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TAXONOMY OF LUPINUS, GROUP MICRANTHI (LEGUMINOSAE) OF THE PACIFIC COAST

DAVID B. DUNN*

The group *Micranthi* of *Lupinus* is a series of variable taxa found on the Pacific slope from Canada to Central America. It is centered in California. The outlying species of Mexico and Central America were so poorly represented in the herbaria that a clear definition of the entities involved was impossible. The Pacific Coast components are nearly ubiquitous and are well represented in herbaria. A total of approximately 3000 sheets have been loaned by the following institutions: the University of California at Berkeley, Stanford University, the California Academy of Sciences, the United States National Herbarium, the Missouri Botanical Gardens, the Gray Herbarium, the University of Washington, Oregon State College, Pomona College, the San Diego Society of Natural History, the Vegetation Type Map Herbarium of the United States Department of Agriculture, and the private herbarium of the late Mr. Joseph P. Tracy. I am grateful to the curators and officials of these herbaria for the loan of their material and the privilege of studying it. This mass of material has been further supplemented by approximately 5000 specimens which I have collected, which represent more than 200 field samples made in California from the San Francisco peninsula to the northern part of Baja California. I am also indebted to Professor Carl Epling of the University of California at Los Angeles for counsel and guidance during the work and his continued interest and aid in preparation of the manuscript.

METHODS

The components of *Micranthi* differ primarily in the size and proportions of the flower and much less in respect to the vegetative characters. Nineteen taxa were accordingly first established on the basis of overall resemblances and were analyzed in respect to the floral parts in particular. The measurements of the flower parts were made from boiled flowers. After boiling, two flowers were arranged on a glass slide and mounted in thin mucilage to which a small quantity of glycerin had been added. One flower was allowed to dry in its normal flattened position, as viewed laterally, the other was dissected and the parts extended to their full size. Measurement of the flower parts was made under a dissecting microscope with a transparent celluloid ruler to the nearest tenth of a millimeter. The angle of the banner and keel was obtained from a protractor on another celluloid ruler, using two rulers along the edges of the object to be measured. In all cases the measurements were made upon the largest representative parts of the plant concerned. Wherever possible a sample of at least 25 individuals of each taxon was measured, in the case of the flower parts, and 30 to 40 individuals in the case of the vegetative parts.

MORPHOLOGICAL CRITERIA FOR SPECIFIC AND SUBSPECIFIC DIFFERENTIATION

From a statistical analysis of the measurements of the various morphological parts it was found that the vegetative parts of the plants were highly modifiable and hence of value only as secondary characters of a general nature. However, in one case there was no overlap in the measurements of the vegetative characters, a condition which I have interpreted as indicating a relatively large hiatus between the

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taxa involved. The length of the raceme and the number of verticils produced were found to be influenced to a large degree by the vigor of the plant and the habitat. There were, however, hereditary differences noted in the number of verticils.

The most constant and reliable characters for the differentiation of the taxa on both the specific and subspecific levels were the floral parts. The length of the pedicels was found very useful and in general was correlated with the size of the flower. The banner and the keel were the most useful of the petals, the wings being difficult to describe with regard to shape. The angle of the banner and keel and the distance from the base that the banner was reflexed, expressed as the reflexed/appressed ratio, were useful. The lower portion of the banner remains appressed to the upper margin of the wings. The shape of the banner, size and the length/width ratio of the banner were also very useful characters. The banner was the most important single structure with regard to the identification of the taxa in the *Micranthi*.

In some cases the size, shape and conformation of the calyx lobes were found to be useful characters. Since the clear recognition of the taxa depends to such a large degree on the size, shape and the conformation of the floral parts a comparative chart of these is shown in Fig. 1. The numbers used for the taxa shown in Fig. 1 are also used in the key to the taxa and the taxonomic descriptions.

NOMENCLATURE

Type specimens or duplicates have been available for the definition of the names of the taxa dealt with. The only exception was *Lupinus bicolor* ssp. *microphyllus* and in this case a specimen of Watson's in the Gray Herbarium was interpreted as being the equivalent.

PHYLOGENY (Figure 2)

As stated in the introduction, there is little material of the Mexican species so that there is little chance to improve the present nomenclature on that portion of the *Micranthi*. I shall, however, try to indicate their relationship to the rest of the section at this point. The Mexican species of the *Micranthi* are all large flowered and would presumably be similar to *L. nanus* in their breeding mechanism. They were cut off from the remainder of the group sufficiently long ago and have evolved sufficiently so that their relationship is obscure. They are at present restricted to

Figure 1. A comparative chart of the floral parts of the Pacific Coast *Micranthi*. The lateral view of the flower, the flattened view of the banner, the lateral view of the wings, the lateral view of the keel containing the pistil, and a spread view of the calyx, split between the upper and lower lips on the left side, are shown respectively for each entity. The mean length of the banner of each is shown below and all drawings were made to the same scale.

1. *Lupinus micranthus*, 6.2 mm.
2. *Lupinus congdoni*, 6.5 mm.
3. *Lupinus bicolor* subsp. *bicolor*, 7.5 mm.
- 3a. *Lupinus bicolor* subsp. *umbellatus*, 7.6 mm. (var. *umbellatus*).
- 3b. *Lupinus bicolor* subsp. *microphyllus*, 4.8 mm.
- 3c. *Lupinus bicolor* subsp. *umbellatus* var. *trifidus*, 5.5 mm.
- 3d. *Lupinus bicolor* subsp. *pipersmithii*, 5.7 mm.
- 3e. *Lupinus bicolor* subsp. *tridentatus*, 5.6 mm. (var. *tridentatus*).
- 3f. *Lupinus bicolor* subsp. *tridentatus* var. *rostratus*, 4.6 mm.
- 3g. *Lupinus bicolor* subsp. *marginatus*, 6.1 mm.
4. *Lupinus nanus* subsp. *latifolius*, 12.4 mm.
- 4a. *Lupinus nanus* subsp. *nanus*, 9.96 mm.
- 4b. *Lupinus nanus* subsp. *menckerae*, 12.2 mm.
5. *Lupinus vallicola* subsp. *vallicola*, 8.6 mm.
- 5a. *Lupinus vallicola* subsp. *apricus*, 8.3 mm.
6. *Lupinus pachylobus*, 7.7 mm.
7. *Lupinus affinis*, 10.1 mm.
8. *Lupinus spectabilis*, 14.7 mm.
9. *Lupinus niveus*, 10.5 mm.

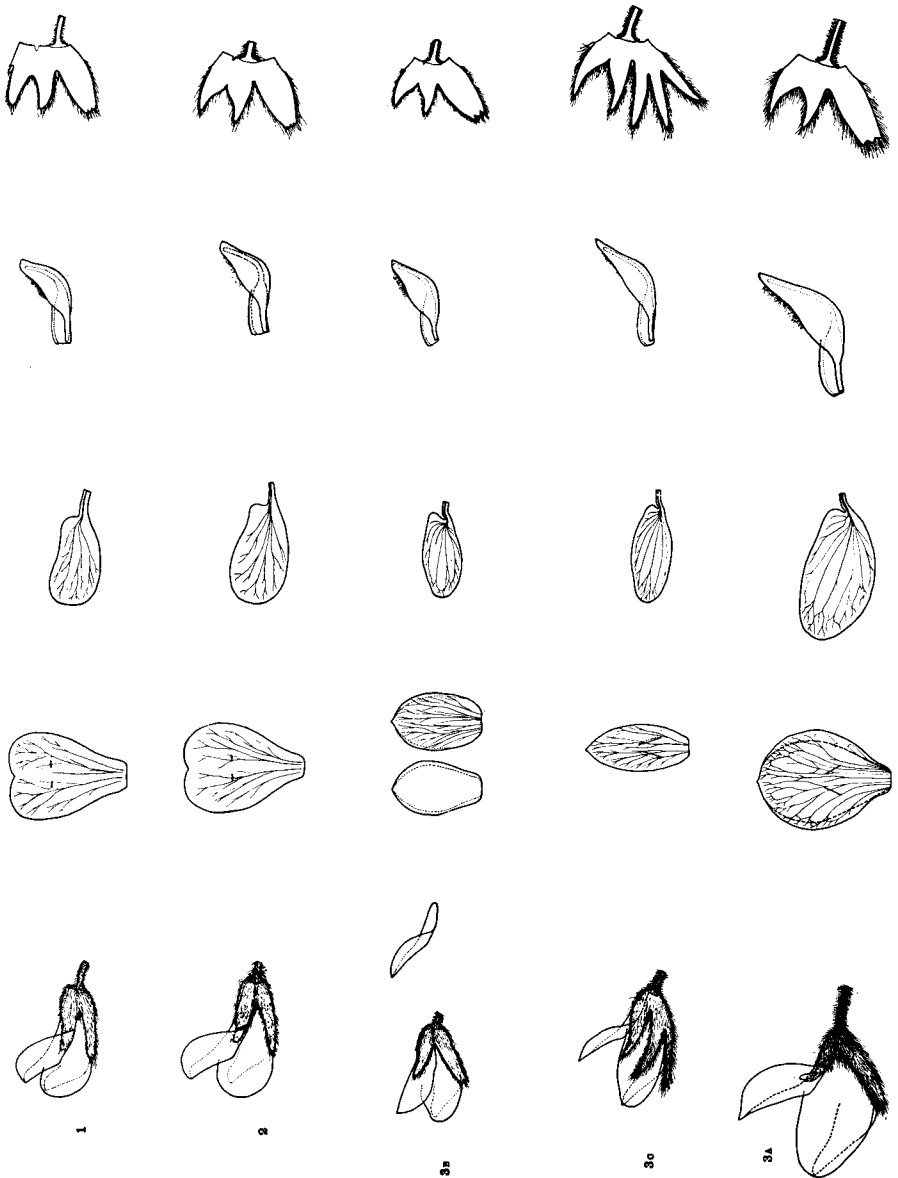


Fig. 1, continued. For explanation see page 136.

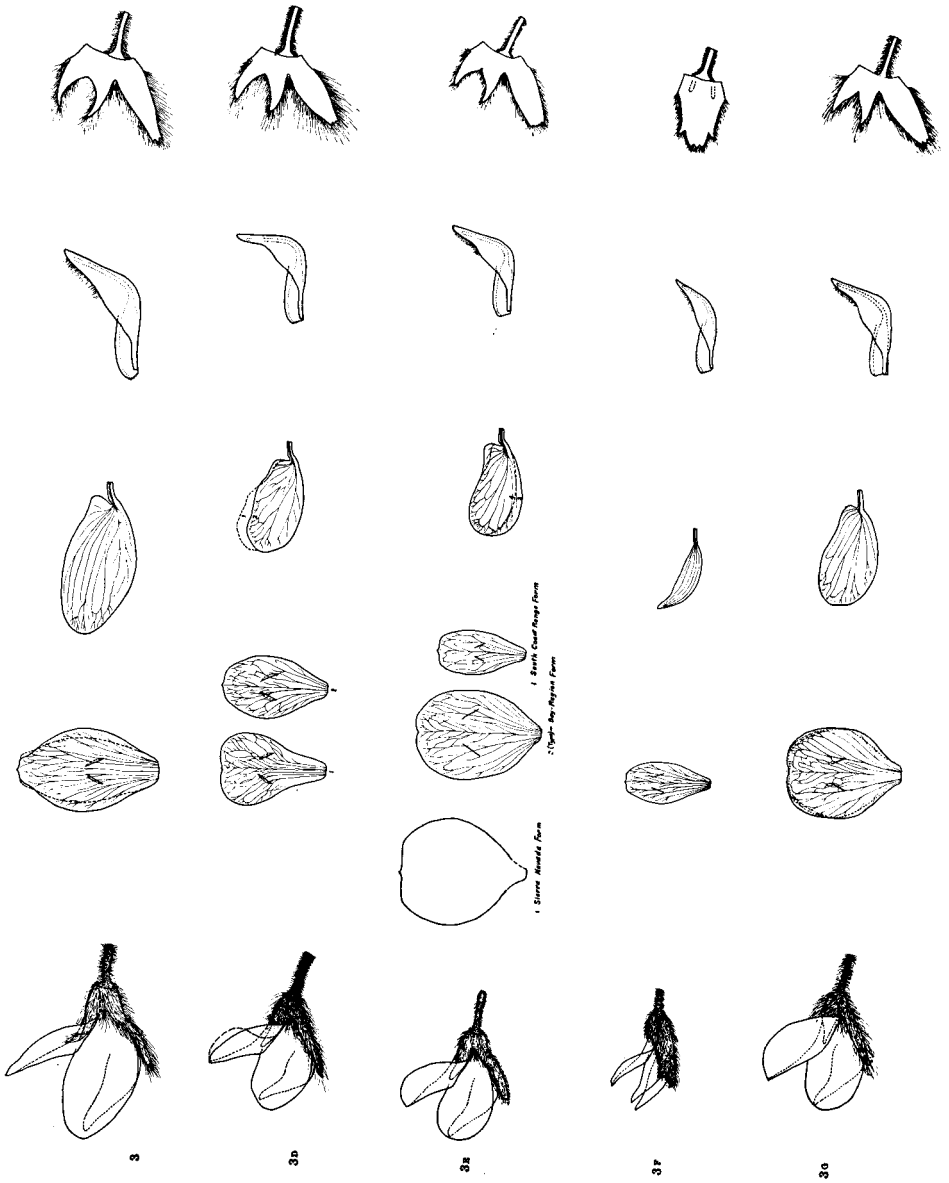


Fig. 1, continued. For explanation see page 136.

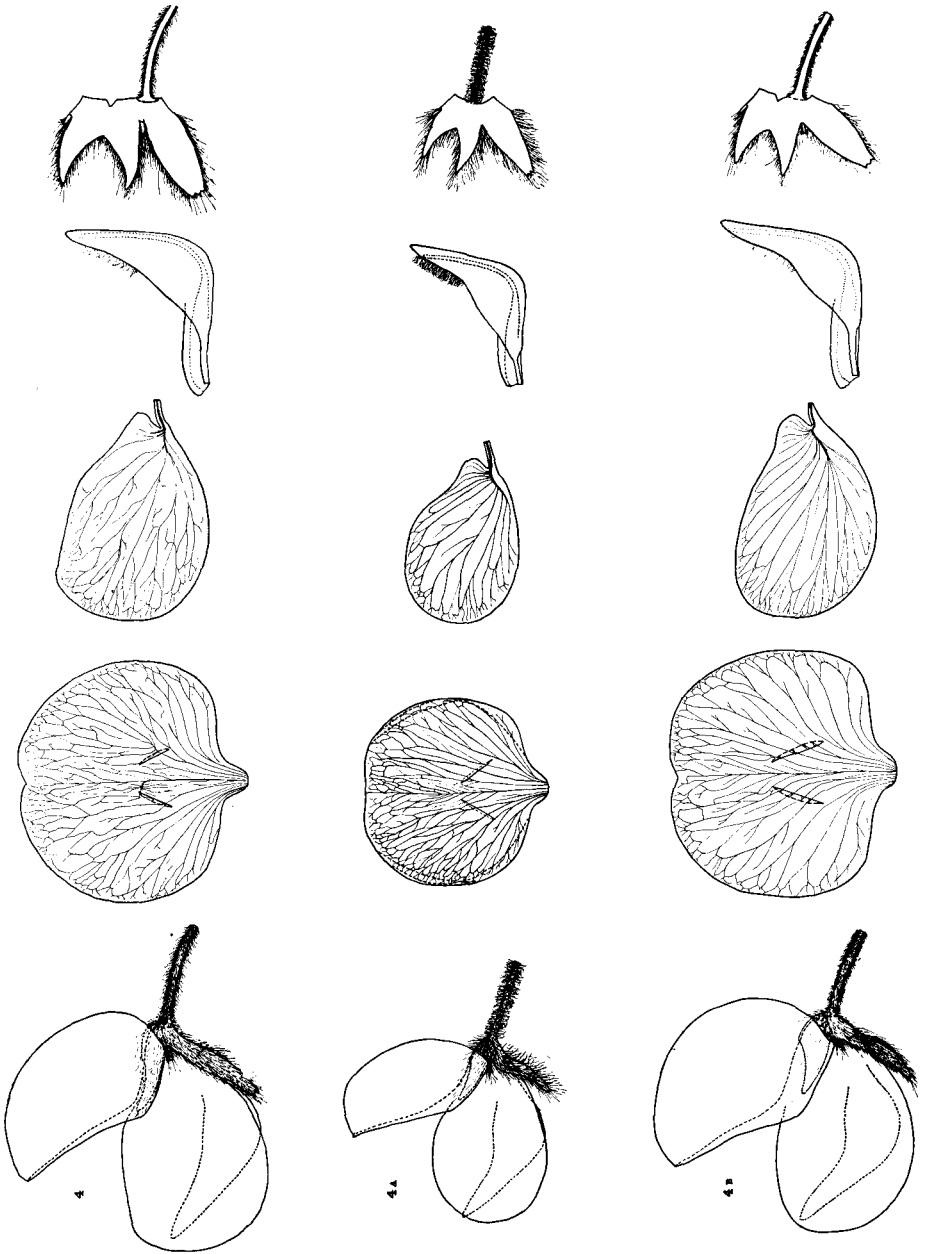


Fig. 1, continued. For explanation see page 136.

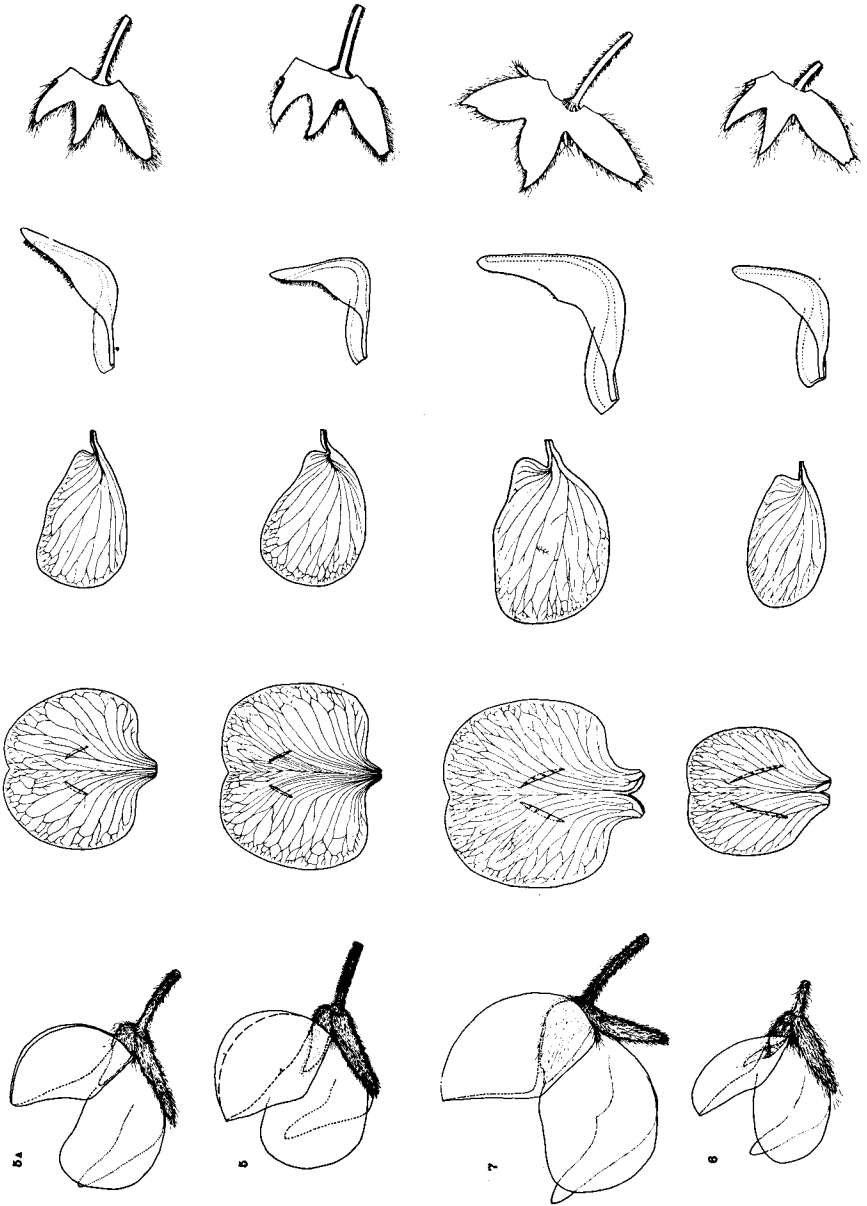


Fig. 1, continued. For explanation see page 136.

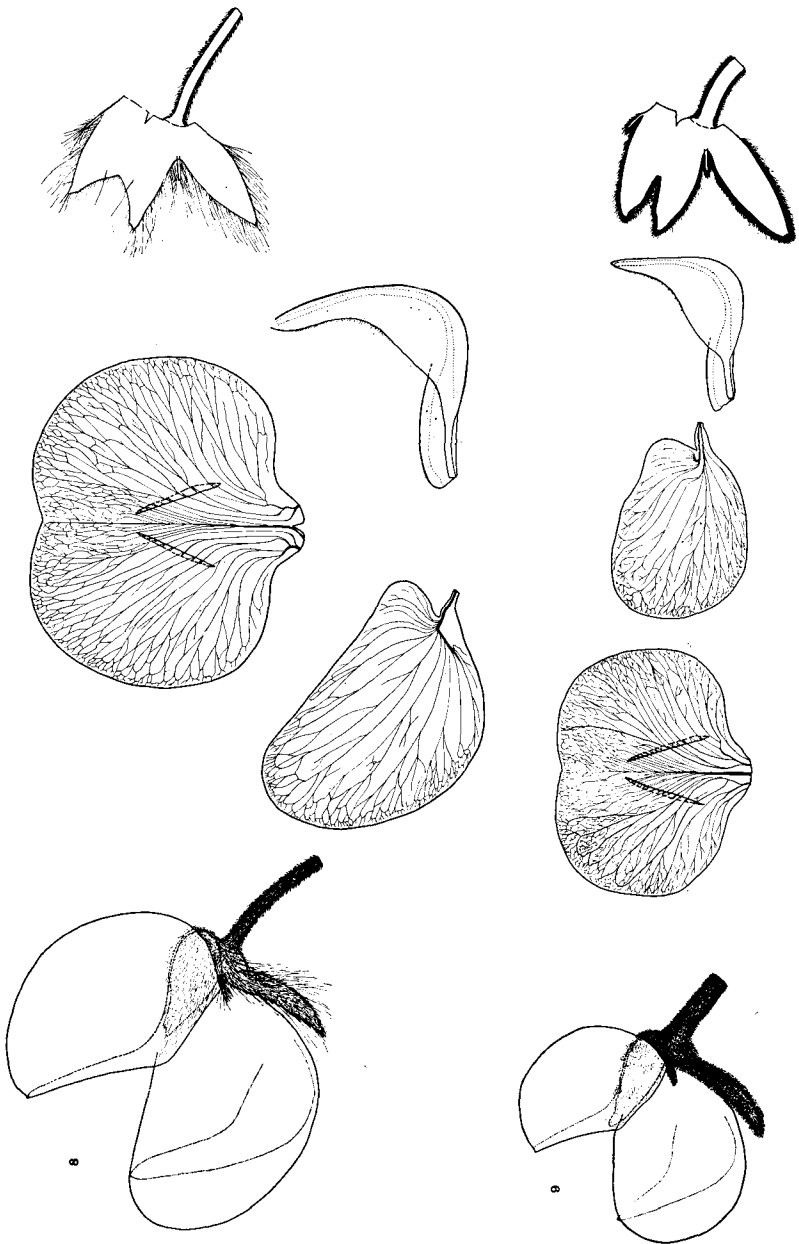


Fig. 1, continued. For explanation see page 136.

various mountain ranges in Mexico and Central America at relatively high elevations, according to the meager data available. Such a distribution would tend to indicate that these Mexican species probably represent relictual populations.

Of the species represented on the Pacific slope of the United States *L. affinis* is probably one of the oldest. This species has a close affinity to the group, *Succulenti*, in regard to floral structures, stem structure, pod size and pod pubescence which is almost like sandpaper, not at all silky like the rest. In addition, *L. affinis* is one of the more northerly present day representatives and is adapted to a large supply

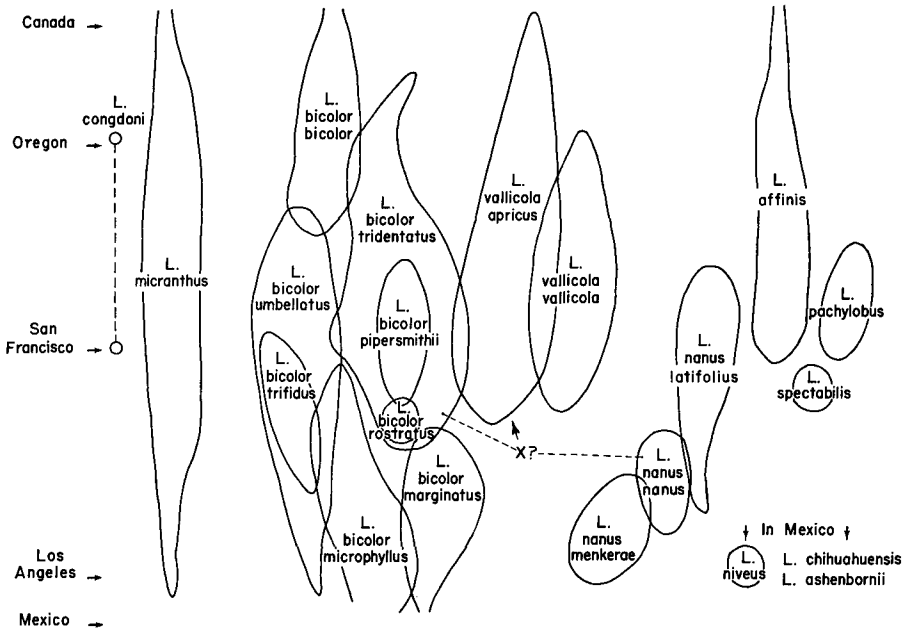


Figure 2. The phylogenetic relationship of the *Micranthi* and their north-south relative distribution. The taxa within *Lupinus bicolor* are roughly in their east-west position. The other taxa, however, are sympatric with *L. bicolor*.

of moisture. *L. micranthus* is similarly distributed and adapted but has very small flowers. Its relationship is obscure, evolution having gone too far to check its derivation. *L. micranthus* and *L. affinis* are two of the very early North American species in this group. However, since most of the perennial lupines bear relatively large flowers it is probable that a large flowered species was derived first. From *L. micranthus* one additional species has been derived, namely *L. congdoni*. *L. nanus latifolius* was derived from *L. affinis* as a taxon best adapted to deep loam soil with a maritime habitat. *L. nanus latifolius* has given rise to two subspecies, *L. n. nanus* which occupies the mountain valleys of the south coast range and *L. n. menckerae* which occupies the south end of the San Joaquin Valley. *L. n. nanus* forms hybrids with *L. n. latifolius* at points in the distribution where they come into contact and is almost exactly intermediate vegetatively in pod and seed sizes between *L. n. latifolius* and *L. n. menckerae*. It, however, has smaller flowers than either. *L. n. menckerae* hybridizes with *L. n. nanus* in the northwestern part of its range. The shift from *L. n. latifolius* to *L. n. menckerae* involved a progressive reduction in the

size of the vegetative, pod and seed characters. The flower size, however, reverted back to approximately the same size as in *L. n. latifolius*. All three crossed readily in the greenhouse. *L. pachylobus* is a species which probably developed from *L. affinis* into the Great Valley and Sierra Nevada concurrently with *L. n. latifolius* which was developing along the coast.

L. bicolor appears to have two points of origin, one from *L. n. nanus* in the vicinity of Santa Barbara Co. and the second from the Sierra Nevada representatives of *L. n. latifolius* down through *L. vallicola vallicola*; but the interfertility experiments do not indicate such a relationship. While interfertility among the taxa within *L. bicolor* is relatively low, successful crosses have been made among them, all indicating a common source but branching into two main lines, one without a branched midvein in the banner and the other with a branched midvein similar to that of *L. nanus* (see Fig. 1). While the cross between *L. bicolor umbellatus* (colony at Carpenteria) and *L. nanus nanus* (colony at Gaviota) has not been attempted, certain aspects of the raceme make the relationship of these two quite close even though they may now prove to be intersterile. The colony of *L. b. umbellatus* still has the branched midvein in the banner although the specimen of *umbellatus* used for the sketch in Fig. 1, did not; the character apparently developed later. *L. bicolor umbellatus* in the vicinity of Nipomo is mixed with *L. b. microphyllus* and *L. b. trifidus* which undoubtedly were derived from it, all three having the same banner venation. *L. b. microphyllus* is centered southward in the Los Angeles basin and down into Mexico, while *L. b. trifidus* is sympatric with *L. b. umbellatus*. *L. b. bicolor* segregated from *L. b. umbellatus* in the vicinity of Humboldt Bay and is now the prevalent form of *L. bicolor* in Oregon, Washington and into Canada. The second line of development within *L. bicolor* retained the central branched vein in the banner and apparently developed from a colony similar to that of *L. b. umbellatus* near Carpenteria. It involved the development of *L. b. tridentatus* which gave rise to *L. b. piperismitthii* which predominates in parts of the Great Valley and *L. b. marginatus* from the Tehachapi Mts., southward.

In the South Coast Range between Monterey and San Francisco *L. vallicola apricus* is fairly common and must have arisen as a rare chance hybrid between *L. b. tridentatus*, normally selfed, and *L. n. nanus* with the gradual segregation of a compatible somewhat intermediate genome. The affinity of *L. vallicola vallicola* is with *L. bicolor* but the floral mechanism is like that of *L. nanus* and has a small interfertility in the greenhouse with two of the subspecies of *L. nanus*. All of the colonies of *L. bicolor* which were tested were intersterile with all three subspecies of *L. nanus*.

TAXONOMY

LUPINUS GROUP MICRANTHI

Erect, decumbent or prostrate annuals 5-50 cm. tall, the longest branches mostly basal; pubescence minute, either appressed or spreading, and of longer spreading hairs of varying length; leaflets 5-9, quite variable in size and shape, petiolate, with linear stipules adnate to the base; racemes peduncled, bearing one to many verticils, which may be either clearly whorled or indistinct, all bracteate, the bracts early deciduous; flowers pedicellate to nearly sessile, blue (frequently albino), the banner marked in its center with a white or lemon-yellow patch which changes to deep maroon or light purple in old flowers, and several deep blue spots on its folded margin above the angle; calyx two lipped, the two upper lobes partly connate, the three lower lobes fused almost completely, the sinuses between the lip provided with an appendage (bracteole); banner glabrous (but see *L. bicolor* subsp. *tridentatus*), generally reflexed, but the margins sometimes remaining folded down over the

wings; wings fused on the outer margin in varying degrees, glabrous (but see *L. bicolor* var. *rostratus*); keel ciliate only on the upper margin of the distal half, or glabrous, the angle 75°-150°; pods pubescent; seeds 4-14 per pod, variously mottled and stippled; cotyledons petiolate.

KEY TO THE SPECIES AND SUBSPECIES*

- I. Pedicels 1-3 mm. long; banner longer than broad, the wings and banner 4-10 mm. long (see also *L. vallicola* subsp. *vallicola* and *L. vallicola* subsp. *apricus*).
- A. Reflexed portion of banner much shorter than the portion appressed to the wings, the reflexed/appressed ratio 0.5-0.7, the banner being reflexed near the tip of the wings; acumen blunt; leaflets generally glabrous above.
- B. Plants 15-45 cm. tall, the leaflets 1.3-4.0 cm. long, linear-oblong to narrowly elliptic or oblanceolate, generally glabrous above; pods glabrate, 1.7-3.4 cm. long.
1. *L. micranthus*
- BB. Plants 3-6 cm. tall, the leaflets 5-7 mm. long, oblanceolate-spatulate, pubescent above; pods pubescent, 1.0-1.5 cm. long (rare).
2. *L. congdoni*
- AA. Reflexed portion of banner generally as long as the appressed portion or longer, the ratio 0.7-1.3; acumen either blunt or very slender; leaflets always pubescent on both sides.
- B. Keel wholly glabrous, rarely with one or two small cilia on the upper margin.
- C. Banner 5.2-6.5 mm. long, 3.0-5.0 mm. wide, spatulate to oblong; pods 3.8-4.8 mm. wide, with 5 to 9 seeds.
- 3 d. *L. bicolor* subsp. *pipersmithii*
- CC. Banner 7-8.5 mm. long, 6.5-7.5 mm. wide, obovate, tending toward orbicular; pods 7-9 mm. wide, with 3 to 5 seeds.
6. *L. pachylobus*
- BB. Keel clearly ciliate along the upper margin in the distal half.
- C. Lower lip of the calyx deeply cleft, the teeth 1-5.5 mm. long; verticils strictly whorled.
- D. Banner linear-oblong, 4.8-6.4 mm. long; plants mostly sprawling.
- 3c. *L. bicolor* subsp. *umbellatus* var. *trifidus*
- DD. Banner narrowly obovate to obovate, 6.0-9.5 mm. long; plants erect or decumbent.
- 3a. *L. bicolor* subsp. *umbellatus* var. *umbellatus*
- CC. Lower lip of the calyx entire or merely tridentate, the teeth usually less than 1 mm. long.
- D. Wings the same shape as the keel, that is, with a long tapering acumen, 1-1.6 mm. wide; lobes of the upper lip of the calyx turned downward so that all five lobes of the calyx appear below the flower; an intermediate condition with only the wing modification is most common, occurring sporadically from Banning northward into the South Coast Range.
- 3f. *L. bicolor* subsp. *tridentatus* var. *rostratus*
- DD. Wings normal, not shaped like the keel; calyx with 2 distinct lips.
- E. Banner 3.6-6.0 mm. long, often remaining folded down over the rest of the flower, oval and lemon shaped when flattened, mucronate, the base usually broad; acumen of the keel blunt and short.
- 3b. *L. bicolor* subsp. *microphyllus*
- EE. Banner obovate or oblong, rounded-truncate, often mucronate, constricted below the middle; acumen of the keel slender.
- F. Banner obovate, rounded or truncate, seldom mucronate, (see also *L. bicolor* subsp. *tridentatus*).
- G. Banner 5.7-8.6 mm. long (ave. 7.6 mm.) 4.2-8 mm. wide, the apex rounded or rarely mucronate; verticils generally only 1-2, rarely more than 4. (2 forms with 6-9 verticils are chiefly coastal in the South Coast Ranges and on the Channel Islands).
- 3a. *L. bicolor* subsp. *umbellatus*

*Based upon normally developed plants in full growth; stunted or aberrant forms may not conform.

- GG. Banner 4.5-7.5 mm. long (ave. 5.6 mm.), 3.0-6.8 mm. wide, the apex truncate, often slightly emarginate; verticils 3-9, generally 5-6; mountain valleys and high desert margins of southern California.
 3g. *L. bicolor* subsp. *marginatus*
- FF. Banner oblong, rarely narrowly obovate, truncate at the apex but sometimes mucronate as well, constricted below the middle.
 G. Banner 3.1-7.5 mm. long (ave. 5.6 mm.), racemes usually with numerous flowers extending well above the foliage; verticils usually quite distinct, (interior of the Coast Ranges).
 3e. *L. bicolor* subsp. *tridentatus* var. *tridentatus*
- GG. Banner 6.0-8.9 mm. long; racemes with few flowers on relatively long pedicels, nearly included by the foliage; verticils few, indistinct (plants from Humboldt County north to Canada).
 3. *L. bicolor* subsp. *bicolor*
- II. Pedicels 3-7 mm. long, slender; banner broader than long (except some forms of *L. vallicola* subsp. *apricus*), the wings and banner 9-17 mm. long (except *L. vallicola* subsp. *vallicola* and *L. vallicola* subsp. *apricus*).
- A. Largest leaflets 5-15 mm. wide, oblanceolate or somewhat spatulate; pods 6-8.5 mm. wide, rarely less; seeds 4-6 mm. long, rarely less.
 B. Pubescence of small hairs, felt-like, spreading hairs mostly absent; pods 8 mm. wide; seeds 5.7 mm. long, 5.2 mm. wide.
 9. *L. niveus*
- BB. Pubescence of appressed, and often of numerous spreading hairs, not felt-like.
 C. Entire plant hirsute, the hairs numerous, 3.6 mm. long; leaves mostly basal; the pods 6-7 mm. wide; seeds 4 mm. long.
 8. *L. spectabilis*
- CC. Plants pubescent, or the longer spreading hairs less than 3 mm. long, if present; leaves cauline as well as basal.
 D. Keel with a distinct tooth on the upper margin near the middle; spreading hairs generally few; largest leaflets 2-5 cm. long, 5-14 mm. wide; longest petioles 4-15 cm. long; pods 7.5-8.5 mm. wide; seeds 5 mm. long, 3.6 mm. wide.
 7. *L. affinis*
- DD. Keel entire, not toothed; spreading hairs generally abundant; largest leaflets 1-3 cm. long, 2-7.5 mm. wide, the longest petioles 3.5-7.5 cm. long; pods 5.5-6.5 mm. wide; seeds 3.5-4.0 mm. long, 2.8-3.1 mm. wide.
 4. *L. nanus* subsp. *latifolius*
- AA. Largest leaflets 1.5-5.0 mm. wide, linear to linear-oblanceolate; pods 3.5-5.5 mm. wide; seeds 2.0-4.0 mm. long.
 B. Reflexed portion of banner shorter than the appressed portion (see also *L. vallicola* subsp. *apricus*), the tip reflexed only 2.3 mm. from the tip of the wings, the sulcus of the banner consequently deep, the angle of the keel 63°-97° (plants chiefly of the Sierra Nevada Mountains, but occasional in the hills of the San Francisco Bay region).
 5. *L. vallicola* subsp. *vallicola*
- BB. Reflexed portion of banner equal to or longer than the appressed portion, the tip reflexed more than 3 mm. from the tip of the wings, the sulcus consequently shallow, the keel angle from 77°-112°.
 C. Reflexed portion of banner as long as or longer than the appressed portion, the banner 8.4-15.5 mm. long, 9-17 mm. wide; verticils distinct.
 D. Leaflets 1.6-3.9 mm. wide, linear to linear-oblanceolate; pods 3.5-4.5 mm. wide; seeds 2.0-2.9 mm. long, 1.9-2.2 mm. wide.
 4b. *L. nanus* subsp. *menckerae*
- DD. Leaflets 2.2-4.8 mm. wide, linear-oblanceolate; pods 3.8-5.8 mm. wide; seeds 2.6-3.7 mm. long, 2.2-2.9 mm. wide; banner 8.4-11.5 mm. long.
 4a. *L. nanus* subsp. *nanus*
- CC. Reflexed portion of banner about as long as the appressed portion, the banner 7-10 mm. long, 6-11 mm. wide; verticils often indistinct.
 5a. *L. vallicola* subsp. *apricus*

1. LUPINUS MICRANTHUS Dougl. in Lindl. Bot. Reg. 15: t. 1251. 1829. Type collected by Douglas "upon the gravelly banks of the southern tributaries of the Columbia and the barren ground of the interior of California."

L. polycarpus Greene. Pittonia 1: 171. 1888. Type collected by Greene near San Francisco, California.

Erect to suberect annuals 1.5-4.5 dm. tall, branched mostly at the base, sparsely appressed-pubescent, longer hairs absent or essentially so; leaflets 5-7, the largest 1.3-4.0 cm. long, 2.4-4.8 mm. wide, linear-oblong to narrowly elliptic or oblanceolate, the upper surfaces generally quite glabrous and green; longest petioles 4.0-9.6 cm. long; stipules 6.2-17.0 mm. long, adnate to the petioles 2.4-6.5 mm.; peduncles 2.5-10.5 cm. long; racemes 1.0-7.5 cm. long; verticils 2-7 or more, either clearly whorled or indistinct, 5-11 mm. distant at anthesis, as much as 2.0 cm. at maturity; bracts 3.2-5.6 mm. long, fugacious; pedicels 1.0-2.2 mm. long at anthesis; calyces pubescent with hairs 0.2-0.7 mm. long, the lips connate 1-1.6 mm., the lower 3.2-4.4 mm. long, straight, entire or the teeth to 0.3 mm. long, the lobes of the upper 2.5-4.0 mm. long, united 1.3-2.0 mm., the bracteoles 0.1-0.7 mm. long; banner heart-shaped, 5.1-7.4 mm. long, 4.0-5.2 mm. wide, (ratio 1.2-1.5) the reflexed part 1.7-2.7 mm. long, the appressed part 3.2-4.2 mm. long, (ratio 0.48-0.66) the angle 120°-150°; wings 4.9-6.8 mm. long, 1.9-3.4 mm. wide; keel ciliate on the upper margin of the distal half, sometimes almost glabrous, 1.1-1.6 mm. wide at the middle, the upper limb 2.2-3.4 mm. long, the lower 3.0-4.4 mm. long, the angle 90°-120°; pods 1.7-3.4 cm. long, 4.7-6.5 mm. wide, pubescent with subappressed hairs or glabrate; ovules 4-8, 2.8-3.5 mm. long, 2.0-2.8 mm. wide, dark gray to brown, usually abundantly stippled and mottled with black or brown, the angle mark wanting.

A variant found chiefly in Oregon in the same region as the typical forms is characterized by an abundance of spreading hairs 2-3 mm. long on the stems and petioles. Some specimens thus characterized gave the maximum measurements recorded above for height, leaflet size, pod size and the length of raceme. Others, however, fell within the median range of the species. In other words these plants were for the most part significantly more robust than the average. Although occasional plants elsewhere in the species are sometimes hairy with spreading hairs, they do not in this respect approach the Oregon form. The etching published with the original description clearly shows the reflexed/appressed ratio which characterizes *L. micranthus*.

DISTRIBUTION (Map 1, partial citation).

CALIFORNIA. ALAMEDA CO. Redwood Ridge, *Constance* 519 (in part). BUTTE CO. Chico, April 11, 1912, *Wooton*. Oroville, *Heller* 11198. CALAVERAS CO. Angels Camp, *Eastwood* 11585. COLUSA CO. Colusa, *Ferris* 6297. Williams, *Ferris* 545 (in part). CONTRA COSTA CO. Antioch, *Eastwood* and *Howell* 2144. Mt. Diablo, *Brewer* 1074; 1149. DEL NORTE CO. Klamath Glen, *Kildale* 9513. GLENN CO. Willows, *Eastwood* 10220. HUMBOLDT CO. Bridgeville, *Harris* 3319. LAKE CO. Cache Creek, *Abrams* 12511. Dashielle Mt., *Eastwood* 12818 (in part). LASSEN CO. Susanville, Perkins Ranch, June 26, 1897, *M. E. Jones*. LOS ANGELES CO. Beverly Hills *Mulliken* 33. Westwood, *Dunn* 1375; 1376; 1416; 1417. MARIN CO. Sausalito, *Abrams* 6883. MENDOCINO CO. Potter Valley, *Eastwood* 12662. MERCED CO. Hills Mine, *Yates* 5056. MODOC CO. Without locality, 1893, *Baker*. MONTEREY CO. Priest Valley, *Johannsen* 48. Santa Lucia Mts. *Ferris* 1854. NAPA CO. Calistoga, *Baker* 1988. Summit St. Helena Grade, *Abrams* 12214, 12251. PLACER CO. Roseville, *Applegate* 5357. PLUMAS CO. Greenville, *Eastwood* 14686. SACRAMENTO CO. South of Sacramento, *Applegate* 5356; 5367; 5368. SAN BERNARDINO CO. Upland (Red Hill), April 25, 1918, *Johnston*. SANTA BARBARA CO. Jct. Jaloma and Lompoc Roads, *Dunn* and *Epling* 2173a. Santa Rosa Island, *Munz*. SANTA CLARA CO. Alma, *Brandegge*; *Dunn* and *Brown* 2513; 2514. Montebello Ridge, *C. P. Smith* 3332. SANTA CRUZ CO. Boulder City Bridge, *Dunn* and *Brown* 2605; 2617. Santa Cruz, *Hanks* 180. SAN DIEGO CO. Cuyamaca, *Abrams* 3820. Cuyamaca Lake, *Gander* 1745. SAN FRANCISCO CO. Merced

Lake, April, 1898, *Dudley*. Ocean View, April, 1894, *Eastwood*. SAN JOAQUIN CO. Stockton Road, *Abrams* 9949. College of Pacific, *Stanford* 129. SAN LUIS OBISPO CO. Arroyo Grande, *Brewer* 435. Morro, *Munz* 10240. SAN MATEO CO. Crystal Springs Lake, *Baker* 1931. Sloat Blvd. and Riverton Drive, *Dunn* and *Brown* 2591. Stanford Park, *C. P. Smith* 2338. SISKIYOU CO. Between Mott and Cantara, *Eastwood* 11903. SOLANO CO. Vallejo, *Jones* 175. Mare Island, *Greene* 106. SONOMA CO. Bennett Valley, *Heller* and *Brown* 5226. Healdsburg, *Abrams* 6915. TEHAMA CO. Red Bluff, *Wootton*. TUOLUMNE CO. Stanislaus Forest, *Benner* and *Fisher* R1205. VENTURA CO. Sespe Creek, *Clokey* and *Anderson* 6702. YUBA CO. Marysville, *Heller* 7560. YOLO CO. Winters, *Eastwood* 14237. Guinda, *Rose* 36165.

OREGON. BENTON CO. Corvallis, May 2, 1915, *Elmer*. CLACKAMAS CO. Lake Oswego, *Thompson* 4136. CURRY CO. Chetoo River (near harbor), *Peck* 8799. DOUGLAS CO. Cow Creek (on the Pacific Highway), *Abrams* and *Benson* 10462; 10464. HOOD RIVER CO. Grassland, *Henderson* 496. Hood River, *Heller* 10100; *Whited* 1092. KLAMATH CO. Olene, *Walker* 2931a. JACKSON CO. Ashland, *Epling* 5453. JOSEPHINE CO. Grants Pass, *Ingram* 1721. LANE CO. Eugene, *Bradshaw* 1485. MARION CO. Champoeg, *Gorman* 4453. Chemawa, *Nelson* 71. MULTNOMAH CO. Portland, *Henderson* 192. UMATILLA CO. Walla Walla region, May 31, 1905, *M. E. Jones*. WASCO CO. The Dalles, *Thompson* 4218. Dufur, *Peck* 14914.

WASHINGTON. GRAYS HARBOR CO. Montesano, June, 1920, *Grant*. KINGS CO. Seattle, *Piper*; *Thompson* 6283. KLUCKITAT CO. Bingen, *Suksdorf* 7240; 7743. Columbia River, *Thompson* 8168. PIERCE CO. Tacoma, June 19, 1920, *Eastwood*. American Lake, December 7, 1907, *Frye*. THURSTON CO. Tumwater, *Otis* 1852.

BRITISH COLUMBIA. Vancouver Island, Manoose, May, 1915, *Carter*. Victoria, *Eastwood* 9742. May 16 and 17, 1914, *Henry*. May, 1907, *Pineo*. Canadian Pacific R. R. (in Province), June, 1896, *Cummings*.

2. *Lupinus congdoni* (C. P. Smith) Dunn, comb. nov.

L. micranthus var. *congdoni* C. P. Smith, Bull. Torr. Bot. Club 51: 99. 1924. Type collected by Congdon at the Smith Ranch on the Big Oak Flat—Yosemite Road, California.

Erect or suberect annual 3-6 cm. tall, branching at the base; pubescence 0.6-1 mm. long, subappressed and abundant; leaflets 5-7, 5-7 mm. long, 2-3 mm. wide, oblanceolate-spatulate, both surfaces subappressed pubescent, petioles 1.5-3.0 cm. long; stipules 4-5 mm. long, connate to the petioles 2-3 mm.; peduncles 0.5-2.5 cm. long; racemes 5-10 mm. long, often surpassed by the foliage; verticils 1-2, indistinct, 2-5 mm. distant; bracts 3 mm. long, fugacious, a few occasionally persisting; pedicels 1 mm. long; calyx appressed pubescent, the lips connate, 1.1-1.2 mm., the lower 3.6-4.0 mm. long, straight, the teeth to 0.1 mm. long, the lobes of the upper 3-3.5 mm. long, united 1.6-1.7 mm., the bracteoles 0.1-0.2 mm. long; banner heart-shaped, 6.3-6.7 mm. long, 4.5-5.0 mm. wide, (ratio 1.3-1.4), the reflexed part 2.7 mm. long, the appressed part 4.0 mm. long, (ratio 0.68), the angle 130°; wings 5.9-6.3 mm. long, 2.9-3.0 mm. wide, keel ciliate on the distal half, 1.6 mm. wide at the middle, the upper limb 2.5-3.1 mm. long, the lower 3.4-5.7 mm. long; angle 115°-120°; pods 1.2-1.5 cm. long, 4-5 mm. wide, their pubescence 0.5-0.8 mm. long, subappressed to spreading; ovules 3-5, 2.7-3.3 mm. long, 2.4 mm. wide, almost black, but mottled and stippled, the angle mark not present.

The three specimens which are cited herewith are all but identical in habit and measurements. In flower size and proportions they are essentially the same as *L. micranthus*. In stature and habit of foliage they are sharply set off from any extremes of that species. One's first impression suggests that they are merely depauperate individuals of it. However, they do not conform in leaflet shape or size to other depauperate individuals, the leaflets of which are correspondingly narrowed and are linear-oblanceolate. On the contrary, the leaflets of *L. congdoni* are broad, varying in shape from oblanceolate to spatulate, showing an affinity with *L. concinnus*. Furthermore, they are pubescent on the upper surface, a condition unusual in *L. micranthus*. Because the morphological hiatus between *L. congdoni* and *L.*

micranthus is greater and sharper than that between the subspecies of polymorphic species treated here and equivalent to that between the species it has seemed expedient to me to suggest its specific segregation, despite its scarcely known distribution. Because of its dwarf habit, it may have been overlooked in the intervening region.

DISTRIBUTION (Map 1).

CALIFORNIA. MARIPOSA CO. Smith Ranch, Big Oak Flat and Yosemite Road, April 24, 1902, *Congdon*. NEVADA CO. 2 miles west of Grass Valley, *Heller* 15066.

OREGON. JACKSON CO. Top of Table Rock near Medford, April 12, 1934, *Thompson* 10309.

3. LUPINUS BICOLOR Lindl. subsp. BICOLOR

L. bicolor Lindl., Bot. Reg. 13: t. 1109. 1827. Type a garden plant grown from seed collected by Douglas "in the interior of the country about the Columbia River, from Fort Vancouver to the branches of the Lewis and Clark's River," *L. micranthus* var. *bicolor* Wats., Proc. Am. Acad. 8: 536. 1873. *L. hirsutulus* Greene, Leaflets 2: 152. 1911. Type collected by Macoun at Beacon Hill, Vancouver Island, June 15, 1908.

Erect or suberect annuals 4-35 cm. tall, the longest branches mostly basal; pubescence appressed, or spreading and ascendant, with few to many longer spreading hairs 1.0-1.5 mm. long; leaflets 6-7, the largest 13-35 mm. long, 1.7-5.0 mm. wide, linear-oblancoelate, the tips acute or obtuse, both surfaces appressed-pubescent; longest petioles 3.0-6.3 cm. long; stipules 6.0-12.5 mm. long, connate to the petioles 1.4-5.4 mm.; peduncles 2.5-8.7 cm. long; racemes 0.3-7.0 cm. long; verticils 1-5, generally 2, distinct or indistinct, 0.3-1.7 cm. distant, or as much as 2.7 cm. at maturity; bracts 3.8-6.0 cm. long, fugacious; pedicels 1.7-3.4 mm. long, evenly ascendant-pubescent; calyces silky, subappressed-pubescent, the lips connate 0.9-1.4 mm., the lower 4.0-5.1 mm. long, straight, tridentate, the teeth occasionally as much as 0.4 mm., the lobes of the upper lip 3.1-4.2 mm. long, united 1.1-1.8 mm., the bracteoles wanting, or as long as 0.8 mm.; banner oblong, truncate, but sometimes mucronate, 6.0-8.9 mm. long, 3.1-5.8 mm. wide (L/W ratio 1.2-1.8), well reflexed from the wing tip, the reflexed part 3.5-4.7 mm. long, the appressed part 3.0-3.8 mm. long, (ratio 1.03-1.38), angle 115°-140°; wings 6.2-9.1 mm. long, 3.1-4.6 mm. wide, oblong or oval, fused for only a short distance; keel ciliate on the distal half, 1.5-2.3 mm. wide at the middle, the angle 102°-135° (ave. 112°), the upper limb 4.4 mm. long, the lower 4.7 mm. long; largest pods 1.9-2.5 cm. long, 4.0-5.4 mm. wide, covered with subappressed hairs .8-1.2 mm. long; seeds 4-8, 2.3-3.3 mm. long, 1.7-2.4 mm. wide, light gray to tan with varying amounts of black stippling, a black angle line present in most colonies.

L. hirsutulus has been referred by C. P. Smith to *L. nanus* var. *apricus*. However, the shape of the banner and the pedicel length suggest its reference here (see note under *L. vallicola* subsp. *apricus*). Flowering May-July.

DISTRIBUTION (Map 2).

CALIFORNIA. DEL NORTE CO. Crescent City, *Abrams* 8366. Klamath Glen, *Kildale* 9521. HUMBOLDT CO. Buck Mt., *Harris*, *Tracy* and *Yates* 3423. "High Prairie" on Bald Mt., *Tracy* 4561. Humboldt Bay, *Chandler* 1146. Bucksport, *Tracy* 3195. Willow Creek, *Harris* and *Tracy* 3250.

OREGON. CLACKAMAS CO. Eagle Creek, *Suksdorf* 3329. Estacada, *Thompson* 3637. COOS CO. Coos Bay, *Scullen* 125. Marshfield, *House* 5012. CURRY CO. The Heads, Port Orford, *Peck* 8458. Dunes, *Peck* 8486. LINN CO. Halsey, *Thompson* 11143. MARION CO. Salem, *Nelson* 1181. Yeoman, *Nelson* 598. WASCO CO. Deschutes Rd., *Thompson* 4885. Suavie's Island, May 1886, *T. Howell*.

WASHINGTON. CLARKE CO. Vancouver, *Heller* 10069. ISLAND CO. Whidbey Island, Mt. Gardner. LEWIS CO. Centralia, Fords Prairie, July 3, 1926, *Zundel*. PIERCE CO. American Lake, June 20, 1890, *Smith*. Muck Creek, *Jones* 4648; 4652. Roy, June 8, 1898, *Seckenby*. Tacoma, May 28, 1908, *Flett*. SAN JUAN CO. San Juan Island, *Argyle*, *Zeller* 923. Friday Harbor, *Peck* 13017. SKAGIT CO. Deception Pass State Park, Fidalgo Island,

C. P. Smith 999. THURSTON CO. Gate, *Faster* 2057. Olympia, *Abrams* 9289. Woodlawn, June 22, 1892, *Henderson*.

BRITISH COLUMBIA. Fraser River Valley, *Macoun* 382. Vancouver Island, 1858, *Lyll*. Beacon Hill, *Henry* 3505. Fowl Bay, May 17, 1914, *Henry*. Oak Bay, *Diebl* 152. Victoria, *Macoun* 5143.

3a. *Lupinus bicolor* subsp. *umbellatus* (Greene) Dunn, comb. nov.

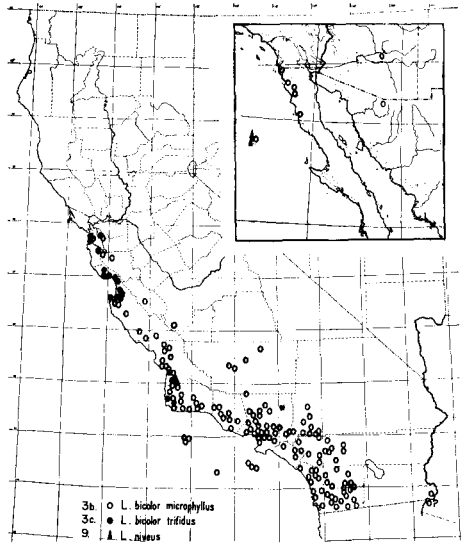
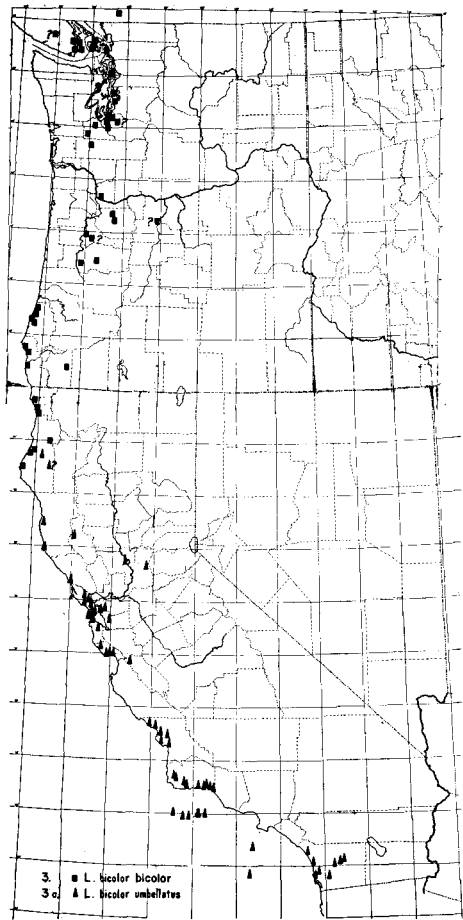
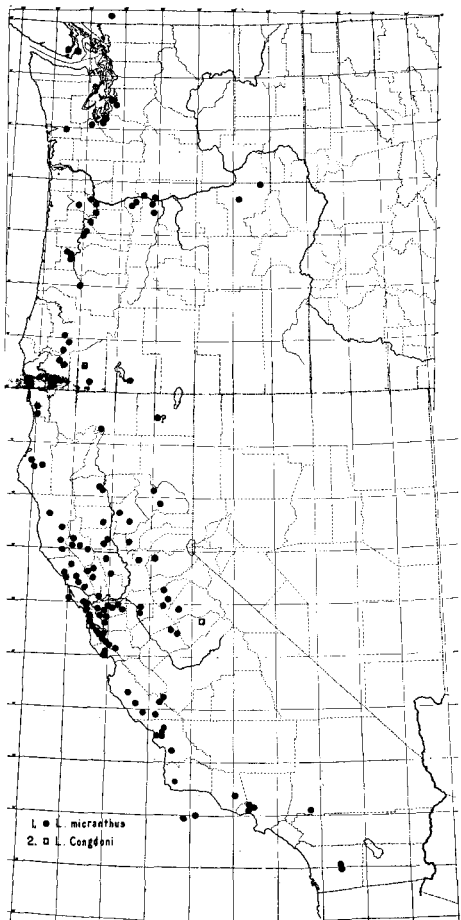
L. bicolor var. *umbellatus* (Greene) *C. P. Smith*, Bull. Torr. Bot. Club 50: 377. 1923.

L. umbellatus Greene, Bull. Calif. Acad. Sci. 2: 145. 1886. Type collected by Greene on Santa Cruz Island, Santa Barbara County, California.—*L. sabulosus* Heller, *Muhlenbergia* 7: 9. 1911. Type collected by Heller (no 6627) near the Marine Hospital, San Francisco.—*L. plebeius* Greene ex Baker, West Am. Plants 1: 11. 1902 (nomen nudum; Baker No. 816).

Decumbent, prostrate or suberect annuals 3-33 cm. tall, the main branches mostly basal; pubescence spreading or subappressed, with few to numerous longer spreading hairs 1-2.5 mm. long; leaflets 6-8 or more, the largest 9-22 mm. long, 1.7-5.3 mm. wide, linear to oblanceolate, the tips acute or bluntly rounded, both surfaces covered with appressed or subappressed pubescence; longest petioles 1.8-8.5 cm. long; stipules 3.5-12 mm. long, adnate to the petioles 1.2-4.7 mm.; peduncles 1.5-7.5 cm. long; racemes 0.3-4.8 cm. long (ave. 1.3); verticils 1-4, distinct, 3-22 mm. distant; bracts 3-7 mm. long, fugacious; pedicels 1.7-3.4 mm. long, pubescent; calyx densely subappressed-pubescent, the lips connate 0.8-1.6 mm., the lower 3.3-5.3 mm. long, reflexed or straight, tridentate, the teeth as much as 0.7 mm. long, the lobes of the upper lip 2.5-4.4 mm. long, united 1.2-1.8 mm., the bracteoles 0.1-0.7 mm. long; banner obovate, well reflexed, bluntly rounded at the apex or occasionally mucronate, 5.7-8.6 mm. long, 4.2-8 mm. wide, (ratio 1.07-1.63), the reflexed part 2.4-5.0 mm. long, the appressed part 2.4-4.5 mm., (ratio .95-1.28), the angle 112°-142°; wings 5.5-10.0 mm. long, 2.6-5.3 mm. wide; keel ciliate on the distal half, 1.7-2.5 mm. wide at the middle, the angle 90°-120°, the upper limb 3.3-5.8 mm. long, the lower 3.7-6.0 mm. long; largest pods 19-27 mm. long, 4.0-5.2 mm. wide, covered with subappressed or appressed pubescence 0.5-1.5 mm. long; seeds 5-9, 2.3-3.3 mm. long, 1.8-2.8 mm. wide, gray with fine stippling and no angle line, to dark brown or black and mottled, with or without the angle line, the angle line not infrequently marking off a tan corner, with the rest of the seed darkly mottled, or the tan patch streaked with brown.

From the Bay region southward subsp. *umbellatus* shows a trend toward a diminution in flower size and a more dwarfed habit, with smaller leaves. This trend reaches its limit on the Channel Islands and in San Diego County, where many individuals are found which are difficult to separate from subsp. *microphyllus*. Taken as a whole, these extremes resemble each other more than those of the Channel Islands resemble those of the mainland. I have been able to demonstrate in the greenhouse that these insular extremes, the nomenclatorially typical form, are ecological modifications. Those of San Diego County are presumably so also.

Some colonies of subsp. *umbellatus*, found in Santa Barbara and Santa Cruz counties, in both of which areas var. *trifidus* occurs, show a transition in calyx shape to that variety, but in other respects, particularly banner shape and size, are referable to subsp. *umbellatus*. It is believed that these may represent an intermediate type in the development of var. *trifidus* from subsp. *umbellatus* since these small flowered forms are predominantly, if not obligatorily, selfed. In Humboldt County, where subsp. *umbellatus* approaches subsp. *bicolor* geographically, intermediates occur which are equally referable to either subspecies.



Map 1. (LEFT). Distribution of *Lupinus micranthus* and *L. congdoni*. Map 2 (CENTER). Distribution of *Lupinus bicolor* subsp. *bicolor* and *L. bicolor* subsp. *umbellatus*. Map 3 (RIGHT). Distribution of *Lupinus bicolor* subsp. *microphyllus*, *L. bicolor* var. *trifidus* and *L. niveus*.

DISTRIBUTION (Map 2, partial citation).

CALIFORNIA. ALAMEDA CO. Oakland, *Smith* 3535. COLUSA CO. Colusa, *Chandler* 794. CONTRA COSTA CO. Moraga Valley, May 1, 1888, *Greene*. HUMBOLDT CO. Kneeland Prairie, *Kildale* 5938. Snow Camp, *Kildale* 10561. LAKE CO. Bachelor Valley, *Baker*. LOS ANGELES CO. San Clemente Island, east coast, *Munz* 6742. Santa Catalina Island, *Dunkle* 1741. MARIN CO. Mt. Tamalpais, April 1899, *Eastwood*. Rock Springs, *Abrams* 8069. MENDOCINO CO. Fort Bragg, *Duncan* 212. Point Arena, *Eastwood* and *Howell* 4463. PLACER CO. Newcastle, May, 1884, *Curran*. SACRAMENTO CO. Folsom, April, 1883, *Brandege*. SAN BENITO CO. San Juan, *Elmer* 4910. SANTA BARBARA CO. Carpenteria, *Dunn* and *Brydon* 1171; *Dunn* and *Epling* 2155; 2156; 2157. Gaviota, *Eastwood* 48; *Dunn* and *Epling* 2164. Santa Cruz Island, Prisoners harbor, *Clokey* 4977. San Miguel Island, *Munz* and *Norris* 11775. Santa Rosa Island, *Munz* and *Crow* 11592; 11701. SAN DIEGO CO. Leucadia, *Dunn* 850. Oceanside, *Dunn* 1002. La Jolla, March 1, 1914, *Clements*. Ramona, *Dunn* 998. SAN FRANCISCO CO. Ingleside, *Inez Smith*. Lake Merced, *Tracy* 1830. San Bruno Hills, *Baker* 1888. Sunset District, *C. P. Smith* 2753. SAN LUIS OBISPO CO. Black Hill, *Belshaw* 1691. Morro, *Eastwood* 14261. San Luis Obispo, *E. Palmer* 95. SAN MATEO CO. San Bruno Hills, *Abrams* 7053; *Elmer* 4526. Sloat Blvd. and Riverton Dr.; *Dunn* and *Brown* 2590. SANTA CRUZ CO. Big Basin, *Epling* 8345. Santa Cruz, *Heller* 6554. SONOMA CO. Bodega Bay, *Eastwood* and *Howell* 4505. Salmon Creek, *Bacigalupi* 1896. YOLO CO. Knight's Landing, April, 1892, *Nutting*.

3b. *Lupinus bicolor* subsp. *microphyllus* (Wats.) Dunn, comb. nov.

L. bicolor var. *microphyllus* (Wats.) C. P. Smith, Bull. Torr. Bot. Club 50: 382. 1923.

L. micranthus var. *microphyllus* Wats., Proc. Am. Acad. 8: 535. 1873. Type collected by Nuttall in San Diego County, California.

Erect, suberect or sometimes prostrate annuals 0.9-4.5 dm. tall; longer branches usually basal and ascending, but considerably branched above, the first lateral bud below a raceme having generally grown into a branch almost as long, or longer than the raceme, by the time the raceme is in full bloom; pubescence appressed, abundant or sparse, with or without longer hairs 1.0-1.5 mm. long; leaflets 5-8, the larger ones 0.9-2.7 cm. long, 2-4 mm. wide, linear-oblong to linear-oblongate, the tips obtuse or acute, both surfaces sparsely or densely appressed-pubescent; longest petioles 3.5-6.0 cm. long; stipules 4-9 mm. long, adnate to the petioles 2-4 mm.; peduncles 2.0-12.5 cm. long; racemes 0.5-5.0 cm. long verticils 1-3, or 4, occasionally 5, generally close and somewhat indistinct, or distinct, as much as 3-7 mm. distant at anthesis; bracts 3-4.5 mm. long; calyx thinly appressed-pubescent, the lips connate 0.6-1.2 mm., the lower 2.7-4.0 mm. long, the lobes of the upper 2.0-3.7 mm. long, fused for 0.8-1.5 mm., the bracteoles wanting, or as much as 0.3 mm. long; banner 3.6-6.0 mm. long, 1.8-4.2 mm. wide, (ratio 1.4-2.4), reflexed part 1.6-2.9 mm. long, the appressed part 1.6-2.7 mm. long (ratio 1.0-1.3), (in approximately 50% of the colonies the banner remains folded down over the rest of the flower), the angle 130°-155°; wings 3.8-6.8 mm. long, 1.7-3.0 mm. wide, fused in front of the keel; keel 1.1-2.0 mm. wide at the middle, the upper limb 2.1-3.5 mm. long, the lower 3.5-4.7 mm. long, the angle 100°-125°; pods 1.5-2.4 cm. long, 4.0-5.0 mm. wide, subappressed pubescent; seeds 3-7, 1.8-2.8 mm. long, 1.7-2.4 mm. wide, cream to gray, plain or with dark brown mottling and stippling, with or without an angle mark.

The geographic ranges of subsp. *microphyllus* and subsp. *umbellatus* are similar, although the former extends further inland, whereas the latter is chiefly maritime; however, north of San Luis Obispo County, the colonies of subsp. *microphyllus* are relatively few. Throughout most of this range no intermediates have been found. The two subspecies merge in San Diego County and on the Channel Islands, and frequent colonies occur there which are intermediate. Some colonies in San Diego County, as at Descanso, may embrace both subspecies (together with subsp. *margi-*

natus). In such colonies the subspecies are generally readily distinguishable in habit.

South of the Bay Region the margins of the ranges of subsp. *microphyllus* and subsp. *tridentatus* overlap, the latter is more extensive and ranges farther inland, as well as in the foothills of the Sierra Nevada. Occasional mixed colonies are found, such as that mentioned above, but I have observed little or no intergradation (however see p. 160) each demonstrating a separate habitat preference in southern California. The former is generally a lowland subspecies and the latter tends to be montane in woodland meadows.

DISTRIBUTION (Map 3, partial citation).

CALIFORNIA. ALAMEDA CO. Oakland, 1888, *Rattan*. FRESNO CO. Hills W. of Coalinga, *Dunn* and *Brydon* 1234. IMPERIAL CO. Laguna, Campbell's Ranch, *Mearns* 3531. KERN CO. Bakersfield, *Davy* 1789. Kern River, *Palmer* 113. Kernville, *Voegelin* 180. LOS ANGELES CO. Acton, *Dunn* and *Epling* 2117; 2119. Antelope Valley, S. side, *Hall* 3068. Claremont, *Baker* 4007; 4101; 5252; 5290; 5306; *Dunn* 942; 945. Oak Flat Camp, *Dunn* and *Epling* 2126. Pasadena, *Abrams* 1437. Pomona, *Dunn* 938; 976. Pt. Dume, *Dunn* 2650. Santa Catalina Isl., Hamilton Canyon, *Fosberg* S4377. MONTEREY CO. Big Sur Camp, *Dunn* and *Brown* 2630. Bradley, *Bright* 8545. Carmel Valley, *Abrams* 5592. Pacific Grove, *Heller* 6631. Pinnacles, *Ferris* 1734; 4127. ORANGE CO. Santa Ana Mts., *Munz* and *Harwood* 3768; *Pequegnat* 28. RIVERSIDE CO. Banning, A. M. *Johnson* 3871. Cabazon, *Dunn* 2922. Coachella Valley, *Munz* 10895. Corona, *Dunn* 932. Palm Springs, *Bright* 8195. SAN BENITO CO. San Benito, *Walker* 5063. SAN BERNARDINO CO. Bloomington *Wilder* 51. Cajon Pass, May 16, 1903, M. E. *Jones*. San Bernardino, *Parish* 68; 1084; Plains, 4659; 7085. SAN DIEGO CO. Alpine, *Gander* 5570. Bonsall, *Gander* 971. Crown Point, *Gander* 1433. Cuyamaca Valley, *Vasey* 97. Harper's Ranch, *Dunn* 1276. Palomar Mt. (Doane Valley), *Munz* 8302. Rincon, *Gander* 5168. San Diego, *Baker* 3363. San Marcos, *Dunn* 1030. Santa Ysabel, *Munz* 9813. SAN LUIS OBISPO CO. Atascadero, *Dunn* and *Brydon* 1197; *Dunn* and *Brown* 2293; 2295; 2296; 2325; 2329. Bradley, *Baker* 3034a. Nipomo, *Dunn* and *Epling* 2183; 2194; 2196; 2198; 2201. SAN FRANCISCO CO. San Francisco, May 16, 1882, *Jones*. SANTA BARBARA CO. Gaviota, *Dunn* and *Epling* 2161; 2163; 2165. SANTA CLARA CO. Stanford Univ. *Abrams* 5065. VENTURA CO. Cornell, *Gifford* 143. Foster Park, *Eastwood* 5006.

ARIZONA. Apache trail, Amethyst Mine, *Eastwood* 17343. Willets, April 25, 1924, *Jones*.

MEXICO. LOWER CALIFORNIA. Ensenada, *McKeever* 35. Guadalupe Island, June, 1906, *Brown*. San Quintin Bay, E. *Palmer* 666. San Sebastian, April 28, 1889, *Brandegee*. Santo Tomas, April 25, 1940, *Epling* and *Lewis*. March 20, 1935, *Harbison*. San Vicente, April 17, 1925, *Jones*. Tijuana, April 7, 1885, *Orcutt*.

SONORA. Castia, May 24, 1892, *Brandegee*.

3c. *Lupinus bicolor* subsp. *umbellatus* var. *trifidus* (Torr. ex Wats.) *Dunn*, comb. nov.

L. bicolor var. *trifidus*, C. P. *Smith*, Bull. Torr. Bot. Club 50: 386. 1923.

L. trifidus Torr. ex Wats., Proc. Am. Acad. 12: 250. 1877. Type collected by (?) *Torrey* in California.—*L. micranthus* var. *trifidus* *Wats.*, Proc. Am. Acad. 8: 535. 1873.

Suberect, decumbent or prostrate annuals 6-30 cm. tall, branched mostly at the base, minutely spreading-pubescent, the longer hairs of varying length and density, 1-2 mm. long, spreading; leaflets 6-8, the largest 0.9-2.8 cm. long, 1.3-3.8 mm. wide, linear-oblong to linear-oblongate, the tips acute or obtuse, both surfaces covered with subappressed pubescence; longest petioles 2.5-6.7 cm. long; stipules 5-10 mm. long, adnate to the petioles 2-4 mm.; peduncles 3.5-7 cm. long; racemes 0.5-6 cm. long; verticils 1-5, distinct, 6-15 mm. distant at anthesis, as much as 2-2.5 cm. at maturity; bracts 4-5 mm. long; pedicels 1.0-2.0 mm. long at anthesis; calyces densely pubescent with subappressed hairs 0.4-0.6 mm. long, the lips connate 0.7-1.2 mm., the lower 3.5-6.8 mm. long, straight, incised 1-5.5 mm. (ave. 2.9 mm.), the lobes of the upper 2.8-5.1 mm. long, united 0.7-1.5 mm., the bracteoles 0.2-0.6 mm. long; banner 4.8-6.4 mm. long, 1.8-3.4 mm. wide (ratio 1.77-2.89) the reflexed part 2.8-3.3 mm. long, the appressed part 2.4-3.3 mm. long (ratio 0.8-1.2), the angle 130°-170°, or the banner not at all reflexed; wings 5-6.9 mm. long,

1.6-2.8 mm. wide, keel ciliate above on the distal portion, 1.0-1.7 mm. wide at the middle, the angle 104° - 123° , the upper limb 2.4-3.9 mm. long, the lower 3.0-4.3 mm.; pods 1.5-2.2 mm long, 3.3-4.6 mm. wide, pubescent with subappressed or spreading hairs 0.5-1.2 mm. long; seeds 4-8, 2.1-2.7 mm. long, 1.6-2.1 mm. wide, either dark or light gray, usually abundantly stippled and mottled with dark brown, the angle mark wanting. Flowering April and May.

The distribution of var. *trifidus* is apparently disjunct, one area being found from San Francisco Bay to Monterey Bay, the other being found in coastal San Luis Obispo and Santa Barbara counties. The plants of the two areas do not differ significantly in morphology with the exception of a race found on San Francisco peninsula. This race is prostrate in habit, relatively dwarfed and more densely pubescent. The lower lip of the calyx is relatively short and the seeds are more darkly mottled.

In floral morphology var. *trifidus* occupies an intermediate position between subspecies *umbellatus* and *microphyllus*. Its banner and flower size approach the latter; its keel approaches that of the former. Variety *trifidus* has been found growing in a mixed colony with both subspecies *microphyllus* and *umbellatus* at Nipomo, San Luis Obispo Co. and with subsp. *umbellatus* on the San Francisco peninsula, *Dunn & Brown* 2596; 2597. It has also been found in the Monterey region growing in pure stands. However, it is completely sympatric with subsp. *umbellatus* and is maintained as an entity only by virtue of the selfing mechanism. Further its characters are believed to be recessive and would be lost if the selfing barrier were removed. Since var. *trifidus* has not demonstrated a better physiological adaptedness for a given habitat than the other subspecies it cannot be considered as anything more than a variety.

DISTRIBUTION (Map 3).

CALIFORNIA. ALAMEDA CO. Alameda, May, 1888, *Greene*. MONTEREY CO. Del Monte, April 13, 1894, *Dudley*. Jct. of Ft. Ord and Salinas Hwy. *Dunn and Brown* 2458; 6-11 mi. E. of Jct., *Dunn and Brown* 2472; 2484. Salinas Rd., *C. P. Smith* 3245. Pacific Grove, *Elmer* 3512. Salinas, *Eastwood* 2172. Seaside, May 29, 1912, *Eastwood*. SAN FRANCISCO CO. Lake Merced, April, 1883, *Dudley* (in part). San Francisco, 1876, *Vasey*. SAN MATEO CO. By cemeteries, *C. P. Smith* 1422a; 1423. Ravine N. of Sloat Blvd. *Dunn and Brown* 2596. SAN LUIS OBISPO. Arroyo Grande, May, 1895, *King*. Nipomo, *Belshaw* 1599; *Dunn and Epling* 2184. Nipomo Mesa, *Eastwood and Howell* 3869. SANTA BARBARA CO. Jct. of Jalama Rd. and Lompoc Rd. *Dunn and Epling* 2173. Surf, *Ferris* 7521. Veronica Springs Rd., March 22, 1930, *Hoffman*. SANTA CRUZ CO. Capitola, *Baker* 1963. Santa Cruz, *M. E. Jones* 2667. Santa Cruz Peninsula, April 17, 1904, *Dudley*. Between Scott Valley and Glenwood, *Abrams* 10932. 6-10 mi. S. of Soquel, *Dunn and Brown* 2623; 2626.

3d. *Lupinus bicolor* subsp. *pipersmithii* (Heller) *Dunn*, comb. nov.

L. bicolor var. *pipersmithii* *C. P. Smith*, Bull. Torr. Bot. Club. 50; 380, 1923. *L. pipersmithii* *Heller*, *Muhlenbergia* 7; 93. f. 16-17. 1911. Type collected by *C. P. Smith* (No. 1403) at Cedro Cottage near Stanford University.

Erect or suberect annuals 1.0-4.0 dm. tall, branched mostly at the base, appressed-pubescent with numerous longer, spreading hairs 2-2.5 mm. long; leaflets 6-8, the larger ones 1.5-3.0 cm. long, and 2.0-4.0 mm. wide, linear-oblong to oblanceolate, the tip acute or obtuse, both surfaces sparsely appressed-pubescent; longest petioles 3.5-6.0 cm. long; stipules 6-11 mm. long, adnate to the petioles 2-5 mm.; longer peduncles 4-8 cm. long; racemes 1-7 cm. long; verticils 2-5, distinct or nearly so, 4-14 mm. distant at anthesis; bracts 4-8 mm. long, diminished upwards; calyces subappressed-pubescent, the lips connate 0.7-1.2 mm., the lower 3.5-4 mm. long, straight, entire or with teeth 0.1-0.2 mm. long, the lobes of the upper 2.4-4.3 mm. long, united 0.7-1.6 mm., the bracteoles wanting or as much as 0.4 mm. long; banner 5.2-6.5 mm. long, 3.0-5.0 mm. wide, (ratio 1.6), the reflexed part 2.2-3.2

mm. long, the appressed part 2.7-4.2 mm. long (ratio .86), the angle 120° - 145° ; wings 5-7 mm. long, 2.2-3.5 mm. wide, keel 1.2-1.7 mm. wide at the middle, the upper limb 3.7 mm. long, the lower 3.4 mm. long, the angle 75° - 100° ; largest pods 2.0-2.5 cm. long, 3.8-4.8 mm. wide, subappressed pubescent; seeds 5-9, 2.4-2.7 mm. long, 2.0-2.5 mm. wide, light cream colored with very little mottling, the angle mark present.

The geographic range of subsp. *pipersmithii* is included within that of subsp. *tridentatus*, although the former occupies areas in the Great Valley where the latter does not occur. The glabrous keel sets off this subsp. sharply, but is the only single difference which can be relied upon. Nevertheless, the modes of variation are different and the extremes of each subspecies can be readily distinguished. Two forms are more or less geographically segregated. That of the Great Valley, the foothills of the Sierra Nevada and the Bay Region (the typical) has a spatulate banner and an average keel angle of 90° . That of the South Coast Ranges has an oblong, truncate banner, identical with that of subsp. *tridentatus* of the same region (see p. 156). The average angle of the keel, however, is essentially the same as that of the first form. At the same time, the form of subsp. *tridentatus* found in the South Coast Ranges, in the same area, differs sharply from the remainder of that subspecies in the banner form. If banner form alone should be chosen as a criterion, rather than the glabrous keel, or the angle of the keel, then these two forms might readily be considered one entity. However, the weight of evidence suggests the present arrangement, suggesting parallel development in both forms. In cross breeding experiments subsp. *pipersmithii* showed 33% interfertility with var. *rostratus*, less than 10% interfertility with subsp. *tridentatus* and thus far all attempts to cross it with any of the other subspecies have met with failure. In any event, subspecies *pipersmithii* and *tridentatus* are very similar and much closer to each other, apparently, than any other subspecies of this species. Even though these two grow in mixed populations in various parts of their range there appears to be a physiological difference in the two subspecies as evidenced by the above mentioned distribution, in addition to the partial sterility barrier. Hence, even if the selfing mechanism were not present the two would continue to maintain themselves as entities with at best some gene flow such as described by Anderson.*

DISTRIBUTION (May 4).

CALIFORNIA. ALAMEDA CO. Berkeley, April 28, 1892, *Blankinship* (in part). San Lorenzo Valley, *Kellogg & Harford* 180. COLUSA CO. Colusa, *Eastwood* 10244. Williams, *Ferris* 545, (in part). CONTRA COSTA CO. Antioch, *Baker* 2822. Brentwood, May 5, 1893, *Eastwood*. Byron Springs, *Eastwood* 3784; 3794. EL DORADO CO. Placerville, April 21, 1928, *Votriede*. FRESNO CO. Big Trees, *Brandegee*. Clovis, April 5, 1902, *Thompson*. Pollasky, *Heller* 8154. Selma, *Abrams* 10797. GLENN CO. Orland, *Heller* 11886. KERN CO. Delano, March 24, 1912, *Wooton*. Summit Hwy. McKittrick to Maricopa, *Dunn & Epling* 2232. KINGS CO. Banner, April 19, 1906, *M. E. Jones*. MADERA CO. Fairmead, *Abrams* 10766. Madera, *Davy* 1698. MARIPOSA CO. Blochman's Ranch, *Eastwood* 4253. MERCED CO. Hills Mine, *Schlobohm* 37. Between Hopston and Merced Falls, *J. T. Howell* 1045. Livingston, *Smith and Menker* 120. Snelling, 1912, *Wooton*. MONTEREY CO. Aromas, *Meyers* 353. Bradley, *Dunn and Brydon* 1210. King City, *Eastwood* 4072. San Lucas, *Dunn and Brydon* 1227. San Ardo, *Ferris* 7498. Santa Lucia Mts., 10 miles from King City, *Dunn and Brydon* 1222. NAPA CO. Calistoga, April, 1889, *Lemmon*. SACRAMENTO CO. Alders, *Nordstrom* 48. Antelope, *Bright* 8536. Del Paso Park, *Heller* 13384. Courtland, *Heller* 14523. SAN BENITO CO. Panoche Pass, *Abrams and Borthwick* 7981. San Juan, *Elmer* 4914. Tres Pinos, *Ferris* 8337. SAN FRANCISCO CO. San Francisco, April, 1886, *Brandegee*. SAN JOAQUIN CO. Banta, April 2, 1917, *Eastwood*. Escalon, *Stanford* 1300. Lathrop, *Stanford* 1257. Live Oaks, March, 1877, *Rattan*. Manteca, *Abrams* 9957. Peters *Stanford* 819. Stockton, *Stanford* 179. Tracy, *Baker* 2910. SAN LUIS OBISPO CO. 2.5-22

*Edgar Anderson "Introgressive Hybridization" Wiley & Sons Inc. 1950.

mi. South of Cholame on Rd. to Simmler, *Dunn and Epling* 2215; 2218; 2220; 2225. Estrella, *Dunn and Brydon* 1201-2; 1203-1; *Dunn and Epling* 2206; 2207. Paso Robles, *Dunn and Brydon* 1199-1. SAN MATEO CO. Menlo Heights, *Abrams* 5095. Stanford Park, April 22, 1911, *McMurphy*. Stanford University, *Heller* 10250; 10251. Stanford University near Cedro Cottage, *C. P. Smith* 1402; 1403. SANTA BARBARA CO. Refugio Pass, April 1, 1928, *Hoffman*. SANTA CLARA CO. Palo Alto, *Heller* 10253. STANISLAUS CO. Adela, *Stanford* 853. Ceres, April 5, 1916, *Wagner*. Hughson, April 6, 1927, *Fosberg*. Knights Ferry, *Abrams* 9957. Modesto, April 28, 1917, *Brandege*. Riverbank, *Abrams* 9962. Turlock, April 16, 1927, *Fosberg*. TULARE CO. Banks of Tule River, March 27, 1897, *Dudley*. Earlimart to Delano, *Eastwood* 3959. Hanford, *Eastwood* 3841. Tulare, March 30, 1937, *Winblad*. YOLO CO. Woodland, April 25, 1899, *Blankinship*.

3e. *Lupinus bicolor* subsp. *tridentatus* (Eastw.) Dunn, comb. nov.

- L. bicolor* var. *tridentatus* Eastwood ex C. P. Smith, Bull. Torr. Bot. Club 50: 377. 1923.
L. inanoemus Greene ex Baker, West. Am. Plants 2: 14. 1903. (nomen nudum *Baker* 2910).—*L. bicolor* var. *tetraspermus* C. P. Smith, op. cit., 385. Type collected by C. P. Smith (No. 3405), at Wright, Santa Clara County, California.

Erect, suberect, or decumbent annuals 4.0-40.0 cm. tall, the longest branches usually basal, appressed-pubescent throughout with few to many spreading hairs 1.0-1.5 mm. long; leaflets 6-8, the largest 0.8-4.2 cm. long, 0.5-4.2 mm. wide, linear to linear-oblancoate, the tips acute or occasionally rounded, both surfaces covered with appressed pubescence 0.5-1.0 mm. long; longest petioles 2.5-7.2 cm. long; stipules 4.3-17.0 mm. long, adnate to the petioles 2.0-6.0 mm.; longest peduncles 3.0-8.5 cm. long; corresponding racemes 1.5-11.0 cm. long; verticils 1-9, generally quite distinct, 4.0-15.0 mm. distant at anthesis; bracts 2.9-6.4 mm. long, fugacious; pedicels 1.0-3.8 mm. long, pubescence even, subappressed; calyces appressed-pubescent, the lips connate 0.4-1.4 mm., the lower 2.8-5.6 mm. long, generally straight, tridentate, the teeth less than 0.1 mm. long to 1.0 mm. long, the lobes of the upper 1.8-4.3 mm. long, united 0.5-1.8 mm., the bracteoles wanting or as much as 0.8 mm. long; banner oblong, truncate, constricted somewhat below the middle, or obovate, sometimes mucronate, 3.1-7.5 mm. long, 1.8-6.0 mm. wide, (ratio 1.2-2.3), well reflexed, the reflexed part 1.9-3.8 mm. long, the appressed part 1.7-3.8 mm. long, (ratio 0.74-1.2), the angle 120°-150°, wings 3.8-7.6 mm. long, 1.4-3.9 mm. wide; keel ciliate on the distal half, 1.0-2.0 mm. wide at the middle, the angle 95°-115°, occasionally more, the upper limb 2.5-4.0 mm. long, the lower 2.5-4.8 mm. long; largest pods 1.7-2.9 cm. long; 4.0-5.6 mm. wide, subappressed-pubescent; seeds 3-8, 2.2-3.3 mm. long, 1.8-2.7 mm. wide, generally angled, dark or light, variously mottled with brown, minutely stippled.

The type of var. *tetraspermus* is a plant with dwarf, linear leaves and 4-5 seeds per pod. Both characters are found not infrequently in subsp. *tridentatus* when the plants are grown under arid conditions. It seems, therefore, that var. *tetraspermus* is only an environmental modification, which, because of its banner shape and flower size, is properly referable to subsp. *tridentatus*.

Subspecies *tridentatus* is the most widespread and diverse of the group of *Micranthi*. Its range includes all or part of all other subspecies. Except for subsp. *bicolor*, it is the only one found in Oregon, where it appears to integrate with that subspecies also extending southward and intergrading with subsp. *marginatus* in southern Kern Co.

Apart from such intergradation, it is by no means uniform throughout its range, but presents a series of geographically segregated forms between which intergradation is complete. Two principal geographical variants can be discerned; 1) a form with an oblong banner, more or less truncate at the apex, 2) a form with an obovate banner and loose racemes.

The first form, with the oblong truncate banner, is found in the North and South Coast Ranges, usually inland. In the northern part of its range it approaches subsp. *bicolor*, but lies usually interior, whereas subsp. *bicolor* is usually maritime. In the form of its banner it approaches *bicolor*, but its flowers are smaller, of somewhat different conformation and are more numerous. Where the two subspecies approach each other geographically individuals may be found which are of uncertain reference to either. A study of colonies in this region should yield valuable information. The other extreme of this form is found in the South Coast Ranges where the flowers are sometimes no more than 3.0 mm. long, and the leaflets similarly dwarfed.

The second form referred to, with obovate banner, extends from southern Oregon along the Sierra Nevada and the margin of the Great Valley and occurs also in the Bay Region. In the Sierra Nevada its racemes are usually indistinctly verticillate, but in the Bay Region they are frequently quite distinct, and not crowded. It intergrades in the Bay Region with the first form.

In addition to these shadowy geographical forms, frequent abnormal individuals occur. The following are the principal examples observed:

- 1) *Sharsmith* 619. (Smith Creek, Mount Hamilton, Santa Clara Co. Calif.)—Banner of the shape of a Delicious apple, that is, ovate and cordate at the base, but with a truncate, somewhat emarginate apex.
- 2) *Bright* 8316. (Tehachapi Mountains, Kern Co., Calif.)—Fold of the banner densely ciliate above the angle on the front side.
- 3) *Heller* 13109. (Richardson Springs, Butte Co., Calif.). The same.
- 4) *Head* in June 1906, (Yosemite Valley, Calif.)—Similar to "rostratus" in respect to the calyx only (see below).

Such individuals are known only from herbarium specimens and from them it was impossible to ascertain to what extent each abnormality had become locally established.

DISTRIBUTION (Map 4).

CALIFORNIA. ALAMEDA CO. Arroyo Mocho, *Bacigalupi* 1279. Berkeley, May 15, 1888, *Greene*. Berkeley Hills, *Tracy* 643. Cypress Ridge, above Livermore, 1931, *Van Dyke*. Livermore, *Bacigalupi* 1517. 6 mi. S. of Livermore, above Arroyo Mocho, *Mexia* 2328, Mills College, April 15, 1904, *Hincks*. Between Mission San Jose and Livermore, *Heller* 7314. Oakland, *Brewer* 2773. Sunol Valley, *Abrams* 5698; 9935. AMADOR CO. Agricultural Station, *Hansen* 15. Buena Vista, *Roseberry* 57. Churchbell Hill, *Nordstrom* 779. Jackson, *Hansen* 33. Jackson Gate, *Hansen* 339. Ione, *Brandege*e. New York Falls, *Hansen* 15. BUTTE CO. Big Chico Creek, *Heller* 11227. (in part). Butte Creek, *Bruce* 2034, (in part). Chico, *Copeland* (*Baker* 3032). Mud Creek above Richardson springs, *Heller* 13109. Sierra Foothills below Centerville, *Heller* 11557. CALAVERAS CO. Angels Camp, *Eastwood* 11610; 11605. Hodson, *Rutter* 146. Mokelumne Hill, *Blaisdell* 52. Altaville, *Renner* R1207. San Andreas, Sonoma Rd. *Renner* R1211. CONTRA COSTA CO. Lafayette Acalanes grant, *Lundb* 220. Moraga Valley, April 17, 1888, *Chesnut*. Mt. Diablo, *Bauer* 7. Mt. Diablo, Pine Canyon, *Chandler* 975. Pacheco Pass, *Eastwood* 14079. St. Mary's College Hills, *Howell* 11250. EL DORADO CO. Between Clarksville and Shingle Springs, *Heller* 12285. Colma, *Benson* 27. Lakeside, April 9, 1896, *Cummings*. Laynes Ranch, May 1, 1909, *Brandege*e. Pilot Hill, April 28, 1915, *Brandege*e. FRESNO CO. Big Sandy Creek, April 1-5, 1915, *McDonald*. Parlier, along King's River, March 25, 1929, *Quick*. Squaw Valley, *Rose* 36049. Trimmer, May 23, 1937, *Winblad*. Zapato, March 27, 1893, *Eastwood*. HUMBOLDT CO. Garberville, *Kildale* 1711. Trinidad Road, 1899, *Dudley*. Van Duzen River Valley, *Tracy* 2693. Willow Creek, *Abrams* 7172. KERN CO. Bakersfield, April 4, 1893, *Eastwood*. Chanac Creek, *Weston* 588. Delano, April 5, 1893, *Eastwood*. Greenhorn Mts., May 31, 1931, *Van Dyke*. Havilah, *Brandege*e. Mt. Breckenridge, *Grinnell* 245. Isabella, April 20, 1915, *Evermann*. Neason's Flat, *A. Lewis* 642. Poso Creek, *Babcock* 5013. Summit of Rd. from Maricopa to McKittrick, *Dunn & Epling* 2231. Walker Pass, *Eastwood & Howell* 5562. 5 mi. S.W. of Willow Springs, *Armstrong* 1064. S. of Woody, *Benson* 3268. KINGS CO. Hanford, *Eastwood* 3841. LAKE CO. Bartlett Mt., *Abrams* 12404. Clear Lake Park, *Eastwood & Howell* 5562. Cobb Mt.,

March 21, 1931, *Jussel*. Dashiells Mt., *Eastwood* 12818 (in part). Kelseyville, *Abrams* 12330. Lower Lake, *Baker* 2983. Middleton, *Abrams* 12298. LOS ANGELES CO. Devils Gate, Pasadena, *Abrams* 1437. Elysian Hills, *Braunton* 819. Liebre Mts., *Abrams* & *McGevier* 353. 5 mi. S. of Los Angeles Honor Farm on Ridge Route, *Dunn* & *Epling* 2121; 7 mi. No. of L. A. Honor Farm, *Dunn* & *Epling* 2125. Oak Flat Camp, *Dunn* & *Epling* 2127; 2128. MADERA CO. Madera, *Eastwood* 12492a. North Fork, *Griffiths* 4439. San Joaquin Experiment Station, *Biswell* 179. MARIN CO. Kentfield, *Eastwood* 12 (in part). Mt. Tamalpais, April, 1899, *Eastwood*. Ross Valley, April, 1892, *Bioletti*. MARIPOSA CO. Blockmans Ranch, *Eastwood* 4253. Cathay Valley, *Eastwood* 4351. Indian Gulch, *Belsbaw* 1796. 10 mi. E. of Mariposa, *Bacigalupi* 1479. White Rock Mine, *Yates* 5107. Yosemite Valley, Base of El Capitan, *Hall* 8871. MENDOCINO CO. Potter Valley, April, 1899, *Brandege*. Ukiah Valley, *Abrams* 6977. Wolf Creek, *Abrams* 5862. MERCED CO. Los Banos, *Wooton*. Pacheco Pass, *Abrams* 10742. MONTEREY CO. Jamesburg, *Bacigalupi* 1107. Jolon, *Eastwood* 4142. Between Jolon & Bradley, *Eastwood* & *Howell* 1974. Parkfield, *Munz* 9182. Pleyto Well, *Graham* 228. San Antonio River, *Ferris* 3671. Santa Lucia Mts., May 1-12, 1897, *Eastwood*. Santa Lucia Mts., Los Pesaros, *Abrams* 7354. Los Burros Mines, *Plaskeitt* 87. Pine Valley E. of Cold Springs, June, 1901, *Dudley*. Shearers School, Pine Canyon Rd., *Ferris* 1793. Tassajara Hot Springs, *Bacigalupi* 1112. 6-7 mi. N. of Jct. of Tassajara Hot Springs Hwy. on Rd. to Jamesburg, *Dunn* & *Brown* 2385; 2395. 16.4 mi. N. of Jct., *Dunn* & *Brown* 2428. NAPA CO. Calistoga, *Baker* 1982. NEVADA CO. Nevada City, *Eastwood* & *Howell* 4355. Penn Valley, *Yates* 3611. Between Smartville and Rough, *Heller* 15069. PLACER CO. Applegate, April 1, 1899, *Smith*. Newcastle, May, 1884, *Curran*. Roseville, April, 1883, *Brandege*. SACRAMENTO CO. Brighton, May, 1883, *Brandege*. Fair Oaks, March 17, 1900, *Baker*. Folsom, *Heller* 12307. Sacramento, 1928, *Vorriede*. SAN BENITO CO. Hernandez, *Howell*, 11179. Idria, *Ferris* 7008. Pinnacles, *Howell* 4626. Emmet to Panoche Pass, *Abrams* & *Borthwick* 7934. San Benito, *Walker* 5063. San Carlos Creek, *Eastwood* & *Howell* 5158. Tres Pinos, March 23, 1893, *Price*. SAN BERNARDINO CO. Redlands, April 10, 1888, *Parish*. Upland, *Johnston* 1974; 1975. SAN FRANCISCO CO. San Francisco, *Curran*. SAN JOAQUIN CO. Clements, *Stanford* 233. Peters, *Stanford* 819. Tracy, *Baker* 2910. Waverly, *Stanford* 72. SAN LUIS OBISPO CO. Atascadero, *Eastwood* 14381. Black Butte, *Carlson* 230. Cavidos, *Eastwood* 14363. Cholame, *Eastwood* 13862. 2.5-22.2 mi. S. on Rd. to Simmler, *Dunn* and *Epling* 2215a; 2217; 2221; 2224. Estrella, *Dunn* and *Brydon* 1202; *Dunn* and *Epling* 2205; 2208. Goodwin, February, 1891, *Jared*. La Panza Ranch, *Peterson* 657. Paso Robles, *Baker* 2765a; *Dunn* and *Brydon* 1199. Pismo, June, 1889, *Summers*. San Luis Obispo, *Roadhouse* 189. Spanish Ranch, *Johannsen* 1021. Templeton, *Wiggins* 5857. SAN MATEO CO. Crystal Springs Lake, *Abrams*, 3.7 m. N.E. of La Honda, *Dunn* and *Brown* 2543. San Andreas Lake, *Baker* 1921. Skyline Blvd. S. of Canyon Rd., *Dunn* and *Brown* 2608. SANTA BARBARA CO. Cuyama Ranch, *Axelrod* 230. Cuyama Valley, *Weston* 565. Jaloma Rd. Jct. with Lompoc—Las Cruces Hwy. *Dunn* and *Epling* 2173. Miranda Pine Mt., *Graham* 478. San Marcos Pass, *Dunn* and *Brydon* 1184; 1187. Santa Inez Mts., 1888, *Brandege*. San Rafael Mts., April 17, 1938, *Epling*. SANTA CLARA CO. Alamitos Creek, *Constance* 2076. Coyote, *Hendrix* 776. Edenville, Serpentine Hill, *Ferris* 807. Evergreen, Dry Creek, C. P. *Smith* 1485. Guadalupe Mines, *Parks* 535. Halls Valley, C. P. *Smith* 1485. Loma Prieta, *Davy* 427; 531; 635. Los Gatos Canyon, C. P. *Smith* 3234; 3314. Mt. Hamilton, *Eastwood*. 11672; *Candler* 6052. Packard Ridge, *Sharsmith* 735, (in part). San Antonio Valley, *Sharsmith* 1689a. Santa Isabella Creek, *Sharsmith* 697; 1935. Smith Creek Hotel, C. P. *Smith* 1464. Morgan Hill, C. P. *Smith* 3249. Pacheco Pass, *Eastwood* and *Howell* 5321. Palo Alto, May 12, 1893, *Tidestrom*. Saratoga, *Pendleton* 335. San Martin, *Abrams* 5179. W. of Stanford Lake, *Dunn* and *Brown* 2519. Stanford Univ. Golf Course, *Dunn* and *Brown* 2526. Stanford University, *Abrams* 2372. Wright, C. P. *Smith* 3750. SANTA CRUZ CO. Glenwood, 1914, *Davis*. Rays, June 2, 1890, *Price*. SHASTA CO. Anderson, *Heller* 12991. Redding, *Heller* 12992. SISKIYOU CO. Yreka, *Bulter* 1190; 1252. SOLANO CO. Good-year, *Baker* 3218. Vacaville, *Heller* 13372. SONOMA CO. Healdsburg, *King*. Petaluma, *Newberry*. Russian River, 1860-67, *Bolander*. Santa Rosa, *Eastwood* 10369. STANISLAUS CO. Adela, *Stanford* 853. Arroyo del Puerto, *Sharsmith* 1784. Arroyo del Valle, *Eastwood* 12458, (in part). Modesto, May, 1928, *Dudley*. Mouth of Arroyo Del Puerto, *Sharsmith* 1561. Oakdale, *Abrams* 9965. SUTTER CO. Marysville Buttes, *Ferris* 649; 6368. TRINITY CO. Hay Fork Mts., *Tracy* 6461. Upper Van Duzen River near Cobbs, *Kildale* 10423. Weaverville, *Kildale* 10823. TULARE CO. Bear Creek, *Purpus* 1726. Delano, *Munz* 9012. Between Earlimart and Delano, *Eastwood* 3959. Kaweah, *Hopping* 550. Lewis Creek, *Lindsay*, *Munz* 9109. Loch Ranch, April 25, 1928, *Winblad*. Milo, April 5, 1900, *Dudley*. Oak Grove, Mineral King Road, *Bacigalupi* 1207. Porterville, *Donnelly* 32. Sequoia National Forest Hot Springs, *Jardine* 158. Three Rivers, *Abrams* 10798. Tulare, *Davy* 3048. Tule River, *Munz* 9134. Grapevine Springs, 35 mi. E. of Visalia, March, 1898, *Woolsey*. TUOLUMNE CO.

French Flat, *Ferris* 1535. Indian Creek, *Ferris* 1535. Jamestown, *Abrams* 10007. 10 mi. W. of Mather, *Keck*, 403; 407. Standard, *Johannsen* 747. VENTURA CO. Mutan Flat, *Abrams* and *McGregor* 190. Cat. Mt. *Gifford* 36. Ojai Valley, *Munz* and *Crow* 11464. Santa Paula, *Davy*. Sespe Creek, *Clokey* and *Anderson* 6702. Ventura, March 25, 1922, *Kendall*. YUBA CO. Marysville, April 2, 1913, *Wootton*.

OREGON. JOSEPHINE CO. Coves City to Waldo, *Eastwood* and *Howell* 1377. 11 mi. N. of Grants Pass, *Eastwood* and *Howell* 1456. Sexton Mt., *Thompson* 2067. Takelina, *Abrams* and *Benson* 10340. Waters Creek, *Henderson* 5776. JACKSON CO. Rouge River, Central Point, *Heller* 13077. LANE CO. Eugene, *W'ynd* 1281. LINN CO. Santiam Rd. near Halsey, *Thompson* 10143. YAMHILL CO. *Summers* 155.

3f. *Lupinus bicolor* subsp. *tridentatus* var. *rostratus* (Eastw.) Dunn, comb. nov.

L. bicolor var. *rostratus* Jeps., Fl. Calif. 2: 273. 1936.

L. rostratus Eastwood, Proc. Calif. Acad. II 6: 424, Pl. 46, 1896.

Vegetative parts identical with Coast Range *L. b. tridentatus*; pedicels 1.6 mm.; calyx pubescence 0.4-0.6 mm. long, lower lips 3.6 mm. long, teeth 0.1 mm., upper lobes 3.1 mm. long, fused laterally to the lower lip for 2.9 mm., upper lobes connate for 1.0 mm., bracteoles 0.6 mm. long; banner 4.6 mm. long; reflexed part 2.3 mm., appressed part 2.5 mm. (ratio 0.90); wings 4.7 mm. long, 1.1 mm. wide; keel 1.0 mm. wide at the middle, angle 119°, distal part 2.7 mm. long, basal part 3.3 mm. long; pods 1.7 cm. long, 3.9 mm. wide; seeds 4-7, 2-4 mm. long, 2.0 mm. wide.

The measurements given above are approximate since they apply only to the complete rostrate modification, of which there were only a limited number of specimens. This once proposed species is an entity in which the lobes of the upper lip of the calyx, themselves deeply split, are almost wholly united laterally with the lower lip. Hence, the calyx somewhat resembles a scoop with five teeth, of which the two lateral, representing the upper lobes, are larger than usual. The corolla is also different. The keel and banner are normal, but the wings are slender and of the same size and shape as the keel. This gives a remarkable "rostrate" form to the flower. The wings are also sometimes ciliate along the distal half of the upper margin in the same fashion as the keel and are frequently fused on the upper margin, the lower margin being free. This completely modified form is known only from the type locality at Estrella, San Luis Obispo County, where it has established itself, growing together with subspp. *tridentatus* and subspp. *pipersmithii*. However, similar individuals and colonies are also found in subspp. *microphyllus* and *umbellatus*, in which case the banner and the keel, as well as the vegetative parts, are normal for those subspecies.

The characters of the calyx and the wings of the corolla are independent, as shown by the specimen collected by *Head*, referred to under subspp. *tridentatus*, in which only the calyx was modified, and also specimens of subspp. *umbellatus* collected by *Brandege* (Santa Cruz Island), more robust than the rest of the colony however, by *Heller* 14507 (Brentwood, Contra Costa Co.) and by *Eastwood* and *Howell* 5269 (Livermore Valley, Alameda Co.) in which the calyces were normal, but the wings were modified as described. There is a transition form which is quite common from the type locality, Estrella, southward at least as far as Simmler in San Luis Obispo Co. in which the tip of the wing is prolonged into a nipple, the wings and rest of the flower being otherwise normal for *L. b. tridentatus*. This form is believed to be the first step in the developmental series in the formation of *L. b. var. rostratus*.

One specimen *Heckner* (Brownsboro, Jackson Co., Oregon) has the wing tip modification only. It is of the Sierran type of subspp. *tridentatus* with the larger flowers and obovate banner approaching, if not related to, *L. vallicola* subspp. *apricus*.

"Rostrate" modifications were also found in several colonies of *L. bicolor* subsp.

microphyllus. Some of these had only the wings modified, while others had both the wings and the calyx modified. These include specimens from Pasadena (*Grant 735*), Inglewood (*Abrams 2350*), the Tehachapi Mts. (*Bright 8342*), and Acton Jct. (Epling), all of Los Angeles County. In Riverside Co. at Beaumont there is a population of *L. bicolor* subsp. *marginatus* showing the wing tip modification.

There is no demonstrated ecological adaptedness but this unusual variant has successfully maintained itself for well over 50 years.

DISTRIBUTION (Map, not shown).

CALIFORNIA. SAN LUIS OBISPO CO. Estrella, *Dunn* and *Brydon 1201-1*; *Dunn* and *Epling 2211*; years 1894, 1895, and 1897, *Jared* (Type). Citation limited to the complete modification only.

3g. LUPINUS BICOLOR subsp. *marginatus* Dunn, subsp. nov.

Type—*Dunn* and *Epling* (No. 2129), collected at Gorman, California.

Erect vel suberectus annuus 18-50 cm. altus, adpresso-pubescentis et pilis extensis 1.0-2.0 mm. longis ornatus; foliolis 7-8, raro 9, maximis 15-31 mm. longis, 2.6-5.4 mm. latis, anguste oblanceolatis, mucronatis; paginis ambabus pilis adpresso-pubescentibus; pedunculis 4.0-8.0 cm. longis; racemis 3.0-12.5 cm. longis; verticillis 3-9, inter se 1.2-2.3 cm. distantibus; bracteis 4.0-9.0 mm. longis, caducis; pedicellis 1.5-2.8 mm. longis, pubescentibus; calycibus bilabiatis subadpresso-pubescentibus, labiis ad basim 0.7-1.2 mm. connatis, inferiore 3.3-4.7 mm. longo, tridentato, superiore 2.1-3.5 mm. longo, bracteolis 0.2-0.6 mm. longis; vexillo obovato, truncato vel paulo emarginato 4.5-7.5 mm. longo, 3.0-6.8 mm. lato; carina ad medium 1.4-2.3 mm. lata et supra medium ciliolata; siliquis maximis 2.1-3.5 cm. longis, 4.4-6.0 mm. latis, subadpresso-pubescentibus; seminibus 6-8, 2.5-3.0 mm. longis, 1.8-2.5 mm. latis, variegatis.

Erect or suberect annuals 18-50 cm. tall, usually with numerous long basal branches; pubescence appressed, or spreading and ascendent 0.2-0.6 mm. long, with few to numerous spreading hairs 1.0-2.0 mm. long; leaflets 7-8, occasionally 9, the largest 15-31 mm. long, 2.6-5.4 mm. wide, usually narrow oblanceolate or linear, in dry seasons, mucronate, both surfaces with appressed pubescence 0.4-0.9 mm. long; longest petioles 4.0-9.0 cm. long; stipules 8.0-16.0 mm. long, connate to the petioles 2.0-6.0 mm.; peduncles 4.0-8.0 cm. long; racemes 3.0-12.5 cm. long; verticils 3-9, generally 5 or 6, distinct, 1.2-2.3 cm. distant, usually 2 cm. or more at maturity; bracts 4.0-9.0 mm. long, fugacious; pedicels 1.5-2.8 mm. long, evenly ascendent-pubescent; calyces with subappressed-pubescence 0.8-1.3 mm. long, the lips connate 0.7-1.2 mm., the lower 3.3-4.7 mm. long, straight, tridentate, the teeth occasionally as much as .4 mm., the lobes of the upper lip 2.1-3.5 mm. long, united 0.9-1.6 mm., the bracteoles 0.2-0.6 mm. long; banner obovate, truncate or slightly emarginate, 4.5-7.5 mm. long, 3.0-6.8 mm. wide, (L/W ratio 1.1-1.6) well reflexed from the wing tip, the reflexed part 2.3-3.6 mm. long, the appressed part 2.3-3.7 mm. long, (R/A ratio .88-1.0), angle 120°-155°; wings oblong, 4.9-7.4 mm. long, 2.0-5.0 mm. wide; fused along the outer margin; keel ciliate on the distal half, 1.4-2.3 mm. wide at the middle, the angle 93°-115° (ave. 108.5°), the upper limb 3.0-4.2 mm. long, the lower 3.3-4.8 mm. long; the largest pods 2.1-3.5 cm. long, 4.4-6.0 mm. wide, covered with subappressed pubescence .6-.9 mm. long; seeds 6-8, 2.5-3.0 mm. long, 1.8-2.5 mm. wide, variously colored and mottled.

The obovate banners and more compact racemes, which are distinctly verticillate, tend to set this subspecies apart. It is also generally more hairy. The extreme is found in the Cuyamaca Mountains where individuals are frequently 40 cm. tall, quite villous, with basal petioles 7 cm. long and not uncommonly with 6-9 verticils in a raceme. It ranges from the Tehachapi Mountains to the Sierra Juarez in Lower California. It descends on to the margin of the Mohave and Colorado deserts.

Its closest relative is the Coast Range form of *L. bicolor tridentatus* from which it was undoubtedly derived. The banner venation is similar and there are populations

in the Tehachapi Mountains which are difficult to place in one subspecies or the other. *L. b. marginatus* may well have been derived by a rare chance cross of *L. b. tridentatus* and *L. b. microphyllus*. Vegetative characters show some similarity to the latter, although this may be due to environmental selection alone. It is also partially interfertile with both while failures to cross were recorded with everything else but *L. vallicola vallicola*.

DISTRIBUTION (Map 4).

CALIFORNIA. KERN CO. Arvin, March 30, 1941, Epling, Caliente, *Heller* 7622. Clear Creek Service Sta., *Dunn* 902a; 903; 905. Fort Tejon, *Abrams* 11673. Grapevine, *Dunn* and *Brydon* 1248. Keene, *Dunn* 892. Lebec Hotel, *Dunn* and *Epling* 2132; 2137. Tehachapi Pass, *Munz* 8969. Tehachapi, *Brandegeee*. Tehachapi Mts., *Bright* 8316. Monolith, *Keck* 2270. LOS ANGELES CO. Acton, *Dunn* and *Epling* 2120. Antelope Valley, *Abrams* 11710; May, 1905, *Davidson*; *Dunn* and *Epling* 2138; 2139; 2140. Elizabeth Lake, *Clokey* and *Templeton* 4716. Gorman, *Dunn* and *Epling* 2129; *Nordstrom* 381. Palmdale, *Dunn* and *Epling* 2150. 10 mi. W., *Johnson* 3970. Redrock Mt., *Gifford* 541. Sandberg, *Munz* 4420. RIVERSIDE CO. Banning, *Abrams* 10999; *Dunn* 989. Beaumont, *Dunn* 5541. Cabazon, *Dunn* 2921; *Munz*, *Street* and *Williams* 2460. 9 mi. S. Hemet, March 28, 1929, *Vestal*. Keene Camp, May 19, 1922, *Munz* and *Johnston*. San Jacinto Mts., June 4, 1941, H. Lewis. SAN BERNARDINO CO. Hook Creek, *Axelrod* 406. San Bernardino, *Parish* 4639; 4662. SAN DIEGO CO. Banner, *Brandegeee*; *Dunn* 996. Campo, Warrens Ranch, *Eastwood* 9391; 9472. Cuyamaca Lake, *Abrams* 3841. Cuyamaca Ranch, *Dunn* 1280. Cuyamaca Valley, June, 1880, *Vasey*. Descanso, *Eastwood* 9177a; *Dunn* 1269a. Below Desert View, *Stover* 231. Harper's Ranch, between Cuyamaca Lake and the Laguna Mts., *Dunn* 1277; 1278; 1279. Laguna, *Mearns* and *Schoenfeldt* 3586. Laguna Mts., Laguna Camp, *Munz* 8384; 9692. Lake Henshaw, *Gander* 2013. Pine Hills, *Gander* 1759. Rattlesnake Valley, Harper's Ranch, *Gander* 5903. San Felipe, *Dunn* 920. San Felipe Ranch, *Wiggins* 1981. Santa Ysabel, May 1, 1893, *Henshaw*. Warners Springs, 1911, *Coombs*. Witch Creek, 1893, *Alderson*.

MEXICO. BAJA CALIFORNIA. Sierra Juarez, Laguna Hansen, June 10, 1933, *Gander*.

4. *Lupinus nanus* subsp. *latifolius* (Benth. ex Torr.) *Dunn*, comb. nov.

L. nanus var. *latifolius* Benth. ex Torr. Pac. R. R. Rep. 4: 81. 1857. A lectotype designated by me is in the Lindley Herbarium at Cambridge, England, on the same herbarium sheet as an isotype of *L. nanus* subsp. *nanus*. Torrey's only reference was that material in the Coulter Herbarium was designated as *L. nanus* var. *latifolius* by Bentham, hence my use of the Coulter specimen so designated. (See *Dunn* and *Epling* No. 2181 and *Dunn* and *Brown* No. 2456 for typical material.)

Erect or decumbent annuals 14-42 cm. tall, branching mostly at the base, appressed-pubescent with occasional or sometimes numerous spreading hairs 1-2.5 mm. long; leaflets 5-7, the larger 1.2-3.3 cm. long, 1.8-7.6 mm. wide, oblanceolate to linear-oblanceolate, the tips acute or rounded, both surfaces generally pilose, the hairs 0.2-0.5 mm. long, or occasional individuals with more or less hispid pubescence up to 1 mm. long, frequently appearing glabrous to the eye, the longest petioles 3.5-7.7 cm. long; stipules 3.5-10 cm. long; racemes 5.0-18.5 cm. long, verticils 2-10, distinct, 1.0-2.5 cm. distant at anthesis; bracts 4.5-12 mm. long, fugacious, generally not greatly exceeding the flower buds; pedicels 3.5-9.0 mm. long; calyces appressed-pubescent, the lips connate 1-1.5 mm., the lower 4.3-7.1 mm. long, well reflexed, tridentate, the teeth as much as 0.5 mm. long, the lobes of the upper 2.9-5.7 mm. long, united 1.5-2.4 mm., the bracteoles 0.3-2.2 mm. long; banner orbicular, emarginate, 10.0-15.4 mm. long, 10.6-16.3 mm. wide, (ratio 0.87-1.10), the reflexed part 5.5-8.6 mm. long, the appressed part 4.2-6.5 mm. long, (ratio 1.0-1.7), angle 115°-140°; wings 9.8-14.0 mm. long, 5.8-9.0 mm. wide; keel ciliate in the distal half, 2.7-3.9 mm. wide at the middle, the angle 90°-105°, the upper and lower limbs subequal; the largest pods 2.9-4.0 cm. long, 5.2-6.7 mm. wide, subappressed-pubescent; seeds 4-12, 3.8 mm. long, 2.9 mm. wide, tan, the angle mark a brown streak, unevenly stippled outside this mark.

The subsp. *latifolius* of *L. nanus* (formerly considered and distributed as *L.*

nanus typical) extends along the foothills of the northern Sierra Nevada and along the coast from Mendocino County to Los Angeles County. Throughout most of this area it occupies territory in common with either *L. vallicola* or *L. vallicola* subsp. *apricus* or both although there seems to be a habitat difference. In the North Coast Ranges and in the Bay Region, it maintains its identity with respect both to *apricus* and *vallicola*. How closely it comes into contact with subsp. *menckerae* is not clear. The three subspecies of *L. nanus* proposed here intergrade wherever they come into contact and breeding experiments have shown them to have a fair degree of interfertility. Intermediate individuals were found in the vicinity of Monterey, San Luis Obispo, Tassajara Hot Springs and King City indicating some gene flow between the subspecies. Each is adapted to a particular habitat, however, and shows geographic segregation. All three subspecies show a self preference in fertility but have opportunity for both selfing and crossing as will be demonstrated in another paper.

DISTRIBUTION (Map 5, partion citation).

CALIFORNIA. ALAMEDA CO. Alameda, 1888, *Greene*. Oakland, *Brewer* 2775. AMADOR CO. Ione, *Hansen* 1600. BUTTE CO. Chico, *Heller* 11311. Clear Creek, *Brown* 155. Durham, March 13, 1932, *Morrison*. Oroville, *Heller* 10685. Table Mt. Summit, *Heller* 15034. CALAVERAS CO. Angels Camp, *Eastwood* 11596. Camp Seca, *Yates* 5273. Knights Ferry, *Carlson* 385. Mokelumne Hill, *Blaisdell*. Sugar Loaf Mt., *Carlson* 306. Telegraph City, *Rutter* 129. LOS ANGELES CO. Santa Monica, April 29, 1899, *Barber*. Big Tujunga, April 15, 1928, *Welch*. San Dimas, Calif. Poly. Campus, *Dunn*. MARIN CO. Ignacio, *Abrams* 6896. Mill Valley, *Davy* 1241. MARIPOSA CO. Rear Valley, *Bolander* and *Kellogg*. MENDOCINO CO. Potter Valley, April, 1894, *Brandege*. Ukiah Valley, *Abrams* 6979. MONTEREY CO. Carmel, *Bright* 9100. Carmel Highlands, *Epling* 8294; 8535; 8544. Pacific Grove, *Dunn* and *Brown* 2456. *Elmer* 3553. Partington Creek, *Eastwood* and *Howell* 6002. San Jose Canyon, *Abrams* 4277. Seaside, *Heller* 6571. Salinas, *Wiggins* 5856. Tassajara Hot Springs, *Bacigalupi* 1115. NAPA CO. Calistoga, *Baker* 1990. Napa, *Howell* 6082. Rutherford, *Heller* 13845. PLACER CO. Lincoln, *Ramaly* 11099. SAN BENITO CO. Aromas, April, 1925, *Hickman*. San Juan, *Elmer* 4668. SAN FRANCISCO CO. Lake Merced, *Abrams* 1581. San Francisco Presidio, *Baker* 698. SAN LUIS OBISPO CO. Arroyo Grande, *Brewer* 451. *Dunn* and *Brown* 2281; 2283. Avila, *Eastwood* 13776. Nipomo, *Belsbaw* 1607. *Dunn* and *Brown* 2152. SAN MATEO CO. Belmont, *C. P. Smith* 3494. Daly City, *Dunn* and *Brown* 2598. *Howell* 1920. Moss Beach, *Dunn* and *Brown* 2572; 2577. SANTA BARBARA CO. San Miguel, *Coulter* 388. Santa Maria, *Dunn* and *Epling* 2181. *Munz* 9283. Surf, *Ferris* 7587; 7588; 7589. SANTA CLARA CO. Palo Alto, *Dunn* and *Brown* 2528. Permanente Creek, *Abrams* 6432. Stanford University, *Baker* 844. SANTA CRUZ CO. Bolsa Pt., *Akey* 25. Capitola, *Baker* 1964. Santa Cruz, *Jones* 2261; 2666 (in part). Soquel to 10 mi. S. *Dunn* and *Brown* 2621; 2622; 2625. SOLANO CO. Green Valley, *Howell* 2328. SONOMA CO. Bodega Pt. *Eastwood* 4842. Healdsburg, *Hellen* and *Brown* 5233. STANISLAUS CO. Knights Ferry, *Abrams* 10094. SUTTER CO. Sutter Buttes, April 10, 1935, *Whitaker*. TUOLUMNE Don Pedro Bar. *Nordstrom* 640. Jamestown, *Dudley* 10032.

4a. LUPINUS NANUS Dougl. ex Benth. subsp. NANUS

Lupinus nanus Dougl. ex Benth., Hort. Trans., N. S. Ser. II. 1: 409, t. 14 1835. Type a garden plant grown from seed collected by Douglas while at Monterey, California.

Erect or suberect annuals 14-57 cm. tall, commonly with several basal branches; pubescence appressed or spreading and ascendent 0.2-0.6 mm. long with few to many spreading hairs 1.0-1.9 mm. long; the largest leaflets 12.34 mm. long, 1.4-4.8 mm. wide, linear to linear-oblongate, the tips acute, both surfaces appressed pubescent 0.4-0.8 mm. long; longest petioles 2.5-8.5 cm. long; stipules 6.0-19.0 mm. long, connate to the petioles 1.8-6.0 mm.; peduncles 5.4-14.0 cm. long; racemes 4.0-24.0 cm. long; verticils 3-15, ave. 8.5, generally distinct, 1.2-2.5 cm. distant, occasionally as much as 3.5 cm. at maturity; bracts 5.5-10.0 mm. long, fugacious; pedicels 3.0-5.2 mm. long, ascendent-pubescent; calyces with silky sub-appressed-pubescence 0.8-1.5 mm. long; the lips connate 1.0-1.4 mm., the lower 3.7-5.7 mm. long, straight or reflexed, tridentate or entire, the teeth occasionally

as much as 0.4 mm. long, the lobes of the upper lip 3.2-5.0 mm. long, united 1.0-1.9 mm., the bracteoles 0.4-0.8 mm. long; the banner suborbicular 8.4-11.5 mm. long, 8.2-12.2 mm. wide, (L/W ratio 0.91-1.10) well reflexed from the wing tip, the reflexed part 4.6-6.9 mm. long, the appressed part 3.8-5.3 mm. long, (R/A ratio 1.00-1.50), angle 116° - 148° ; the wings 8.5-10.9 mm. long, 5.0-7.4 mm. wide, fused along the outer margin; keel ciliate on the distal half 2.4-3.3 mm. wide at the middle, the angle 92° - 118° (ave. 102°), the upper limb 5.7-7.2 mm. long, the lower 5.6-7.2 mm. long; the largest pods 2.2-3.4 cm. long, 3.8-5.6 mm. wide, covered with subappressed hairs 1.0-1.6 mm. long; seeds 6-10, 2.6-3.7 mm. long, 2.2-2.9 mm. wide, colored and mottled.

The vegetative characters of this subspecies as well as the pod and seed sizes are intermediate between *L. nanus latifolius* and *L. nanus menkeræ*. The flower size, however, is smaller than either but larger than most of the flowers of *L. vallicola apricus*. Those of the Sierra Nevada *L. vallicola vallicola*, however, are in some cases larger. *L. nanus nanus* was completely intersterile with *L. vallicola vallicola*, in all the tests to date, while both *menkeræ* and *L. nanus latifolius* showed some fertility in the laboratory with *L. vallicola vallicola*. The two collections from Santa Barbara County at the southern end of the distribution show the development of some rather fine characters similar to Santa Barbara County *L. bicolor umbellatus* except for flower size. The relationship suggests this area as the point of origin of the *L. bicolor* complex, although interfertility tests of these colonies have not yet been made. The banner venation of these colonies of *L. b. umbellatus* is like that of *L. nanus* complex.

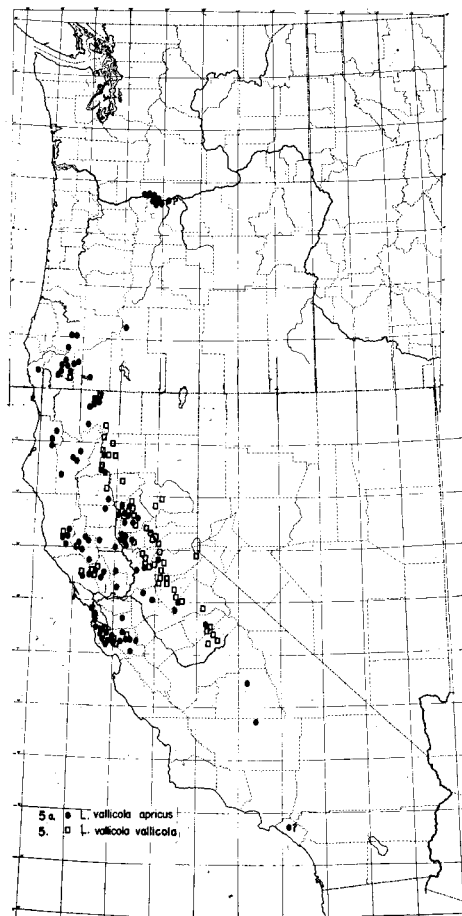
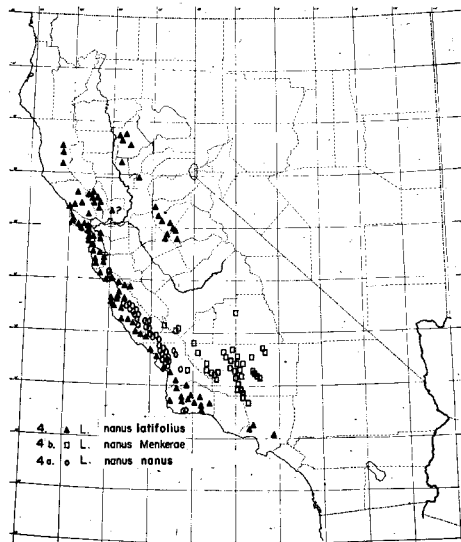
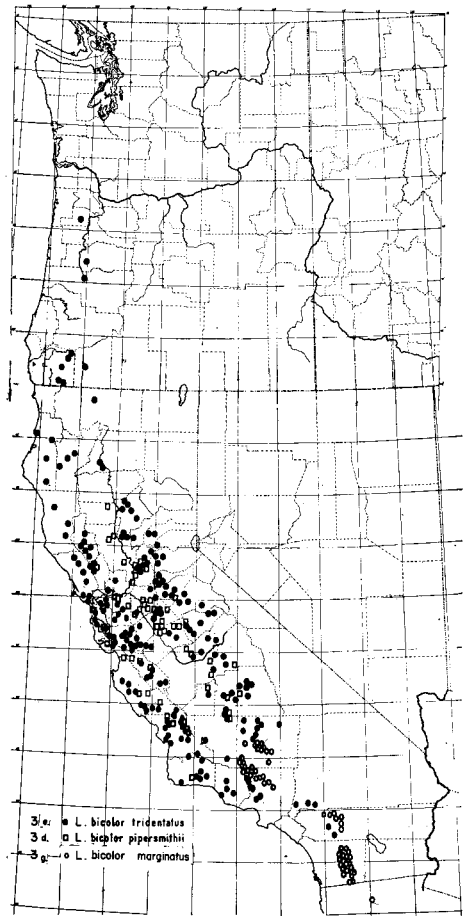
DISTRIBUTION (Map 5).

CALIFORNIA. MONTEREY CO. Bradley, *Baker* 3263a. Burnett Cr., April 4, 1901, *Dudley*. Jamesberg, April 10, 1905, *Bacigalupi*. Jolon, *Dunn and Brown* 2350; 5-7 mi. N., *Dunn and Brown* 2354; 2357. Jct. of Rd. S. to Jamestown, *Dunn and Brown* 2430; 5 mi. N. of Jct., *Dunn and Brown* 2431; 9 mi. N. of Jct., *Dunn and Brown* 4232. King City, *Abrams* 6473. May 12, 1897, *Eastwood*; *Keck and Clausen* 3044. 7-12 mi. W. of Hwy. 101 on Rd. to Lockwood, *Dunn and Brown* 2339; 2347. 17.8 mi. W. of Jct. *Dunn and Brown* 2348. Rancho Camillo Carmel Valley, *Dunn and Brown* 2437. 4.7 mi. N., *Dunn and Brown* 2439. 5.9 mi. N. (*L. nanus nanus* and hybrids present), *Dunn and Brown* 2442. Jct. Salinas-Monterey Hwy. and Rd. S. to Jamestown (*L. nanus nanus* and hybrids present), *Dunn and Brown* 2448. Santa Lucia Mts., Lynch Ranch, April, 1908, *Dudley*. Santa Lucia Mts. Mansfield Ranch, May 1-12, 1897, *Eastwood*. Santa Lucia Mts., San Miguelito Ranch, May 1-12, 1897, *Eastwood*. Tassajara Hot Springs, *Elmer* 3272; 3298. Jct. of Tassajara Hot Springs Hwys. & Rd. N. to Jamestown, ca. 15 mi. W. of Greenfield, *Dunn and Brown* 2360. 1.3 mi. N. of Jct. 3269; 6.5 mi. N. of Jct. 2386; 7-12 mi. N. of Jct. 2393; 2399; 2401; 2403; 2406; 2412; 15-17 mi. N. of Jct. 2425; 2426; 2427. SAN LUIS OBISPO CO. Atascadero, *Dunn and Brown* 2294; 2297; 1-4 mi. S., *Dunn and Brown* 2292; 2323; 2324; 2326. Estrella, *Dunn and Epling* 2212. Hay Canyon, *Peterson* 720. La Panza, *Keck* 2820. 4-6 mi. N. Nipomo, *Dunn and Brown* 2279; 2280. Paso Robles, *Grant* 725. 7.3 mi. U. San Luis Obispo on Hwy. 101, *Dunn and Brown* 2284. Santa Margarita, *Dunn and Epling* 2203; *Dunn and Brown* 2288; 2290. 8 mi. S., *Dunn and Brown* 2286; 4 mi. N., *Dunn and Brown* 2291. Templeton, *Wiggins* 2065; *Dunn and Brown* 2333. Williams Ranch, *Nordstrom* 1141. SANTA BARBARA CO. Gaviota, *Dunn and Epling* 2160; 2166. SANTA CRUZ CO. 1 mi. N. of Boulder Creek Bridge, Hwy. 9, *Dunn and Brown* 2616. Hwy. 9 mi. N., of Felton, *Dunn and Brown* 2618.

4b. *Lupinus nanus* subsp. *menkeræ* (C. P. Sm.) *Dunn*, comb. nov.

L. nanus var. *menkeræ* C. P. Smith, Bull. Torr. Bot. Club 50: 167. 1923. Type collected by Heller (No. 7588) at Bakersfield, California.

Erect to decumbent annuals 9-40 cm. tall, the longer branches chiefly basal, generally sprawling, minutely appressed-pubescent throughout and more or less hispid with spreading hairs 1.5-2.0 mm. long; leaflets 6-8, the largest 1.1-4.0 cm. long, 1.6-3.9 mm. wide, linear to linear-oblancoate, the tips acute, both surfaces sparsely appressed-pubescent, the upper appearing glabrous; longest petioles 3.5-7.4 cm. long; stipules 5.8-14.6 mm. long, adnate to the petioles 2.4 mm.; long-



Map 4 (LEFT). Distribution of *Lupinus bicolor* subsp. *tridentatus*, *L. bicolor* subsp. *pipersmithii* and *L. bicolor* subsp. *marginatus*. Map 5 (CENTER). Distribution of *Lupinus nanus* subsp. *nanus*, *L. nanus* subsp. *menckerae* and *L. nanus* subsp. *latifolius*. Map 6 (RIGHT). Distribution of *Lupinus vallicola* subsp. *vallicola* and *L. vallicola* subsp. *apricus*.

est peduncles 3.2-11 cm. long; racemes 4.3-12.5 cm. long, bearing 2-8 generally distinct verticils, as much as 3 cm. distant; bracts 4.2-8.6 mm. long, fugacious, generally much exceeding the flower buds; pedicels 3.5-7.0 mm. long, very slender; calyx covered with hairs of varying length, the lips connate 1-1.5 mm., the lower 4.3-6.5 mm. long, reflexed, the tips tridentate, the teeth as much as 0.5 mm. long, the lobes of the upper 3.6-5.7 mm. long, united 1.5-2.3 mm., the bracteoles 0.2-1.0 mm. long; banner rotund and emarginate, 9.0-15.0 mm. long, 9.2-17.0 mm. wide (ratio 0.85-1.0); generally broader than long, the angle 120° - 145° ; the strongly reflexed part 5.0-8.8 mm. long, the appressed part 4.7-7.2 mm. long (ratio 1.0-1.5); wings 9.8-14.2 mm. long, 5.7-9.0 mm. wide; keel ciliate in the distal half, 2.3-3.7 mm. wide at the middle, the angle 95° - 110° , the upper limb 6.2-8.5 mm. long, the lower 5.7-8.8 mm. long; largest pods 1.7-3.7 cm. long; 3.6-4.6 mm. wide, the appressed to subappressed hairs as much as 2.5 mm. long; seeds 5-13, 2.0-2.9 mm. long, 1.9-2.2 mm. wide, almost pure white or with small tan mottled patches, the angle faintly mottled or without markings.

Subsp. *menkeræ* is found in the southern end of the Great Valley, chiefly in Kern County. It differs from the other subspecies of *L. nanus* in the narrower pods and the mean number, size and color of the seeds. It has usually narrower leaves, as well. However, the population of *L. n. latifolius* which occurs in the foothills of the Sierra Nevada referred to above, is similar to subsp. *menkeræ* in respect to its narrow leaves, but can still be distinguished by its wider pods and characteristic ovules.

The range in flower size of subsp. *menkeræ* does not differ essentially from that of *L. n. latifolius*. This fact is shown by measurements of numerous field samples. The vegetative characters, pod and seed size however, represent the extreme in deviation from the parental *L. n. subsp. latifolius* with *L. n. subsp. nanus* forming an intermediate condition. The material cited from Nevada was termed common on the herbarium label but is the only known collection from that state. It presumably was transported to Nevada by livestock shipments, as the seed would readily pass through the digestive track of a cow.

DISTRIBUTION (Map 5).

CALIFORNIA. FRESNO CO. Alcalde and Coalinga, *Eastwood* 13489. KERN CO. Arvin, March 30, 1941, *Epling*. 30 mi. S. of Bakersfield, *Bacigalupi* 2338. San Dunes 10 mi. S. of Bakersfield, *Benson* 3109. Buena Vista Hills, April 9, 1893, *Eastwood*. Caliente, *Brandegge*. Clear Creek, *Dunn* 906. Dalloway's Station, *Abrams* 10859. Grapevine, *Dunn* 914; 917; *Dunn* and *Epling* 2131. Greenhorn Mts., *Benson* 3258. Junction of Bitter Valley Rd. with Paso Robles, Lost Hills Hwy., *Ferris* 9067. Lebec, April 29, 1927, *Jones*. 10 mi. E. of Maricopa, *Keck* and *Clausen* 3162. McKittrick. *Johannsen* 1490. Oildale, *Benson* 3252. Rose-dale, *Abrams* 7188. Shafter, *Abrams* 13751. Taft, *Munz* 13611. 41 mi. N. of Taft, *Dunn* and *Brydon* 1242. 5 mi. E. of Wasco, *Munz* 1011. LOS ANGELES CO. Fort Tejon, *Vasey* 22. MONTEREY CO. 35 mi. W. of Coalinga, *Dunn* and *Brydon* 1229. TULARE CO. Kaweah River Basin, *Hopping* 97.

NEVADA. ELKO CO. Holmgren Range Survey No. 135.

5. LUPINUS VALLICOLA Heller subsp. VALLICOLA

L. nanus var. *vallicola* C. P. Smith, Bull. Torr. Bot. Club 50: 168. 1923. *L. vallicola* Heller, *Muhlenbergia* 4: 40. 1908. Type collected by Heller (No. 7850) at Redding, California. *L. persistens* Heller, op. cit., 2: 62. 1905 (not Rose). *L. blaisdellii* Eastw. Leaflets W. Bot. 18. 1941.

Erect or suberect annuals 1.9-5.5 dm. tall; longer branches mostly basal; pubescence appressed, with scattered or numerous spreading hairs 1.0-3.5 mm. long; leaflets 6-7, the largest 1.4-3.7 cm. long, 1.7-5.0 mm. wide, linear-oblong to linear-oblongate, the tips acute or obtuse, both surfaces appressed-pubescent; longest petioles 3.0-8.0 cm. long, averaging 5.0 cm. long; stipules 3-10 mm. long, adnate

to the petioles 1.3-4.7 mm.; longest peduncles 4-10 cm. long; corresponding racemes 3.5-16.0 cm. long; verticils 3-11, distinct, the longest internodes 0.8-2.2 cm. long at anthesis; calyx densely pubescent with fine hairs, the lips connate 0.9-1.4 mm., the lower 3.5-5.7 mm. long, generally straight or only slightly reflexed, tridentate to entire, the teeth averaging 0.1 mm. long, the lobes of the upper 2.8-4.7 mm. long, united for 1.4-1.8 mm., the bracteoles 0.2-1.1 mm. long, banner squatly orbicular, emarginate, the apex reflexed only 2 or 3 mm. away from the tips of the keel, giving the flowers a very compact orbicular appearance in outline when viewed laterally, 7-11 mm. long 7.6-13.0 mm. wide, (ratio 0.8-0.9) the reflexed part 3.3-5.4 mm. long, the appressed part 3.6-6.5 mm. long (ratio 0.7-1.0), the angle 115° - 140° , the sulcus deep; wings 6.7-9.3 mm. long, 4.4-6.6 mm. wide; keel ciliate on the distal half, 1.9-2.6 mm. wide at the middle, the angle 65° - 95° , the upper and lower limbs about equal; largest pods 2.1-2.9 cm. long, 4.0-5.2 mm. wide, appressed-pubescent; seeds 5-9, 2.9-3.7 mm. long, 2.3-2.7 mm. wide, dark with abundant fine stippling and scattered mottling on a tan background, the angle mottled.

Lupinus vallicola subsp. *vallicola* is chiefly an inhabitant of the Sierra Nevada foothills but occurs also in the North Coast Ranges and in the Bay region. It is found with both subsp. *apricus* and *L. n. latifolius*, but generally grows at higher elevations. In habit and aspect it is similar to both, as they occur in the Sierra Nevada, but it is generally readily distinguished by the proportions of the banner and the angle of the keel, but is sometimes difficult to separate from subsp. *apricus*. In the Bay Region and North Coast Ranges the narrower leaflets distinguish it from *L. n. latifolius* and the proportions of the banner from both. Using the Bay Region *L. vallicola* subsp. *vallicola* as breeding stock, experiments have shown the three subspecies of *L. nanus* to be virtually intersterile with it. There were no pods with full seed sets using pollen from any of the subspecies of *L. nanus* on *L. vallicola vallicola* and only about 12% pod set in the reciprocal crosses with two of the subspecies of *L. nanus* and no full pod sets in 94 tries with *L. n.* subsp. *nanus*. A few pods with 1-3 seeds developed which must be ruled as possible contamination until proven otherwise. Successful crosses were made, however, with all of the subspecies and varieties of *L. bicolor* that were attempted except one and it was only tried twice. Most of these crosses were in proportions of about 50% success. Thus the affinity of *L. vallicola* is with *L. bicolor* and not *L. nanus*. In addition colonies of *L. nanus* subsp. *latifolius* and *L. vallicola* subsp. *vallicola* have been found growing within 30 feet of each other with no intermediates and with both honey bees and bumblebees visiting the two indiscriminately. *L. vallicola* is thus an "ecospecies" apparently intersterile in nature with *L. nanus*. It is held apart from the subspecies of *L. bicolor*, with which it is fertile, by its requirement of insect aid in pollination and the general lack of insect visitation to the subspecies of *L. bicolor*. *L. bicolor* definitely does not need insect aid for pollination. There is also a considerable difference in the time of stigma receptivity in these latter two.

DISTRIBUTION (Map 6).

CALIFORNIA. AMADOR COUNTY. Agricultural Station, Hansen 16. Caminetti Ranch near Jackson, Mulliken 104. Middle Fork, Hansen 367. Ione, Hansen 1600. Plymouth, Nordstrom 422. Rich Gulch, Belsbaw 2436. Sutter Creek, May 10, 1918, Ann Wood. BUTTE CO. Butte Creek, Bruce 2034 (in part). Cherokee Mine, Heller 13105. Chico, Austin. Clear Creek and Paradise Grade, Heller and Brown 5530. De Sabla, June, 1917, Edwards. Durham, May 15, 1932, Morrison. Feather River bridge, Highway No. 26, Heller 15046. Oroville, Heller 11890; 15046. CALAVERAS CO. Calaveras Ranger Station, Eggleston 9182; 9273. Murphy, Stanford 412. EL DORADO CO. Clarksville, Johannsen 655. Nashville, July 12, 1902, Rixford. Placerville, April 21, 1928, Vorriede. Tallac, June 8, 1893, Dudley. Kelsey, May 8, 1883, Jones. LAKE CO. Lakeport, May 16, 1917, Bentley. MADERA CO. North Fork, Eastwood and Howell 5418. Sugar Pine, May, 1928, McDonald. MARIPOSA CO.

Miami, *Schlobohm* 148. Morison Bar, May 10, 1903, *Congdon*. Wawona, *Augustine* 151. MENDOCINO CO. Ridgewood, *Kildale* 4374. NAPA CO. Calistoga, *Eastwood* 11100. Mt. St. Helena Grade, *Abrams* 12246. Pope Valley, May 2, 1893, *Jepson*. NEVADA CO. Grass Valley, *Heller* 15067. Penn Valley, west of Grass Valley, *Heller* 13185. San Juan, May 23, 1935, *Whitaker*. PLACER CO. Applegate, May 28, 1937, *Pbelps*. Colfax, *Eastwood* 495. Between Lincoln and Sheridan, *Eastwood* 10584. Loomis, *Keck* 2434. Rocklin, *Eastwood* and *Howell* 4365. PLUMAS CO. Quincy, *Heller* 10865. SACRAMENTO CO. Cortland, *Heller* 14524. Folsom, May 1, 1928, *Vorriede*. Roseville, *Applegate* 5369. SANTA CLARA CO. Alama, *Dunn* and *Brown* 2515a. Lick Observatory, *Pendleton* 908. Los Gatos, *C. P. Smith* 3404. Stanford Univ. Golf Course, *Dunn* and *Brown* 2525. Walsh Rd. W. of Palo Alto, *Dunn* and *Brown* 2533. Wright, *C. P. Smith* 3749. SHASTA CO. Castella, *Eastwood* 1396. Ingot, *Applegate* 5831. McCloud River, near fish hatchery, *Heller* 13019. Pit River Ferry, *Brown* 253. Pollock, *Applegate* 5754. Redding, *Heller* 7850; 13929; 14356. SIERRA CO. Cedar Glen, May 25, 1920, *Jones*. SISKIYOU CO. Hornbrook, *T. Howell* 1343; 1345. Shasta City, *Eastwood* and *Howell* 1800. SONOMA CO. Knight's Valley, *Howell* 11792. Santa Rosa, *Baker* 706; *Heller* and *Brown* 5115. TEHAMA CO. Payne's Creek, *Eastwood* and *Howell* 1872. Red Bluff, April 6, 1913, *Wooton* (in part). TUOLUMNE CO. Columbia, *Lewis* 743. Mather, *Keck* 1200. YUBA CO. Los Vergils, *Eastwood* 10552. Marysville, June, 1932, *Jackson*.

OREGON. JOSEPHINE CO. Applegate River near Slate Creek, *Abrams* and *Benson* 10307.

5a. *Lupinus vallicola* subsp. *apricus* (Greene) Dunn, comb. nov.

L. apricus Greene, Leaflets 2:67. 1910. Type collected by *Baker* (No. 610) near Stanford University, California. *L. vallicola* var. *apricus* C. P. Smith, *Muhlenbergia* 6:135. 1911. *L. nanus* var. *apricus* C. P. Smith, *Bull. Torr. Bot. Club* 50:170. 1923.

Erect or suberect annuals 15-40 cm. tall, branching mostly at the base, minutely appressed-pubescent, with numerous longer spreading hairs; leaflets 6-8, the largest 1.0-4.0 cm. long, 1.4-5.0 mm. wide, oblanceolate to linear-oblanceolate, both surfaces pubescent; longest petioles 2.5-7.5 cm. long; stipules 5.0-12.0 mm. long, adnate to the petioles 2.0-5.0 mm.; peduncles 1.5-9.5 cm. long; racemes 1.0-12.5 cm. long; verticils 1-9, frequently indistinct, 12-23 mm. distant at anthesis; bracts 3.6-5.4 mm. long; pedicels 2.5-5.4 mm. long; calyces pubescent with hairs 0.2-0.5 mm. long, the lips connate 0.8-1.4 mm., the lower 4.0-5.5 mm. long, the lobes of the upper 2.8-4.4 mm. long, united 1.2-1.8 mm., the bracteoles 0.2-1.4 mm. long; banner nearly orbicular, 7.0-10.0 mm. long, 6.5-10.8 mm. wide (ratio 0.8-1.15), the reflexed part 3.5-5.5 mm. long, the appressed part 3.5-5.0 mm. long (ratio 0.8-1.25), the angle 115°-150°; wings 7.5-10.0 mm. long, 3.7-5.6 mm. wide; keel ciliate on the distal half, 1.5-2.5 mm. wide at the middle, the upper limb 4.5-6.0 mm. long, the lower 4.5-6.1 mm. long, the angle 75°-100°; pods 1.7-2.7 cm. long, 4.4-5.4 mm. wide, pubescent with subappressed hairs 0.2-0.6 mm. long; seeds 4-8, variously mottled.

Subspecies *apricus* is very widespread, corresponding in this respect to *L. bicolor* subsp. *tridentatus*, and at the same time it appears to intergrade with that subspecies. In habit the two are almost identical. The principal diagnostic characteristic is the shape of the banner. In addition, subspecies *apricus* usually has larger flowers and longer pedicels. As these two subspecies are found in the coastal parts of their respective ranges, except for occasional individuals in the Bay Region, they are quite distant. Along the Sierra Nevada, however, numerous individuals are found which can be referred as readily to one as to the other. The transition between *L. vallicola* and *L. bicolor* is therefore complete.

While *L. vallicola* subsp. *apricus* was not tested in the breeding experiments conducted, its morphological relationship is even closer to *L. bicolor* subsp. *tridentatus* and it will probably be found at least equally interfertile with the various subspecies of *L. bicolor*, as well as, equally intersterile with the subspecies of *L. nanus*. It is

presumably held apart from *L. bicolor* by the same mechanism which maintains *L. vallicola* subsp. *vallicola*.

L. strigulosus is an isolated population which is found in the vicinity of the Dalles, along the Columbia River. It was referred by C. P. Smith to *L. bicolor bicolor*, but after an analysis of its characteristics it seems to me to be rather a shadowy form of *L. vallicola* subsp. *apricus*, with which it is nearly identical.

DISTRIBUTION (Map 6).

CALIFORNIA. ALAMEDA CO. Livermore, *Eastwood* 12480. AMADOR CO. Ione, *Eastwood* 10079. BUTTE CO. 7 mi. below Centerville, *Heller* 11857. Cherokee, *Heller* 15010, Chico, *Heller* 1131; 11227. 14 miles northwest of Chico, *Heller* 11817. Mud Creek above Richardson Springs, *Heller* 13109. Irilde, *Bruce* 2035. COLUSA CO. College City, *King*, Leesville, *Brandegee*. EL DORADO CO. Coloma, *Benson* 27. GLENN CO. Orland, *Applegate* 5381. Walter Creek, *Eastwood* 1186. HUMBOLT CO. Hoopa, *Chandler* 1312. Klamath River, *Kildale* 9765. KERN CO. Greenhorn Mts., *Hall* and *Babcock* 5040. Pastoria Creek, *Noordstrom* 460. LAKE CO. Bartlett Springs, *Abrams* 12416. Bendmore Valley, *Yates* 3730. Burns Valley, *Bowman* 154. Eppersons, *Brandegee*. Hough's Springs, *Heller* 13143. Lakeport, *Baker* 2960 (in part). Kelseyville, April 12, 1930, *Blankinship*. Middletown, *Wolf* 1906. Sulphur Banks, *Bowman* 36; 204. MARIPOSA CO. Wawona, June 15, 1894, *Dudley*. MENDOCINO CO. Potter Valley, *Eastwood* 12736. Ukiah, *Abrams* 6991. Between Ukiah and Largo, *Abrams* 7013. NAPA CO. Calistoga, *Wiggins* 5765. Putah Canyon, March 18, 1928, *Robbins*. ORANGE CO. (?) Orange, April 4, 1902, *Davy*. SACRAMENTO CO. Folsom, *Heller* 12316. Sacramento, April 7, 1918, *Hannibal*. SAN FRANCISCO CO. San Bruno Hills, *Greene* 1969. San Francisco, C. P. Smith 3737. SAN JOAQUIN CO. Ione Road, *Stanford* 1341. Peters, *Stanford* 818; 1039. SAN MATEO CO. Adelante Villa, April 5, 1903, *Davis*. Los Trancos and San Francisquito Creek, *Abrams* 5128. La Honda, *Dunn* and *Brown* 2544. Langley Hill, *Yates* 5200. Skyline Blvd., 4 miles south of Canyon Rd. *Dunn* and *Brown* 2607. Canyon Rd. 4 miles east of Skyline Blvd. *Dunn* and *Brown* 2600. Stanford Univ. near Cedar Cottage, C. P. Smith 1374. SANTA CLARA CO. Alma, *Brandegee*; *Dunn* and *Brown* 2515; 2508; 2511. Black Mt., *Elmer* 4797. Campbell, *Borthwick* 55. Gilroy, C. P. Smith 3254. Guadalupe Canyon, March 20, 1921, *Mason* and *Borthwick*. Guadalupe Mines, *Parks* 0535. Los Gatos, *Heller* 7294a. Monte Bello Ridge, C. P. Smith 3334. Mt. Hamilton, *Howell* 1876. Palo Alto, March, 1893, *Dudley*. San Antonio Valley, *Sharsmith* 1842. Stanford University, *Abrams* 270; 2372; *Dunn* and *Brown* 2518. SANTA CRUZ CO. 7 mi. W.S.W. of Saratoga, *Jobannsen* 601. SHASTA CO. Anderson, *Jones* 178. 7 mi. S. of Redding, *Heller* 12992. SISKIYOU CO. Callahan, *Kildale* 8723. Yreka, April 27, 1928, *Applegate*. Yreka Creek, *Wheeler* 4399. SOLANO CO. Little Oak, May 15, 1896, *Jepson*. SONOMA CO. Santa Rosa, *Holman*. St. Helena, *Brandegee*. STANISLAUS CO. Arroyo Del Valle, *Eastwood* 12458 (in part). SUTTER CO. Marysville Buttes, *Ferris* 6368. Sutter City, *Heller* 7568. TEHAMA CO. Corning, March 26, 1929, *Benson*. TRINITY CO. Hawkins Bar, *Kildale* 10928. Ruth, *Tracy* 10235. Weaverville, *Yates* 292. TULARE CO. 35 mi. E. of Visalia, March, 1898, *Woolsey* (in part). TUOLUMNE CO. Chinese Camp, *Eggleston* 9085. Columbia, *Grant* 648. Jacksonville, May 19, 1895, *Blasdale*. YOLO CO. Winters, *Eastwood* 14229. YUBA CO. Marysville, *Heller* 7555.

OREGON. CURRY CO. Snow Camp, *Thompson* 35. DOUGLAS CO. Cow Creek on Pacific Hwy., *Abrams* and *Benson* 10463. Myrtle Creek, *Thompson* 10176. JACKSON CO. Ashland, *Applegate* 2160. Evans Creek, *Hammond* 75. Wimer, *Hammond* 75. JOSEPHINE CO. Gold Hill, Rouge River, *Applegate* 4167. Grants Pass, *Canby* 58. Selma, *Applegate* 5708. Waters Creek, *Henderson* 5776. KLAMATH CO. Crater Lake National Forest, *Ingram* 1295. WASCO CO. The Dalles, *Peck* 5443.

WASHINGTON. KLICKITAT CO. Bingen, *Suksdorf* 497; 2591; 2592; 7204. The Dalles, *Gorman* 6032. Lyle, M. E. Jones 6311.

BRITISH COLUMBIA. Valley of Fraser River, *Macoun* (in part). Vancouver Island, Victoria, May, 1901, *Pineo* (in part).

6. LUPINUS PACHYLOBUS Greene, *Pittonia* 1:65. 1887. Type collected by Greene in the Briones Hills, Contra Costa County, California.

L. micranthus var. *pachylobus* Jeps., Fl. Western Middle Calif. ed. 1:318. 1901.

Erect or suberect annuals 10-25 cm. tall, occasionally 35 cm., finely appressed-pubescent and with numerous longer, spreading hairs 2-2.5 mm. long; leaflets 5-8, 1.5-3 cm. long, 2-4 mm. wide, linear-oblong to slightly oblanceolate, widest at the

middle, both surfaces subappressed-pubescent; petioles 4-8 cm. long; stipules 9-18 mm. long, adnate to the petioles 3-6 mm. or more; peduncles 3-12.5 cm. long, occasionally longer; racemes few-flowered, 1.0-3.5 cm. long; subverticils 1-3, rarely 4, 0.3-2.4 cm. distant; pedicels 1.5-2.5 cm. long; calyx densely pubescent, the lips connate 1 mm., the lower 4-5 mm. long, generally straight, the teeth 0.1-0.4 mm. long, the lobes of the upper 3.5-4.5 mm. long, united 1.3-2.2 mm., the bracteoles 0.3-0.9 mm. long; banner 7-8.5 mm. long; 6.5-7.5 mm. wide (ratio 1.0-1.17), the reflexed part 3-4.2 mm. long, the appressed part 3.6-4.7 mm. long (ave. ratio .883), the angle 140° - 155° ; wings 7.5-8.5 mm. long, 3.5-4.5 mm. wide; keel glabrous, bearing an occasional hair near the acumen, 1.6-2.0 mm. wide at the middle, the angle 90° - 105° , the upper limb about 5.1 mm. long, the lower 5.6 mm. long; pods 2.5-3.5 cm. long, 7.2-9.2 mm. wide, subappressed-pubescent; seeds 3-5, 4.3-5 mm. long, 3-3.5 mm. wide, cream colored, with a very fine brown stippling and brown mottled patches, the angle marked by a brown band.

The exact relationship of *L. pachylobus* to the other members of the *Micranthi* is obscure. It appears to be closest to *L. affinis*, but has undoubtedly been separated for some time.

DISTRIBUTION (Map 7).

CALIFORNIA. ALAMEDA CO. Livermore, *Constance* 93. AMADOR CO. New York Falls, *Hansen* 954. BUTTE CO. Chico, *Copeland* 3043. Chico Creek, *Heller* 15038. CALAVERAS CO. Mokelumne Hill, *Blaisdell*. Telegraph City, *Rutter* 129. CONTRA COSTA CO. Mt. Diablo, *Abrams* 8039. Peak east of Tassajara Creek, *Hoover* 3342. EL DORADO CO. Between Pilot Hill and Salmon Falls, May 7, 1909, *Brandegee*. Pilot Hill, Sayne's Ranch, April 28, 1915, *Brandegee*. FRESNO CO. Piedra, *Hoover* 3979. MARIPOSA CO. Cathay Valley, *Eastwood* 4350. Indian Gulch, *Belsbaw* 1797a. NAPA CO. Mt. St. Helena, *Eastwood* 6844; 11272. MONO CO. Sweetwater, *Simpson*. SANTA CLARA CO. Los Gatos, *Heller* 10379; *Smith* and *Eggleston* 19552. San Antonio Creek, March 19, 1898, *Dudley*. SHASTA CO. Redding, *Baker* 50. SONOMA CO. Altruria, April 7, 1900, *Eastwood*. Santa Rosa, March 29, 1920, *Mullory*. Taylor Mt., *Baker* 631. TUOLUMNE CO. Dudley, *Belsbaw* 1910. Jamestown, *Abrams* 10004. Keystone, *Abrams* 10052. YUBA CO. Marysville, April 23, 1935, *Whitaker*.

7. LUPINUS AFFINIS Agardh., Syn. Gen. Lupini 20, 1835. Type collected by Douglas in California.

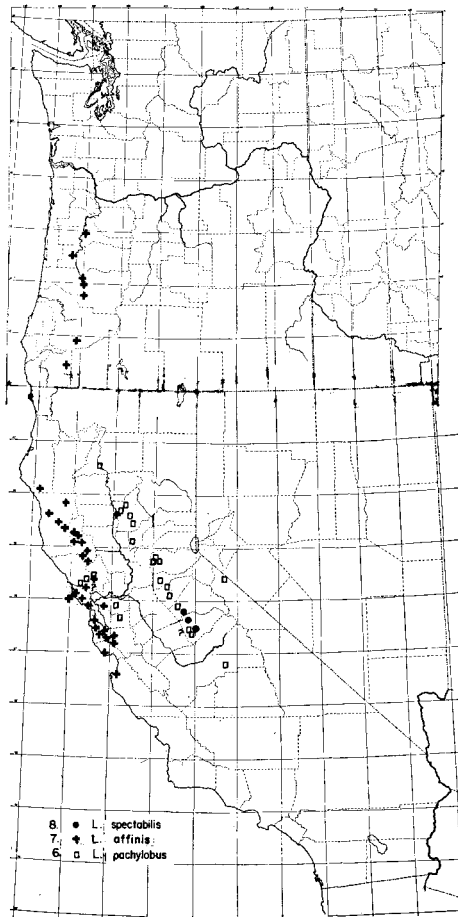
L. carnosulus Greene, Bull. Calif. Acad. 2:144. 1886. Type collected by Greene near Olema, Marin County, California. *L. affinis* var. *carnosulus* Jeps. Fl. West Middle Calif. 317. 1901. *L. nanus* var. *carnosulus* C. P. Smith, Bull. Torr. Bot. Club. 50: 165. 1923.

Suberect annuals 1.5-5.5 dm. tall, with or without longer hairs 2.0-3.0 mm. long; leaflets 5-7, the largest 2-5 cm. long, 5-14 mm. wide, spatulate to oblanceolate, the tips obtuse or acute, both surfaces pubescent, tending to appear glabrous; longest petioles 4-15 cm. long; stipules 7-20 mm. long, adnate to the petioles 2-7 mm.; peduncles 5-18 cm. long; racemes 4-20 cm. long; verticils 2-7, distinct, the lower 2.2-4.0 cm. distant; bracts 5-7.5 mm. long; pedicels 3.5-6.5 mm. long; calyx densely pubescent, the lips connate about 1 mm., the lower 4-6 mm. long or more, reflexed, entire or with teeth as much as 0.3 mm. long the lobes of the upper 4-6 mm. long, united 1.5-2.5 mm., the bracteoles 0.2-1.5 mm. long; banner orbicular, slightly emarginate, 8.5-11.5 mm. long, 8-12.5 mm. wide (ratio 0.82-1.18), the angle 100° - 130° ; wings 7.5-12 mm. long, 5-7.5 mm. wide; keel shortly ciliate on the distal half, the keel 2-3 mm. wide at the middle, a tooth or sharp shoulder on the upper margin near the middle (illustrated in Fig. 1), the angle 80° - 100° , the upper limb about 7.9 mm. long, the lower about 7.7 mm. long; largest pods 3.5-4.5 cm. long, 7.5-8.5 mm. wide, covered with spreading hairs 1-1.5 mm. long; seeds 5-8, 5 mm. long, 3.6 mm. wide, dark gray or brown with fine dark stippling.

This species shows as much affinity with *L. succulentus* as it does with *L. nanus* subsp. *latifolius*. The texture of the hair of the pod, the pod and seed size and shape, as well as the hollow succulent stem, and the size of the leaflets are all quite similar to *L. succulentus*.

DISTRIBUTION (Map 7).

CALIFORNIA. BUTTE CO. Chico, *Bruce* 2059. CONTRA COSTA CO. Oakland Road, *Smith* 3531. HUMBOLDT CO. Garberville, *Tracy* 9877. LAKE CO. Clear Lake Lodge, *Benson* 707. Dashiell's Mt., Sanhedrin, *Eastwood* 12801. Lower Lake, *Bowman* 255. Middletown, *Bacigalupi* 1258. Sulphur Banks, March 30, 1901, *Bowman*. Upper Lake to Lucerne, *Abrams* 12361. Weldon Valley, *Bowman* 222. MARIN CO. Lagunitas, *Eastwood* 3987. Mill Valley, March 23, 1896, *Jepson*. Olema, April 16, 1886, *Greene*. Pt. Reyes, April, 1886,



Map 7. Distribution of *Lupinus spectabilis*, *L. affinis* and *L. pachylobus*.

Greene. Rose Valley, *Michner* and *Bioletti* 2310. MENDOCINO CO. Junction of Fort Bragg Road and Redwood Hwy., *Kildale* 4397. Potter Valley, *Eastwood* 12749. Round Valley, *Chesnut* 141. Between Westport and Branscomb, May 27, 1921, *Head*. MONTEREY CO. Monterey, *Coulter* 387. NAPA CO. Mt. St. Helena, March 29, 1907, *Eastwood*. SAN MATEO

CO. Burlingame, May 31, 1895, *Eastwood*. Canyon Rd. E. of Skyline Blvd. *Dunn and Brown* 2601. Crystal Springs Lake, *Baker* 473; 1928. 3.7 mi. N.E. of La Honda, *Dunn and Brown* 2542. Portola, *Elmer* 5021. San Mateo Canyon, *C. P. Smith* 3290; 3292. San Mateo Ravine, April 21, 1894, *Dudley*. SANTA CLARA CO. Between Alma and Wright's Station, *Abrams* 10925. Canyon Rd. 4.7 mi. E. of Skyline Blvd., *Dunn and Brown* 2599. Stanford University, *Baker* 858. Forest Grove below Wright's, April 21, 1895, *Dudley*. Los Gatos, *Brandege*. Los Gatos Canyon, *C. P. Smith* 3386; 3323; 3320. Page Mill Road, April 26, 1914, *Dudley*. West of Los Gatos, *Heller* 7298. SANTA CRUZ CO. Mindogo Hill (Santa Cruz Quadrangle), *Wilson* 220. Santa Cruz, June 28, 1901, *Jones*. SONOMA CO. Larkspur Rock, *Eastwood* and *Howell* 7361.

OREGON. BENTON CO. Corvallis, *Gilbert* 120. DOUGLAS CO. Umpqua Valley, *T. Howell*. JOSEPHINE CO. Grants Pass, *T. Howell*. JANE CO. Coburg, *T. Howell* 1110. Eugene, *Rose* 32193. McKenzie River, *Henderson* 16045. MARION CO. Salem, *Nelson* 1165.

8. *LUPINUS SPECTABILIS* Hoover, Leaflets West. Bot. 2:31, 1938. Type collected by Hoover (No. 3397) on the grade from Coulterville to Bagby, Mariposa County, California.

L. nanus var. *perlasius* C. P. Smith, Bull. Torr. Bot. Club 50:164. 1923. Type collected by Congdon on the Mariposa-Coulterville Road, Mariposa County, California.

Erect annuals 15-50 cm. tall, branching mostly at the base; stems finely appressed-pubescent and bearing numerous spreading hairs 3-6 mm. long; leaves mostly basal; leaflets 7-9, oblanceolate, the largest 2-4 cm. long, 3.5-9 mm. wide near the apex, both surfaces covered with soft spreading hairs 2-3 mm. long; petioles 4-9 cm. long; stipules 12-18 mm. long, adnate to the petioles 4-5 mm. or more; peduncles 5-12 cm. long; racemes 5-30 cm. long; verticils 3-11, distinct, or mainly so, generally 2-3 cm. distant; bracts 8-9 mm. long; pedicels 6-8 mm. long, very slender at flowering time; calyx densely pubescent, the lips connate 1.4-2 mm., the lower reflexed, 5.5-7 mm. long, almost entire, or with teeth 0.1 mm. long, the lobes of the upper 5-7 mm. long, united 3-4 mm., somewhat saccate, the bracteoles 1-2 mm. long; banner orbicular, 14-17.5 mm. long, 14.2-21.5 mm. wide (ratio 0.74-0.93), the reflexed part 7.4-9.4 mm. long, the appressed part 6.6-7.8 mm. long (ratio 1.1-1.2), the angle 135°-143°; wings 13-16 mm. long, 8.3-11.7 mm. wide; keel ciliate on the distal half or almost glabrous, 3-4 mm. wide at the middle, the angle 70°-95°, the upper limb 10.6 mm. long, the lower 10 mm. long; pods 25-35 mm. long, 6-7 mm. wide, finely appressed-pubescent and bearing numerous spreading hairs 2.5-3.5 mm. long; seeds 5-7, 3 x 4 mm., cream to gray, mottled with brown.

The morphological hiatus of this species with the *Micranthi* is rather large. It may have been derived by a chance cross of the larger flowered southern Sierra Nevada members of *L. vallicola vallicola* with another species, (probably *L. benthami*).

DISTRIBUTION (Map 7).

CALIFORNIA. MARIPOSA CO. Coulterville Road, May 87, 1898, *Congdon*. Coulterville to Bagby, *Hoover* 3397. Mariposa, April, 1883, *Congdon*. TUOLUMNE CO. Upper Moccasin Creek Basin, *Hoover* 3389.

9. *LUPINUS NIVEUS* Wats. Proc. Am. Acad. 11:114, 126. 1876. Type collected by E. Palmer (No. 25) on Cliffs near the central part of Guadalupe Island, Mexico.

Erect annuals (or biennials) 14-35 cm. tall; branched at the base or simple, relatively few leaved, the entire plant covered by a yellowish (when dry) felt-like pubescence; largest leaflets 2.3-3.7 cm. long, 8-12 mm. wide, oblanceolate to obovate, the tips acuminate, both surfaces felty-pubescent; longest petioles 3.8-7.2 cm. long; stipules 6.5-11.5 mm. long, adnate to the petioles 1.7-2.7 mm.; peduncles 3-5 cm. long; racemes 1.0-9.3 cm. long; verticils 2-9, distinct, 8-14 mm. distant at anthesis; bracts 4.5-5.0 mm. long; pedicels 3.6-4.2 mm. long at anthesis; calyces felty-pubescent, the tips connate 0.9-1.2 mm., the lower 6.3-7.9 mm. long, reflexed,

the teeth as much as 0.1 mm. long, the lobes of the upper 6.0-6.4 mm. long, united 3.0-4.3 mm. the bracteoles 0.8-1.5 mm. long; banner oval, 10.5 mm. long, 13.2 mm. wide (ratio 0.80), the reflexed part 4.5 mm. long, the appressed part 5.3 mm. long (ratio 0.85), the angle 135° ; wings 10.2-11.0 mm. long, 7.3 mm. wide; keel sparsely and minutely ciliate on the distal half, 3.3-3.5 mm. wide at the middle, the upper limb 6.4-7.4 mm. long, the lower 7.3-7.6 mm. long, the angle 90° - 97° ; pods 3.9 cm. long, 8.3 mm. wide, thinly pubescent; seeds 4-5, 5.7 mm. long, 5.2 mm. wide, light tan with marginal stippling.

Any exact relationship of this species to the rest of the *Micranthi* is completely obscure as long as breeding experiments are not possible.

DISTRIBUTION (Map 3).

MEXICO. Guadalupe Island, *Franceschi*. High on the cliffs, middle of the Island, March 25, 1875, *E. Palmer* 25. Sandy canyon, south end of the Island, March 25, 1889, *E. Palmer* 861.

A new Subspecies of *Lupinus lyallii*

DAVID B. DUNN¹

While preparing the manuscript for *Lupinus* for the Flora of Nevada it was discovered that the following taxon had only an herbarium name. I wish to thank Dr. P. A. Munz for assistance in correcting the Latin and to express my appreciation for the use of the facilities at the Rancho Santa Ana Botanic Garden.

The type specimen is A. H. Holmgren, June 28, 1938, collected 10 miles N.W. of Elko, Elko Co., Nevada (UTC), (Isotypes at NA & Nev. Agr. Exp. both are numbered 00134). The name *subpandens* was applied to the herbarium sheets in a varietal status by C. P. Smith.

LUPINUS LYALLII Gray ssp. *subpandens* C. P. Smith ex. Dunn ssp. nov.

Herbae dense caespitoses, ex caudice lignoso; foliis 3-6 cm. altis; herba tota pilis crassis densis subadpressis, et pilis anulosis scaberulosis vel uncinatulis; petiolis 1-3.5 cm. longis, aliquando 6.5 cm. longis; foliolis 5-6, maximis 10-13 mm. longis, 2-2.5 mm. latis, ellipticis; pedunculis 3-7 cm. longis, supra foliis 2 cm. extensis; racemis 1-6 cm. longis, dense verticillatis; bracteis persistentibus; pedicellis 1 mm. longis; calycibus bilabiatis, labio superiore 4-4.7 mm. longo, 2-2.5 mm. inciso, labio inferiore 5 mm. longo, bracteolis 0.2-0.6 mm. longis; vexillo anguste oblongo; carina supra prope a acumine lanato-ciliolata; seminibus 3.

Plants densely caespitose, from a woody caudex; foliage 3-6 cm. tall; densely subappressed coarse-hairy throughout, the hairs scaberulous, ringed or barbed; petioles 1-3.5 cm. long, occasionally 6.5 cm. long; leaflets 5-6, 10-13 mm. long, elliptic, the hairs of the upper surface less scaberulous; peduncles ascending, 3-7 cm. long, exceeding the foliage by 2 cm. or more; racemes 1-6 cm. long, densely verticillate; bracts persistent; pedicels 1 mm. long; upper-lip of the calyx 4-4.7 mm. long, incised 2-2.5 mm., lower-lip 5 mm. long, entire, bracteoles 0.2-0.6 mm. long; banner narrowly oblong, yellow with a tinge of blue; keel lanate-ciliate above near the acumen, the acumen deep purple; ovules 3.

The taxon combines some of the characters of *L. aridus* with those of *L. lyallii*. The coarse barbed hairs are typical of *L. aridus* but are found in a diminutive form throughout most of the Lepidi group. The habitat, in flatlands of Artemisia at 5500

1. Visiting Botanist, at the Rancho Santa Ana Botanic Garden, Claremont, California.