of *Downingia bella* (triangles) and *Downingia concolor* (circles).

Filament-tube (2.0) 2.5—4.0 (4.5) mm. long, glabrous, the filaments united their whole length or nearly so; summit of the tube mostly exceeded by the base of the dorsal sinus of the corolla, the base of the anther-tube thus included. Anther-tube 1.4—2.5 mm. long (the mean about 1.7 mm.); anthers smooth or sparsely pubescent on the backs, all minutely white-tufted at tip, the three shorter ones prominently so and each bearing a short horn-like process as well.

Seeds lustrous, twisted, the very fine cellular markings running obliquely to the long axis of the seed. Placentae axile; valves 4 or 5.

Wet or drying clay soil of vernal pools, mud-flats, stream-beds and grassy meadows, at elevations up to about 450 meters. Coast Ranges and central Sierra Nevada foothills, California. Collected in flower and fruit mostly from mid-April to mid-May; in the northern Coast Ranges collections have been made as late as mid-June, and in southern California flowering specimens have been collected as early as March 28.

Specimens examined: CALIFORNIA: Without loc., *V. Rattan* in 1884 (G); Sacramento Valley, *E. L. Greene* in 1895 (US). CALAVERAS: Mokelumne Hill, *F. E. Blaisdell*, without date (CalAc); 4.7 miles from San Andreas, road to Valley Spr., *J. T. Howell* 4702 (CalAc, F); Salt Springs Valley, *J. P. Tracy* 5649 (P). HUMBOLDT: Fort Seward, *J. P. Tracy* 4468 (UC, US). LAKE: Jordan Park, road to Lower Lake, *M. S. Jussel*, May 1, 1932 (CalAc); 2 miles w. of Lower Lake, *L. S. Rose* 36206 (CalAc); 4 miles s. of Kelseyville, *M. S. Baker* 7507 (CalAc); Kelseyville, *J. W. Blankinship*, May 4, 1925 (CalAc) and June 16, 1926 (CalAc); midway between Kelseyville and Lower Lake, *M. S. Baker* 7642 (CalAc). MADERA: 5 miles from Raymond, road to Coarse Gold, *Eastwood & Howell* 5458; San Joaquin Experimental Range, *H. H. Biswell* 130 (FS, USNA, UC). MARIPOSA: Mariposa-Raymond Rd., near Oakvale School, *R. F. Hoover* 3445 (UC). MENDOCINO: Without loc., *G. R. Vasey* in 1875 (F, US); Round Valley, *P. B. Westerman*, without date (UC); Round Valley (county?), *V. Rattan* in 1884 (S); Round Valley, *V. K. Chesnut* 24 (US); Sherwood Valley, *J. B. Davy* 5163 (UC). MERCED: 4 miles s. of Snelling, *R. F. Hoover* 2068 (G, UC). MODOC: Egg Lake, *M. S. Baker*, June 18, 1893 (UC). MONTEREY: 1.3 miles s.e. of Jolon, *Keck & Stockwell* 3224 (P, S, UC); 2.5 miles s.e. of Jolon, *B. O. Schreiber* 2488 (FS); Pacific Grove, *Miss M. E. B. Norton*, without date (CalAc). NAPA: Napa, *Hilda Smyth* in 1899 (CalAc). RIVERSIDE: 1.5 miles s. of Lake Elsinore, *P. A. Munz* 5093 (P, R, S, UC); Perris, collector unknown, May 1, 1922 (P); Menifee Valley, *Munz & Johnston* 5380 (P); Menifee, *Elta McEven*, April 19, 1897 (S, UC); Winchester, *Lillian Dickson*, April 1896 (UC). SAN DIEGO: 4 miles north of San Diego, *L. R. Abrams* 3445 (CalAc, F, G, NB, O, P, S, UC, US); mesas, San Diego, *T. S. Brandegee* 1668 (ELG, G, NB, P, UC, US); "in paludibus prope San Diego," *M. F. Spencer* 1073, 5/6/1923 (G); "in pools, Camp Kearney road, San Diego," *M. F. Spencer* 1073, April 16, 1919 (CalAc, G, NB, P); Camp Kearney Mesa, *M. F. Spencer* 141, April 16, 1919 (F); Camp Kearney, *Purer* 6890 (P); Camp Kearney mesa, *F. Youngberg* 15 (P); Miramar-Kearney mesa, *F. F. Gander* 1651 (CalAc); mesa, San Diego, *C. R. Orcutt*, May 1889 (NB); "mesas," *C. R. Orcutt*, May 19, 1884 (ELG, F, US); mesas back of San Diego, *H. M. Hall* 3923 (NB, UC, US); 6

miles n. of San Diego, *F. W. Peirson* 3394 (P); Ramona, *T. S. Brandegee* (C. F. Baker 3425) (ELG, O); Ramona, *T. S. Brandegee*, May 25, 1903 (CalAc, P, UC); s. of Ramona, *E. A. Purer* 6949 (P). SAN LUIS OBISPO: Paso Robles, *Condit & White*, April 17, 1909 (UC); Paso Robles, *Benj. Cobb*, April 20, 1907 (S, UC); e. of Paso Robles, *C. Dudley*, April 1936 (CalAc); Estrella, *L. Jared*, without date (UC); near Estrella, *Eastwood & Howell* 4190 (CalAc, F, NB, US); 3 miles e. of Templeton, *I. L. Wiggins* 2072 (S). SHASTA: 3 miles e. of Redding, *R. F. Hoover* 1204 (CalAc, G, S, UC). SONOMA: Without loc., *F. T. Bioletti* in 1894 (ELG); Los Guilucos Valley, *F. T. Bioletti*, June 10, 1893 (G, S, UC). STANISLAUS: Warnerville, *R. F. Hoover* 1042 (CalAc, S, UC); 2046 (G, UC). TEHAMA: Coyote Cr. Bridge s. of Red Bluff, *R. F. Hoover* 2289 (UC); 10 miles e. of Red Bluff, *D. K. Gillespie* 9274 (S, UC). TUOLUMNE: 1 mile w. of Chinese Camp, *R. F. Hoover* 1977 (G, S, UC); Sonora, *E. A. Greene*, April 25, 1925 (S).

The present writer has been unable to find a means by which one can separate *Downingia cuspidata* from *D. immaculata* and *D. pallida*, and feels that it is impossible to accord even varietal status to the two last-mentioned. *D. cuspidata* was originally described from the region north of San Francisco Bay and its existence elsewhere has not been suspected. Jepson¹⁰ and Hoover¹¹ separate the species essentially as follows:

Corolla-tube longer than the calyx-lobes.....*D. cuspidata*
 Corolla-tube equalling or shorter than the calyx-lobes.....*Downingia* spp.

In any of the species of *Downingia* that may be confused with *D. cuspidata*, the calyx-lobes are so variable in length that the above key-character is a very weak one. Flowers having calyx-lobes of the two sorts indicated may often be found on the same plant.

Examination of all the available material indicates that *D. cuspidata* is one of a group of five species having a bilocular ovary and a relatively long and narrow corolla-tube (see figures 11, 12, for indication of the general sort of corolla meant). *D. cuspidata* is unique, however, in having the following combination of characters:

Base of lower corolla-lip yellow, with no purple spots or blotches; two upper lobes of corolla not sharply recurved nor inrolled.

Capsule splitting at maturity, the valves separated by usually prominent hyaline lines, the tissue of which soon breaks up and allows the valves to separate.

Seeds appearing as if twisted; cellular markings of the seedcoat, at least on one side of the seed, strongly oblique to the long axis of the seed. *D. pusilla* is the only other species having this feature.

The species with which *D. cuspidata* may be confused are chiefly *D. concolor* and *D. bella*, either of which may be distinguished at once by the

¹⁰ Madroño 1: 98-102. 1922. A Manual of the Flowering Plants of California, 1923-1925.

¹¹ Leaf. West. Bot. 2: 33-35. Au 1937.

non-twisted seeds, the purple spots on the corolla-tube, or the much tougher capsule. *D. ornatissima* lacks the purple spot of the corolla, but its own corolla is so characteristic that it should not ordinarily be confused with *D. cuspidata*.

The series of plants from Riverside and San Diego Counties, designated by Munz and Johnston as *D. immaculata*, seems not to differ from typical *D. cuspidata* in any essential features. The corolla, and flower-parts in general, seem to average slightly larger than those of plants from the region north of Sacramento, but many individual plants are found which match exactly, feature for feature, material of *D. cuspidata* from the type region. The cotype material, from Sonoma County, is very slender, with short leaves and smallish flowers; it seems probable that this represents a form of ecological origin, since the plants of *Downingia* were mixed with those of a species of *Eleocharis* and other grass-like aquatics, and apparently came from a wet, swampy situation. Other material from the type region and northward is much stouter and taller, with longer leaves and larger flowers.

The second proposed species, here thrown into synonymy under *D. cuspidata*, is *D. pallida* Hoover. This was based largely upon a pale color-form occurring in the central Sierra Nevada foothills. This color-form is sometimes recognizable even in dried material, but the writer has been unable to detect additional differences between it and typical *D. cuspidata*. The color, furthermore, does not appear to be constantly related to range, for blue-flowered specimens, exactly matching material from the northern Coast Ranges, have been seen from Madera, Mariposa, and Tuolumne Counties.

6. DOWNINGIA PUSILLA (G. Don) Torrey, U. S. Expl. Exped. 17: 375. 1874. *Clintonia pusilla* G. Don, Gen. Syst. 3: 718. 1834. (Based on *Lobelia pusilla* Poeppig ms., ex Cham. in Linnaea 8: 217. 1833, nomen nudum). *Type locality*: Chile. *TYPE*: Not verified.

Bolelia humilis Greene, Pittonia 2: 226. 1892. *Type locality*: "Moist plain, Sonoma County" (California). *TYPE*: F. T. Bioletti in 1892, No. 16097 of the Greene Herbarium.

Downingia humilis Greene, Leaf. Bot. Obs. & Crit. 2: 45. 1910.

Plants 2—12 cm. high, entirely glabrous or the hypanthium minutely scabrous; stems relatively stout for their height, up to 1.5 mm. in diameter at base. Leaves 0.5—1.0 mm. wide by 4.0—7.0 mm. long. Inflorescence 2—5 cm. long, 1—7-flowered. Flower-bracts 1.0—1.5 mm. wide by 5—8 mm. long, 5—7 times as long as wide, elliptic or lanceolate, obtuse.

Ovary linear, in fruit becoming narrowly ellipsoid or subulate; mature capsule 1—1.2 mm. in diameter, 20—27 mm. long, the lateral walls firm and not easily ruptured, the valves appearing as impressed lines or as scarious divisions. Calyx-lobes elliptic to linear, blunt-tipped, widest at or near the middle, erect and often appressed, 3.0—8.0 mm. long, the two lower ones usually plainly shorter than the others.

Corolla 2.5—4.0 mm. long, glabrous. Two upper lobes deltoid-lanceolate, about 0.8 mm. wide by 1.2—1.5 mm. long (somewhat recurved ?); lower lip (more or less erect?), not sharply deflexed at base, the three deltoid lobes about 0.8 mm. wide by 1.2 mm. long. Color white or the lower lip blue-tipped, with white center and yellowish patch near base.

Corolla-tube 1.3—2.0 mm. long, narrowly funnel-shaped, the lateral sinuses cut about as deeply as the dorsal one.

Filament-tube 1.0—1.8 mm. long, glabrous, the filaments connate nearly their whole length. Anther-tube 0.6—1.1 mm. long, the anthers white-apiculate, the two shorter ones with a few bristles and a blunt horn-like process at the tips.

Seeds twisted, the cellular lines markedly oblique to the long axis of the seed; placentae axile.

Vernal pools at low elevations, Sacramento Valley and San Joaquin Valley, California. Collected in flower and fruit from March 27 to May 4. Also in Chile, where collected in January, according to available data. Reported from southern Argentina (Golfo de San Jorge) by Spegazzini (An. Soc. Cient. Arg. **53**: 70. 1902).

Specimens examined: CALIFORNIA—MERCED: 5 miles n. of Snelling, *R. F. Hoover* 2063 (G, UC). NAPA: Near Napa, *Heller & Brown* 5362 (F, G, NB, P, R, S, US). SOLANO: Vanden, *Mrs. Brandegee*, April 1893 (UC). SONOMA: Sonoma Co., *F. T. Bioletti* in 1892 (UC, US); Shellville, *Michener & Bioletti*, May 1, 1892 (UC); summit of Bennett Valley road from Glen Ellen to Santa Rosa, *J. T. Howell* 11807 (CalAc). STANISLAUS: Near La Grange on Snelling Road, *R. F. Hoover* 970 (CalAc); Warnerville, *R. F. Hoover* 1992 (G, S, UC).

CHILE: Panguipulli, *F. Claude Joseph* 2725 (US); Prov. Colchagua, *Bridges* 169, in 1862 (NB); Valle de Marga-Marga, Prov. Aconcagua, ca. lat. 33° 10' S., *Jaffuel & Pirion* 3136 (G) and 3137 (G); without locality or date, *Fielding* (G).

This species is regarded for the present as a derivative one, related to *D. cuspidata* by the twisted seeds and the corolla, which is unmarked by purple. If *D. pusilla* be actually a derivative species, of relatively recent origin as compared to the rest of the genus, its presence in Chile may be accounted for in one of two ways. It is possible that it arose at a time when a hypothetical ancestor existed both in North and South America, all traces of the ancestor having now been lost in the latter continent. The second and seemingly more plausible explanation is that the single species, *D. pusilla*, was transported accidentally, by birds or other agency, from California to Chile.

There are no apparent differences between North and South American material, so that the writer can see no justification for maintaining *D. humilis* (Greene) Greene as a distinct species. Material from South America is very scarce in North American herbaria, and it is possible that examina-

tion of more ample collections will demonstrate at least varietal differences between the Chilean plant and that of California.

D. pusilla is often associated with *D. laeta* in keys and synoptical treatments, largely because of the size of the flowers; the corolla is relatively small in both species, as compared to that of other species of the genus. There is, however, little actual affinity between the two. The present study indicates that *D. laeta* is a derivative species akin to the group having a broad funnel-shaped or campanulate corolla-tube, with three purple spots at the base of the lower lip.

7. DOWNINGIA PULCHELLA (Lindley) Torrey, Pacific Rail. Rep. 4⁵: 116. 1856. *Clintonia pulchella* Lindl., Bot. Reg. 22: t. 1909. 1836. *Type locality*: "California." *TYPE*: Not seen. A specimen labelled "Nova California," collected by David Douglas in 1833, now in the Gray Herbarium, is apparently an isotype.

Bolelia pulchella Greene, Pittonia 2: 126. 1890.

Plants few—25 (40) cm. high, entirely glabrous or the hypanthium sparsely scabrous. Leaves 1—2 mm. wide by 4—12 mm. long. Inflorescence few—15 (20) cm. long, loosely few—15- (20-) flowered. Flower-bracts elliptic to lanceolate or ovate, usually obtuse, 2—7 mm. wide, 8—20 (25) mm. long, usually 3—6 times as long as wide.

Ovary linear, in fruit little changed in shape or becoming narrowly subulate or fusiform; mature capsule 1.0—1.5 (2.0) mm. in diameter by 30—75 mm. long, the lateral walls tough and ruptured with difficulty when dry, the valves never apparent. Calyx-lobes elliptic, obtuse or rounded at tip, usually rotately spreading in flower and fruit, subequal in length, 0.5—2.0 mm. wide, 3—7 (10) mm. long.

Corolla 8—13 mm. long, glabrous. Color "deep bright blue," less often pink or pure white; lower lip with central white area bearing two yellow spots which pass into low narrow yellow folds at the base of the lip; alternating with the folds, at the base of the lip, are three dark purple spots; tube purple.

Corolla-tube (1.5) 2.0—3.0 mm. long, funnel-shaped, with narrow base; lateral sinuses usually cut slightly deeper than the dorsal one; tube measured to dorsal sinus 2.0—3.0 (3.3) mm. in length. Two upper corolla-lobes elliptic or oblanceolate, strongly divergent and spreading, acute at tip, 2.0—3.0 (4.0) mm. wide by 6.0—8.0 mm. long. Lower lip reflexed, the lobes oblong, acute or mucronate, 3.5—5.0 mm. wide by 4.5—6.0 mm. long.

Filament-tube (2.5) 3.0—4.5 (5.0) mm. long, glabrous, the filaments united their whole length or nearly so; summit of the tube usually considerably exceeding the dorsal sinus of the corolla, the anther-tube thus prominently exerted. Anther-tube (2.2) 2.6—3.5 mm. long, attenuate and pointed at tip; anthers glabrous or minutely ciliate on the backs, the two shorter ones minutely white-tufted at tip and each with a slender horn-like process as well.

Seeds shining, not twisted; placentae axile.

Low moist soil; muddy borders of drying vernal pools, moist fields, salt-marshes. Low elevations, central California from Monterey and Mer-

ced Counties north to Colusa County; an isolated station in Lassen County. Collected in flower and fruit from April 15 to June 7 (Lassen Co. in Aug. ?).

Specimens examined: CALIFORNIA: "Nova California," Douglas in 1833 (G; ISOTYPE); "California," Douglas (Torrey Herb.) (NB; probably ISOTYPE); "Wallamet," Tolmie (G); "Cult. Hort. Cantab." (Torrey Herb.) July 1868 (NB); "upper Mojave," Dr. J. G. Cooper, 1860-1861 (G); without loc., V. Rattan in 1884 (G). ALAMEDA: Mt. Eden, Mrs. T. S. Brandegee, May 22, 1893 (G, NB, R, S, UC, US); Evelina Cannon, May 1893 (CalAc); Alvarado, W. L. Jepson, June 1896 (G); June 7, 1896 (UC); between Alvarado and Mt. Eden, I. L. Wiggins 5860 (CalAc, Cath, P, S, UC); Haywards, collector unknown, May 1915 (CalAc); Haywards, Lemmon herb., without date (P, UC); near Newark, J. Burt Davy 1106 (UC); Mt. Diablo base, w. 121°, W. P. Gibbons 238 (NB). COLUSA: Near College City, Heller & Brown 5434 (G, F, NB, P, S, US). LASSEN: Bieber, W. C. Merrill, Aug. 1892 (P; also a mixed collection, with *D. insignis*). MERCED: 10 miles w. of Merced, R. F. Hoover 2105 (CalAc, G, UC). MONTEREY: Near Santa Rita, E. K. Abbott, May 1889 (CalAc). SACRAMENTO: Near DelPaso, E. A. Wilkins, April 28, 1932 (UC). SAN BENITO: Hollister, W. A. Setchell, April 14, 1897 (UC); near Hollister, Eastwood & Howell 5304 (CalAc); 7 miles n.w. of Hollister, J. T. Howell 11029 (CalAc, Cath, P). SAN JOAQUIN: Stockton, E. L. Greene, June 1889 (ELG); near Stockton, J. A. Sanford, May 1890 (ELG); Oxford Manor, Stockton, C. R. Quick, Apr. 22, 1929 (US); French Camp, J. A. Sanford 155 (UC). SANTA CLARA: San Jose, Miss M. E. B. Norton, May 1879 (F); San Jose, G. R. Kleeberger, in 1879 (CalAc); "prope San Jose, Mrs. Atwater," June 1873 (US); East San Jose, R. L. Pendleton 860 (P); east of San Jose, V. Rattan, June 1880 (S); Milpitas, R. J. Smith, April 1906 (R, S); Bolsa road near San Benito Co. line, R. F. Hoover 3482 (UC); Santa Clara, B. F. Leeds, May 29, 1891 (F). SOLANO: Central Solano, W. L. Jepson, May 2-6, 1891 (NB, US); near Elmira, E. L. Greene, May 1890 (ELG); near Vacaville, W. L. Jepson, May 2-6, 1891 (S); Little Oak, W. L. Jepson, May 2-6, 1891 (ELG, UC); Suisun, A. Eastwood 10423 (CalAc) and without no., Apr. 30, 1921 (CalAc); Suisun, E. L. Greene, May 4, 1890 (ELG). YOLO: Near Madison, Heller and Brown 5421 (F, G, NB, S, UC, US); "By-Pass," E. A. Wilkins, April 28, 1932 (UC).

OREGON—MARION: Silverton, Elihu Hall in 1871 (US). The plants of this collection are mounted on a mixed sheet with specimens of *D. elegans*, and a mixing of labels may have occurred.

All collections of the genus *Downingia* made in California between 1836 and 1886 were either unidentified as to species, labelled *D. elegans*, or thrown indiscriminately into *D. pulchella*. This lack of discrimination accounts for much of the misinformation that has been published concerning a very clear and unmistakable species. In Gray's *Synoptical Flora* (1886) the range of *Downingia pulchella* is given as "California, nearly throughout the state, and in the borders of N. Nevada and Oregon." In 1924 Munz & Johnston¹² stated that it did not occur in southern California south of the

¹² Bull. Torrey Club 51: 300-301. 1924.

region of San Luis Obispo County, but in 1925 Jepson¹³ gave the range as "South Coast Ranges; Sacramento Valley, Sierra Co.; n. to southern Ore." Essentially the latter range was repeated by Hoover.¹⁴ The actual center of distribution for the species seems to be in the neighborhood of San Francisco Bay. From this center it extends southward to Merced and northern Monterey County and northward to Colusa County. The writer has seen collections from Lassen County, as well as from Ormsby County, Nevada, and Marion County, Oregon, in which specimens of *D. pulchella* had been mounted on the herbarium sheets with full collections of another species. It is probable that the Nevada and Oregon collections are not authentic, so far as concerns the occurrence of *D. pulchella* at the stated localities. The occurrence of the species in Lassen County, California, is also open to doubt but is entirely possible, since *D. insignis*, a related species with similar range, has been found both in Lassen and in Modoc Counties.

There is in the Gray Herbarium a specimen of *Downingia pulchella*, collected by Dr. J. G. Cooper during the spring of 1861, labelled "upper Mojave." There is also a specimen of *D. laeta*, collected by Dr. Cooper on June 6, 1861, now in the United States National Herbarium and labelled "Upper Mojave River." The locality on the former appears to have been written by Asa Gray. Dr. Cooper is known to have passed over the trail from Fort Mohave to Cajon Pass in the spring of 1861, and to have travelled along the Mohave River, above Soda Lake, in May of that year. It is scarcely credible, however, that he should have collected there both *Downingia pulchella* and *D. laeta*, neither of which is known otherwise from this part of California. The origin of his specimens is accordingly unknown; it is not unlikely that these specimens were mixed with a series of other plants from southern California.

Like *Downingia ornatissima*, *D. pulchella* is a species which is exceedingly easy to recognize and not closely related to any other species, but which is difficult to set off by the use of key characters. It differs from all other species in its long and narrow anther-tube which is narrowed and pointed at the apex, rather than obtuse or rounded as in the rest of the species. It is characterized further by the short and flaring corolla-tube, from which the filament-tube is conspicuously exerted. The three purple spots at the base of the lower lip of the corolla are usually visible, even in dried material.

The species most closely related to *D. pulchella* appears to be *D. insignis*. The two resemble each other strongly in capsule characters, in habit and in color-pattern of corolla.

¹³ A Manual of the Flowering Plants of California.

¹⁴ Leaflet. West. Bot. 2: 33-35. Aug 1937.

8. *DOWNINGIA INSIGNIS* Greene, *Pittonia* 2: 80. 1890.

Type locality: "Fields of the lower Sacramento valley near Elmira" (Solano County, California). *TYPE*: "Near Elmira," E. L. Greene, May 2, 1890, No. 16107 of the Greene Herbarium.

Bolelia insignis Greene, *Pittonia* 2: 126. 1890.

Plants slender, the stems attaining a maximum diameter of about 2 mm. at base, often somewhat zigzag, (6) 10—24 (30) cm. high, the whole plant glabrous or the capsule sometimes minutely scabrous. Leaves 1—2 mm. wide by 5—15 mm. long. Inflorescence 4—12 (20) cm. long, loosely 1—8- (16-) flowered (the mean about 5 flowers); inflorescence-axis often poorly defined and overtopped by the tips of the capsules even of the lower flowers. Flower-bracts 1—5 mm. wide by 6—20 mm. long, mostly about 2—6 times as long as wide, elliptic to ovate, obtuse, rounded or sometimes subacute.

Ovary linear, enlarged in fruit, the mature capsule terete or slightly angled, linear or narrowly subulate, usually strongly appressed, 0.8—1.5 (2.0) mm. in diameter by (25) 45—80 mm. in length; lateral walls tough when dry and ruptured with difficulty, with no evidence of impressed or scarious valves. Calyx-lobes elliptic, obtuse or rounded, ascending, 1—2 (3) mm. wide by 3—8 (12) mm. long, usually broadest about the middle.

Corolla 9—15 mm. long, glabrous. Color "sky-blue" (according to Greene), the veins darker; lower lip with central white area, this sometimes with two oblong parallel green spots; base of lower lip with two low golden-yellow folds in a field of dark violet-purple, or the latter reduced to three purple spots at the summit of the corolla-tube.

Corolla-tube (3.0) 3.5—5.0 mm. long, broadly funnelform ("campanulate," according to Greene), the lateral sinuses deeper than the dorsal one; length of tube measured at dorsal sinus 4.5—6.0 mm. Two upper lobes ascending and parallel, elliptic, acute, 2.0—3.0 mm. wide by 6.0—10.0 mm. long. Lower lip concave, usually exceeded in length by the two upper corolla-lobes, not reflexed, not forming an angle with the tube, the three lobes oblong to ovate, acute or mucronate, 2.5—7.0 mm. long.

Filament-tube (7.0) 9.0—10.5 (11.5) mm. long, glabrous, the filaments united very nearly their whole length. Anther-tube 2.4—3.0 (3.5) mm. long, 1.0—1.3 mm. in diameter, usually strongly incurved and standing about at right angles to the filament-tube. Anthers a dirty white in color, the cells hardly darker than the connectives, all the anthers minutely granular-roughened over the whole surface; two shorter anthers white-tufted at tip, each with a short horn-like process in addition.

Seeds not twisted; placentae axile.

Heavy clay soils of vernal pools and in low grassy places, Great Valley of California, at low elevations from Stanislaus County northward. Also extends to Lassen and Modoc Counties, California, and to Washoe County, Nevada. Collected in flower and fruit from March 3 to June 14; a single collection in August. Most of the collections have been made in May.

Specimens examined: CALIFORNIA—BUTTE: 6 miles n.w. of Chico, A. A.

Heller 11468 (CalAc, ELG, F, G, NB, S, UC, US). COLUSA: Near Princeton, *A. Eastwood 11201* (CalAc); near College City, *M. A. King* in 1905 (UC); Colusa, *A. A. Heller*, May 19, 1902 (CalAc, G, NB, UC, US); near Colusa, *Heller & Brown 5438* (F, G, NB, P, S, US). CONTRA COSTA: Near Byron, *E. L. Greene*, May 23, 1886 (ELG); Byron, *L. S. Rose 37225* (F, NB); $\frac{1}{4}$ mile s. of Byron, *I. L. Wiggins 4570* (P, S, UC); Byron Springs, *A. Eastwood 14444* (CalAc, P); 8 miles s. of Antioch, *L. S. Rose 36154* (CalAc, F, NB, UC, US). GLENN: "Glenn Co.," collector unknown, April 27, 1916 (CalAc); Willows, *A. Eastwood 10223* (CalAc). LASSEN: Susan R. at Litchfield, *L. Constance 2328* (USNA); Pete's Valley, *Jean Linsdale*, June 9, 1929 (CalAc); Bieber, *W. C. Merrill*, Aug. 1892 (P). MODOC: 2 miles e. of Alturas, *J. T. Howell 12202* (CalAc). PLUMAS: Prattville, collector unknown, July 4, 1892 (UC). SAN JOAQUIN: Without loc., *Tracy*, April 1892 (ELG); Stockton, *A. L. Grant*, March 3, 1916 (P), *J. A. Sanford 161* (UC), *J. A. Sanford*, May 10, 1890 (ELG); *V. Rattan*, without date (S); *E. E. Stanford 168* (G, P, S); 5 miles s.e. of Stockton, *R. F. Hoover 2078* (G, S); "Stockton, St. Joaquin Riv.," *Dr. Rich*, without date (NB); French Camp, *R. F. Hoover 2185* (UC); Lockeford, *W. P. Steinbeck*, May 9, 1923 (CalAc). SOLANO: Near Vanden, *J. T. Howell 5213* (CalAc, Cath, F, US); "north-western Solano," *W. L. Jepson*, May 2-6, 1891 (ELG, NB, UC, US); near Suisun, *E. L. Greene*, May 5, 1890 (NB); and May 1890 (UC); near Elmira, *E. L. Greene*, May 5, 1890 (US); Elmira, *Heller & Brown 5591* (F, G, NB, P, R, S, US); near Elmira, *A. A. Heller 14546* (US); Little Oak, *W. L. Jepson*, May 15, 1896 (G, UC). SONOMA: Near Sonoma, *F. T. Bioletti*, in 1892 (NB). STANISLAUS: 7 miles w. of Modesto, *R. F. Hoover 3077* (UC). SUTTER: "Edge of tule land," *E. B. Copeland 3285* (ELG, G, NB, P, US). YOLO: 4 miles n. of Zamora, *D. K. Kildale 5026* (S); between Woodland & Davis, *L. R. Abrams 12604* (S). YUBA: "Yuba Co.," without collector or date (CalAc).

NEVADA—WASHOE: 3.5 miles n. of Reno, *R. C. Wilson 640* (FS); 5 miles e. of Poeville, *D. Tillotson 156* (FS); Chas. Sheldon Antelope Refuge, *G. H. Greenway 139* (USNA).

OREGON—MALHEUR: Barren Valley, *W. C. Cusick 1261* (F). The Cusick specimens are typical *D. insignis*, but mixed with them on the sheet is a number of plants with the stamens of *D. elegans* and the longer corolla-tube of *D. insignis*. The ovary is unilocular, as in *D. elegans*, but none of the plants has mature fruit. These anomalous specimens may represent a hybrid between *D. elegans* and *D. insignis*; similar plants from what is apparently the same collection, are in the herbarium of the University of Oregon.

As discussed above (p. 11), this species is perfectly distinct from *D. elegans*. The two species seem to have arisen from a common stock, to judge by their very similar flowers, but at the present time, in the writer's opinion, *D. insignis* has much more in common with *D. pulchella* than with *D. elegans*. Some of the differences between *D. elegans* and *D. insignis* are brought out in the key (p. 15); additional differences worthy of note may be summarized as follows:



MAP 5. Distribution of *Downingia laeta*. MAP 6. Distribution of *Downingia montana*.
 MAP 7. Distribution of *Downingia elegans* var. *elegans* (circles) and var. *brachypetala* (triangles).
 MAP 8. Distribution of *Downingia willamettensis* (circles) and *Downingia yina* (triangles).

<i>insignis</i>	<i>elegans</i>
Capsule tough when dry, usually 45—80 mm. in length	Capsule papery when dry, usually 25—45 mm. in length
Corolla with purple spots at summit of tube	Corolla without purple spots at summit of tube
Corolla-tube mostly 3.5—5.0 mm. long	Corolla-tube mostly 2.0—3.2 mm. long
Range throughout Sacramento Valley, sparingly northward and eastward	Range from mountains of northern California northward

The range of *Downingia insignis* comprises the whole of the lower Sacramento Valley and extends southward into the lower part of the San Joaquin Valley. There are also records, apparently well authenticated, of the occurrence of the species at several localities in Lassen and Modoc Counties, California, and in Washoe County, Nevada. The Nevada records are unexpected ones, but specimens were collected at three localities by Forest Service collectors working independently, and there appears to be no doubt of the authenticity of the collections. Undoubted plants of *D. insignis* make up a part of the collection from "Barren Valley, Malheur Co., Oregon," *W. C. Cusick 1261*, in the Field Museum. As explained under the citation of specimens (p. 41), the remainder of the collection is made up of somewhat anomalous plants of *D. elegans*; it is quite possible that both species occur at this locality, and that it is the northernmost known locality for *D. insignis*.

9. *DOWNINGIA LAETA* (Greene) Greene, *Leafl. Bot. Obs. & Crit.* **2**: 45. 1910. *Bolelia laeta* Greene, *Erythea* **1**: 238. 1893. *Type locality*: "Humboldt Wells, Nevada." *TYPE*: *E. L. Greene*, July 6, 1893, in the Greene Herbarium, without number.

Bolelia brachyantha Rydberg, *Mem. N. Y. Bot. Gard.* **1**: 483. 1900. *Type locality*: "Augusta, Montana." *TYPE*: *R. S. Williams 712*, July 30, 1887, in the herbarium of the New York Botanical Garden.

Downingia brachyantha (Rydb.) A. Nels. & Macbr., *Bot. Gaz.* **55**: 382. 1913.

Plants few—20 (30) cm. high, entirely glabrous. Leaves 0.5—2.0 mm. wide by 5—18 (25) mm. long. Inflorescence few—10 cm. long, rather closely 1—10-flowered. Flower-bracts elliptic to lanceolate or ovate, obtuse or subacute, 1—4 mm. wide by 7—22 mm. long, usually 3—6 (8) times as long as wide.

Ovary linear, in fruit becoming narrowly subulate or fusiform, terete, the mature capsule 1.0—2.0 mm. in diameter by 21—43 mm. in length; lateral walls thin but rather tough and tardily dehiscent, the valves inconspicuous, sometimes appearing as faintly impressed lines. Calyx-lobes elliptic, rounded to subacute at tip, 1.0—2.0 mm. wide, (2.5) 3.0—7.0 (9.0) mm. long, ascending.

Corolla 4—7 mm. long, glabrous. Color light blue or purplish; lower lip with central area white or yellow and with a transverse band of purple at base, this sometimes reduced to two or three purple spots. Tube yellow on lower side below the purple area.

Corolla-tube (1.0) 1.3—1.6 (2.0) mm. long, funnellform, the lateral sinuses cut about as deeply as the dorsal one or very slightly deeper; length of tube measured at dorsal sinus (1.1) 1.5—2.0 mm. Two upper lobes ascending (?), lanceolate or triangular, acute, 1—2 mm. wide, 2.0—4.5 mm. long; lower lip

concave (?), not reflexed nor forming a sharp angle with the tube, the three lobes oblong, acute, 1.5—3.5 mm. long.

Filament-tube 1.8—2.5 (2.8) mm. long, glabrous, the filaments united their whole length or nearly so. Anther-tube 1.3—2.0 (2.2) mm. long, little or not at all incurved, its long axis nearly or quite parallel with that of the filament-tube; anthers glabrous or ciliate on the backs, the two shorter ones white-tufted at apex and each with a slender horn-like process as well.

Seeds not at all or very slightly twisted; placentae axile.

Wet muddy places in low fields, ditches, borders of sloughs, ponds, and streams, and in vernal pools, often at elevations of 1200—2000 meters. Southwestern Saskatchewan south to southwestern Wyoming, south-central Oregon, and western Nevada. Collected in flower and fruit from June 1 to August 23.

Specimens examined: CALIFORNIA: "Upper Mojave River," Dr. J. G. Cooper, June 6, 1861 (US). LASSEN: Honeylake Valley, G. H. True 518 (CalAc); 10—15 miles w. of Amedee, M. E. Jones, June 24, 1897 (P); 10 miles s. of Amedee, M. E. Jones, June 22, 1897 (US). MODOC: Fort Bidwell, along Alkali Lake, M. H. Manning 327 (US).

IDAHO—BEAR LAKE: Road from Paris to Montpelier, L. F. Henderson, August 1899 (NB); same loc., L. F. Henderson 4821 (G, Ore, US). JEFFERSON: Roberts, R. J. Davis 1059 (Id).

MONTANA—LEWIS & CLARK: Near Augusta, R. S. Williams 712 (NB, US).

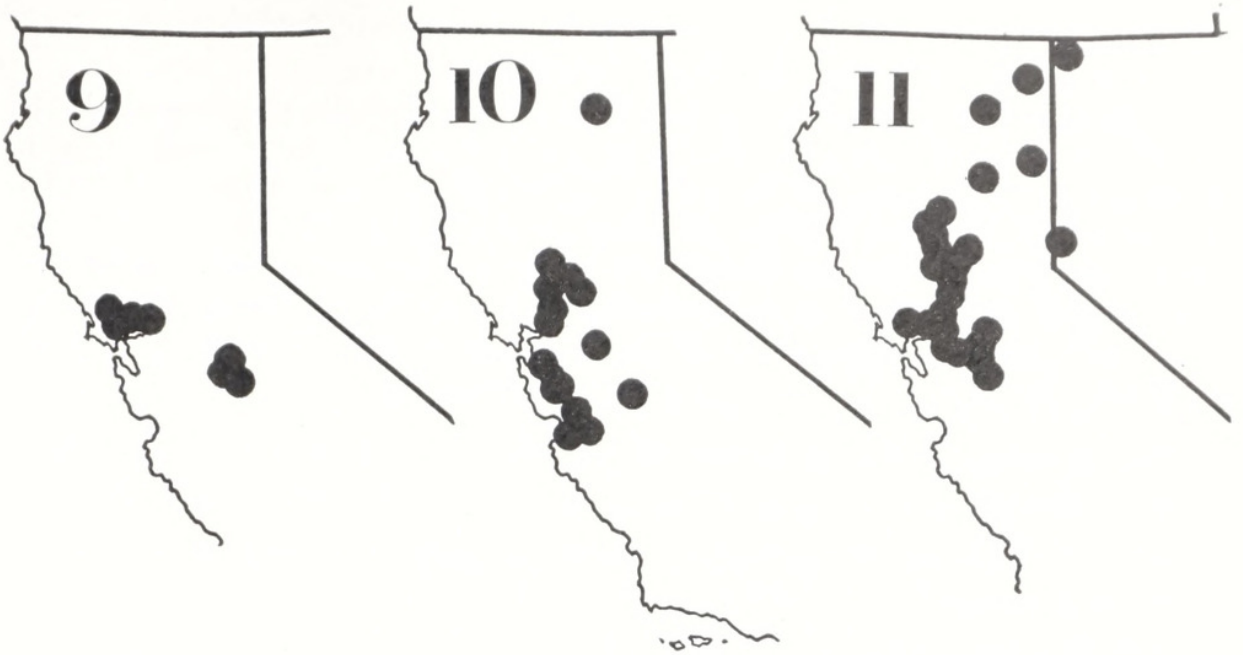
NEVADA—ELKO: Humboldt Wells, E. L. Greene, July 6, 1893 (ELG, UC); O'Neil, Nelson & Macbride 2084 (G, NB, R, US); Deeth, A. A. Heller 9039 (F, G, NB, S, US); Deeth, A. A. Heller 10555 (CalAc, F, G, NB, S, UC, US); H. D. Ranch, 28 miles n. of Wells, M. E. Jones, July 25, 1901 (P). EUREKA: Palisade, E. L. Greene, July 24, 1896 (F, UC). NYE: Potts Ranger Station, Toiyabe Forest, B. K. Crane 205 (FS). ORMSBY: Eagle Valley near Carson, C. F. Baker 1051 (ELG); Eagle Valley, C. F. Baker 1057 (G, NB, P, US). WASHOE: Near Sparks, Heller & Kennedy 8653 (F, G, NB, S, US); Truckee Meadows, near Glendale, W. W. Bailey 728 (NB, US); Glendale, P. B. Kennedy 1571 (NB, US); 5 miles n. of Carson City, D. R. Goddard 1041 (F, UC).

OREGON—HARNEY: Harney Valley, W. C. Cusick 2602 (ELG, F, G, NB, Ore, P, R, UC, US); near Burns, L. F. Henderson 8850 (CalAc, Ore); east of Burns, J. W. Thompson 13286 (CalAc, NB, US, WU); 1 mile e. of Burns, J. W. Thompson 11968 (NB, P, US); 4 miles s.e. of Burns, M. E. Peck 18940 (WU); 5 miles s.e. of Burns, M. E. Peck 13915 (S, WU). LAKE: Near Lakeview, M. E. Peck 15284 (WU); Goose Lake Valley, near Lakeview, M. E. Peck 15296 (S, WU); S. of Paisley, Chewaucan Marsh, Constance 9681 (Ore).

UTAH—BOX ELDER: Brigham, collector unknown (USNA). CACHE: $\frac{1}{2}$ mile w. of Logan airport, B. Maguire 2444 (G, P, R, UC). DAVIS: Farmington, W. W. Jones 133 (UC) and 295 (G). JUAB: Willow Spring, M. E. Jones, June 4, 1891 (G, P). UTAH: Mt. Nebo, L. N. Goodding 1108 (G, R).

SASKATCHEWAN: "Crane Lake, Assiniboia," J. Macoun, June 11 and July 3, 1894 (herb. G. S. Can. 7532 and 7533) (ELG, O).

WYOMING—UINTA: 2 miles n. of Evanston, L. Williams 7933 (R).



MAP 9. Distribution in North America of *Downingia pusilla*. MAP 10. Distribution of *Downingia pulchella*. MAP 11. Distribution of *Downingia insignis*.

10. DOWNINGIA MONTANA Greene, Pittonia 2: 104. 1890. *Type locality*: Lake Eleanor, Tuolumne County, California. TYPE: "Lake Eleanor," Elmer Drew, June 1889, No. 16098 of the Greene Herbarium.
Bolelia montana Greene, Pittonia 2: 127. 1890.
Downingia bicornuta var. *montana* Jepson, Madroño 1: 102. 1922.

Plants few—15 cm. high, slender, entirely glabrous or the hypanthium minutely scabrous; upper part of the stem rarely minutely scabrous. Leaves linear to elliptic or subulate, sometimes few-toothed, 0.3—1.0 (1.5) mm. wide by (2.0) 5.0—13.0 (18.0) mm. long, acute to acuminate. Inflorescence 3—12 cm. long, loosely 1—10-flowered. Flower-bracts similar to the leaves but slightly larger, often toothed, 0.8—1.5 mm. wide by 8—16 mm. long, 8—13 times as long as wide.

Ovary linear, becoming narrowly subulate in fruit, the mature capsule 0.6—1.5 mm. in diameter by 15—35 (45) mm. long, the lateral walls firm, usually with evident hyaline valves, these apparent as impressed longitudinal lines at an early stage. Calyx-lobes linear-subulate or very narrowly elliptic, acute, sometimes scabrous-ciliate on the margins, the two lower ones usually conspicuously shorter than the others; all ascending, often appressed in anthesis, (2.0) 4.0—8.0 (11.0) mm. long.

Corolla 9—12 mm. long, glabrous. Lobes of the lower lip light blue or violet; central part of lip white; base dark bluish-purple, with two prominent purple folds at the angle; tube "blue becoming violet," the lower side within with two greenish yellow ridges alternating with three purple grooves. (Central part of lower lip usually appears bright yellow in dried material.)

Corolla-tube 3.3—5.0 mm. long, narrowly funnel-shaped, often nearly cylindrical below and expanded near the summit; lateral sinuses extending well below the angle of the lower lip, cut more deeply than the dorsal one by a distance of 0.5—1.0 mm. Two upper corolla-lobes narrowly triangular, erect,

usually concealing the anther-tube (in dried material), 4.0—5.5 mm. long, sometimes minutely roughened on the margins near tips.

Filament-tube 3.0—4.0 (4.7) mm. long, its apex usually not surpassing the dorsal sinus of the corolla; filaments connate nearly their whole length, glabrous or very minutely pubescent on the margins at base. Anther-tube 1.7—2.2 mm. long; all 5 anthers prominently bearded at tip, the two shorter ones with stiff tufts of bristles and each with a short horn-like process as well.

Seeds not twisted, the surface scarcely lustrous, the fine longitudinal markings easily visible with a magnification of about 20 \times . Placentae parietal; valves 3.

Moist open grassy meadows in pine forests, mostly at elevations of 1000—1700 meters; western slope of the Sierra Nevada from Tuolumne County, California, northward to Shasta County. Collected in flower and fruit from May 22 to August 1.

Specimens examined: CALIFORNIA: Without loc., *D. C. Roberts*, Aug. 1905 (CalAc); *Kellogg & Harford 616*, in 1868—9 (CalAc, NB, US). BUTTE: Butte Meadows, *A. A. Heller 12843* (ANS, CalAc, F, G, NB, S, US); *A. A. Heller 14656* (NB, S, US). CALAVERAS: Avery Station, *R. F. Hoover 2350* (UC); Calaveras Ranger Station, Avery, *W. W. Eggleston 9178* (USNA, US); Big Trees, *Harry Edwards*, June 1874 (NB). ELDORADO: Sly Park, *H. M. Hall 11311* (CalAc). PLACER: Near Emigrant Gap, *H. M. Hall 8736* (UC, US); without loc., *Mrs. M. M. Hardy* in 1893 (ELG, UC, US). SHASTA: 3 miles e. of Redding, *R. F. Hoover 1203* (CalAc, G, UC); n. fork of Battle Creek, 4000 ft., *Hall & Babcock 4280* (UC). TUOLUMNE: Hog Ranch, Mather, *Keck & Heusi 285* (CalAc, G, Ore, P, S, UC); Mather, *D. D. Keck 1167* (CalAc); Mather, *P. A. Munz 7338* (P); vicinity of Hog Ranch, *Hall & Babcock 3311* (NB, P, R, S, UC, US); Ranger's Cabin, Hetch-Hetchy, *Adele L. Grant 852* (P); Dry Meadows, Big Trees Quadrangle, *R. D. Roseberry 280* (UC).

Downingia montana is one of the group of three species having an unilocular ovary, a long narrow corolla-tube and short stamens, with the anthers not strongly bent inward and the lower part of the anther-tube usually included. It is more difficult to decide upon specific limits in this group than anywhere else in the genus. *Downingia montana* is ordinarily easy to separate from the closely related *D. yina* and *D. willamettensis* by its very narrow, often linear or subulate leaves and its very unequal calyx-lobes, which are also linear-subulate for the most part. Individual plants, however, both of *D. yina* and *D. willamettensis* are not separable by vegetative characters from *D. montana*, so that it is impossible to construct a key to this group based upon such characters. The flowers of the three species are closely similar; the corolla of *D. montana* is prominently marked with purple at the base of the lower lip, with two purple ridges; the corollas of the other two species, however, are less prominently marked with purple. In *D. yina* there are no purple spots, so far as known to the writer, and

in *D. willamettensis* there are ordinarily three purple spots at the base of the lower lip, these sometimes being reduced or absent. The characters of seeds and anthers, emphasized in the key (p. 16), prove to be the most dependable means for separating the species.

In the opinion of the writer, *Downingia montana* is to be regarded as a well-marked species, perfectly distinct from the other two species just discussed. It is restricted in range and habitat, and, although undoubtedly closely akin to *D. yina* and *D. willamettensis*, seems never to form intermediates with them. It differs markedly from them in seed and capsule characters, and probably should be regarded as slightly less highly evolved than either of them.

11. DOWNINGIA YINA Applegate, Contr. Dudley Herb. 1: 97. 1929.

Type locality: Four Mile Lake, Klamath County, Oregon. TYPE: *E. I. Applegate* 4479, July 29, 1925, No. 163277 of the herbarium of Stanford University.

Plants 3.0—10.0 cm. high, usually diffusely branched from the base, entirely glabrous or the hypanthium sparsely scabrous. Leaves up to 1.5 mm. wide by 8.0 mm. long. Inflorescence 5 cm. long or less, with 10 flowers or fewer. Flower-bracts narrowly elliptic or lanceolate, acute, up to 3.0 mm. wide by 13.0 mm. long.

Ovary in fruit becoming fusiform, terete, not conspicuously twisted, broadest about the middle, about 1.5 mm. in diameter by 20.0—25.0 mm. long; lateral walls thin and easily fractured, the three valves separated by thin hyaline divisions. Calyx-lobes elliptic to subulate, acute, up to about 1.0 mm. wide by 6.0 mm. long.

Corolla 8—10 mm. long, glabrous, resembling that of *D. willamettensis*. Color dark blue or purplish; lower lip with central yellow area and with two low yellow ridges at base.

Corolla-tube 3.5—4.5 mm. long. Two upper lobes "erect," according to Applegate. Filament-tube 2.5—3.5 mm. long; anther-tube 1.6—2.0 mm. long, the two smaller anthers white-tufted at tip and each with a short horn-like process as well, the three larger anthers sparsely ciliate on backs, scarcely tufted at tip.

Seeds dull or slightly lustrous, lacking lines, not twisted; placentae parietal, central septum none.

Boggy places about lakes and ponds, and beds of partially dried rain-pools; Cascade Mountains of southern Oregon and northern California, at altitudes up to at least 1650 meters. Collected in flower from July 1 to August 15. The only fruiting specimen seen by the writer (*Peck* 14698) was collected July 1, 1931.

Specimens examined: OREGON—KLAMATH: Lake of the Woods, *M. E. Peck* 14698 (WU); Lake of the Woods, *M. W. Gorman*, August 14, 1896 (US); small pond, south side of Four Mile Lake, east base of Mt. Pitt, *E. I. Applegate* 4479 (S, TYPE); Four Mile Lake, *M. E. Peck* 16572 (WU).

CALIFORNIA—SISKIYOU; Soda Creek, Siskiyou Mts., Sect. 30, T48N, R8W, L. C. Wheeler 2870 (FS, USNA, P).

The following are referred doubtfully to this species:

CALIFORNIA—SISKIYOU: Bray, L. E. Smith, July 1915 (CalAc). TRINITY: Big Flat, J. T. Howell 13206 (CalAc); Preacher Meadow, Eastwood and Howell 4931 (CalAc).

This species is intermediate in many respects between *D. montana* and *D. willamettensis*, and its exact status is uncertain. The writer has examined but five collections that may be referred here without hesitation. Further collections may demonstrate that *D. yina* and *D. willamettensis* are conspecific, in which case the former name, being the earlier, will have to be applied to the whole group. At the present time the writer prefers to uphold both as valid species, the name *Downingia yina* being restricted to a small diffuse plant of the high Cascades. The fruits of this species, in the single specimen seen, differ considerably from those of *D. willamettensis* in their fusiform rather than subulate shape, and in being terete and very thin-walled, with evident hyaline divisions. The flowers are, on the average, slightly smaller than those of *D. willamettensis*, and the plants themselves are small and usually diffuse, as contrasted to the larger and usually erect plants of the other species.

12. *DOWNINGIA WILLAMETTENSIS* M. E. Peck, Proc. Biol. Soc. Wash. 47: 187. 1934.

Type locality: "2 miles east of Aumsville, Marion Co." (Oregon). *TYPE*: M. E. Peck 16291, July 11, 1930, in the herbarium of Willamette University.

D. pulcherrima M. E. Peck, Proc. Biol. Soc. Wash. 50: 94. 1937.

Type locality: Silver Creek Valley, 10 miles west of Riley, Harney County, Oregon. *TYPE*: M. E. Peck 18919, June 19, 1936, in the herbarium of Willamette University.

Plants (few) 10—35 cm. high, glabrous except for the hypanthium which is usually plainly scabrous. Leaves 0.5—2.0 mm. wide by (3.0) 8—23 mm. long. Inflorescence few—15 (25) cm. long, loosely or closely (few) 10—20- (35-) flowered. Flower-bracts elliptic to ovate, usually acute, (1.0) 2—7 mm. wide by (6.0) 8—20 (27) mm. long, mostly 3—5 (8) times as long as broad.

Ovary linear, in fruit becoming subulate, usually somewhat angled, up-curved distally, usually prominently twisted near base; mature capsule 1.0—1.5 (2.0) mm. in diameter, 20—40 (50) mm. long, the lateral walls thin and papery, the three valves usually invisible before splitting, with no impressed lines nor hyaline divisions on the hypanthium. Calyx-lobes linear to narrowly elliptic, usually strongly ascending and acute, mostly of two distinct lengths, 1.5 mm. or less in width, (2.7) 4—7 (8) mm. in length.

Corolla 7—12 (16) mm. long, glabrous. Color lavender to deep bright blue; lower lip with central yellow area surrounded by white except at base, where the yellow is continued over two low ridges into the tube; alternating with

these low ridges, which are parallel to the long axis of the tube, are three purplish patches which may be faint or entirely absent. Tube about the same color as the limb, or lighter-colored on the lower side.

Corolla-tube (3.2) 3.5—5.5 mm. long, nearly cylindrical but slightly dilated distally, the lateral sinuses usually slightly deeper than the dorsal one and cut very slightly below the plane of the lower lip; tube measured to dorsal sinus 4.0—6.5 mm. long. Two upper corolla-lobes acute, linear-lanceolate or linear-oblongate, rarely broader, slightly divergent, erect or slightly curving backward, 1.0—1.5 (2.2) mm. wide; (4.0) 5.0—7.0 mm. long. Lower lip plane or slightly concave, the lobes oblong to obovate, rounded and mucronate.

Filament-tube 2.0—4.0 (5.0) mm. long, glabrous, the filaments united their whole length or nearly so; base of anther-tube usually covered by dorsal side of corolla-tube; anther-tube (1.7) 2.0—2.5 (3.1) mm. long, the anthers somewhat pubescent on the backs; two shorter anthers prominently white-tufted at tips and each bearing a short horn-like process as well.

Seeds usually shining as if varnished, with no lines visible at a magnification of 20 \times , not twisted. Placentae truly parietal; central septum none.

Wet soil, usually in heavy clay, vernal pools, banks of sloughs, small ponds and streams, ditches and wet depressions in fields. Central and western Washington south to Humboldt County, California, mostly west of the Cascade Ranges. Collected in flower and fruit throughout the summer, mostly from June 1 to August 1.

Specimens examined: CALIFORNIA—HUMBOLDT: Alton, *J. P. Tracy* 3781 (NB, US); near Fortuna, *A. A. Heller* 13771 (F, NB, S); Hydesville, *V. Rattan* in 1878 (S); near Hydesville, *J. P. Tracy* 3271 (G, UC, US); Rohnerville, *J. B. Feudge* 108 (P). SISKIYOU: S. side Mt. Shasta, *H. E. Brown*, July 1897 (NB); n. side of Mt. Shasta, *H. E. Brown* 480, July 1–15, 1897 (NB, S, US) and *H. E. Brown* 980 (F).

OREGON: Without loc., *E. Hall* in 1871 (G); Pelican Ranger Sta., Crater Forest, *Brown & Murray* 121 (FS); Willamette Valley, *T. Howell* 1678 (NB); COOS; Myrtle Point, *G. A. Holzinger* 59 (US). CURRY: east of Lowery's, bluffs of Rogue R., *L. F. Henderson* 11728 (Ore). DOUGLAS: Near Drain, *G. C. Kimber* 59 (NB, S); n. of Yoncalla, *A. A. Heller* 14707 (NB, US); near Sutherlin, *Eastwood & Howell* 2831 (CalAc). HARNEY: 40 mi. s.e. of Burns, *J. W. Thompson* 13280 (NB); Silver Creek Valley 10 miles w. of Riley, *M. E. Peck* 18919 (WU). JACKSON: Desert of Sam's Valley, *Henderson* 12407 (Ore); near Medford, *J. B. Leiber* 4117 (Ore, US); 30 miles e. of Medford, *J. H. Heckner*, June 1927 (S, WU); nr. Woodville, *M. E. Peck* 3137 (WU); n. of Medford, *J. W. Thompson* 10293 (NB, S). JOSEPHINE: Grant's Pass, *C. V. Piper* 6141 (Cath, G, US). LANE: Florence, *W. S. Cooper* 33–166 (UC); nr. Eugene, *Patterson*, without date (Ore); Noti Road, *Henderson* 16608 (Ore); 9 mi. n.w. of Eugene, *L. F. Henderson* 16360 (Ore). MARION: Salem, *E. Hall* in 1871 (F); 2 miles e. of Aumsville, *M. E. Peck* 16291 (WU, TYPE); 1 mile east of Salem, *J. W. Thompson* 2666 (S); Salem, *Mrs. L. Reynolds*, without date (WU); Salem, *M. E. Peck* 3134 (WU). WASCO: Near Dalles City, *W. N. Suksdorf* 1552 (F, G, NB, Ore, S, US).

WASHINGTON: "Yakima Region. Simcoe Mts. & Klickitat," *T. S. Brandegee* in 1882 (F, UC); "La Camas Meadows," *Gorman 5006* (Ore). CLARK: Lacamas Cr., *C. English, Jr. 422* (US). DOUGLAS: Wilson Creek, *Sandberg and Leiberg 6219*, June 1893 (NB); without collection no. (F, O, UC); near Wilson Creek, *Sandberg and Leiberg 287* (NB, Ore, US); junction of Crab and Wilson Creeks, *Sandberg and Leiberg 287* (CalAc, F, G, O, UC). KLICKITAT: Rockland, *W. N. Suksdorf 2763* (G). LEWIS: Chehalis, *J. M. Grant*, Aug. 1917 (NB, US); Centralia, *M. E. Jones*, June 21, 1902 (P); Lewis & Clark State Park, *J. T. Howell 7347* (CalAc). MASON: 20 miles s.w. of Shelton, *W. J. Eyerdam 1232* (F, UC).

This species has usually been confused with *D. elegans*, although the two are easily distinguished by the totally dissimilar corollas and stamens (see figures 2, 11). The ranges of the two species overlap to some extent in western California, Oregon, and Washington, and it is possible that some hybridization has taken place between them. This will be discussed under *D. elegans* var. *brachypetala*. The other species with which *D. willamettensis* might possibly be confused, in the southern part of its range, are *D. concolor* and *D. cuspidata*. If mature fruit is available, *D. willamettensis* is at once separable from the others; in the absence of fruit *D. concolor* may at once be eliminated by the ciliate upper lobes of the corolla and the large purple area at the base of the lower lip; *D. cuspidata* may be distinguished by the absence of purple coloration at the base of the lower lip, and by the seeds, which are twisted even when young.

13. DOWNINGIA ELEGANS (Dougl. ex Lindl.) Torrey, U. S. Expl. Exped. 17: 375. 1874.

Plants mostly 10—40 (50) cm. high, glabrous except for the scabrous hypanthium; stems mostly stoutish, sometimes 4 mm. in diameter at base. Leaves 0.2—4.0 (6.0) mm. wide by 5—25 mm. long. Inflorescence few—20 (30) cm. long, loosely or closely few—25- (50-) flowered (the mean about 10 flowers); inflorescence-axis well-marked and straight, usually much overtopping the early flowers. Flower-bracts elliptic to lanceolate or ovate, (1.0) 2.0—9.0 mm. wide by (6.0) 8.0—26.0 mm. long, usually 3—6 times as long as wide.

Ovary linear, in fruit becoming subulate, the mature capsule broadest near the base, (1.0) 1.5—2.0 mm. in diameter by (15) 25—45 (55) mm. in length, terete or somewhat angled at maturity. Lateral walls papery and easily ruptured when dry, splitting along longitudinal lines but with no evidence of impressed or hyaline divisions. Calyx-lobes linear or elliptic, broadest about the middle, obtuse or subacute, 1.0—2.5 mm. broad by (3.0) 4.0—10.0 (14.0) mm. long, ascending.

Corolla glabrous, minutely roughened within at base. Color "blue," "wisteria blue," "deep navy blue," varying to "lavender-pink" or pure white; lower lip with central white spot, this marked near base by two low yellow ridges which are distinctly white-margined; corolla-tube lighter, with purple

veins and often with three oblong purple blotches at very base on the lower side.

Corolla-tube broadly funnelform ("campanulate," according to Jepson), the lateral sinuses usually much deeper than the dorsal one. Two upper lobes ascending and somewhat divergent, acute, lanceolate or elliptic, 1.0—2.5 mm. wide by 3.5—13.0 mm. long. Lower lip concave, in length somewhat exceeded by the two upper lobes, not reflexed nor forming an angle with the tube, the three lobes parallel, in shape oblong, ovate, or deltoid, acute, 2—4 mm. long.

Filament-tube glabrous, the filaments united their whole length. Anther-tube 0.6—1.0 mm. in diameter, usually strongly incurved and often standing at right angles to the filament-tube; anthers bluish-gray with white connectives, these forming (usually) conspicuous longitudinal bands; anthers smooth and glabrous or few-ciliate, not scabrous nor granular-roughened, the two shorter anthers white-tufted at tip, each with a short, usually recurved, horn-like process as well.

Placentae truly parietal; central septum none. Seeds not twisted.

KEY TO THE VARIETIES

1. Filament-tube 4.5—10.5 mm. long; corolla 8.0—18.0 mm. long. var. *elegans*
 1. Filament-tube less than 4.5 mm. long; corolla 5.0—9.0 mm. long. var. *brachypetala*

13a. DOWNINGIA ELEGANS var. **elegans** McVaugh, nom. nov.

- *Downingia elegans* (Dougl. ex Lindl.) Torrey, l.c.
- *Clintonia elegans* Dougl. ex Lindl., Bot. Reg. **15**: t. 1241. 1829. *Type locality*: "Plains of the Columbia, near Wallawallah R., and near the head springs of the Multnomah." *TYPE*: Not seen.
- Gynampsis flexuosa* Raf., Herb. Raf. 48. 1833, nomen nudum. *Type locality*: "Oregon Mts." *TYPE*: Not seen.
- Clintonia corymbosa* A.DC., DC. Prodr. **7**: 347. 1839. *Type locality*: "In America bor. occid." *TYPE*: Columbia River, *David Douglas* in 1830, in the DeCandolle Herbarium, Geneva, Switzerland, not seen. Photograph of type in the herbarium of the National Arboretum, Washington, D. C.
- *Bolelia elegans* Greene, Pittonia **2**: 126. 1890.
- Downingia corymbosa* (A.DC.) A. Nels. & Macbr., Bot. Gaz. **55**: 382. 1913.

Corolla 8—13 (18) mm. long; corolla-tube (1.5) 2.0—3.2 (4.3) mm. long (measured to lateral sinuses) and (3.3) 4.0—5.5 mm. long (measured to dorsal sinus). Filament-tube (4.5) 6.0—8.0 (10.5) mm. long; anther-tube (2.2) 2.5—3.5 (4.0) mm. long.

Vernal pools, mud flats, muddy borders of ponds, grassy meadows, wet roadside ditches, sometimes partially immersed; at middle altitudes, the maximum being about 2000 meters. Northern Idaho and northeastern Washington south in mountain ranges to Elko County, Nevada, and Plumas and Humboldt Counties, California. Flower throughout the summer, from June 1 to September 1; an occasional collection in late May or in early October.

Included in this variety is *D. elegans* forma *rosea* St. John, Res. Stud.

St. Coll. Wash. 1:105. 1929. The TYPE was collected 3 miles east of Princeton, Latah County, Idaho (*H. St. John* 9627). The writer has seen isotypic material of this form, the flowers of which are stated to be "lavender-pink" instead of the usual blue.

Specimens examined: LOCALITY UNKNOWN: "Rocky Mts.," *Geyer* 665, in 1845 (NB); "Oregon and northern California," *Wilkes exp.* 532 bis (US); "U.S. Exploring Expedition, under Command of Capt. Wilkes," without date (NB); "Cult., Hort. Cantab.," July 1868 (Torrey Herb.) (NB); "Morelia, Michoacan," *Bro. Arsene*, Feb. 1911 (F).

CALIFORNIA: Without loc., *Mrs. R. M. Austin* (ELG, NB); without loc., *J. G. Lemmon* 174 (F, NB); Upper Sacramento, *F. W. Morse* in 1886 (ELG); Sierra Nev. Mts., *J. G. Lemmon* in 1875 (US); Sacramento River, upper Sacramento Valley, *Hall & Babcock* 4023 (NB, R, UC, US); Indian Valley, *A. W. Roberts*, May 10, 1872 (NB); Haywards, *Lemmon herb.*, without date (P, US); $\frac{1}{8}$ mile below McCullom's Mill on Klamath River, *M. S. Baker* 8290 (CalAc); Lake Tahoe, *Harry Edwards* 545 (NB). DEL NORTE: 2 miles e. of Gasquet, *Parks & Tracy* 11327 (UC); Gasquet, *F. W. Peirson*, July 13, 1923 (P). HUMBOLDT: Without loc., *Chesnut & Drew*, Aug. 1888 (UC); near Jarnigan's, *Chesnut & Drew*, July 10, 1888 (UC); 6 miles n. of Garbersville, *F. W. Peirson* 3871 (P); Miranda, s. fork Eel River, *D. K. Kildale* 5231 (S). LASSEN: Hall's Flat, Sec. 20 T33N, R7E, *G. A. Fischer* 34 (FS). MENDOCINO: Without loc., *H. N. Bolander* 6570 (F, US); Mendocino Creek, *State Survey* 6570 (UC). MODOC: Rim Rock Valley Reservoir, Devil's Garden, *L. C. Wheeler* 3916 (G, NB); Willow Creek Valley, *Mrs. R. M. Austin*, June 1894 (NB, UC); Willow Creek, Devil's Garden, *Mrs. R. M. Austin* 119, July 1895 (P, US); Goose Lake Valley, *Mrs. R. M. Austin* 277, July 1894 (UC) and August 1894 (NB, S); Goose Lake, *Mrs. C. C. Bruce*, July 1899 (S); Egg Lake, *M. S. Baker*, July 25, 1893 (G, NB, UC); Egg Lake, *L. S. Smith* 1368 (FS); Little Hot Spring Valley, *M. S. Baker*, June 15, (UC); Mt. flats, 6500 feet, *M. F. Gilman* 644 (UC); Forestdale, *F. P. Nutting*, in August (P); Sibley Draw, Modoc N. F., *Ivar Tidestrom* 3660 (Cath). NEVADA: Near Truckee, *E. L. Greene*, July 25, 1895 (ELG, O); Master Valley near Truckee, *C. F. Sonne*, July 25, 1895 (NB); w. of Sardine Valley, *C. F. Sonne*, July 18, 1884 (F, S); near Russell Valley, road to Sardine Valley, *C. F. Sonne*, July 18, 1885 (P); Truckee River at Malheur Dam, *C. F. Sonne*, Sept. 20, 1885 (P). PLUMAS: Greenville, *M. S. Clemens*, June 8, 1920 (CalAc, NB); 7 miles s. of Chester, *Mrs. H. P. Bracelin* 695 (CalAc, Cath, F, NB, Ore, P, R, S, UC, US); between Vinton and Beckwith, *Heller & Kennedy* 8677 (CalAc, F, G, NB, P, S, US); Charlie's Valley, Sec. 26, *Sawyer* 159 (FS); Blairsden, *A. J. Rosenberg*, July 20, 1917 (CalAc, US); Taylorsville, *M. S. Clemens*, June 12, 1920 (CalAc); Gray Eagle Canyon, *Mrs. Chas. Durbrow*, July 1918 (CalAc); Prattville, *M. E. Jones*, July 3, 1897 (NB, P, R, US); Prattville, *Mrs. A. L. Coombs*, July 7, 1902 (NB, R, S, UC, US) and summer 1906 (CalAc); Prattville, collector unknown, July 4, 1892 (UC); between Prattville and Chester, *D. D. Keck* 1716 (CalAc, P, S); Lake Almanor, near Prattville, *J. T. Howell* 2166 (CalAc); near Lake Almanor, *F. W. Peirson* 6802 (P); Big Meadows, *Mrs. R. M. Austin* in 1880 (UC); *Mrs. R. M. Austin & Bruce*, July 1897 (G), *Mrs. A. L. Coombs*, Sept. 1912

(CalAc, G, US); without loc., *J. M. Coulter* in 1876 (F); *Mrs. Austin* in 1879 (F, O) and in 1876 (US); *Mrs. Ames* in 1873 (G, NB). SHASTA: Goose Valley, *Eastwood* 745 (CalAc) and 978 (G, NB, US); *Anderson, W. W. Jones* 296 (G); Fall River Springs, *Hall and Babcock* 4197 (P, UC). SIERRA: Loyalton, *A. Eastwood* 7834 (CalAc); Campbell's Hot Springs, *J. A. DeCou* 460 (UC); Sierra Valley, *Hall & Babcock* 4464 (UC); Sierra Valley, Hot Springs, *W. R. Dudley*, Aug. 26, 1909 (S); Sierra Valley, *J. G. Lemmon*, without date (G); without loc., *Lemmon* 136 (G). SISKIYOU: Weed, *L. E. Smith* 386 (CalAc, G, US). TRINITY: Without loc., *V. Rattan*, June 1883 (G); Hyampom, *V. Rattan*, June 1883 (S); Hyampom, *Bolander*, without date (S).

IDAHO: Priest River Forest Reserve, *J. B. Leiberg* 2862 (Ore, US) and *J. B. Leiberg* 162 (US); Middle St. Joseph's River, Coeur d'Alene Mts., *J. B. Leiberg* 1275 (G, NB, Ore, UC, US); Thatuna Hills, *Epling & Hauck* 9701 (US); "Palouse country and about Lake Coeur d'Alene," *G. B. Aiton*, June-July 1892 (G, S, US); "Pend Oreille river banks," *Dr. Lyall* in 1861 (Oregon Boundary Comm., Ft. Colville to Rocky Mts.) (G); Chacolet Lake, *R. C. Stillinger* 15 (US). BENEWAH: St. Maries, *C. C. Epling* 8052 (F). BONNER: N. shore of Lake Pend Oreille, *J. B. Leiberg*, July 15, 1888 (ELG, NB); Lake Pend Oreille, *E. L. Greene*, Aug. 9, 1889 (ELG, S); Lake Pend Oreille, *B. W. Everman*, Aug. 7, 1893 (F); Sand Point, *L. M. Umbach* 431, Aug. 24, 1901 (NB); without number, Aug. 24, 1901 (F, S, US); Hope, *D. T. McDougal* 942 (F, G, NB); Hope, *A. A. Heller* (No. 942, same collection as that of McDougal, just preceding) (F, S); valley of Lake Pend Oreille, *J. H. Sandberg et al.* 942 (CalAc, ELG, F, G, NB, P, S, US). CLEARWATER: 5 miles w. of Weippe, *L. Constance* 2025 (R, UC, US). KOOTENAI: "Coeur d'Alene Lake," *Geyer*, without date (G); "shore of Coeur d'Alene Lake," *S. Watson* 247 (G); Farmington Landing, Lake Coeur d'Alene, *J. H. Sandberg et al.* 536 (CalAc, ELG, F, G, NB, P, S, US); Lake Coeur d'Alene, *L. Benson* 2458 (G, NB, S, US); Lake Coeur d'Alene, *H. J. Rust* 406 (US); without loc., *J. H. Sandberg* 6467 (UC) and without number, July 1888 (F); without loc., *J. B. Leiberg*, July 1892 (F). LATAH: Moscow, *L. R. Abrams* 741 (NB, S, UC); 3 miles e. of Princeton, *H. St. John* 9626 (G, NB, Ore, P, R, S) and 9627 (G, NB); Moscow, *L. F. Henderson* 4878 (G); Moscow, *Henderson* in 1894 (US). SHOSHONE: Kellogg to Mullan Pass, *Wiegand et al.* 2398 (NB).

NEVADA—ELKO: Owyhee, Duck Valley Res., *Nelson & Macbride* 2216 (G, NB, R, US).

OREGON: Without loc., *W. C. Cusick* 108 (F); without loc., *Rev. Mr. Spalding*, July 31 (G); Elk Creek, 600 m., *J. B. Leiberg* 4170 (US); "eastern Oregon," *W. C. Cusick* 1753 (ELG, S, UC, US); "Oregon & Washington Terr.," *Wilkes Exped.* 5532 bis, in 1838-42 (NB); Clear Water, *Rev. Mr. Spalding*, without date (G); Barren Valley (Malheur Co.), *Cusick* 1261 (G, US); Wallamet, *Tolmie*, without date (G); Blue Mts., *R. D. Nevius* in 1874 (G); Silver Lake to Fort Klamath, *H. W. Furlong et al.*, June 15-July 15, 1901 (UC); Lower Williamson River, *J. B. Leiberg* 728 (G, NB, Ore, P, R, S, US); "Big Valley," *Mrs. R. M. Austin & Bruce* 2151 (NB, S, UC); "Clark's Creek 3 miles above mouth," *Sheldon* 8864 (NB, US); Willamette Valley, *Th. Howell* 1678 (NB); Elk Creek, *Leiberg* 4170 (Ore). BENTON: Corvallis, *M. Craig* 5076 (NB); near Corvallis, *W. E. Lawrence* 2027 (S, US); near Corvallis,

E. S. Spalding, Aug. 24, 1923 (P); 8 miles s. of Corvallis, *J. W. Thompson* 4368 (S, US); Jct. City to Corvallis, *L. R. Abrams* 8732 (S); Monroe, *P. A. Munz* 9899 (P, S); Monroe, *Eastwood & Howell* 2860 (CalAc). CLACKAMAS: Gladstone, *C. V. Piper* 6191 (G, US); *Th. Howell*, July 1898 (Ore). HARNEY: Near Burns, *L. F. Henderson* 8851 (CalAc); Silver Creek Valley, *M. E. Peck* 18923 (WU); 5 miles s.w. of Riley, *Mrs. R. D. Cooper*, May, 1914 (WU). JACKSON: Wimer, *E. W. Hammond* 251 (NB, US); near Prospect, *A. A. Heller* 13483 (F, NB, S, US); Fall Creek, *E. B. Copeland* 3471 (CalAc, ELG, G, NB, P, R, UC, US); Butte Falls, *L. E. Smith*, Aug. 1912 (CalAc); lower part of Antelope Cr., *E. I. Applegate* 2378 (US); near Woodville, *M. E. Peck* 3135 and 3137 (WU); 4 miles s. of Medford, *P. B. Kennedy*, June 11, 1935 (CalAc); High Cascades 30 miles e. of Medford, *J. H. Heckner*, June 1927 (WU); Big Butte Creek, *E. I. Applegate* 2524 (US). JOSEPHINE: Grant's Pass, *H. S. Prescott*, June 4, 1912 (F); 5 miles s.w. of Grant's Pass, *F. W. Peirson* 3872 (P); 1 mile s.w. of Obriens, *H. S. Yates* 5791 (UC); 5 miles w. of Cave City, *Maguire et al.* 15290 (R); Takilma, *D. K. Kildale* 10163 (S); w. fork Illinois River, near Floyd School, *L. R. Abrams* 8631 (P, S); 4 miles e. of Applegate River on Crescent City road, *D. K. Kildale* 8223 (S); near Kerby, *J. W. Thompson* 12937 (CalAc, NB); 10 miles w. of Kerby, *D. K. Kildale* 8148 (S); near Waldo, *W. C. Cusick* 2934 (F, G, NB, Ore, P, UC, US); Waldo, *A. A. Heller* 14633 (NB, S, US); near Waldo, *J. W. Thompson* 4681 (Cath, G, S, US); Waldo, *P. A. Munz* 9896 (G, P); 3.5 miles w. of Waldo, *J. T. Howell* 6743 (CalAc); Waldo, *A. Eastwood* 2118 (CalAc). KLAMATH: 10 miles w. of Beattie, *J. W. Thompson* 13192 (CalAc, NB, US, WU); Keno, *M. E. Peck* 16771 (S); 15 miles s.w. of Lake of the Woods, *M. E. Peck* 16704 (S, WU); Klamath Valley, *Dr. H. M. Cronkhite* 47 (G, UC, US); Swan Lake Valley, *F. A. Walpole* 2231 (US) and 2239 (US); Swan Lake Valley, *E. I. Applegate* 251 (G, US); w. of Klamath Lakes, *K. M. Wiegand et al.* 2400 (F). LANE: Eugene City, *Mrs. S. A. Collier*, Sept. 1880 (G); Eugene City, *E. L. Greene*, Aug. 1889 (ELG, NB); 5 miles s.w. of Eugene, *L. Constance* 947 (F, G, NB, P, R, S, US); Mackenzie River, *Mrs. A. L. Coombs*, without date (CalAc). LINN: Near Brownsville, *L. F. Henderson* 13638 (Ore). MARION: $\frac{1}{2}$ mile n.w. of Detroit, *D. C. Ingram* 1371 (FS); Salem, *Drake & Dickson*, July 1887 (F); Salem, *J. C. Nelson* 254 (S) and 1629 (G); Salem, *Mrs. L. Reynolds*, without date (WU); Salem, *L. F. Henderson* 593 (S, UC); Silverton & Salem, *Elihu Hall* 330 (F, G, NB); Silverton, *Elihu Hall* in 1871 (US); near Aumsville, *M. E. Peck* 16280 (WU). SHERMAN: Kent, *M. E. Peck* 9969 (NB, S, WU). UNION: Without loc., *W. C. Cusick* 108 (G); La Grande, *M. E. Peck* 3136 (WU); near Island City, *Eastwood & Howell* 3464 (CalAc, US). WASCO: Mayers State Park, *Eastwood & Howell* 3536 (CalAc); near The Dalles, *J. W. Thompson* 11875 (CalAc, G, P, US); near The Dalles, *G. N. Jones* 4195 (CalAc). WASHINGTON: Farmington, *J. E. Kirkwood* 211 (NB); Gaston, *M. E. Peck* 16191 (WU); "Tualitin Plains," *J. Howell*, July 1877 (F); Hillsboro, *T. J. Howell*, July 1881 (F); near Hillsboro, *J. T. Howell* 7327 (CalAc).

WASHINGTON: Without loc., *G. R. Vasey* 388 (G, NB, US); Topnish Creek, *T. S. Brandegees* in 1882 (UC). CLARKE: Manor, *C. V. Piper*, July 14, 1899 (NB). KITTITAS: Ellensburg, *F. D. Kelsey* in 1888 (ELG); Ellensburg, *K. Whited* 569 (US). SPOKANE: Near Spangle, *W. N. Suksdorf* 1551 (G, S); 12

miles w. of Spokane, *Sister Mary Milburge* 630 (S); Medical Lake, *G. W. Turesson*, July 13, 1913 (R); without loc., *W. N. Suksdorf* 146 (NB). STEVENS: Calispell Lake, *F. O. Kreager* 316 (G, NB, US); "Fort Colville," *S. Watson*, Oct. 2, 1880 (G). WHITMAN: 2 miles n. of Garfield, *H. St. John* 7613 (G, NB, P, R, S); between Moscow and Pullman, *A. Eastwood* 13394 (CalAc); Pullman, *C. V. Piper* 1728 (F, G, R, S) and without number, July 15, 1901 (P); Pullman, *A. D. E. Elmer* 131 (NB, P, US); Pullman, *W. R. Hull* 454 (G).

13b. *DOWNINGIA ELEGANS* var. ***brachypetala*** (Gandoger) McVaugh, comb nov.

Downingia brachypetala Gandg., Bull. Soc. Bot. France 65: 55. 1918.
Type locality: Falcon Valley, Klickitat County, Washington. TYPE: *W. N. Suksdorf* 2762, June 22, 1897, not seen. Isotypes seen in the Gray Herbarium and in the herbaria of Stanford University and of the University of Oregon.

Corolla 5.0—9.0 mm. long; tube 1.5—2.5 (3.5) mm. long, the length when measured to dorsal sinus 3.6—4.0 mm. Filaments 3.0—4.0 mm. long; anther-tube 2.0—2.5 mm. long. Capsule apparently slightly broader in proportion to its length than in var. *elegans*.

Habitat the same as that of var. *elegans*. Range somewhat more restricted than that of var. *elegans*; var. *brachypetala* is the principal representative of the species in Lake and Mendocino Counties, California, whence it extends northward along the Cascade Ranges to southern Washington. A few collections of this variety have been made in northeastern California and in northern Idaho. Flowering season the same as that of var. *elegans*.

Specimens examined: CALIFORNIA—LAKE: Snow Mountain, *T. S. Brandegee*, June 1892 (CalAc); Snow Mt., *Mrs. Brandegee*, Aug. 1892 (CalAc); w. slope of Snow Mt., just beyond Cedar Creek, *M. S. Baker* 3478b (S); Snow Mt. House, *M. S. Baker* 3099a (UC). LASSEN: 10 miles s. of Amedee, *M. E. Jones*, June 22, 1897 (Ore, P, R, US); 10–15 miles w. of Amedee, *M. E. Jones*, June 24, 1897 (NB). MENDOCINO: Sherwood Valley, *W. R. Dudley*, June 17, 1899 (S); Little Lake, *V. Rattan*, June 1882 (S); Willits, *L. R. Abrams* 7527. (S); 1 mile n. of Willits, *D. K. Kildale* 5670 (S); middle fork of Eel River, *J. W. Blankinship*, June 8, 1893 (CalAc); Potter Valley, *J. W. Blankinship*, June 5, 1893 (CalAc); Potter Valley, *A. Eastwood* 12639 (CalAc); Laytonville, *A. Eastwood*, Aug. 3, 1902 (CalAc). TRINITY: Van Duzen River near Cobb, *L. B. Kildale* 10439 (S).

IDAHO—BONNER: Lake Pend d'Oreille, *J. B. Leiberger*, July 15, 1888 (NB). KOOTENAI: Without loc., *J. H. Sandberg*, July 1887 (F).

OREGON—CLACKAMAS: Clackamas, *J. Lunell*, July 8, 1903 (R, US). HOOD RIVER: Hood River, *L. F. Henderson*, July 6, 1880 (Ore), June 30, 1882 (S); near Hood River, *L. F. Henderson* 814, June 7, 1924 (G). JOSEPHINE: Old road to Waldo between Rough & Ready and Dew Creeks, *D. K. Kildale* 5831 (S). KLAMATH: Klamath Lake, *Constance* 9682 (Ore). MARION: Salem, *L. F. Henderson* 593 (F); Salem (locality not certain), *Elihu Hall* 330 (NB); Silver-

ton, *Elihu Hall* 330 (US). MULTNOMAH: Mt. Scott, *E. P. Sheldon* 11166 (F, G, NB, Ore, P, S, US). WASCO: Near The Dalles, *M. E. Jones*, July 29, 1897 (P, US); The Dalles, *Mr. C. Davidson*, June 1886 (P); The Dalles, *T. S. Brandegee* in 1882 (UC); The Dalles, *J. W. Thompson* 2818 (S, WU); near The Dalles, *J. W. Thompson* 11875 (NB, P); Dalles, *Harford and Dunn*, June 10, 1869 (NB; the label on this sheet is accompanied by that of the widely distributed collection, *Kellogg and Harford* 617, with the simple locality "Oregon"; it is possible that the two collections are in reality one and the same); Dalles of Oregon, *Kellogg & Harford* 617, June 1869 (US). WASHINGTON: Forest Grove, *F. E. Lloyd*, July 6, 1894 (NB); Forest Grove, *C. P. Smith* 3692 (S); Tualatin, *M. W. Gorman* 5059 (S); north of Gaston, *J. W. Thompson* 821 (S) and 2969 (WU).

WASHINGTON—Klickitat: Falcon Valley, *W. N. Suksdorf* 2762 (G, Ore, S); "western Klickitat County," *W. N. Suksdorf*, Sept. 4, 1881 (F, O); North Dalles, *J. W. Thompson* 11124 (CalAc, Cath, G, NB, P, US); Trout Lake near Mt. Adams, *F. E. Lloyd*, Aug. 22, 1894 (NB).

The flowers of *Downingia elegans* are extremely variable in size, both the corolla and the stamens being involved. The filament-tube, usually a flower-part of limited variability in this genus, ranges from 3.0 to 10.5 mm. in length. Measurements were obtained from the plants of 267 collections of this species and these were tabulated as follows:

<i>Length of filament-tube (mm.)</i>	<i>Number of collections</i>
3.0	3
3.5	24
4.0	16
4.5	8
5.0	18
5.5	13
6.0	41
6.5	31
7.0	42
7.5	23
8.0	30
8.5	5
9.0	7
9.5	1
10.0	3
10.5	2

The critical point for the upper limit of variability seems here to be at the 8 mm. level. In the other direction, there appears to be a break between 4.0 and 5.0 mm. When the measurements for corolla and anthers, obtained from the same series of specimens, were plotted in like manner, a similar but less sharply defined break was observed in the series. A maximum length of 4.5 mm. for the filament-tube appears to correspond roughly to a maximum length of 9.0 mm. for the corolla and 2.5 mm. for the anther-tube.

The "variety" thus obtained is apparently an arbitrary one, not



McVaugh, Rogers. 1941. "A Monograph on the Genus Downingia." *Memoirs of the Torrey Botanical Club* 19(4), 1–57.

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