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# Genetic and Taxonomic Studies in Gilia: VIII. The Cobwebby Gilias

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# GENETIC AND TAXONOMIC STUDIES IN GILIA

## VIII. THE COBWEBBY GILIAS[1]

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### HISTORY OF THE SECTION

The section *Arachnion* of *Gilia,* including the species *G. tenuiflora, G. latiflora, G. ochroleuca, G. sinuata,* and their relatives, is the largest single group in the genus, comprising some 44 taxa distributed among 17 species. This section has its principal center of distribution in California, where all but three of the species *(G. mexicana, G. tweedyi* and *G. crassifolia)* and all but four of the taxa (the aforenamed species plus *G. ophthalmoides flavocincta*) occur. The Cobwebby Gilias[2] have evolved the largest number of taxa and attained the greatest abundance of individuals in the Mojave Desert and the mountain ranges on its western border. The group extends also into various peripheral areas, particularly the South Coast Range of California, Baja California, the Sonoran Desert of Arizona, the Organ and Franklin Mountains region of New Mexico and western Texas, the northern Sierra Nevada, the Great Basin, and the Rocky Mountains. In South America a secondary center of distribution exists in the Chilean Desert, the Argentine Andes, and Patagonia.

Not only does the section *Arachnion* include the largest number of entities in any subdivision of *Gilia,* but it also comprises the taxonomically most complex and critical group in the genus and perhaps in the entire family Polemoniaceae. In consequence of numerous intergrades between the species, resulting from the widespread occurrence of natural hybridization, and in consequence of the presence of several pairs of sibling species separated by elusive distinguishing characters, the development of a taxonomic treatment serving the practical purposes of identification and classification has been beset with serious difficulties and has been greatly retarded as compared with many other plant groups. No existing regional flora or revisional treatment permits the correct identification of more than a small fraction of the Cobwebby Gilias. This situation is reflected in the state of chaos which is found in the Cobwebby Gilia folders in every herbarium, where several standard and well-known names have been applied more or less indiscriminantly to a variety of specimens.

The charting of the variation pattern in the section *Arachnion* may for convenience be divided into the three stages of exploration, surveying, and analysis, which according to Camp and Gilly (1943) and Stebbins (1950, ch. 1) describe the course of development of taxonomic research in general. The exploratory stage has consisted of the finding and describing of new forms. This process began with the first botanical expeditions to western North America and southern South America and has continued to the present day. Among the botanists who have contributed to the taxonomic exploration of the Cobwebby Gilias are Bentham (1883)[3], Douglas (1845), F. Philippi (1857-1860), Gray (1870-1886), R. A. Philippi (1895), Jones (1898-1908), Parish (1900), Eastwood (1904-1943), Rydberg (1904),

[1]This study was aided by a research grant from the National Science Foundation.

[2]Also referred to as the Woolly-leaved Gilias in earlier publications.

[3]Literature citations corresponding to these dates of publication of new taxa will be found in the lists of synonyms in the formal taxonomic section of this paper.

Milliken (1904), Brand (1907-1913), A. Nelson (1934), Munz (1935), Jepson (1943), Mason and A. Grant (1948), and numerous others who collected without publishing new names. Nor is the exploratory work on the section *Arachnion* ended yet. In the course of our own studies embodied in the present work it has been necessary to describe 4 new species and 15 new subspecies, and some additional described entities will almost certainly be added by future students.

Attempts to organize the scattered knowledge about the Cobwebby Gilias into a system of classification were begun, rather prematurely as it now appears, by Gray in the Synoptical Flora of North America (1886), Milliken in her Review of Californian Polemoniaceae (1904), and Brand in Das Pflanzenreich (1907). These early efforts led up to Jepson's treatment of the genus *Gilia* in his Flora of California (1943), with which the surveying stage of the taxonomic work may be properly said to have begun. This very competent treatment of the Cobwebby Gilias was soon superseded by the treatment of Mason and A. Grant in Abrams' Illustrated Flora of the Pacific States (1951). The latter treatment has served as a stepping-stone for the revision of *Gilia* § *Arachnion* which is presented in the following paper.

In Jepson's Manual (1925) the entire group was placed in six taxa, and in Jepson's Flora (1943) in nine taxa (cf. Table 1). Munz (1935) recognized eight taxa, and Mason and A. Grant (1951) fourteen taxa. The present treatment recognizes 39 taxa in California. Until the treatment of Mason and A. Grant it was customary to include *G. splendens,* now regarded as belonging in the section *Saltugilia,* as a variety of *G. tenuiflora.* The latter authors segregated *G. splendens* as a species, but failed to exclude it and several other extraneous elements *(G. stellata, G. scopulorum, G. leptomeria)* from the section.

In the present paper the section *Arachnion* is circumscribed and named; a new system of classification of the constituent entities is proposed; new formal descriptions and illustrations of the species and subspecies are given; their geographical areas are mapped; and the nomenclature is straightened out. The system of classification adopted here is outlined in Table 2.

This treatment is most reliable for the large-flowered diploid species, to which the closest attention has been paid. The small-flowered diploid and tetraploid species of the Great Basin and Rocky Mountains, viz. *G. inconspicua, G. ophthalmoides, G. tweedyi, G. transmontana,* require much further study; the treatment proposed here should be regarded as a framework within which the future studies can be carried out. *Gilia crassifolia* and its allies in South America can not be dealt with in any satisfactory way for the present and are included in the treatment merely to indicate their general relationships to the North American members of the section.

The third or analytical stage in the mapping of the taxonomic landscape, designed to elucidate the evolutionary relationships and history of the various entities, has been fairly commenced by a series of cytotaxonomic and genetic studies underway since 1948. The systematic revision of *Gilia* § *Arachnion* which follows is both a summary of the surveying work which has been carried out up to this point and a preface to future contributions to the evolutionary genetics of the group.

## METHODS

### *Herbarium and Field Studies*

The present study is based primarily on a combination of herbarium studies and field studies. The herbarium work revealed the critical problems and areas which required attention, and the field work in those areas made it possible to interpret more intelligently the herbarium material. Each winter the Cobwebby Gilia collec-

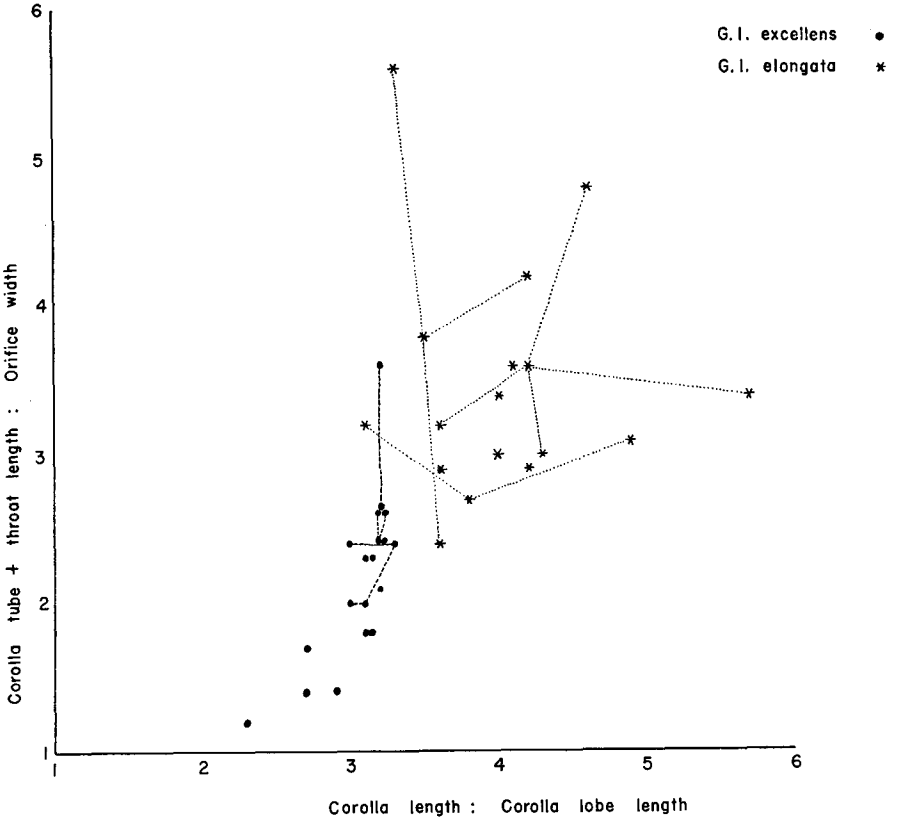



Fig. 1. Range of variation in *Gilia latiflora excellens* and *G. l. elongata.*

tions in the Rancho Santa Ana Botanic Garden and Pomona College Herbaria were restudied in the light of the field experience of the preceding spring and summer; each spring and summer we made a series of field trips which clarified problems raised by the herbarium studies of the winter before. This coordinated herbarium and field approach, carried on during the past seven years, has been indispensable for gaining an understanding of the section.

In the final analysis, nearly all of the western North American herbaria, and several eastern ones, were consulted. Specific and subspecific names were applied after consultation of type specimens or photographs thereof.

The steps followed in working out one particular taxonomic problem may be described as an illustration of the method of analysis. Preliminary observations in nature and in the herbarium indicated that there were two similar but markedly different forms of long-tubed large-flowered Cobwebby Gilias in the El Paso Mt. area of the northwestern Mojave Desert. A series of herbarium specimens including population samples collected by the authors was measured for thirteen carefully chosen characters in an effort to determine precisely the taxonomic differences. Two ratios using four of these characters proved consistently useful in separating the two forms. These two composite characters involved the proportions of the corolla: the ratio of corolla length to throat width, and the ratio of corolla length to lobe size.

TABLE 1. PREVIOUS CLASSIFICATIONS OF THE COBWEBBY GILIAS IN CALIFORNIA.

| Jepson (1925) | Munz (1935) | Jepson (1943) | Mason & A. Grant (1951) |
|---|---|---|---|
| 1. *G. ochroleuca* | 1. *G. ochroleuca* | 1. *G. ochroleuca* | 1. *G. ochroleuca* |
| 2. *G. tenuiflora* | 2. *G. tenuiflora* | 2. *G. tenuiflora* | subsp. *transmontana* |
| var. *purpusii* | 3. *G. exilis* | var. *arenaria* | 2. *G. abramsii* |
| var. *cana* | 4. *G. latiflora* | var. *exilis* | subsp. *integrifolia* |
| var. *davyi* | 5. *G. davyi* | var. *sinuata* | 3. *G. tenuiflora* |
| 3. *G. latiflora* | 6. *G. inconspicua* | var. *cana* | subsp. *interior* |
| | var. *sinuata* | var. *latiflora* | 4. *G. latiflora* |
| | var. *diegensis* | var. *speciosa* | subsp. *cana* |
| | | var. *davyi* | subsp. *speciosa* |
| | | | subsp. *purpusii* |
| | | | subsp. *triceps* |
| | | | subsp. *leptantha* |
| | | | subsp. *exilis* |
| | | | 5. *G. sinuata* |

TABLE 2. SYSTEM OF CLASSIFICATION OF THE COBWEBBY GILIAS ADOPTED IN THE PRESENT TREATMENT WITH THE GENERAL CHARACTERISTICS OF THE TAXA.

| Taxon | Authority | Geographical Distribution | Flower Size | Ploidy Level | Page No. |
|---|---|---|---|---|---|
| Gilia sect. Arachnion | Grant | | | | 214 |
| A. GILIA OCHROLEUCA GROUP | | | | | A. 221 |
| 1. G. ochroleuca | Jones | Calif. | | 2N | 1. 221 |
| a) exilis | (Gray) Grant | | large | | a. 222 |
| b) bizonata | Grant | | large | | b. 223 |
| c) ochroleuca | | | small | | c. 225 |
| 2. G. cana | (Jones) Heller | Calif., Nev. | large | 2N | 2. 226 |
| a) cana | | | | | a. 228 |
| b) speciosa | (Jepson) Grant | | | | b. 229 |
| c) bernardina | Grant | | | | c. 230 |
| d) speciformis | Grant | | | | d. 230 |
| e) triceps | (Brand) Grant | | | | e. 231 |
| B. GILIA TENUIFLORA GROUP | | | | | B. 232 |
| 3. G. leptantha | Parish | Calif., Nev. | large | 2N | 3. 233 |
| a) leptantha | | | | | a. 234 |
| b) purpusii | (Milliken) Grant | | | | b. 237 |
| c) transversa | Grant | | | | c. 238 |
| d) vivida | Grant | | | | d. 238 |
| e) pinetorum | Grant | | | | e. 239 |
| f) salticola | (Eastwood) Grant | | | | f. 240 |
| 4. G. aliquanta | Grant | Calif. | | 2N | 4. 241 |
| a) aliquanta | | | medium | | a. 242 |
| b) breviloba | Grant | | small | | b. 243 |

| | | | | | |
|---|---|---|---|---|---|
| 5. G. tenuiflora | Bentham | Calif. | large | 2N | 5. 244 |
| a) tenuiflora | | | | | a. 244 |
| b) arenaria | (Bentham) Grant | | | | b. 246 |
| c) amplifaucalis | Grant | | | | c. 246 |
| d) hoffmanni | (Eastwood) Grant | | | | d. 247 |
| 6. G. inconspicua | (Smith) Sweet | Wash., Ore., Ida., Calif., Nev., Utah, Colo., Ariz. | small | 2N | 6. 248 |
| a) inconspicua | | | | | a. 248 |
| b) interior | (Mason & Grant) Grant | | | | b. 253 |
| c) austrooccidentalis | Grant | | | | c. 254 |
| 7. G. minor | Grant | Calif. | small | 2N | 7. 254 |
| 8. G. mexicana | Grant | Ariz., N. Mex., Chihuahua | small | ? | 8. 255 |
| 9. G. ophthalmoides | Brand | Calif., Nev., Utah, Colo., Wyo., Ariz., N. Mex. | | 4N | 9. 258 |
| a) ophthalmoides | | | small | | a. 258 |
| b) clokeyi | (Mason) Grant | | small | | b. 260 |
| c) flavocincta | (Nelson) Grant | | large | | c. 262 |
| d) australis | Grant | | small | | d. 263 |
| 10. G. tweedyi | Rydberg | Ore., Ida., Nev., Wyo. | small | 4N | 10. 263 |
| 11. G. transmontana | (Mason & Grant) Grant | Calif., Nev., Ariz. | small | 4N | 11. 266 |
| C. GILIA LATIFLORA GROUP | | | | | C. 266 |
| 12. G. diegensis | (Munz) Grant | Calif., Baja Calif. | large | 2N | 12. 267 |
| 13. G. latiflora | Gray | Calif. | large | 2N | 13. 269 |
| a) cuyamensis | Grant | | | | a. 270 |
| b) latiflora | | | | | b. 272 |
| c) davyi | (Milliken) Grant | | | | c. 273 |
| d) excellens | (Brand) Grant | | | | d. 274 |
| e) elongata | Grant | | | | e. 275 |
| f) cosana | Grant | | | | f. 276 |
| 14. G. sinuata | Douglas | Wash., Ore., Ida., Calif., Nev., Utah, Colo., Ariz., N.Mex. | small | 4N | 14. 276 |
| 15. G. crassifolia | Bentham | Argentina, Chile | | 4N, 8N | 15. 279 |
| D. GILIA BRECCIARUM GROUP | | | | | D. 280 |
| 16. G. brecciarum | Jones | Ore., Nev., Calif. | | 2N | 16. 281 |
| a) brecciarum | | | medium and small | | a. 282 |
| b) neglecta | Grant | | large | | b. 283 |
| c) argusana | Grant | | large | | c. 283 |
| 17. G. tetrabreccia | Grant | Calif. | small | 4N | 17. 286 |

A scatter diagram was drawn in which a series of specimens of the group was plotted with respect to the two diagnostic characters (Fig. 1). Most collections could only be represented by a single dot on the graph. Our own mass collections, however, yielded information concerning the range of variation within a single population. In Figure 1 the extreme variants of one population are connected with an

average individual by dotted lines, the less extreme individuals being omitted from the diagram in the interest of simplicity. Inspection of the graph now revealed a more or less continuous intergradation in corolla proportions between a stout-formed type and an extremely slender-flowered form. The majority of the specimens, however, could be assigned to one or the other of two groups, as symbolized by round dots and asterisks respectively in Figure 1. Overlap in variation between these two groups is apparently confined to the extreme segregants in certain polymorphic populations belonging on the basis of their average characteristics to one of the alternative groups.

The group symbolized by round dots conforms to the type specimen of *Gilia tenuiflora* var. *excellens* Brand, and the name *excellens* was consequently applied to it. The group symbolized by the asterisks had not been described by any previous author and was tentatively named *elongata.*

The geographical relations of *excellens* and *elongata* were next investigated by plotting the series of specimens on a distribution map. This exercise revealed at once that *excellens* has a more western and *elongata* a more eastern distribution, but that the two taxa overlap in a section of the El Paso Mts. In order to explore further the ecological relations of the two forms in this area of overlap and in adjacent parts of the El Paso and Rand Mts., the specimens were mapped a second time on a large-scale topographic map. The interesting fact now emerged that *excellens* occurs in the open desert plains bordering the mountains and fingering into them, whereas *elongata* inhabits the mountain ranges themselves in the same areas. Where the distribution areas of the two taxa overlap, each form is restricted to its particular ecological niche.

The taxonomic position of *excellens* and *elongata* remained to be decided. The fact that these two taxa intergrade and occupy contiguous geographical areas suggested that they should be treated as a pair of subspecies. The possibility that *excellens* and *elongata* could be included in certain related species, such as *G. cana* or *G. leptantha,* was ruled out by the finding of definite morphological gaps between the *excellens-elongata* assemblage and any member of these other species. Since, however, *excellens* intergrades in another area with *davyi,* which in turn intergrades with *latiflora,* the group falls naturally into the polytypic species, *Gilia latiflora.* The names of the two long-tubed races therefore became *G. latiflora excellens* and *G. l. elongata.*

### *Cultural Studies*

Another procedure has been the growing in Claremont of representative strains of nearly all of the taxonomic entities. Since most of these specialized desert and desert-border annuals had never been successfully grown before, despite various attempts, it was necessary to devise special techniques for handling them. The long history of trial and error cannot be detailed here. The most important methodological advance was the erection at the Rancho Santa Ana Botanic Garden of a specially designed greenhouse with glass roof and screen sides (Fig. 2). Seeds were started in clay seed-pans in early winter in this screenhouse where they were exposed to freezing night temperatures. If they did not germinate under these conditions the seed-pans were permitted to bake out during the ensuing summer, whereupon germination frequently succeeded in the second winter. The seedlings were raised in 2 inch pots in the greenhouse and as they grew larger were either set out in an experimental plot with a well-drained sandy soil or transferred to 5 inch clay pots and retained in the greenhouse. The requirements of the plants for dry air, cold winter temperatures, hot spring and summer temperatures, and bright light were met in

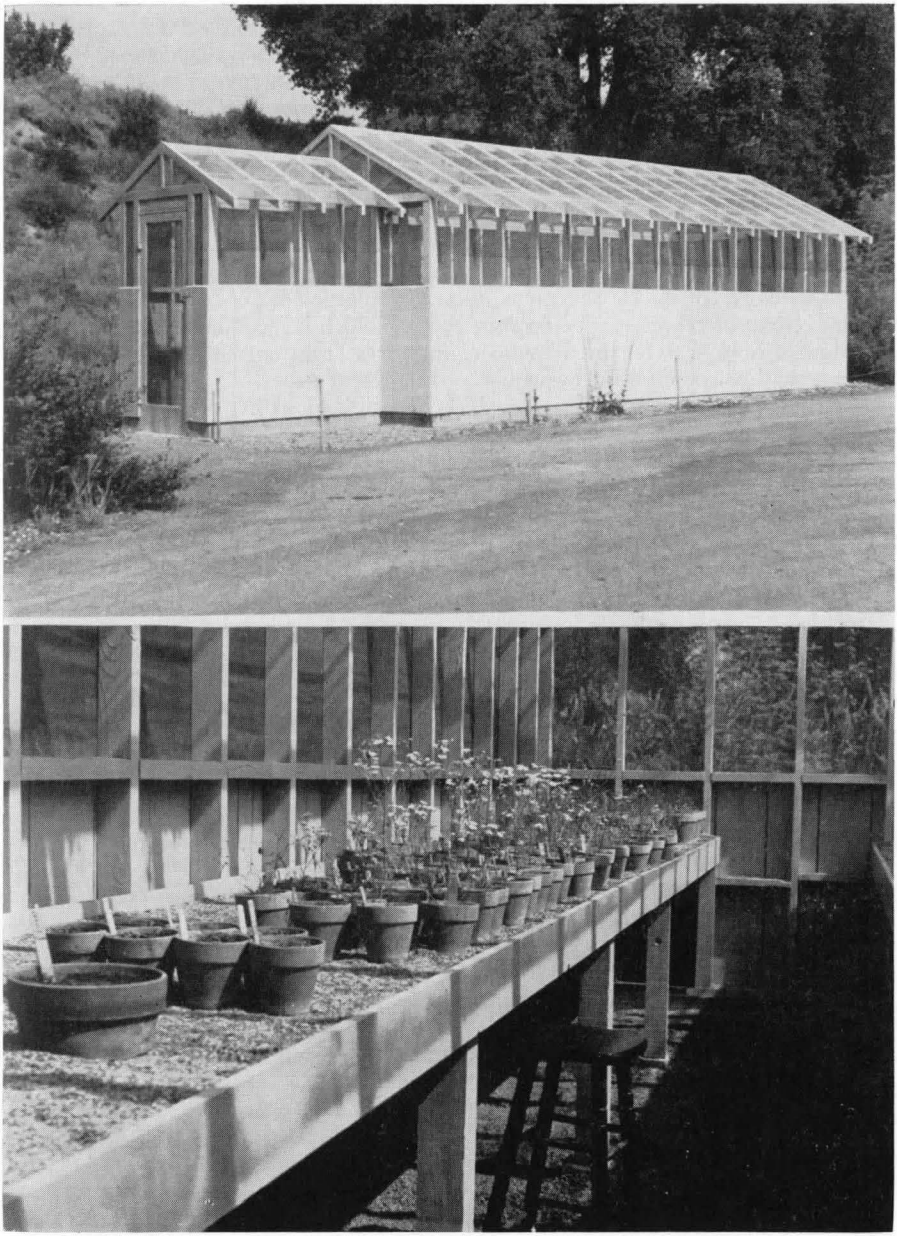


Fig. 2. Screenhouse used for growing desert Gilias at the Rancho Santa Ana Botanic Garden.

the special greenhouse, and their requirements for a porous and well-aerated substratum could be satisfied by the appropriate seed-bed and potting soil.

The living collection of Cobwebby Gilias in Claremont has made possible direct comparisons between the various taxa with respect to numerous characters of habit, general aspect, flower form, rate of development, and coloration of herbage and particularly of flowers, which are not preserved in herbarium specimens. It has had the further advantage of permitting these comparisons to be made in a uniform environment. The observations of the living plants were recorded in the form of notes, photographs, leaf silhouettes, and in other ways. A special problem was encountered in the recording of the complex color patterns of the corolla, which constitute a valuable character that is lost when the specimens are pressed and dried. This problem was finally solved by the preparation of enlarged water-color paintings of a selected group of representative flowers, part of which is reproduced here as Plate I.

Valuable help was obtained in many instances from chromosome counts. This evidence will be reported in the sequel to the present paper.

Finally, an extensive program of artificial hybridizations has been carried on during the years, resulting in a body of information concerning the fertility relationships and genomic affinities of the various species and races. This knowledge has been of the utmost importance in guiding us in our attempts to work out a natural system of classification. It should be admitted, however, that the taxonomic relationships of the entities as inferred from ecological and morphological studies have been at least as important for a critical interpretation of the genetic evidence as the latter has been for guidance in taxonomic decisions. A report on genetic relationships in the section *Arachnion* is being made ready for publication in a future contribution.

## SPECIAL DIFFICULTIES OF THE MATERIAL

The variation pattern of the Cobwebby Gilias is inherently and intrinsically complex. It might be humanly possible to exterminate enough complicating populations to render the variation pattern more amenable to rational treatment, but it is not humanly possible to treat this group as it now exists throughout western North America in any simple and easily followed manner. Some knowledge of the special difficulties of the group is a necessary prelude to the use of the key and descriptions.

Three aspects of variability contribute to the taxonomic perplexity. The aspects in question are phenotypic modifications, polymorphism, and racial variation.

The phenotypic plasticity of the Cobwebby Gilias is very great with the result that dissimilar forms often arise in a colony without any detectable basis. For example, small-flowered forms frequently occur in populations of normally large-flowered individuals as a response apparently to dryness and other unfavorable conditions in the microhabitat. Progeny of the small-flowered individuals and their large-flowered neighbors grown in the experimental garden are uniformly large-flowered. The aberration is thus purely phenotypic. But quite a few pairs of sympatric species are known, one member of which is large-flowered and the other a smaller replica. A common example is *Gilia latiflora latiflora* and *G. sinuata*. Special study has been required in order to distinguish between these contrasting situations.

Many if not most of the populations are polymorphic. This polymorphism involves a number of morphological characters and evidently also some chromosomal features, since some variants exhibit structural hybridity. The morphological types belonging to one population may be as different from one another as certain pairs of poorly characterized but well isolated sibling species. The range of variation in a typical polymorphic population may be illustrated by a single example. Figure 3 shows the range of variation in a population of *Gilia latiflora latiflora* from Hesperia

in the Mojave Desert; this colony contains some individuals approaching the extreme conditions of *G. l. latiflora,* others resembling *G. leptantha transversa,* as well as a varied assortment of recombinations. The decision as to whether the individuals of Cobwebby Gilia in one locality belong to one polymorphic population or to two or more sympatric sibling species is no simple matter.

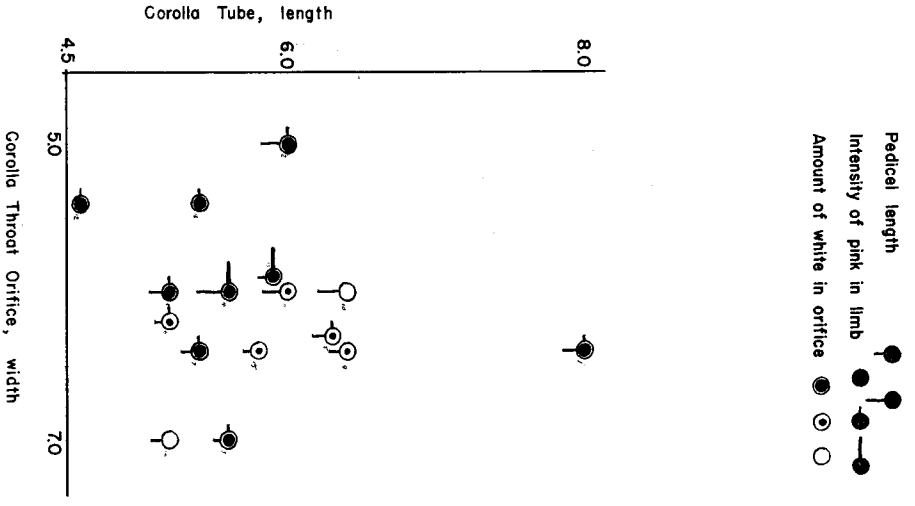



Fig. 3. Characteristics of a polymorphic population of *Gilia latiflora* near Hesperia in the Mojave Desert.

The polymorphism also creates difficulties for the determination of herbarium specimens which do not show the whole range of variation of the population. Since some extreme variants in one polymorphic population may mimic the more common individuals of a related species, an accurate identification may be impossible in the herbarium, given an inadequate series.

The total range of genotypically and environmentally induced variation is large in almost every species of Cobwebby Gilia. Even where the morphological distinctions between species are considerable, as they are generally in the large-flowered diploid groups, the ranges of variation may overlap and certain phenotypes of one species may mimic certain phenotypes of another. Where the interspecific differences are slight to begin with, as among the small-flowered diploid and tetraploid species, the overlapping of phenotypes creates even greater difficulties for identification.

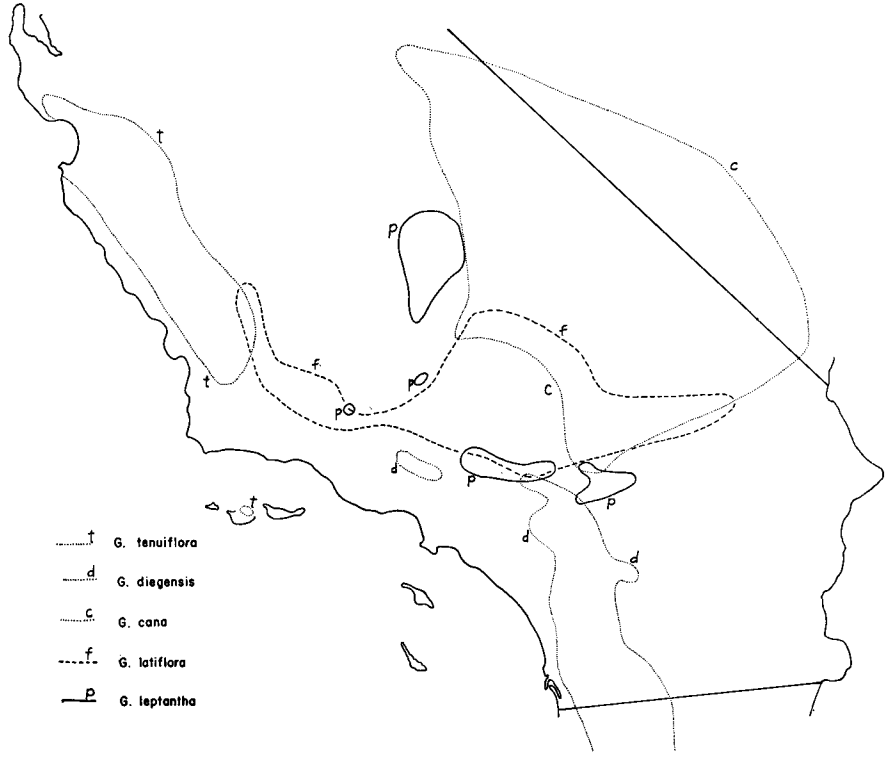
There is a great deal of racial variation from population to population which it is not practicable to recognize taxonomically. The smallest category deemed useful for taxonomic purposes in the present treatment is the broad regional aggregation of populations characterized by distinctive morphological characters, viz. the subspecies. The methods employed in outlining these basic taxa have been described in a previous section.

The study of geographical variation in the Cobwebby Gilias is complicated by the fact that these desert annuals are not regular elements in the flora from one year to the next. The desert species come up in nature only occasionally when the winter rains have been sufficiently abundant and properly spaced. Since one area in the desert may be favorable in one year, and another area in another year, the whole

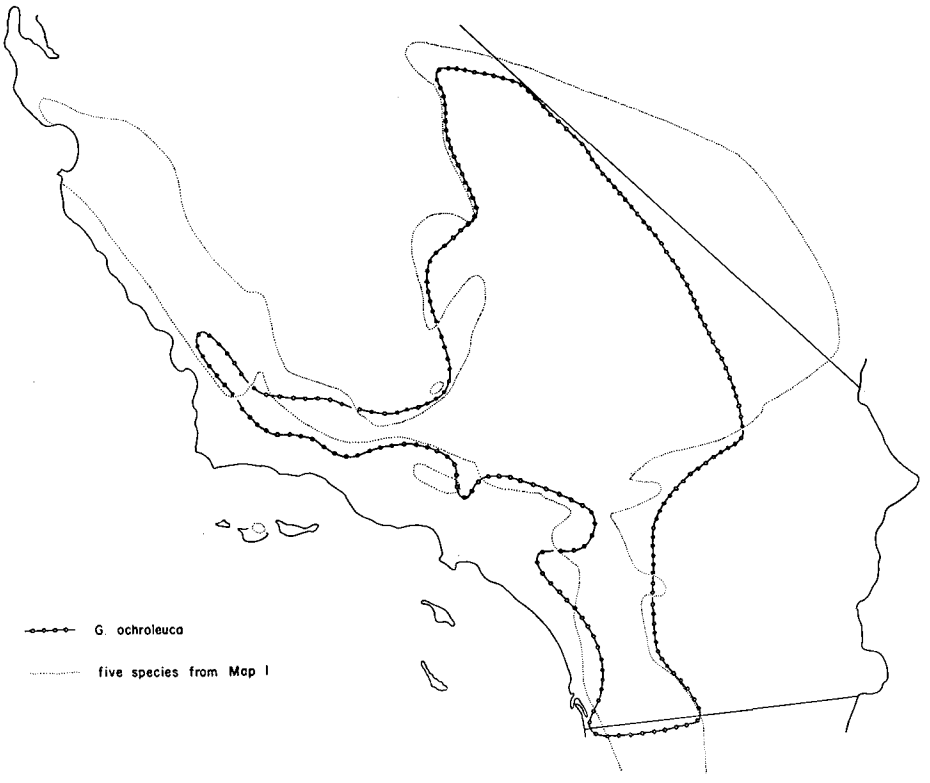
picture of geographical variation must be pieced together from studies and collections made in a succession of years. It is now known that *Gilia latiflora davyi* in Antelope Valley and *G. l. latiflora* in the Victorville region are connected by a complete series of intergrades. In no one spring during the past decade, however, have all populations between Victorville and Antelope Valley, a distance of about one hundred miles, been present simultaneously. The gaps in the cline had to be filled in as the areas occupied by the various intermediate populations received rain and as the populations themselves, one by one, made their appearance on the scene.

A tendency has frequently been observed for taxa inhabiting the same general area to exhibit parallel characteristics. Thus in the region from Kern Valley to Death Valley *Gilia latiflora, G. cana, G. leptantha* and *G. brecciarum* are all represented by subspecies with long corolla tubes and bipinnately dissected leaves. In the Mt. Pinos region five species in this section have developed small flowers and linear-lobed or deeply dissected leaves. Some common, widespread and often collected taxa went undescribed until the present study, because they resemble more or less closely other well known taxa with which they occur sympatrically so that their distinctness is not evident to casual observers.

Many of the races, particularly those which occupy isolated habitats, are separated by a certain degree of morphological discontinuity from all their relatives. On the other hand, as noted above, different taxa in the same area may come to resemble one another as a result of parallel evolution. Under these conditions the gaps in




Map 1. Geographical relationships between five species of large-flowered Cobwebby Gilias.




Map 2. Geographical relationship between *Gilia ochroleuca* and the five species shown on Map 1.

variation between sympatric species may be less apparent than the gaps between related subspecies. Until the whole complex has been carefully studied it is frequently not clear with which species a given taxon should be linked.

The final problem of the linking of the subspecies into species could be avoided in a system of classification designed solely for pigeon-hole purposes. In such a classification it would suffice to block out the natural morphological and geographical entities and apply a binominal nomenclature to them. Where, however, the system is intended to portray the natural relationships the further step must be taken of defining not only the basic taxa but also the collective species units to which these taxa belong. It so happens that the discontinuities by which species limits are traditionally defined are frequently obscure in the Cobwebby Gilias.

Several characteristics of the variation pattern in the Cobwebby Gilias have thus contributed to the taxonomic difficulty of the group. In the earlier stages of our study we more than once despaired of ever being able to unravel the species and subspecies. In case after case, however, where a rational solution once seemed impossible, continued study resulted in the pattern of relationships becoming clear. This is especially true with regard to the large-flowered diploid species, the study of which was particularly emphasized.

## TAXONOMIC CONCEPTS

The taxonomic decisions embodied in the present treatment were carried out within the framework of the biological species concept. A population system exhibiting distinctive morphological characters associated with a natural distribution area was as a rule treated as a subspecies. Subspecies replacing one another in adjacent areas were grouped into a polytypic species. A species was considered to be bounded externally by a gap in the variation pattern, such a gap being taken to reflect the presence of reproductive isolating mechanisms.

A discussion of the biological species concept as applied to higher plants has been given elsewhere (Grant, 1956). The application of this concept in certain members of the section *Arachnion* is not without serious difficulties. In the small-flowered forms these difficulties are largely practical and arise from the presence of morphologically similar but well isolated sibling species. Thus most of the reduced self-pollinating taxa, namely *Gilia aliquanta breviloba, G. minor, G. mexicana, G. ophthalmoides, G. transmontana, G. sinuata* and *G. inconspicua* in the present treatment, have heretofore usually been lumped in a single species .

Both practical and theoretical difficulties are involved in the defining of species in the large-flowered diploid group. The showy diploids, *G. ochroleuca, G. cana, G. leptantha, G. tenuiflora, G. diegensis* and *G. latiflora,* are more or less closely related to one another, have undoubtedly been derived from some common ancestral stock, and since their emergence as distinct entities have become secondarily linked together in various combinations by natural hybridization. (The role of hybridization in the evolution of the Cobwebby Gilias will form the subject of a future paper.) The species consequently interbreed and intergrade to some extent.

Jepson (1943) attempted to reduce all of these and some other entities to varieties of one species *(G. tenuiflora).* That the entities are more than intergrading subspecies, however, is indicated by the existence of numerous sympatric contacts between them. Maps 1 and 2 show the overlapping distribution areas of *G. ochroleuca, G. cana, G. leptantha, G. tenuiflora, G. diegensis* and *G. latiflora.* One solution, as far as this particular complex of forms is concerned, is to recognize the major constituents as species (or semispecies in the sense of Sibley) and the entire assemblage as a supraspecific unit, for which the term syngameon is suggested. A syngameon is defined as a group of hybridizing species (cf. Grant, 1956).

The taxonomic unit next in order above the species in the present treatment is the species group. This taxon is equivalent to the subsection in other classifications except that it does not have nomenclatural status. The latter feature in our view is an advantage since it permits the interrelationships of the species to be set forth with a maximum of informality and simplicity. It is clear that the species group is by no means synonymous with the syngameon either in definition or composition. The former is a taxonomic entity composed of phylogenetically closely related species. Whether the constituent species hybridize with one another in nature or not is irrelevant for the task of blocking out the species groups.

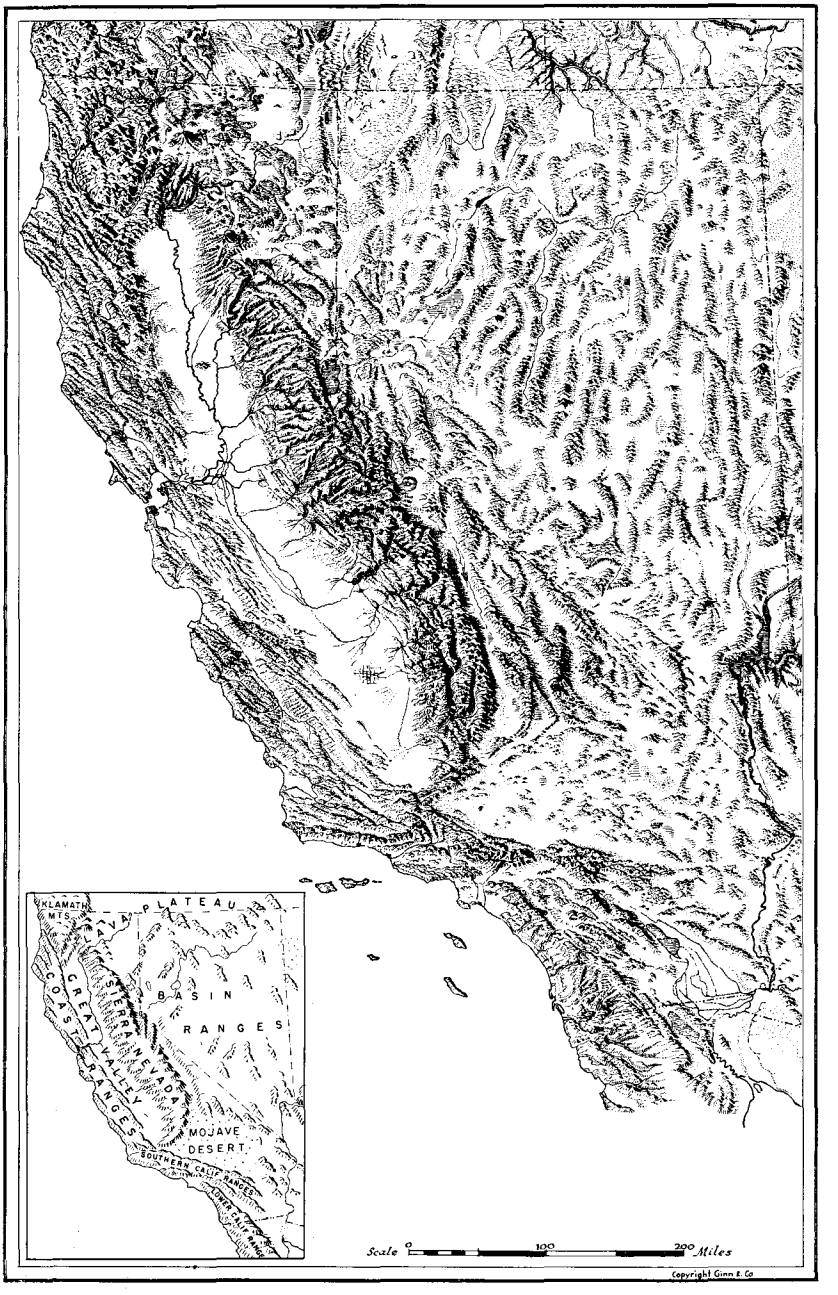
The Cobwebby Gilias as a whole are treated as a section coordinate with the Leafy-stemmed Gilias and the Woodland Gilias. This section appears to be a very natural phyletic unit within the genus *Gilia.*

## TAXONOMIC TREATMENT

*Gilia* sect. **Arachnion** A. & V. Grant, sect. nov.

*Gilia* subg. *Eugilia* of Milliken and of Mason & A. Grant, not sect. *Eugilia* of Bentham.

Annuals of medium to small size. Pubescence of herbage consisting of fine cobwebby hairs. Upper cauline leaves much reduced. Corolla funnelform. Corolla lobes




Map 3. Physiographic features of California and Nevada[4].

[4]Adapted from a map by E. Raisz in W. W. Atwood, *The Physiographic Provinces of North America.* Reproduced here with the permission of the publishers, Ginn and Company.

blue-violet, pinkish-violet or white. Stamens inserted in corolla sinuses.

Plantae annuae mediocres aut breves; pube foliorum ramorumque juvenum araneoso-lanata; foliis caulis superioribus reductis; lobis corollae caeruleo-violaceis vel roseo-violaceis vel albis.

*Range.*—Sandy habitats. Often very abundant in a good year. Western North America and temperate South America.

The center of variation lies in California, particularly in the southern half of the state. This is a region of great topographic and climatic diversity, where numerous different environments fit into a relatively small area. The concentration of a large number of taxa in a small area is made possible by the variety and often abrupt boundaries of the habitats. The general topographic features of this are are indicated in Map 3; some typical habitats are illustrated in Figures 4 and 5.

*Relationships.*—With the Woodland Gilias (sect. *Saltugilia*) and the *Gilia scopulorum* group (sect. *Gilmania*) in the subgenus *Gilia.*

*Type.*—*Gilia latiflora* Gray.

*Excluded Name.*—*Gilia inconspicua* subsp. *sinuata* var. *Milesii* Brand, Pflzr. 250: 105, 1907. The description consists of the statement, "folia valde dissecta." Two specimens are cited: *Miles,* San Luis Obispo County, Berlin Herbarium; and *Lemmon,* in part, Sierra Valley. There is no further identification of the specimens by number, date, or exact locality of collection. The Miles specimen at the Berlin Herbarium probably no longer exists. Lemmon made many collections of Gilia in Sierra Valley. Neither description nor citation of specimens permits us to identify this name, which is accordingly designated a *nomen dubium.*

*Herbaria Consulted.*—CALIFORNIA: University of California; California Academy of Sciences; Stanford University; Pomona College; Rancho Santa Ana Botanic Garden; Los Angeles County Museum. OREGON: University of Oregon, Oregon State College; Willamette University. WASHINGTON: Washington State College. WYOMING: University of Wyoming. COLORADO: University of Colorado. NEVADA: University of Nevada; Nevada Agricultural Experiment Station. UTAH:

Fig. 4. Typical habitats of the Cobwebby Gilias. Southern California mountains. A) Pinyon-Juniper Woodland mixed with sagebrush[5]; lower slopes of Mt. Pinos, Ventura County. Habitat of *G. ochroleuca bizonta.* B) Yellow Pine Forest with occasional *Quercus kelloggii* and *Libocedrus decurrens;* Fish Creek near the south fork of the Santa Ana River, San Bernardino Mts. Habitat of *G. leptantha leptantha.* C) Lower edge of Yellow Pine Forest with *Quercus chrysolepis, Q. kelloggii,* and *Pseudotsuga macrocarpa;* near Oak Glen, San Bernardino Mts. Habitat of *G. diegensis.* D) Chaparral with *Eriogonum fasciculatum, Yucca whipplei,* and *Cercocarpus betuloides;* Mill Creek Canyon, San Bernardino Mts. Habitat of *G. ochroleuca exilis.*

Fig. 5. Typical habitats of the Cobwebby Gilias. Mojave Desert. A) Creosote Bush Scrub; Panamint Mts. Habitat of *G. cana triceps.* B) View from the Argus Mts. across Owens Valley toward the Whitney area of the Sierra Nevada. *Gilia cana triceps* occurs in the desert near the point from which the photograph was taken, *G. cana cana* occurs in Pinyon Woodland and Pine Forest on the east slope of the Sierras; and *G. leptantha purpusii* inhabits Yellow Pine Forest beyond the crest of the range. C) Creosote Brush Scrub; Homewood Canyon, Argus Mts. Six species of *Gilia* were found in a small side canyon angling off to the left: *G. cana triceps, G. brecciarum argusana, G. minor, G. stellata, G. scopulorum,* and *G. filiformis.* D) Creosote Bush Scrub with scattered *Yucca brevifolia;* southwest end of the El Paso Mts. Habitat of *G. latiflora excellens, G. brecciarum argusana,* and *G. aliquanta aliquanta.* E) Creosote Bush Scrub; northwest of Inyokern. *Gilia ochroleuca ochroleuca, G. minor, G. sinuata,* and *G. transmontana* inhabit the plains in the foreground; *G. cana speciosa* the canyons in the background. F) Joshua Tree Woodland with *Chrysothamnus nauseosus;* Nine-mile Canyon in the southeasten Sierra Nevada. Habitat of *G. cana speciosa.*

[5]For details concerning the associations see Munz and Keck, 1949-1950.

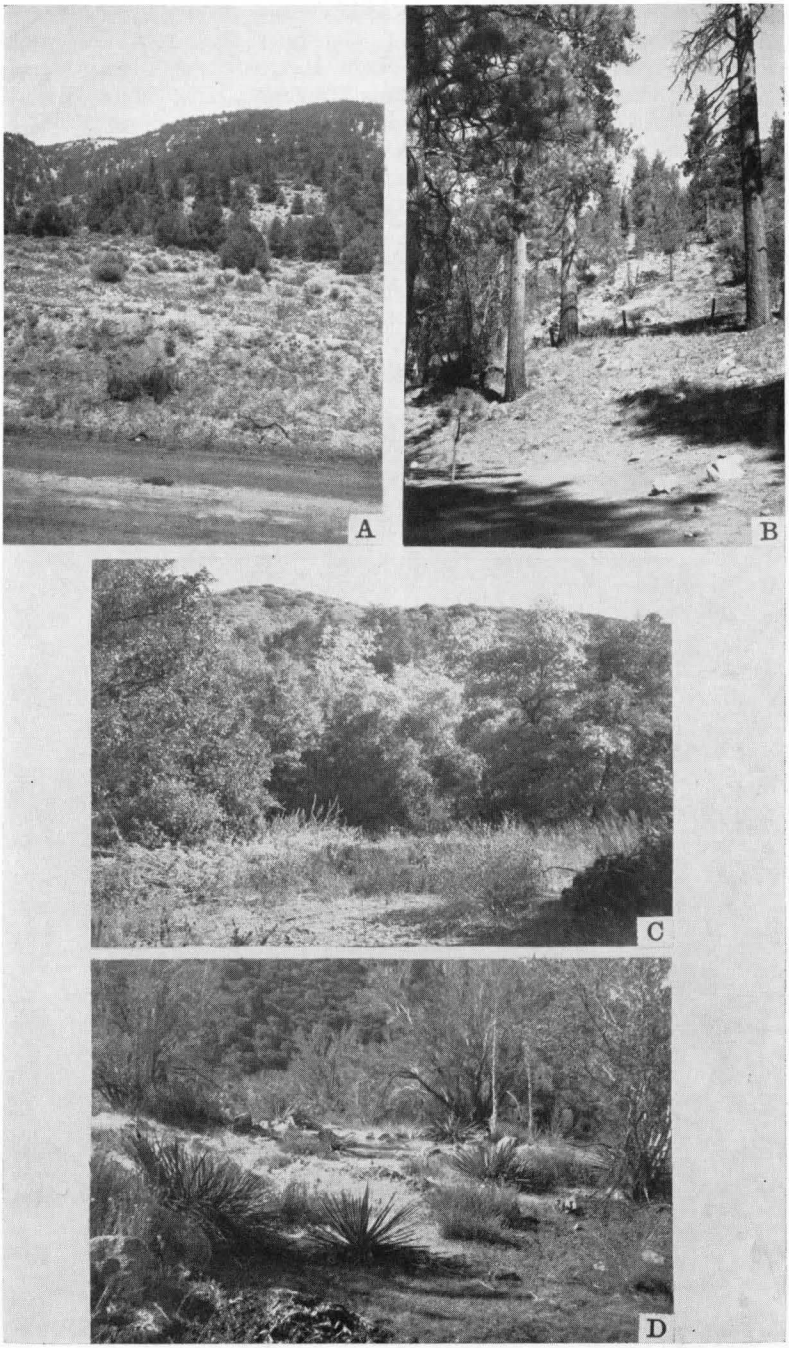



Fig. 4. Caption on page 216.

Utah State Agricultural College. Arizona: University of Arizona. New Mexico: University of New Mexico; New Mexico College of Agriculture and Mechanic Arts. Texas: University of Texas; Ross State College. Eastern United States: Missouri Botanical Garden*; Chicago Natural History Museum*; U. S. National Herbarium; U. S. National Arboretum; New York Botanical Garden*; Harvard University*. Argentina: Instituto de Botánica, Ministerio de Agricultura*; Instituto de Botánica Darwinion*. Chile: Museo Nacional de Historia Natural*. England: Royal Botanic Garden*.

(*Consulted only for type material or South American material or both.)

*Note on Measurements.*—The measurements given in the following descriptions were made from dried specimens. Corolla length is measured on a flattened flower with lobes pressed upward, and covers the distance from the base of the tube to the tip of the lobes. The width of the corolla orifice is the width at the sinuses of the

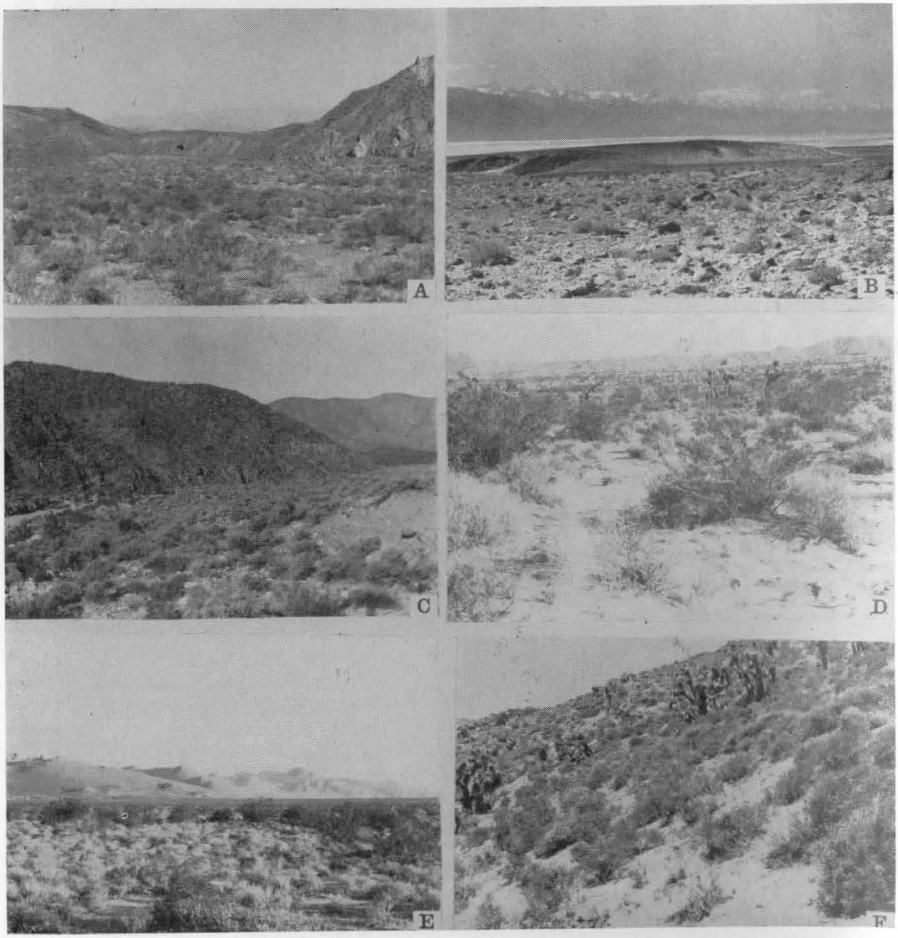



Fig. 5. Caption on page 216.

corolla lobes in a flattened specimen. The corolla tube width is likewise the width of a pressed flower.

*Descriptions of Species Groups.*—Some species have all of the characters given for their group. The other species may not have all but at least some of the characters given. The latter do, however, show by these and often by their ecology and distribution that they are related to the more extreme members. In addition and to a lesser degree they may show relationship to members of other species groups. Usually the tetraploid members do not fit as easily as the diploid members into a species group.

## KEY TO THE SPECIES OF COBWEBBY GILIA

Cobwebby hairs more coarse. South America ..... 15. *G. crassifolia*

Cobwebby hairs fine. North America

Cauline leaves broad and clasping at base with rachis as broad as or broader than basal leaves, narrowing to a pointed apex, margins toothed with teeth shorter than rachis width or margins entire; stems glabrous at base (or cobwebby-pubescent in 3 subspecies of *G. latiflora*).

Flowers small, 6.9-11.4 mm. long, with short lobes, 1.4-3.2 mm. long; stamens and style short, maturing at orifice ..... 14. *G. sinuata*

Flowers medium to large, 9.7-35.0 mm. long, with large lobes, 3.4-11.0 mm. long; stamens unequal, the longer well exserted from orifice, and style long, maturing well beyond longest stamens.

Corolla tube and throat combined 1½ to 2 times as long as calyx; corolla 8.2-12.0 mm. long. Mainly south of the Transverse Ranges ..... 12. *G. diegensis*

Corolla tube and throat combined 2½ to 6 times as long as calyx; corolla 9.5-35.0 mm. long. Mainly north of the Transverse Ranges ..... 13. *G. latiflora*

Cauline leaves deeply lobed, the base not broadly clasping (or slightly clasping in *G. brecciarum*), the lobes longer than the width of the rachis; stems cobwebby-pubescent at base (or sometimes glabrous in *G. ochroleuca*).

Corolla tube and throat purple to middle of throat or higher, or throat yellow with a purple spot in upper part below each lobe or striated with purple.

Sinus membrane of flowering calyx carinate; calyx glabrous or sparsely cobwebby-pubescent ..... 4. *G. aliquanta*

Sinus membrane of calyx not carinate; calyx glandular or cobwebby-pubescent.

Leaf dissection somewhat irregular, the lobes not linear; cauline leaves often with a broad rachis, the terminal lobe much broader than the lateral lobes; calyx usually densely glandular ..... 16. *G. brecciarum*

Leaf dissection regular, the lobes linear; cauline leaves with a narrow rachis, the terminal lobe not conspicuously broader than the lateral lobes; calyx if glandular not usually densely so.

Flowers small, 4.2-11.3 mm. long, with or without purple color in lower throat (purple in lower throat not present if corolla exceeds 7.8 mm.); stigma lobes maturing at stamen level.

Stamens very short, maturing at orifice; 1-2 flowers borne above a bract. California ..... 7. *G. minor*

Stamens unequal, the longest well exserted; 1-5 flowers borne above a bract. Widespread ..... 6. *G. inconspicua*

Flowers large, 11.5-20.0 mm. long, with purple color in lower throat. Stigma lobes maturing beyond stamen level (except in *G. t. arenaria* and *G. t. hoffmanni*) ..... 5. *G. tenuiflora*

Corolla throat lacking purple color, though tube often purple.

Style long, the stigma lobes maturing well beyond stamen level (except in *G. o. ochroleuca*); flowers mostly large and conspicuous.

Leaf segments very narrow and linear; stamens short, equal, slightly exserted ..... 1. *G. ochroleuca*

Leaf segments moderately narrow to broad, roundish and blunt or acuminate (except sometimes linear in *G. l. vivida*); stamens short to very long, equal or unequal.

Upper corolla throat light violet; stamens short, barely exserted or to ⅔ as long as corolla lobes.

Corolla tube long exserted from calyx, or if included then inflorescence full, divaricately branched, with shortest pedicels at least half as long as the longest ..... 2. *G. cana*

Corolla tube included or slightly exserted from calyx ..... 3c, 3d. *G. leptantha*

Upper corolla throat white or yellow; stamens long, subequal to or exceeding corolla lobes .... 3. *G. leptantha*

Style short, stigma lobes maturing at stamen level (except in *G. ophthalmoides flavocincta* and rarely *G. o. australis*); flowers mostly small and inconspicuous.

Pedicels and calyces densely glandular. Mt. Pinos, California ..... 17. *G. tetrabreccia*

Pedicels and calyces glabrous to moderately glandular or cobwebby-pubescent.

Capsule broadly ovoidal.

Leaf lobes linear and at least 3 times as long as width of rachis; inflorescence branches strict; calyx glandular ..... 11. *G. transmontana*

Leaf lobes roundish and blunt or acuminate; inflorescence branches strict or not strict and pedicels divaricate; or if the leaf lobes are linear and at least 3 times as long as the rachis width, then inflorescence not at all strict; calyx glabrous to sparsely glandular or cobwebby-pubescent .. 9. *G. ophthalmoides*

Capsule oblong-ovoidal.

Inflorescence loose, concentrated near ends of branches. Southwest ..... 8. *G. mexicana*

Inflorescence strict, and more or less dispersed throughout plant. Widespread.

Flowers minute, 1¼ to 1½ as long as calyx; calyx sparsely pubescent with small yellow glands ..... 10. *G. tweedyi*

Flowers larger, 2 to 2½ times as long as calyx; calyx moderately pubescent with black glands ..... 6a. *G. inconspicua*

## A. GILIA OCHROLEUCA GROUP

Stems slender and flexous, cobwebby-pubescent or glabrous and glaucous at base. Basal rosette of leaves semi-erect in mature plants; basal leaves pinnate or bipinnate with narrow rachis. Cauline leaves not clasping, deeply lobed, the lobes longer than width of rachis, terminal lobe not broad. Inflorescence divaricately branched and full, broadly spreading. Pedicels in subequal pairs. Caylx glabrous or cobwebby-pubescent. Corolla throat full and abruptly expanded, lobes broadly oval. Corolla throat yellow at base, pale blue violet in upper part, orifice and base of lobes pale blue-violet. Stamens subequal and short, maturing at orifice. Capsule globular.

### 1. GILIA OCHROLEUCA Jones

(Maps 2, 4; Fig. 6; Plate I-A)

Slender-stemmed plants with an erect central leader and usually numerous well developed and somewhat flexuous secondary branches from near base, erect or spreading and ascending at ends. Stems glabrous or cobwebby-pubescent below, and glabrous or partly glandular in the inflorescence. Basal leaves usually numerous and crowded, forming a rosette or tuft, pinnate to bipinnate, the rachis and lobes equally narrow, 1.0-1.5 (-2.0) mm. wide, the lobes linear, or leaves sometimes entire in *G. o. exilis.* Cauline leaves pinnately lobed but becoming progressively reduced above, the middle cauline leaves digitate, having one or two pairs of lobes from near base which are usually more than half as long as the total leaf length, or often entire in *G. o. exilis.* Uppermost leaves reduced to small bracts, linear and entire or with a small pair of lobes at base, glabrous or cobwebby-pubescent. Inflorescence divaricately branched and broadly spreading, the branches slender to filiform and with 2-4 flowers borne above a bract. Pedicels subequal to slightly unequal with the longer of a pair very slightly longer to not more than twice as long as the shorter one. Calyx glabrous or sometimes sparsely cobwebby-pubescent, accrescent and remaining attached even after capsule has matured and dropped. Corolla tube short, included in or slightly exserted from calyx, shorter to a little longer than the corolla throat; corolla throat abruptly expanded with broad orifice. In color the corolla tube purple or sometimes colorless when included in calyx, throat yellow below middle, upper throat and orifice pale violet, lobes pale violet or pink. Stamens short, maturing at orifice or slightly exserted, equal to subequal. Style barely to well exserted, the stigma lobes maturing among stamens or beyond them. Capsules globulate, at least ¾ as wide as long, or sometimes ovoidal in *G. o. exilis,* splitting from top to bottom between valves, the valves then breaking apart but not recurving, detaching readily from calyx; locules 1-5-seeded. N=9.

*Range.*—Foothills and mountains of cismontane southern California and of the Mojave Desert.

#### KEY TO THE SUBSPECIES OF GILIA OCHROLEUCA

Flowers small, 4-6 mm. long; style maturing at orifice. Mojave Desert..... c. *ochroleuca*

Flowers larger, 8.0-13.5 mm. long; style exserted, maturing beyond level of stamens. Mostly cismontane.

- Corolla tube slightly exserted from calyx and slightly longer than throat; lower stems and calyces usually cobwebby-pubescent; pedicels glandular just beneath flowers; herbage yellow-green. San Bernardino County to San Diego County..... a. *exilis*
- Corolla tube shorter than throat and usually included in calyx; lower stems and calyces usually glabrous; pedicels glabrous just beneath flowers; herbage gray-green. San Luis Obispo County to San Bernardino County... b. *bizonata*

1a. **G. ochroleuca** subsp. **exilis** (Gray) A. & V. Grant, comb. nov.

*Gilia latiflora* var. *exilis* Gray, Syn. Fl. N. Amer., ed. 2, 2 (1): 411, 1886, (lectotype seen). *G. arenaria* subsp. *exilis* Brand, Pflzr. 250: 104, 1907. *G. exilis* Abrams, Fl. Los Angeles, ed. 3, 289, 1917. *G. tenuiflora* var. *exilis* Jepson, Fl. Calif. 3: 178, 1943. *G. latiflora* subsp. *exilis* Mason & A. Grant, Madroño 9: 219, 1948.

*Gilia arenaria* var. *Abramsii* Brand, Ann. Conserv. & Jard. Bot. Genève 15-16: 330, 1913, (Tia Juana River, San Diego County, isotype seen). *G. Abramsii* Mason & A. Grant, Madroño 9: 216, 1948.

*Gilia lineata* Davidson, Bull. S. Calif. Acad. Sci. 22; 71, 1923, (Idyllwild, Riverside County, type seen).

*Gilia Abramsii* subsp. *integrifolia* Mason & A. Grant, Madroño 9: 216, 1948, (Temecula Canyon, Riverside County, type seen).

Plants 15-30 cm. tall, erect with central leader, the habit often becoming somewhat spreading with well developed, erect, secondary branches from near base. Herbage yellowish green. Stems leafy below middle, cobwebby-pubescent below, rarely glabrous, glandular or partly glabrous in the inflorescence. Basal leaves moderately cobwebby-pubescent, few to numerous, usually not forming a conspicuous rosette, 2-6 cm. long, simple and entire to pinnately (rarely bipinnately) lobed, the rachis 1.0-1.5 mm. wide, the pinnae usually widely spaced on the rachis and long and slender, 4-15 mm. long. Upper cauline leaves digitately lobed or very often entire. Pedicels glandular throughout or at least immediately beneath flowers, 4-27 mm. long, subequal to slightly unequal in length. Calyx 2.3-3.2 mm. long, sparsely cobwebby-pubescent. Corolla 8.0-10.5 mm. long, shallow-throated, tube longer than throat and slightly exserted beyond calyx. Stigma at level of the anthers or 1-2 mm. above them at maturity, the lobes about 1.5 mm. long. Capsule globulate to ovoidal, 3.8-4.5 mm. long.

*Range.*—Sandy or gravelly soils, often along river floodplains or washes, from 800 to 4500 feet, rarely up to 8000 feet. Coastal mountains of southern San Bernardino, Riverside and San Diego counties, California. Flowering from March to July.

*Variation.*—Leaf form in *G. o. exilis* varies from entire to pinnate and is rarely bipinnate at high elevations. In general the higher the elevation the more complex is the degree of leaf dissection and the more crowded the lobes. At high elevations the leaf form tends to simulate that found in *G. o. bizonata.* Other characters which vary to some extent are the corolla tube to throat proportions, the tube sometimes equalling the throat; and the pubescence of the lower stems which is rarely glabrous as in *G. o. bizonata.* A small-flowered race, resembling *G. o. ochroleuca,* has been found in southern San Diego County.

*Type.*—*S. B. & W. F. Parish 1477,* San Bernardino Valley, California, May 1882. Gray Herbarium.

Gray did not cite any specimens in his original description. There are, however, four specimens in the Gray Herbarium annotated *"Gilia latiflora* var. *exilis"* in Gray's handwriting with the printed label "Syn. Fl. N. Amer. Ed. 2" attached. These specimens, all of which fit Gray's description and belong to one taxon as recognized by the present authors, are: *Parish 634* and *1477, Palmer 326,* and *Cleveland* in 1882. Giving consideration to the general development of the plants, the definiteness of the label, and the absence of extraneous material on the same sheet, *Parish 1477* is selected as the lectotype.

*Representative Specimens.*—CALIFORNIA. Riverside County: *F. W. Peirson 921,* San Gorgonio Pass; *V. & A. Grant 17501,* Whitewater Canyon; *V. & A. Grant 8830,* Hemet; *F. W. Peirson 7725,* Temescal Canyon; *P. A. Munz 5025,* Temescal Canyon; *H. L. Mason 3112,* Temecula; *F. W. Gould 2108,* Corona; *P. A. Munz 5098,* Dripping Springs; *V. Grant 9317,* Dripping Springs. *P. A. Munz 18059,* Coahuila. San Diego County: *F. W. Peirson 8363,* Warner Hot Springs; *F. W. Peirson 8342,* Oak Grove; *L. Abrams 3507,* Tia Juana River.

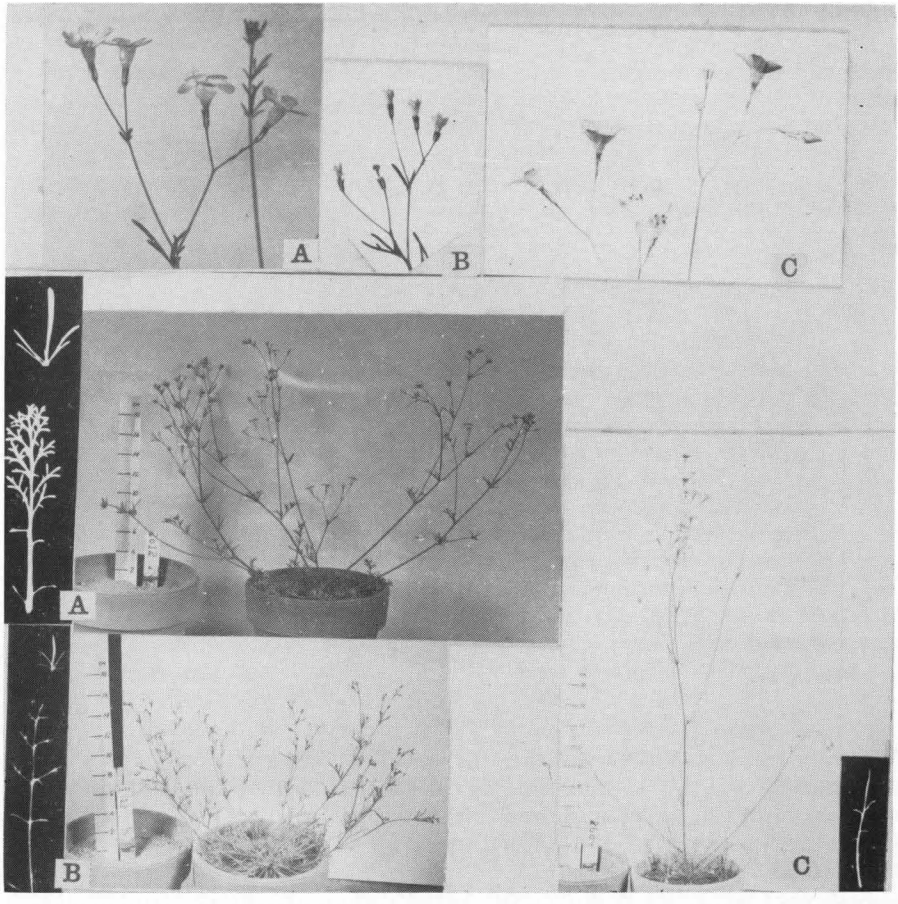


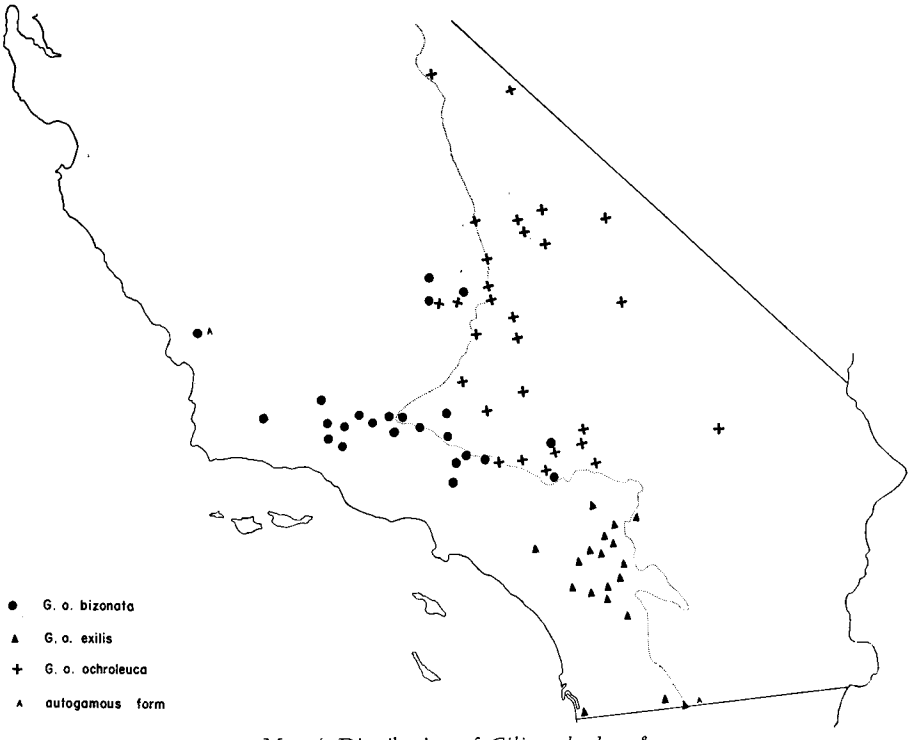

Fig. 6. *Gilia ochroleuca*[7]. A) *G. o. bizonata* from Lockwood Valley, Ventura County. B) *G. o. ochroleuca* from Short Canyon, Kern County. C) *G. o. exilis* from Dripping Springs, Riverside County.

**1b. G. ochroleuca** subsp. **bizonata** A. & V. Grant, subsp. nov.

*Gilia exilis* subsp. *bizonata* V. Grant, nom. nud., Adv. Genetics 8: 60, 1956.

Plants erect, well developed individuals usually having numerous secondary branches spreading widely from near the base and ascending at the ends, 15-50 cm. long, often longer than the central leader. Herbage grayish-green. Lower stems glabrous or rarely cobwebby-pubescent, upper branches glandular but glabrous immediately beneath flowers. Basal leaves pinnate to bipinnate, 2.5-6.0 cm. long, with narrow rachis, 1-2 mm. wide, primary lobes 1-15 mm. long, often bearing a pair of short secondary lobes. Bracts entire or with a pair of lobes at base, glabrous or cobwebby-pubescent. Pedicels 5-30 mm. long, the two pedicels of a pair subequal. Calyx 2.1-3.7 mm. long, glabrous or rarely cobwebby-pubescent, the lobes acute. Corolla 8.0-13.5 mm. long, tube short, included in or sometimes slightly exserted

[7]The characters illustrated for a taxon are habit, basal leaf, upper cauline leaf, inflorescence, and flower. The inflorescence photographs are not to any one scale. All localities are in California unless otherwise specified.




Map 4. Distribution of *Gilia ochroleuca*[6].

from calyx; throat a little longer than the tube, full, with orifice 3.5-5.4 mm. wide; lobes broadly oval, 2.0-3.5 mm. wide. In color the corolla tube purple, throat yellow in lower third, pale violet above and in the orifice, lobes light pink .Style well exserted, the stigma lobes 1-2 mm. long, reflexing well above the stamens. Capsule globular, 3.5-4.5 mm. long.

Rami base late patuli et in extremis ascendentes, 15-50 cm. longi; plantis canoviridibus, caulibus inferioribus glabris aut raro lanoso-pubescentibus; foliis basalibus pinnatis aut bipinnatis; calyce fere glabro; corolla 8-13.5 mm. longa cum fauce aperto et limbo late extenso, 1-2 cm. lato; lobis late ovalibus, mucronatis, tubo fauce breviore et in calyce incluso; capsule cum seminibus 5-9.

*Range.*—Sandy flats in the pinyon-juniper belt, occasionally washing out into desert plains along water courses, from 2800 to 6700 feet. Cismontane southern California from San Luis Obispo County to Kern and San Bernardino counties. Flowering from April to June.

*Variation.*—Leaf form varies from pinnate to bipinnate, but in rare cases may be entire. In general the more complex leaf form is found at higher elevations and in these cases the lobes tend to be somewhat crowded. Plants with entire cauline leaves have been found at low elevations in western Ventura County. They resemble *G. o. exilis* in respect to the character of the upper leaves, as well as in having cobwebby-pubescent stems, and proportionately longer corolla tubes with the tube equalling the throat. A race from San Luis Obispo County with small flowers resembles *G. o. ochroleuca* morphologically, but is here interpreted as a reduced form of *G. o. bizo-*

[6]The dotted line in this and following distribution maps marks the western boundary of the desert.

*nata. G.o. bizonata* intergrades with the closely related *G. o. ochroleuca* in Kern Valley and Antelope Valley.

*Type.*—*V. & A. Grant 16040,* west of Stauffer junction on road to Mt. Pinos, near Kern-Ventura County line, California, June 14, 1951. Rancho Santa Ana Botanic Garden Herbarium 67065. The name refers to the two-toned yellow and violet banding in the corolla throat.

*Representative Specimens.*—CALIFORNIA. Ventura County: *C. Wolf 6975,* Cuyama River; *V. & A. Grant 9102,* Cuyama River; *P. A. Munz 6945,* Mt. Pinos. Los Angeles County: *V. & A. Grant 9093,* Gorman; *L. R. Abrams 11731,* Antelope Valley; *V. & A. Grant 9121,* Antelope Valley; *F. W. Peirson 268,* Arraster Creek, San Gabriel Mts. Kern County: *P. A. Munz 13355,* Weldon. San Bernardino County: *V. & A. Grant 9387,* Summit Valley.

### 1c. G. OCHROLEUCA subsp. OCHROLEUCA

*Gilia ochroleuca* Jones, Contrib. West. Bot. 8: 35, 1898, (type seen). *G. inconspicua* subsp. *eu-inconspicua* var. *ochroleuca* Brand, Pflzr. 250: 105, 1907.

Plants small and delicate with a short central leader, 6-15 cm. tall, and numerous longer secondary branches, to 30 cm. long, spreading and ascending. Herbage grayish-green. Stems glabrous below and glandular in the inflorescence except glabrous just beneath flowers, leaves sparsely cobwebby-pubescent. Basal and lower cauline leaves pinnately lobed with narrow rachis and lobes 1 mm. wide, the lobes 3-10 mm. long. Middle cauline leaves digitately lobed. Bracts entire or with a small pair of lobes at base, glabrous or cobwebby-pubescent. Pedicels glabrous immediately below flowers, 3-10 mm. long. Calyx 2.4-3.2 mm. long, glabrous. Corolla small, 4-6 mm. long, tube and throat together 3.5-4.5 mm. long, the tube included in the calyx. In color the corolla tube and lower throat pale yellow, upper throat and lobes pale violet. Stamens very short, maturing at orifice. Style short, the stigmas maturing at level of stamens. Capsule globular, 3.0-4.6 mm. long.

*Range.*—Sandy soils of mountain slopes, canyons and outwash plains, from 2500 to 5000 feet. Mojave Desert from San Bernardino County to Inyo County, California. Flowering from late March to June.

*Variation.*—Relatively uniform. Small-flowered forms resembling *G. o. ochroleuca* in morphology, but probably belonging to *G. o. exilis* and *G. o. bizonata* on the basis of geography, have been collected near Jacumba, San Diego County, and Santa Margarita, San Luis Obispo County. *Gilia ochroleuca ochroleuca* itself is apparently a reduced autogamous derivative of *G. o. bizonata,* and it would not be surprising if the same process of reduction were to occur independently in other branches of the species.

*Type.*—*M. E. Jones,* May 11, 1897, Darwin Mesa, Argus Mts., Inyo County, California. Pomona College Herbarium 74026.

The original description gives the date of collection as May 1, 1897. There is no specimen of *Gilia ochroleuca* from Darwin Mesa dated May 1, and Jones' journal indicates that on that date he collected in Shepherd's Canyon some twenty miles away; however, both herbarium specimens and journal show that he collected on Darwin Mesa May 11.

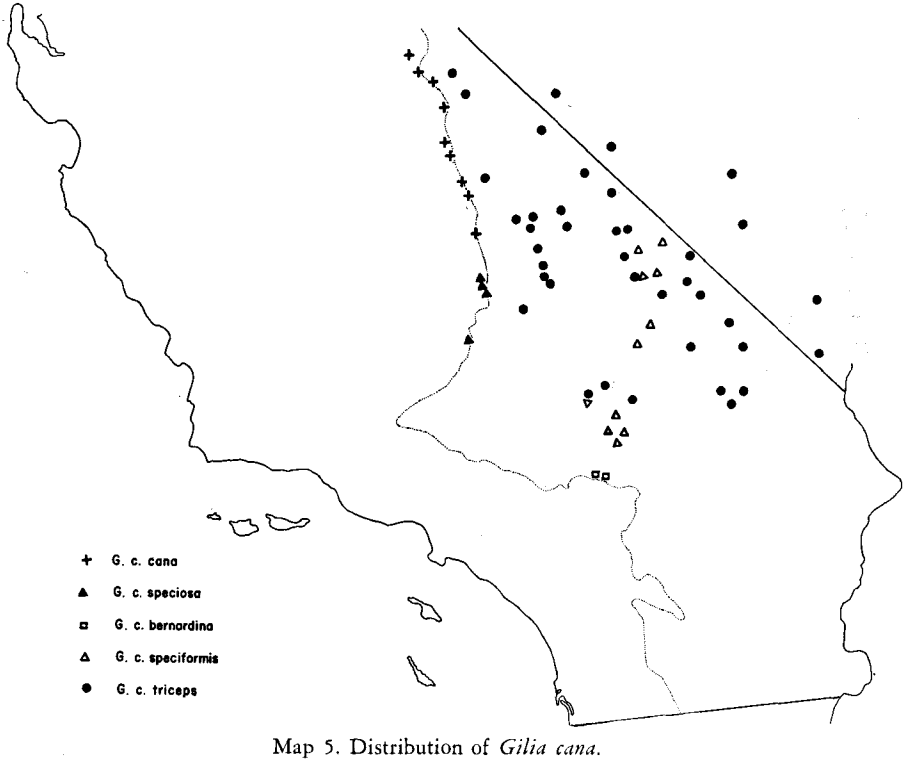
*Representative Specimens.*—CALIFORNIA. San Bernardino County: *P. A. Munz 2519* and *P. A. Munz 15171,* Victorville; *H. L. Mason 8192,* Lucerne Valley; *H. L. Mason 8184,* Stoddard Wells. Los Angeles County: *H. L. Mason 3044-A,* Rock Creek, San Gabriel Mts.; *H. L. Mason 6874,* Roosevelt to Muroc. Kern County: *J. T. Howell 24243,* Isabella; *H. L. Mason 8277,* Onyx; *V. & A. Grant 8858-A* and *V. & A. Grant 8862,* Inyokern; *V. & A. Grant 9084,* Mt. Owen. Inyo County: *V. & A. Grant 8866-B,* Little Lake; *A. A. Heller 8249,* Bishop.

## 2. GILIA CANA (Jones) Heller

(Maps 1, 5; Fig. 7; Plate I-B, C)

Plants erect with one stout stem or several from rosette of basal leaves, branching to form a full inflorescence in upper part of plant. Stems cobwebby-pubescent at base, glandular above, becoming somewhat less glandular in upper part of plant. Basal leaves moderately to densely cobwebby-pubescent, bipinnately lobed or toothed, rachis narrow, 0.5-3.0 mm. wide, the lobes broader than the rachis and longer than the width of the rachis, segments blunt or acuminate, cuspidate-tipped. Cauline leaves much reduced and inconspicuous above the prominent basal rosette of leaves, pinnately lobed with the terminal lobe acuminate, the lateral lobes becoming progressively fewer and arising closer to base of leaf with ascent up the stem. Uppermost leaves reduced to glandular bracts, entire or with a small pair of lobes at base. Inflorescence very loose to slightly congested, showy with numerous flowers in bloom simultaneously high in the plant, one bract subtending a group of 3-8 flowers on long or short pedicels. Calyx glandular or sometimes cobwebby-pubescent, the lobes acuminate. Corolla 3.8-8.5 times the calyx, 10-32 mm. long, with long slender tube (except in extreme *G. c. triceps* where the tube is short). In color the corolla tube purple, throat yellow below and violet above, orifice violet, lobes pinkish-violet (except in *G. c. speciosa* where the throat is purple below and little yellow is present). Stamens short, maturing at orifice or slightly exserted. Style exserted from orifice, usually maturing beyond the stamens but shorter than the corolla. N=9.

*Range.*—Mojave Desert and desert slopes of the Sierra Nevada and San Bernardino Mts., California and Nevada.




Map 5. Distribution of *Gilia cana*.

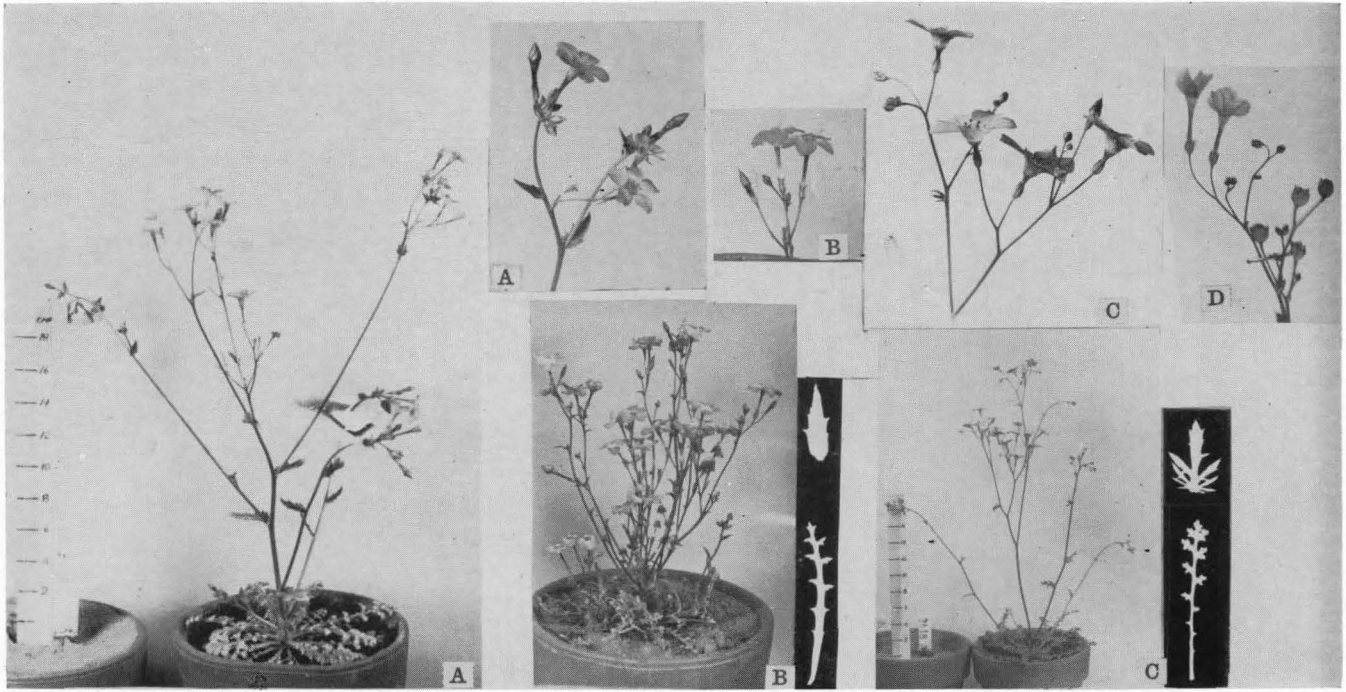



Fig. 7. *Gilia cana.* A) *G. c. cana* from Rock Creek, Mono County. B) *G. c. speciosa* from Short Canyon, Kern County. C) *G. c. triceps* from the Argus Mts., Inyo County. D) *G. c. speciformis* from Shoshone, Inyo County.

KEY TO THE SUBSPECIES OF GILIA CANA

Inflorescence somewhat crowded due to short internodes; shortest pedicels usually much less than half as long as the longest; inflorescence strict, the branches not divaricate. Mountain ranges on the western border of the Mojave Desert.

Capsule small, ovoidal, 3.0-4.5 mm. long; stamens unequal, the longest slightly to well exserted from orifice. Inyo and Mono counties.....a. *cana*

Capsule large, broadly ovoidal to oblong-ovoidal, 5.0-9.0 mm. long; stamens equal or unequal and very short, maturing at orifice, or sometimes the longest slightly exserted in *bernardina*. Southern Inyo County and south.

Purple tube color extending close to orifice, the tube and throat together being 8/10 to 9/10 purple; corolla form narrow (tube and throat length: orifice width=4.4-6.0). Sierra Nevada.....b. *speciosa*

Purple tube color extending only into lower throat, the tube and throat together being 5/10 to 6/10 purple; corolla form broader (tube and throat length: orifice width=2-3). San Bernardino Mts....c. *bernardina*

Inflorescence loose with long upper internodes; shortest pedicels usually at least half as long as the longest; inflorescence full, the branches divaricate. Mojave Desert.

Corolla throat narrow, flaring gently from tube; corolla form slender (tube and throat length: orifice width=3.0-4.5); corolla lobes broad, wider than orifice; stamens maturing just at orifice. Not common.....d. *speciformis*

Corolla throat full, abruptly expanded; corolla form ample (tube and throat length: orifice width 1.5-2.5); corolla lobes narrow, narrower than orifice; stamens exserted from orifice. Widespread.....e. *triceps*

2a. G. CANA subsp. CANA

*Gilia latiflora* var. *cana* Jones, Contrib. West. Bot. 8: 35, 1898, (type seen). *G. cana* Heller, Muhlenbergia 2: 266, 1907. *G. tenuiflora* subsp. *cana* Brand, Ann. Conserv. et Jard. Bot. Genève 15-16: 330, 1913. *G. tenuiflora* var. *cana* Jepson, Man. Fl. Pl. Calif. 798, 1925. *G. latiflora* subsp. *cana* Mason & A. Grant, Madroño 9: 218, 1948.

*Gilia collina* var. *coronata* Brand, Pflzr. 250: 101, 1907, (Guadalupe Canyon, Sierra Nevada, type seen).

*Gilia tenuiflora* subsp. *eu-tenuiflora* var. *triceps* subvar. *speciosissima* Brand, Pflzr. 250: 102, 1907, (Olancha, Sierra Nevada, type seen).

Basal leaves densely matted with cobwebby pubescence. Inflorescence somewhat crowded with short internodes at ends of main branches. Pedicels glandular-pubescent or in first formed flowers cobwebby-pubescent, 3.6-5.5 mm. long in flower; calyx lobes acuminate. Corolla 14.3-26.0 mm. long; the tube and throat sparsely puberulent, tube and throat together 10.5-19.5 mm. long, their length 2-6 times as great as the width of the orifice; tube 0.6-1.3 mm. wide, flaring into a moderately narrow throat which is ½ to nearly as long as the tube; the orifice 2.7-5.0 mm. wide; lobes 3.5-6.0 mm. long and ½ to nearly as wide as long. Stamens slightly unequal, the shortest 0.6-1.4 mm. long, maturing just at orifice, the longest 1.1-2.3 mm. long, slightly to well exserted from orifice, ¼ to ¾ as long as corolla lobes. Capsule small, ovoidal, 3.0-4.5 mm. long.

*Range.*—East slope of the Sierra Nevada from 6000 to 10,000 feet. From Olancha, Inyo County, to Rock Creek, Mono County, California. Flowering in June and July, or to some extent in May and August.

*Variation.*—At elevations of 9000 to 10,000 feet the plant becomes dwarfish in habit with numerous short stems 6-15 cm. long spreading out from near the base. At high elevations the corolla lobes are also shorter (3.8 mm. long) and narrower (1.9-2.5 mm. wide), and the throat and orifice are narrow, whereas the tube and throat remain long. Thus the ratio of tube and throat length: orifice width, which is 2-4 at lower elevations, becomes about 6 at the higher elevations.

Insert after "Pedicels glandular-pubescent, "..... unequal in length, the shorter 0.9-2.7 mm. long, the longer (1.5-) 8.1-13.3 mm. long, and 2-8 times as long as the shorter. Calyx glandular-pubescent....."

*Type.*—*Marcus E. Jones,* Lone Pine, 6000 feet, Inyo County, California, May 14, 1897. Pomona College Herbarium 74023.

In his original description Jones cited a specimen from Lone Pine collected April 27, 1897. This specimen cannot now be found and probably never existed, for both his journal and herbarium labels show that on this date he collected at Darwin in the Inyo Mountains and did not arrive at Lone Pine until May 13. Jones published a new description of the variety *cana* a decade later (Contrib. West. Bot. 12: 54, 1908), in which he cited a collection from Lone Pine dated May 14, 1897. At least two such specimens exist, one in the University of California Herbarium, the other in the Pomona College Herbarium. The latter bears the legend "Type" in Jones' handwriting.

*Representative Specimens.*—CALIFORNIA. Inyo County: *R. Ferris 3750,* Little Cottonwood Creek; *P. A. Munz 14319,* Carroll Creek to Little Cottonwood Creek; *M. Kerr 29,* Onion Valley, 10,000 ft. Mono County: *V. & A. Grant 9249,* Rock Creek; *L. Benson 6011,* Lake Sabrina road.

**2b. G. cana** subsp. **speciosa** (Jepson) A. & V. Grant, comb. nov.

*Gilia tenuiflora* var. *speciosa* Jepson, Fl. Calif. 3: 181, 1943, (type seen). *G. latiflora* subsp. *speciosa* Mason & A. Grant, Madroño 9: 218, 1948. *G. speciosa* V. Grant, nom. nud., Adv. Genetics 8: 61, 1956.

Basal leaves densely cobwebby-pubescent. Inflorescence somewhat crowded with short internodes at ends of main branches. Pedicels slightly to very unequal, the shorter of each pair 0.2-5.0 mm. long, the longer one 5.5-11.5 mm. long and 1.5 to 4.5 times as long as the shorter one at maturity; pedicels glabrous or lightly glandular-pubescent, being most densely glandular just beneath the flowers. Calyx glabrous or glandular or sometimes cobwebby-pubescent, 3.7-5.7 mm. long in flower. Corolla 20-32 mm. long, pubescent on outside of tube and throat with minute glandular or cobwebby hairs; tube slender to stout, 0.9-1.5 mm. wide, widening slightly into a short throat which is ¼ to ⅓ as long as the tube; the orifice narrow, 3.1-5.2 mm. wide; tube and throat together 14-26 mm. long, this length being 4-6 times as great as the width of the orifice; lobes broadly oval, 4.1-8.7 wide and wider than the orifice. In color the corolla tube and lower half of throat dark purple, a very narrow rim of yellow usually (but not always) present above the purple, the upper throat and orifice light violet, the limb pinkish-violet. Stamens equal in length, the filaments short, about 1 mm. long, anthers maturing just at orifice. Capsule globular to oblong-ovoidal, 5-9 mm. long.

*Range.*—Lower canyons and outwash plains, from 2400 to 4000 feet. East slope of the southern Sierra Nevada from Red Rock Canyon to Nine Mile Canyon; Kern and Inyo counties, California. Flowering from late March to May.

*Variation.*—The most extreme form is found in Red Rock Canyon. This race is characterized by bipinnately lobed leaves with a narrowly linear rachis and segments (1 mm. wide). The inflorescence leaves are few, with one small bract subtending an inflorescence branch, and as many as eight flowers are clustered above the bract on a leafless dichotomous system of branches. The pedicels and calyces are mostly glabrous and the pedicels tend to be subequal. In Red Rock Canyon the corollas reach their maximum length of 3.2 cm. and a yellow color in the throat appears at times to be entirely absent.

Other races differ from the Red Rock Canyon race in various ways. A population north of Ricardo has wider and less dissected leaves (to 2 mm. wide). Near Mt. Owen there are fewer flowers (3-4) in a group subtended by a bract. The Short Canyon race has the pedicels very unequal rather than nearly equal. The corolla throat may possess a definite though narrow rim of yellow, as west of Inyokern.

Populations in Nine Mile Canyon have lost the violet orifice color while retaining violet on the outside of the upper throat. Some plants in Red Rock Canyon, finally, have pubescent pedicels and calyces.

*Type.—A. Krames,* Red Rock Canyon, Kern County, California. Jepson Herbarium, University of California.

*Representative Specimens.*—CALIFORNIA. Kern County: *H. L. Mason 8212,* Red Rock Canyon; *V. & A. Grant 9328,* 2 miles north of Red Rock Canyon; *G. T. Robbins 3309,* Ricardo; *V. & A. Grant 9334,* Short Canyon west of Inyokern; *V. & A. Grant 9081,* Outwash plain east of Mt. Owen.

**2c. G. cana subsp. bernardina** A. & V. Grant, subsp. nov.

Basal leaves densely cobwebby-pubescent. Inflorescence somewhat crowded with short internodes in upper part of plant. Pedicels slightly to very unequal, the shorter of a pair 0.5-2.6 mm. long and the longer 1.8-11.5 mm. long, the longer 2-5 times as long as the shorter. Calyx 2.8-4.0 mm. long in flower, cobwebby-pubescent, or in later formed flowers glandular, the lobes acuminate. Corolla 17-23 mm. long, minutely pubescent on tube and throat; tube slender, 0.6-0.8 mm. wide, 5.0-9.6 mm. long, widening gradually to form a moderately long throat; the orifice of the throat rather wide, 4.2-6.0 mm. wide; tube and throat together 10.6-15.3 mm. long, this length 2-3 times as great as the width of the orifice; lobes broad, 4.0-6.2 mm. wide. Stamens unequal, the shortest maturing just within the orifice with filaments 0.2-0.5 mm. long, the longest at orifice or slightly exserted with filaments 0.5-2.2 mm. long. Capsule broadly ovoidal, 5-7 mm. long.

Corolla lata, longitudo tubi et faucis latitudine faucis 2-3 x longior; corolla in tubo et ad basim faucis purpurea.

*Range.*—Sandy flats and washes, from 2700 to 4800 feet. Desert slopes of the San Bernardino Mts. above Lucerne Valley, San Bernardino County, California. Flowering in April and May.

*Type.—V. & A. Grant 8686,* east of Lucerne Post Office, San Bernardino County, California, April 26, 1949. Rancho Santa Ana Botanic Garden Herbarium 67615.

*Representative Specimens.*—CALIFORNIA. San Bernardino County: *F. W. Peirson 6686,* north of Box S Spring; *P. A. Munz 13098,* east of Lucerne; *V. Grant 8690,* east of Box S Spring; *V. &A. Grant 9198,* road to Baldwin Lake.

**2d. G. cana** subsp. **speciformis** A. & V. Grant, subsp. nov.

Basal leaves moderately to densely cobwebby-pubescent. Inflorescence spreading, the branching dichotomous and divaricate. Pedicels slender, glabrous except glandular immediately beneath flower, subequal to unequal with a lateral pedicel arising 2-13 mm. beneath a terminal flower, and growing to exceed the terminal pedicel slightly or to 3 times as long, reaching 6-20 mm. in length. Calyx in flower 2.6-4.2 mm. long, glandular, the lobes acuminate. Corolla 15-29 mm. long; tube stout, 0.8-1.0 mm. wide, 2-4 times the calyx in length, gradually widening to form a slender throat and narrow orifice; tube and throat together 10-19 mm. long, this length 3.0-4.5 times the width of the orifice; lobes oval, 3.0-8.4 mm. wide, broader than long, and broader than the width of the orifice. In color the purple of the corolla tube continuous into the base of the throat with a yellow region just above the purple, the upper throat and orifice light violet. Stamens equal to subequal, filaments short, maturing at the orifice. Capsule globular to ovoidal, 5.0-7.3 mm. long.

Corolla tenuis; ratio longitudinis tubi et faucis: diametro faucis = 3.0-4.5; lobi corollae lati; stamina brevia.

*Range.*—Sandy washes, flats and hills, from 2800 to 3800 feet. Central Mojave Desert from the Ord Mts. through the Avawatz Mts. to the Amargosa and Black

Mts.; San Bernardino and Inyo counties, California. Flowering from late March to May.

*Variation.*—The extreme form of *G. c. speciformis,* which is morphologically closest to *G. c. speciosa,* possesses large flowers more than 2 cm. long; a stout corolla tube which widens slightly to form a narrow throat and orifice; and broad lobes expanding widely beyond the narrow orifice. Intermediates between *G. c. speciformis* and *G. c. triceps* occur in the two regions where the ranges of these entities overlap, namely north of Barstow and in the mountains just east of Death Valley. Here the populations are unusually polymorphic, being composed of individuals with large or small flowers, with corollas of varying proportions, and with stamens of varying lengths.

*Type.*—*P. A. Munz & D. D. Keck 7829,* 7 miles east of Daggett, Newberry Mt., San Bernardino County, California, April 6, 1924. Pomona College Herbarium 47537.

*Representative Specimens.*—CALIFORNIA. San Bernardino County: *C. B. Wolf 6555,* summit of Barstow-Cave Springs road; *H. M. Hall & H. P. Chandler 6788,* East Ord Mt. Inyo County: *P. A. Munz 14891,* Bradbury Well; *P. A. Munz 16541,* Salsbury Pass, south end of Death Valley.

**2e. G. cana** subsp. **triceps** (Brand) A. & V. Grant, comb. nov.

*Gilia tenuiflora* subsp. *eu-tenuiflora* var. *triceps* Brand, Pflzr. 250: 102, 1907, (lectotype seen). *G. latiflora* subsp. *triceps* Mason & A. Grant, Madroño 9: 219, 1948.

Basal leaves moderately cobwebby-pubescent. Inflorescence spreading, the branching dichotomous and divaricate. Pedicels filiform, glabrous except glandular immediately beneath flower, subequal to unequal, a lateral pedicel arising 2-13 mm. beneath a terminal flower and growing so as to slightly exceed the terminal pedicel or to become 3 times as long, attaining 6.0-17.5 mm. in length. Calyx glandular, 2.0-4.0 mm. long in flower. Corolla 7.8-23.2 mm. long; the tube slender to filiform, 0.4-0.9 mm. wide, slightly exserted from calyx or up to 2½ times the calyx; throat full, expanding abruptly; tube and throat together 5-15 mm. long, this length 1½ to 2½ times the width of the orifice; lobes oval, 2.0-5.9 mm. wide, as broad as long or a little narrower than long and narrower than width of corolla orifice. Stamens short, equal or subequal, exserted from orifice, but less than half as long as corolla lobes. Stigma lobes reflexing at level of stamens or beyond. Capsule globular to ovoidal, 4.3-6.3 mm. long.

*Range.*—Desert mountains and outwash plains, from 2800 to 5200 feet. Mojave Desert from Barstow and Kelso north through the Argus, Panamint and Amargosa Mts. to the White Mts. and east to southwestern Nevada; San Bernardino and Inyo counties, California, and Clark, Nye and Esmeralda counties, Nevada. Flowering in April and May.

*Variation.*—The extreme form of *G. c. triceps* is a small-flowered plant with filiform pedicels and corolla tubes; the corolla tube is short, being only slightly longer than the calyx annd expanding above into an ample throat; the lobes are comparatively small; and the stamens are exserted. This form is best developed in the Panamint Mts.

Elsewhere the corolla tube is longer but the proportions are in general variable within populations and between them. Intergradation between *G. c. triceps* and *G. c. speciformis* accounts for some of this variation, especially where their respective ranges overlap.

The morphologically closest relative of *G. c. triceps* is *G. c. cana.* These two wholly allopatric subspecies approach one another geographically in the mountain ranges of Inyo County, where *G. c. cana* occurs on the east slope of the Sierra Ne-

vada and *G. c. triceps* on the ranges immediately east of the Sierras.

Phenotypic modification where moisture is abundant results in leafier stems, the basal rosette being elongated by longitudinal growth of the internodes. Under favorable moisture conditions the flowers are larger, the corolla parts being both broader and longer, than in dryer habitats. The pedicels become proportionately shorter under these same conditions, so that the inflorescence is more congested than under normal desert conditions. Herbarium specimens from nature compared with specimens of the same parental strains grown in the greenhouse demonstrate the above differences.

The observed phenotypic differences between the moist and arid phases of *G. c. triceps* are similar to some of the racial differences between *G. latiflora davyi* and *G. l. latiflora* and between *G. tricolor tricolor* and *G. t. diffusa* (section *Gilia*). In the first named member of each pair the basal rosette is loose with long internodes and leafy lower stems; the leaves and flowers are large and luxuriant; and the pedicels are proportionately shorter so that the inflorescence is more congested. The opposite tendency, viz. a more compact basal rosette, smaller leaves and flowers, and longer pedicels, is found in the second named member of each pair of races. *Gilia latiflora davyi* and *G. tricolor tricolor* occupy moister habitats than *G. l. latiflora* or *G. t. diffusa.* Some of the genetically determined ecotypic differences in *Gilia latiflora* and *G. tricolor* thus parallel the phenotypic responses in *G. cana triceps.*

*Type.*—Brand's meager description of his new variety *triceps* emphasizes the presence of trifid cauline leaves, woolly pubescence on the leaves, and corollas 15-20 mm. long. He cites three specimens in validation of the entity, which belong in as many sections of the genus. Jepson (1943: 181) and Mason and A Grant (1951: 467) have assumed that the first cited collection, *Parish 1592* from the San Bernardino Mts., is the type of *triceps.* But *Parish 1592* is a specimen of *Gilia splendens;* it is, indeed, the lectotype of *G. tenuiflora* var. *altissima* which is a synonym of that species (cf. El Aliso 3: 86). Brand's key and descriptions show that he wished to separate, not merge, *triceps* and *altissima.* Furthermore, *Parish 1592* does not conform to the diagnosis of *triceps,* not having trifid cauline leaves nor woolly pubescence. It is clearly not a suitable type of this entity. The second specimen cited by Brand is *Coville 620* from the Panamint Mts. It is a specimen of *Gilia scopulorum* and differs from the diagnosis of *triceps* in one important feature, in the absence of woolly pubescence. The third cited collection does conform to Brand's description and is therefore chosen as the lectotype. It is *C. A. Purpus 5950,* Gold Mt., 5000-6000 ft., Esmeralda Co., Nevada, in 1898. University of California Herbarium 133740.

*Representative Specimens.*—CALIFORNIA. San Bernardino County: *E. K. Balls & R. M. Straw 19339,* Beck Spring, Kingston Mts.; *P. A. Munz 13754,* north of Kessler Spring. Inyo County: *V. & A. Grant 9344-B,* north of Trona, Argus Mts.; *R. S. Ferris 7847,* northwest base of Maturango Peak, Argus Mts.; *V. & A. Grant 9353,* summit of Argus Mts. on road to Darwin Mesa; *F. W. Peirson 9885,* west of Darwin; *E. C. Jaeger,* in 1927, Black Mts.; *A. A. Heller 16022,* Scotty's Castle, Death Valley; *M. E. Jones,* in 1927, Lone Pine; *A. Eastwood & J. T. Howell 9595,* Westgard Pass; *M. E. Jones 9899,* Bishop; *L. Benson 5951,* canyon above Laws. NEVADA. Clark County: *I. W. Clokey 7642,* mouth of Kyle Canyon; *C. L. Hitchcock 3094,* northwest of Indian Springs.

### B. GILIA TENUIFLORA GROUP

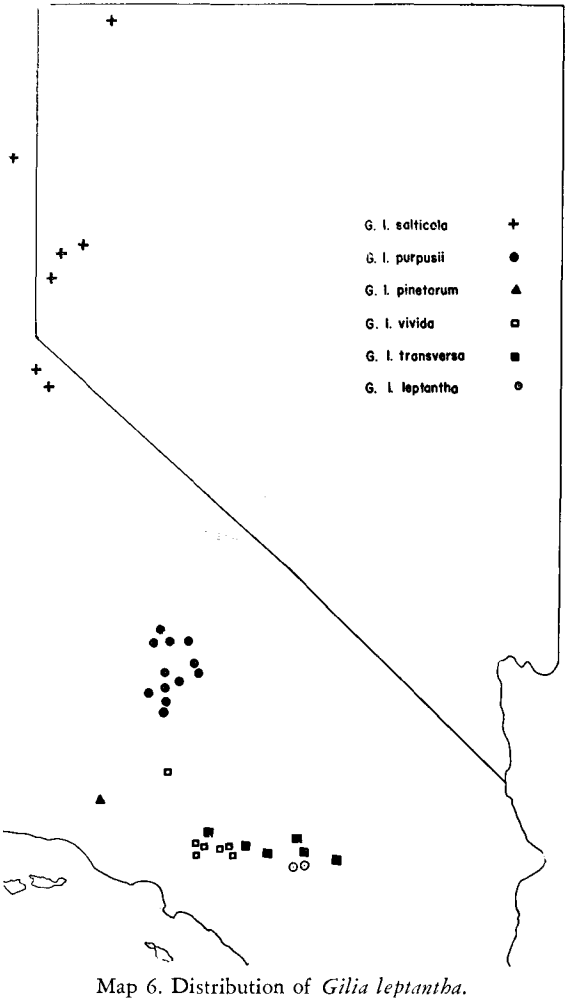
Stems slender and flexuous, cobwebby-pubescent at base. Basal rosette of leaves semi-erect in mature plants; basal leaves pinnate or bipinnate with narrow rachis. Cauline leaves not clasping, deeply lobed, the lobes longer than width of rachis, terminal lobe not broad. Inflorescence diffuse. Pedicels very unequal. Calyx lightly glandular or cobwebby-pubescent. Corolla throat flaring gradually from tube into

narrow throat and orifice, lobes narrowly oval. Corolla throat purple like the tube or with spots of purple on a yellow throat, orifice with a rim of white, lobes pink throughout. Stamens unequal, the longest well exserted. Capsule oblong-ovoidal.

### 3. GILIA LEPTANTHA Parish

(Maps 1, 6; Figs. 8, 9; Plate I-E, H, J, O)

Erect plants, often somewhat spreading with several main stems from near the base. Stems cobwebby-pubescent at base and glandular above. Basal leaves gray-green, numerous and crowded, forming a rosette at base of plant, moderately to densely cobwebby-pubescent, bipinnate (or sometimes almost tripinnate in *G. l. leptantha*), rachis narrow, about 1 mm. wide, rarely to 2.5 mm. wide, lobes short, pointed, often crowded. Cauline leaves much reduced with a few lobes near base, apex elongate and acuminate, the lower cauline leaves often cobwebby-pubescent and the upper ones glandular. Uppermost leaves reduced to minute bracts, entire, or




Map 6. Distribution of *Gilia leptantha*.

sometimes in *G. l. transversa* with a pair of small lobes at base, glandular. Inflorescence diffuse to somewhat congested with unequal pedicels. Corolla small to large, 2½ to 6 times the calyx, with a short to very long filiform tube, a very short to long throat, and narrowly to broadly oval lobes. In color the corolla tube yellow or purple, often striated with white or yellow veins, throat yellow or white, lobes bright pink or deep violet to light pinkish-violet or pale violet. Stamens well to long exserted from the orifice. Capsule globular to ovoidal or oblong-ovoidal. N = 9.

*Range.*—Northwestern Nevada and northeastern California south to Ventura and San Bernardino counties, California.

KEY TO THE SUBSPECIES OF GILIA LEPTANTHA

Corolla tube long, 2-4 times the calyx (or 1½ times the calyx in one race of *G. l. purpusii*). In coniferous forest.
- Corolla lobes very narrow, 1.4-2.8 mm. wide, about 2 to 2½ times as long as wide, bright pink. San Bernardino Mts. ..... a. *leptantha*
- Corolla lobes narrow to moderately broad, 2.5-5.0 mm. wide, 1-2 times as long as wide, pinkish-violet. Southern Sierra Nevada ..... b. *purpusii*

Corolla tube short, 1 to 1½ times the calyx (or sometimes almost 2 times the calyx in *G. l. pinetorum*). In coniferous forest or open scrub communities.
- Stamens shorter than the corolla lobes, the filaments not exceeding 2.5 mm. San Gabriel, San Bernardino and Little San Bernardino Mts.
  - Corollas 13.5-17.0 mm. long; habit erect with tall central leader; corolla color not deep. Below 6000 feet ..... c. *transversa*
  - Corollas 7.5-14.0 mm. long; habit low and spreading with numerous main stems from base; corolla color deep. Above 6000 feet ..... d. *vivida*
- Stamens equalling or exceeding the corolla lobes, the filaments 4 mm. long or longer. Not in the Transverse Ranges.
  - Corolla tube violet, exserted from calyx; calyx glandular. Mt. Pinos, Ventura County ..... e. *pinetorum*
  - Corolla tube yellow, included in calyx; calyx glabrous or cobwebby-pubescent. Washoe County, Nevada, to Lassen and Alpine counties, California ..... f. *salticola*

### 3a. G. LEPTANTHA subsp. LEPTANTHA

*Gilia leptantha* Parish, Zoe 5: 74, 1900, (type seen). *G. arenaria* subsp. *leptantha* Brand, Pflzr. 250; 103, 1907. *G. latiflora* subsp. *leptantha* Mason & A. Grant, Madroño 9: 219, 1948.

Plants tall, 15-45 cm. tall. Stems lightly glandular-pubescent above. Basal leaves 2.5-6.5 cm. long, bipinnately to almost tripinnately lobed, primary lobes 2.5-8.0 mm. long and closely to widely spaced, 1-6 mm. apart, short lobes or teeth often present along edge of rachis between lobes, secondary lobes 0.5-2.0 mm. long. Inflorescence diffuse with 2-3 flowers above a bract; internodes long and pedicels on a branch very unequal, the shortest 1.0-7.5 mm. long, the longest 10-27 mm. long, elongating only slightly as capsules mature. Calyx lightly glandular-dotted, 3.5-4.0 mm. long, the lobes narrow and acuminate, 0.2-0.4 mm. wide, elongating to exceed the mature capsule. Corolla 12.5-23.0 mm. long with slender or filiform tube, 0.5-0.9 mm. wide, flaring gradually or abruptly into a narrow throat and narrow orifice, 1.5-2.7 mm. wide; tube and throat together 7.5-17.5 mm. long, glabrous to sparsely puberulent; lobes narrow, 1.4-2.8 mm. wide, about 2 to 2½ times as long as wide. In color the corolla tube and throat yellow, or the tube purple striated with yellow veins, the throat sometimes tinged with violet on outside, lobes bright pink throughout. Stamens unequal in length; the shortest just at orifice or barely exserted with a filament 1.0-2.2 mm. long; the longest stamens well exserted and almost as long as to longer than corolla lobes, the longest filament being 3.5-6.0 mm. long. Style longer than

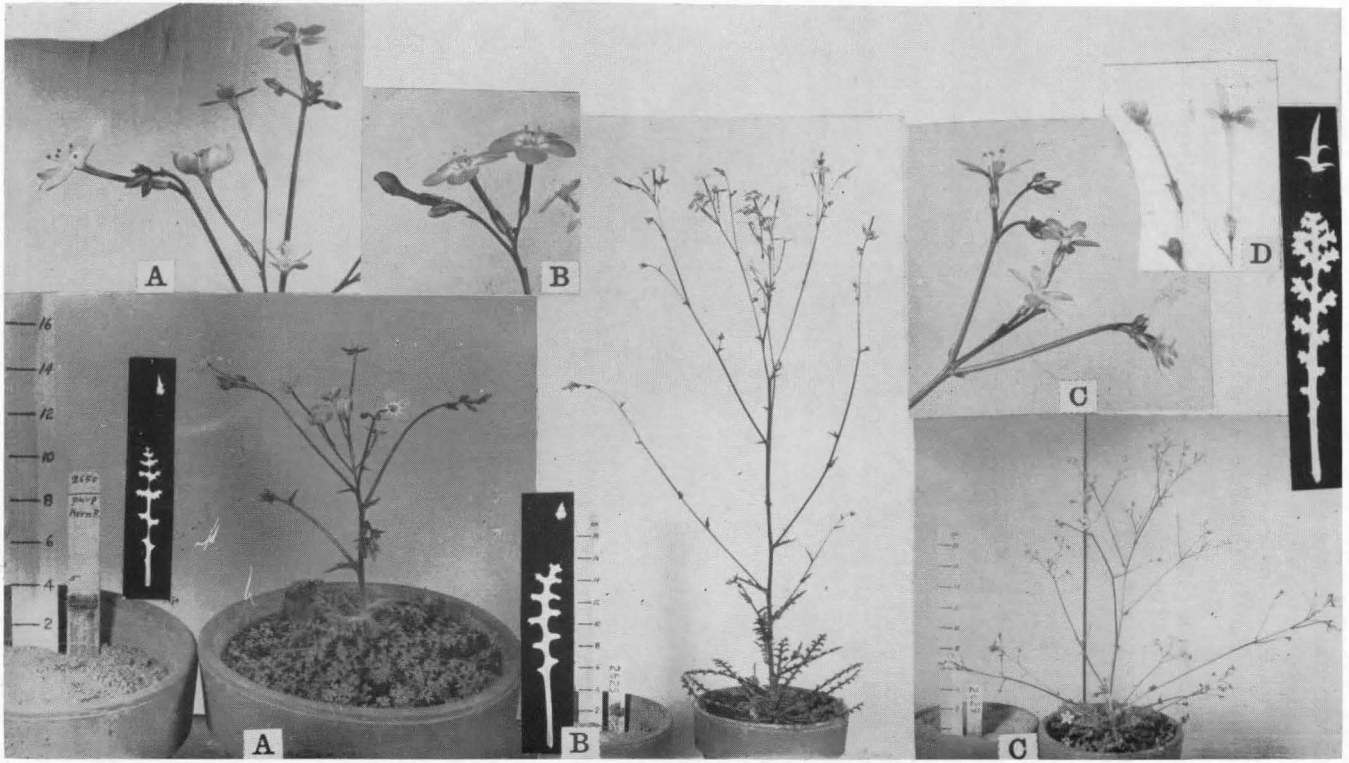



Fig. 8. *Gilia leptantha:* long-tubed races. A) *G. l. purpusii* from Kern River, Tulare County. B) *G. l. purpusii* from Old Isabella, Kern County. C) *G. l. leptantha* from upper Santa Ana River, San Bernardino County; short-tubed variant. D) long-tubed *G. l. leptantha* from the same region.

corolla, stigma lobes 1.0-2.2 mm. long and reflexing beyond level of longest stamens. Capsule ovoidal, 3.2-4.3 mm. long.

*Range.*—Sandy or gravelly stream banks and canyon slopes, from 5000 to 7700 ft. Upper Santa Ana River and its tributaries, San Bernardino Mts., San Bernardino County, California. Flowering from late June to August.

*Type.*—*Mr. & Mrs. Grout* in June 1900, Seven Oaks, San Bernardino Mts., San Bernardino County, California. Dudley Herbarium (Stanford University) 137391.

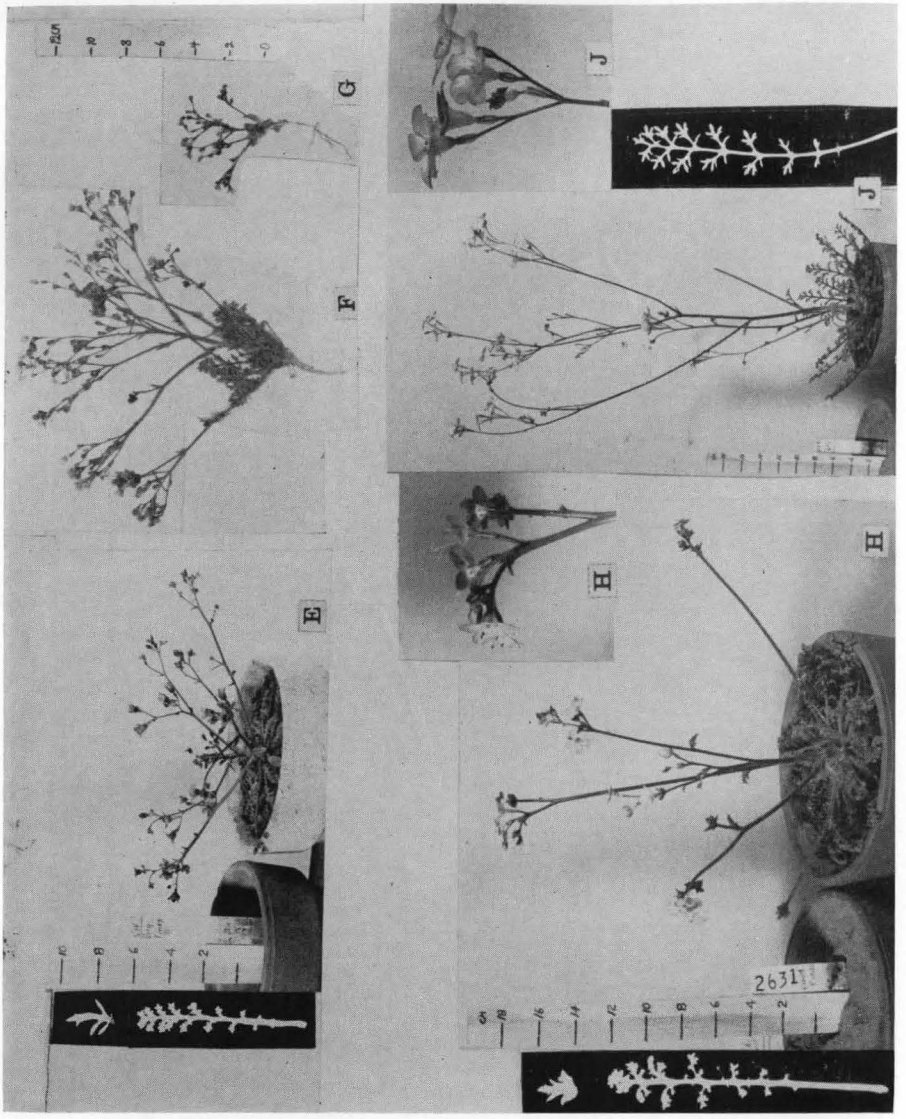



Fig. 9. *Gilia leptantha:* short-tubed races. E) *G. l. vivida* from the San Gabriel Mts. F) *G. l. salticola* from Secret Valley, Lassen County. G) *G. l. salticola* from Ebbetts Pass, Alpine County. H) *G. l. pinetorum* from Mt. Pinos, Ventura County. J) *G. l. transversa* from Cajon Pass, San Bernardino County.

*Representative Specimens.*—CALIFORNIA. San Bernardino County; San Bernardino Mts.: *J. Grinnell 16,* Fish Creek; *F. W. Peirson 4942,* Fish Creek; *P. A. Munz 6284,* Cienega Seca Creek; *P. A. Munz and I. M. Johnston 8649,* above Big Meadows; *V. Grant 9155, 9156,* South Fork Public Camp, Santa Ana River.

### 3b. G. leptantha subsp. purpusii (Milliken) A. & V. Grant, comb. nov.

*Gilia tenuiflora* var. *Purpusii* Milliken, Univ. Calif. Publ. Bot. 2: 29, May 1904, (type seen). *G. latiflora* subsp. *purpusii* Mason & A. Grant, Madroño 9: 218, 1948.
*Gilia collina* Eastw., Bot. Gaz. 37: 445, June 1904, (same type as *G. tenuiflora* var. *Purpusii* Milliken).

Plants with one central stout stem up to 60 cm. in height, well branched with several main stems arising from the base. Stems glandular-pubescent in the inflorescence. Basal leaves 2-6 cm. long, primary lobes 2-8 mm. long, closely spaced (1-4 mm. apart), but with occasional short teeth along edge of rachis between the lobes, secondary lobes 0.5-4.0 mm. long. Inflorescence diffuse with 1-2 flowers borne above a bract, the internodes long, or in low altitude races the inflorescence somewhat less diffuse with 2-4 flowers borne above a bract and the internodes shorter. Pedicels on a branch differing widely in length, the shortest about 1-2 mm. long and the longest 8-17 mm. long, elongating slightly as capsules mature. Calyx glandular-dotted, or sometimes in the first formed flowers cobwebby-pubescent, 3.0-5.2 mm. long at flowering time, elongating so as to almost equal or exceed the mature capsule. Corolla (8.5-) 13.0-29.0 mm. long with slender to moderately stout tube 0.5-1.5 mm. wide), widening abruptly into a short throat (1/9 to 1/3 as long as tube), the orifice narrow, 2.3-4.3 (-5.3) mm. wide; tube and throat together 10-22 mm. long; lobes narrow to moderately broad, 2.5-5.0 mm. wide, 1-2 times as long as wide; tube glabrous to lightly puberulent. In color the corolla tube purple striated with pale veins, or sometimes yellow in lower part or throughout; throat white, often tinged with violet on outside, yellow coloring sometimes present as well; lobes pinkish-violet. Stamens unequal in length, the shortest just at orifice with filaments 0.5-1.0 mm. long, and the longest long exserted but shorter than the corolla lobes, with filaments 3.4-5.8 mm. long. Style long exserted, the stigma lobes 1.9-3.4 mm. long, reflexing above the level of the longest stamens. Capsule ovoidal or oblong-ovoidal, 3.0-6.2 mm. long.

*Range.*—Open river beds and slopes and among Yellow Pines, from 2500 to 8500 ft. Kern River drainage, southern Sierra Nevada, Tulare and northern Kern counties; occasionally on the upper east slopes of the Sierra (above 6500 ft.) in Inyo County, California. Flowering in May at 2500 ft., in June and July at higher elevations.

*Variation.*—The high altitude races from above 8000 feet have a somewhat spreading habit with numerous very slender branches, filiform corolla tubes (0.5 mm. wide), and narrow corolla lobes (2.5-3.0 mm. wide). The opposite extreme is represented in a low altitude race (2500 feet) from Old Isabella in Kern Valley. In this race the habit is erect with a stout central leader, dense inflorescence, large flowers with stout tube, broad orifice and broad lobes, relatively short stamens, and large capsules. The Old Isabella population is exceptionally variable in corolla size, proportions and coloration. A third racial component is found on Mt. Breckenridge to the south of Kern Canyon and in the Greenhorn Mts. west of Kern Canyon. This racial assemblage is distinguished by a short corolla tube which is about 1½ times as long as the calyx. The Mt. Breckenridge population consists of tall erect plants like those in Kern Valley, whereas the Greenhorn Mt. population consists of small plants with slender stems.

*Type.*—*C. A. Purpus 1783,* Hockett Meadow, Sierra Nevada, 7000-8000 ft., Tulare County, California, June 1896. University of California Herbarium 126402.

*Representative Specimens.*—CALIFORNIA. Tulare County: *V. & A. Grant 9266, 9267,* Kern River south of Johnsondale; *R. Bacigalupi, I. Wiggins & R. Ferris 2627,* Quaking Aspen Recreational Area; *C. A. Purpus 5034,* Erskine Creek; *C. A. Purpus 1429,* Little Kern River; *H. M. Hall & E. B. Babcock 5120,* Cannell Meadows; *A. Alexander & Kellogg 2962,* Nine Mile Canyon. Inyo County: *P. A. Munz 19473,* Nine Mile Canyon. Kern County: *F. Grinnell 243,* Mt. Breckenridge; *V. Grant 9218,* Greenhorn Mts.

**3c. G. leptantha** subsp. **transversa** A. & V. Grant, subsp. nov.

Medium to large plant, usually with a tall central leader, later developing numerous strong secondary branches from the base or above. Stems densely glandular just above the basal rosette of leaves, becoming moderately to sparsely glandular above. Basal and lower cauline leaves 2-8 cm. long, usually densely matted with cobwebby hairs, primary lobes 3-13 mm. long, the secondary lobes somewhat crowded, short, blunt but pointed. Leaves above the basal rosette pinnately lobed and the lobes somewhat more acuminate than those of the basal leaves. Inflorescence loose to somewhat crowded with 2-6 flowers borne above a bract on slightly to very unequal pedicels, a lateral pedicel arising 0.5-2.7 mm. below a terminal flower and becoming 2-5 times as long as the terminal pedicel. Pedicels and calyces stipitate-glandular, or in the first formed flowers the calyx cobwebby-pubescent. Calyx 2.3-4.5 mm. long, growing with the capsule and sometimes exceeding it, lobes acuminate. Corolla 13.5-17.0 mm. long, the tube about equalling the calyx or up to one half longer than the calyx; tube and throat together 7.5-10.5 mm. long; throat about as long as or a little longer than the lobes, abruptly expanded and full, the orifice 4.5-7.6 mm. wide; lobes oval, a little longer than wide. In color the corolla tube violet, throat yellow below, white above, lobes pale pinkish-violet. Stamens unequal, the shortest barely exserted from orifice, the longest well exserted but shorter than corolla lobes, the longest filaments 1.5-2.0 mm. long. Style well exserted, maturing just beyond the longest stamens. Capsule ovoidal, 2.8-7.6 mm. long.

Corolla grandis, 13.5-17.0 mm. longa, tubo breve, calycem aequante; stamina brevia, $<2$ mm. longa.

*Range.*—Sandy slopes, flats and washes, from 3000 to 6000 ft. Edge of the Mojave Desert and the bordering north slopes of the Transverse Ranges from Little Rock Creek in the San Gabriel Mts. east to the San Bernardino and Little San Bernardino Mts.; Los Angeles, San Bernardino and Riverside counties, California. Flowering from April to June or July.

*Variation.*—In Cajon Pass some individuals possess a congested and showy inflorescence, others a loose inflorescence. The corolla color likewise varies from pale to deep shades. In Cajon Pass, again, the corollas observed by the authors had white throats and pale pinkish-violet lobes, whereas dried specimens from other localities suggest that the upper throat may sometimes be violet and the lobes a deep pinkish-violet.

*Type.*—*P. A. Munz 15161,* 12 miles east of Lucerne Valley, 3000 ft., southern Mojave Desert, San Bernardino County, California, May 7, 1937. Pomona College Herbarium 229069.

*Representative Specimens.*—CALIFORNIA. Los Angeles County: *F. W. Peirson 4132,* Little Rock Creek, San Gabriel Mts. San Bernardino County: *V. & A. Grant 9385,* Cajon Pass; P. A. *Munz 4458,* between Hesperia and Adelanto; *M. E. Jones,* May 12, 1926, Cushenbury Canyon, San Bernardino Mts.; *J. T. Howell 328,* near Whiskey Spring, San Bernardino Mts.; *C. L. Hitchcock 12239,* 10 miles southwest of Windmill Tank, Little San Bernardino Mts. Riverside County: *L. Rowntree,* April 11, 1930, Morongo Valley.

**3d. G. leptantha** subsp. **vivida** A. &. V. Grant, subsp. nov.

Plants compact with numerous main stems from near base, spreading and ascending, 10-20 cm. long. Herbage dark grayish-green. Lower stems glabrous to cob-

webby-pubescent, basal leaves densely matted or tufted with cobwebby pubescence. Basal rosette dense. Basal leaves 2-5 cm. long, bipinnate or tripinnate, the rachis moderately broad, 2-4 mm. wide, the lobes equal in width to the rachis, often somewhat linear but short, blunt with a point. Cauline leaves much smaller than basal, pinnately lobed, the upper cauline having the terminal lobe elongate, much exceeding the small lateral lobes. Uppermost leaf-like bracts entire, linear, cobwebby-pubescent or glandular. Inflorescence diffuse with 1-4 flowers borne above a bract. Pedicels of a pair of flowers unequal in length, a lateral pedicel arising 1-5 mm. beneath a terminal flower and becoming 7.5-16.5 mm. long, 3-6 times as long as the terminal pedicel, pedicels glandular. Calyx 2.8-3.7 mm. long, slightly exceeding capsule at maturity, glabrous to sparsely cobwebby-pubescent or sparsely and minutely glandular. Corolla small, 9-14 mm. long, with tube 3.0-4.9 mm. long, equalling calyx or to ½ longer than calyx, a little shorter than throat; throat full and abruptly expanded or narrower and gradually expanded above tube, orifice 2.8-5.0 mm. wide; lobes 4-5 mm. long, oval, a little narrower than their length. In color the corolla tube violet, throat yellow below middle, deep violet above and in orifice, lobes deep pinkish-violet. Stamens well exserted, unequal in length, the longest ½ to ⅔ as long as corolla lobes. Style well exserted, stigma lobes about 1 mm. long, reflexing beyond level of stamens. Capsule small, globular, 2.5-3.7 mm. long.

Plantae compactae, obscure cano-virides; caulibus inferioribus glabris aut lanoso-pubescentibus; foliis basalibus, cum pubescentia lanosa concreta aut floccosa, tripinnatis, cum rachibus moderate latis; pedicellis paris florum inaequalibus, uno quam altero ter ad sexius longiore; calyce glabro; corolla infra lutea, supra ianthina satura; capsula cum seminibus 3-12.

*Range.*—Sandy or gravelly places, often in pine woods, from 6000 to 8200 feet. Along the crest and higher slopes of the San Gabriel and Tehachapi Mts., Los Angeles and Kern counties, California. Flowering from May to July.

*Variation*—Corolla tube length and throat width variable both within and between populations. An exceptionally large and robust form has been collected on upper Rock Creek in the San Gabriel Range.

*Type.—V. & A. Grant 16057,* Inspiration Point, 7400 feet, southwest of Big Pines, San Gabriel Mts., Los Angeles County, California, June 15, 1951. Rancho Santa Ana Botanic Garden Herbarium 67060.

*Representative Specimens.*—CALIFORNIA. Los Angeles County: *G. B. Grant* in 1906, Mt. Wilson; *V. & A. Grant 16055,* Big Pines; *T. Craig 433,* Mt. San Antonio; *F. W. Peirson 8438,* Mt. Pacifico. Kern County: *W. R. Dudley 319,* Tehachapi Peak.

**3e. G. leptantha** subsp. **pinetorum** A. & V. Grant, subsp. nov.

Plant small, usually with a short central leader and later a number of longer and somewhat decumbent stems from near base. Stems with long internodes, glandular in the inflorescence. Basal and lower cauline leaves 2-5 cm. long, numerous, crowded, forming a compact rosette, grayish with a dense covering of cobwebby hairs, the segments blunt but pointed, the rachis often bordered with short teeth between the primary lobes. Inflorescence diffuse (or somewhat congested in the middle altitude race), with 1-4 flowers borne above a bract. Pedicels very unequal, a lateral one arising 0.5-1.5 mm. below a terminal flower and becoming 7-20 times as long as the terminal pedicel. Calyx 2.8-4.2 mm. long, glandular-dotted, elongating so as to slightly exceed the mature capsule. Corolla 11-13 mm. long, 2 to 3½ times the calyx; the tube 4.2-6.4 mm. long, slightly to well exserted from the calyx; tube and throat together 6.8-9.4 mm. long; throat abruptly expanded, forming a broad orifice 3.5-5.4 mm. wide; lobes oval, 2.8-3.4 (-4.2) mm. wide, a little longer than wide. In color the corolla tube pale violet, throat white, lobes pale violet. Stamens unequal

but all long exserted, the longest with filaments 5.5-9.4 mm. long, exceeding the corolla lobes. Style long exserted, the stigma lobes maturing beyond the longest stamens. Capsule globular, 4-5 mm. long.

Corolla parva, 11-13 mm. longa, tubo breve, calycem aequante; stamina exserta, 5.5-9.4 mm. longa.

*Range.*—Openings beneath pines, from 5100 to 9000 ft. Mt. Pinos up to the bare summit, northern Ventura County, California. Flowering from late May to June.

*Variation.*—The middle altitude race consists of taller plants with a more congested and showy inflorescence and somewhat shorter (though still well exserted) stamens than the high altitude race.

*Type.—V. & A. Grant 16047,* public camp site, 7000 ft., 13 miles above Stauffer junction, Mt. Pinos, Ventura County, California, June 14, 1951. Rancho Santa Ana Botanic Garden Herbarium 67064.

*Representative Specimens.*—CALIFORNIA. Ventura County: *C. B. Wolf 6991,* Lockwood Valley; *P. A. Munz 7013,* Mt. Pinos; *V. & A. Grant 9275,* summit of Mt. Pinos; *W. R. Dudley & F. H. Lamb 4590,* summit of Mt. Pinos; *A. D. E. Elmer 3992,* Griffins.

### 3f. G. leptantha subsp. salticola (Eastwood) A. &. V. Grant, comb. nov.

*Gilia salticola* Eastwood, Leafl. West. Bot. 3: 199, 1943, (type seen).
*Gilia alpina* Eastwood, non (Wedd.) Brand, op. cit. 2: 282, 1940, (same type as *G. salticola*).

Small plant, much branched, sometimes with somewhat decumbent secondary branches from near base. Main stems 6-20 cm. long, lightly glandular in the inflorescence. Basal leaves 1.0-5.5 cm. long, sometimes grayish-matted with pubescence, the lobes small, crowded, blunt, acerose tipped. Inflorescence somewhat congested to diffuse with 3-8 flowers borne above a bract. Pedicels unequal, a lateral one arising 0.5-2.5 mm. beneath a terminal one and exceeding it 2-12 times. Calyx 2.2-3.8 mm. long, growing to exceed capsule, glabrous or cobwebby-pubescent, herbaceous parts broad and flat, sinus membrane often folded in a slight keel between the lobes. Corolla 6.0-9.3 mm. long, 2½ to 3 times as long as calyx; tube and throat together 4.5-6.0 mm. long; the tube included in or sometimes slightly exserted from calyx; throat much shorter than lobes, abruptly expanded, the orifice 2.4-3.6 mm. wide; lobes 4.0-4.5 mm. long and narrower than long. In color the corolla tube and throat apparently lacking purple, probably pale yellow, the throat with yellow spots, the lobes violet (these statements being based on examination of dried specimens only). Stamens long exserted, slightly unequal, the longest subequal to or slightly exceeding the corolla lobes, or all stamens exceeding the corolla lobes. Style long exserted, stigma lobes reflexing just beyond the stamens. Capsule small, ovoidal, 3.3-5.2 mm. long.

*Range.*—Sandy plains and slopes, from 5000 to 8800 feet. Just east of the Sierra Nevada in Lassen County, California, and Washoe County, Nevada; collected once at summits of Ebbetts and Carson Passes, in the Sierra Nevada, Alpine County, California. Flowering in May and June.

*Variation.*—The high montane race from Ebbetts and Carson Passes is a low dwarfish plant 4-7 cm. tall with short internodes, a small compact basal rosette, leaves 1½ to 2 cm. long which are gray with a densely matted pubescence, and flowers 6-7 mm. long. At lower elevations the plant is larger, as described above, lacks the dwarfish aspect, and possesses larger flowers.

*Type.—A. Eastwood & J. T. Howell 8414,* Carson Pass, Sierra Nevada, Alpine County, California, June 17, 1940. California Academy of Sciences Herbarium 279905.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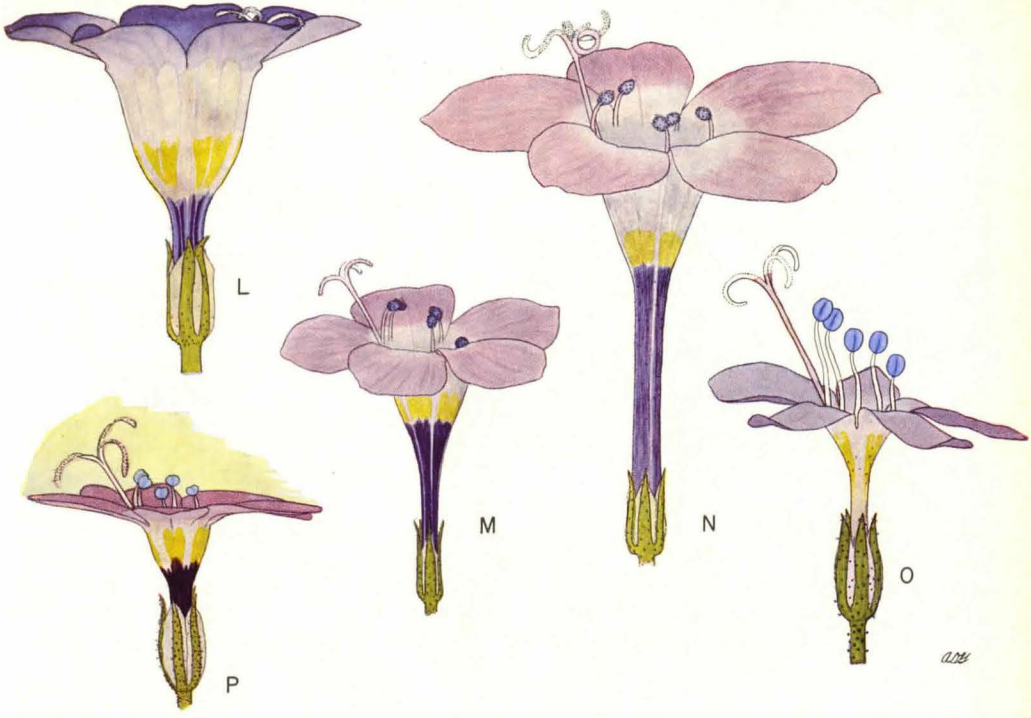



PLATE I. FLOWERS OF COBWEBBY GILIAS.

A) *G. ochroleuca bizonata* from Ventura County.
B) *G. cana speciosa* from Short Canyon, Kern County.
C) *G. cana triceps* from the Argus Mts.
D) *G. ophthalmoides flavocincta* from Apache Trail.
E) *G. leptantha vivida* from the San Gabriel Mts.
F) *G. latiflora davyi* from Gorman.
G) *G. tenuiflora tenuiflora* from Arroyo Seco, Monterey County.
H) *G. leptantha purpusii* from the Kern River.
J) *G. leptantha leptantha* from the Santa Ana River.
K) *G. inconspicua interior* from Kern Canyon.
L) *G. latiflora latiflora* from Apple Valley, San Bernardino County.
M) *G. latiflora latiflora* from Lancaster, Los Angeles County.
N) *G. latiflora excellens* from the El Paso Mts.
O) *G. leptantha pinetorum* from Mt. Pinos.
P) *G. brecciarum neglecta* from Short Canyon, Kern County.

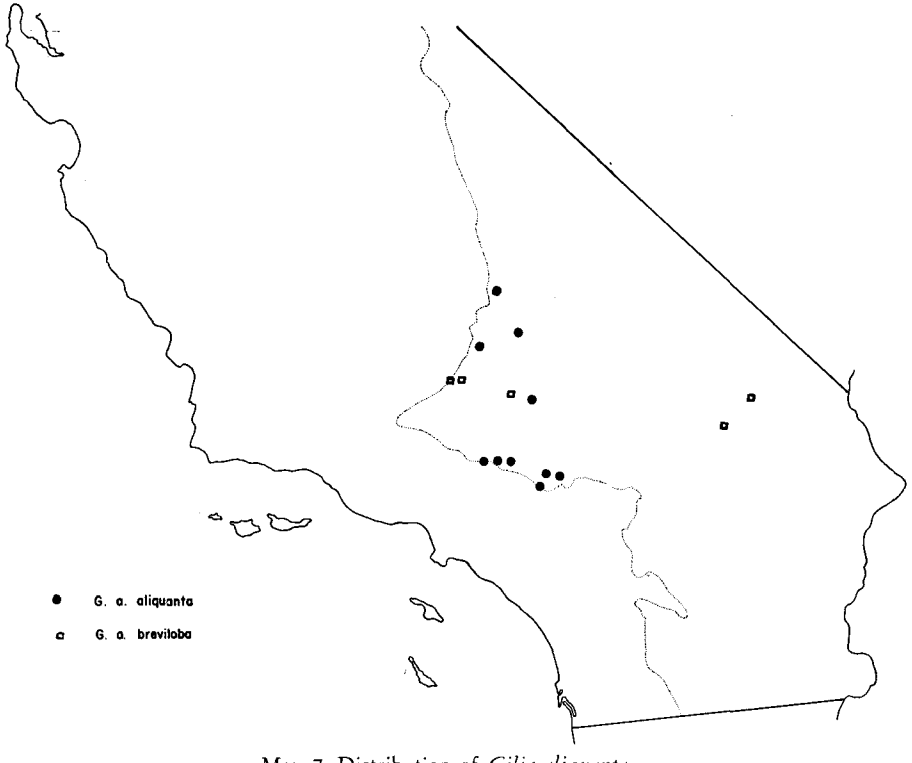
(Magnifications: B, D, F, H, J, L, M, N, P, x 2.5; A, C, E, G, O, x 3.8; K, x 5.0)

*Representative Specimens.*—CALIFORNIA. Alpine County: *A. Eastwood & J. T. Howell 8548,* Ebbetts Pass. Lassen County: *E. I. Applegate 8914,* Secret Valley. NEVADA. Washoe County: *W. A. Archer 6014,* Reno Hot Springs; *W. D. Billings 1300,* near Reno; *O. J. Murie 2872,* Badger Mt., Sheldon Antelope Range; *V. Woodbury 14,* 3 miles southeast of Vista.

### 4. Gilia aliquanta A. & V. Grant, sp. nov.

(Map 7; Fig. 10)

Small erect plant with one main stem above a basal rosette of leaves, later developing numerous secondary stems from near base, the habit thus becoming somewhat spreading. Stems 8-16 cm. long, glabrous to sparsely cobwebby pubescent or glandular near base, and lightly glandular above. Herbage light green, the leaves lightly cobwebby-pubescent. Basal leaves semi-erect, 1-3 cm. long, rachis 1.0-2.5 mm. wide; lobes opposite, linear, blunt but cuspidate, usually narrower than the rachis and 2-3 mm. long. Middle cauline leaves with 1-2 pairs of lobes arising from near base, terminal lobe somewhat linear and elongate, lateral lobes long. Bracts entire or with a pair of lobes at base, lightly cobwebby-pubescent or glandular. Inflorescence loose, with one or two flowers borne above a bract. Pedicels unequal, 1-11 mm. long, usually more than 2 mm. long, and the lateral 3-5 times as long as the terminal one; pedicels elongating only slightly in fruit. Calyx glabrous or sparsely cobwebby-pubescent, 3.5-5.0 mm. long in flower, the hyaline membrane full and folded in the sinuses forming keels at base of calyx, later expanding to enclose the enlarging capsule. Corolla 6-12 mm. long, 2-3 times as long as calyx. In color both the calyx and the corolla bright violet with varying amounts of yellow or cream in the corolla




Map 7. Distribution of *Gilia aliquanta.*

Fig. 10. *Gilia aliquanta* from Red Rock Canyon, Kern County.

throat. Stamens exserted. Style barely to well exserted. Capsule plump, globular to broadly ovoidal. N=9.

Corolla violacea; calyx in sinibus plicis membranaceis praeditus; calyx glaber vel sparse araneoso-lanatus.

*Range.*—Mojave Desert in Kern, Los Angeles, and San Bernardino counties, California.

KEY TO THE SUBSPECIES OF GILIA ALIQUANTA

Corolla lobes broad and long, as long as the combined length of tube and throat; corolla throat shallow, abruptly expanded; stamens long exserted.....a. *aliquanta*

Corolla lobes narrow and short, one half as long as the combined length of tube and throat; corolla throat long and narrow; stamens only slightly exserted.....b. *breviloba*

### 4a. G. ALIQUANTA subsp. ALIQUANTA

Corolla tube and often part of throat included in calyx; throat shallow, usually about ½ as long as the tube, abruptly expanded to form a moderately broad orifice, 2.0-4.3 mm. wide; lobes 2.5-6.0 mm. long, about equal to combined length of tube and throat, ovate, a little narrower than long. Stamens long exserted, the filaments 1.5-6.0 mm. long, unequal in length, the longest about ⅓ longer than the shortest and about as long as the corolla lobes or longer. Style well exserted, the stigma lobes 1.3-3.3 mm. long, reflexing at a level among or just beyond the stamens.

*Range.*—Characteristically on rocky hillsides, from 2500 to 4100 feet. Lower north slope of San Gabriel and San Bernardino Mts. and adjacent desert plains, north along east base of southern Sierra Nevada; San Bernardino County to northern Kern County, California. Flowering in April and May.

*Type.*—*E. K. Balls 8494*, 9.6 miles northwest of Camp Cajon, Mojave Desert, San Bernardino County, California, April 26, 1952. Rancho Santa Ana Botanic Garden Herbarium 77397.

*Representative Specimens.*—CALIFORNIA. San Bernardino County: *F. W. Peirson 4548,* north of Cajon Pass; *I. M. Johnston 2305,* west of Hesperia; *I. W. Clokey & B. C. Templeton 5678,* between Adelanto and Randsburg. Los Angeles County: *F. W. Peirson 6730,* Rock Creek; *V. & A. Grant 9324,* east of Pear Blossom. Kern County: *V. & A. Grant 9117,* Red Rock Canyon; *V. & A. Grant 9083,* near Mt. Owen; *V. & A. Grant 9336,* Short Canyon, northwest of Inyokern.

### 4b. G. aliquanta subsp. breviloba A. & V. Grant, subsp. nov.

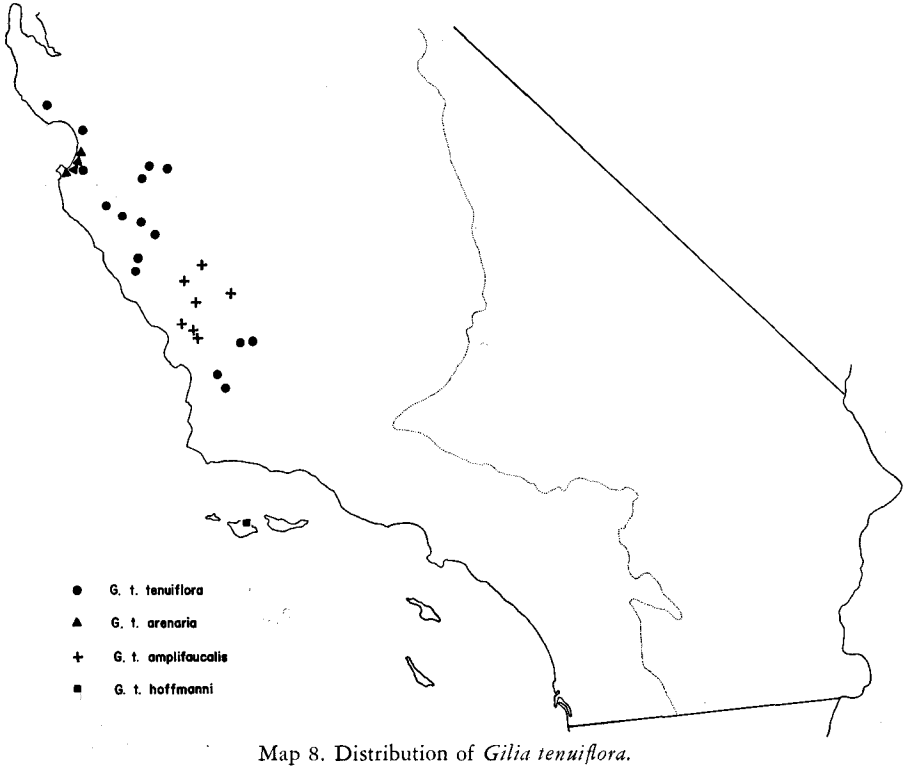
Corolla tube exserted from calyx, flaring slightly to form a narrow throat and narrow orifice, 1.8-2.7 mm. wide; throat as long as or longer than tube; lobes 2.3-4.3 mm. long, ½ as long as combined length of tube and throat, and narrow, about half as wide as long. Stamens subequal to unequal, slightly exserted, or the shortest slightly exserted and the longest well exserted but shorter than corolla lobes. Style maturing at level of stamens, at orifice, or slightly exserted.

Lobi et faux corollae angusti et breves; stamina leviter exserta.

*Range.*—Rocky and gravelly hillsides, from 2800 to 5000 feet. Mojave Desert from Tehachapi Pass to the Granite and Providence Mts.; Kern and San Bernardino counties, California. Flowering in March and April.

*Type.*—*C. B. Wolf 10140,* east fork near summit of Willow Spring Canyon, 5000 feet, south side of Old Dad-Granite Mts., San Bernardino County, California, April 29, 1941. Rancho Santa Ana Botanic Garden Herbarium 24994.

*Representative Specimens.*—CALIFORNIA. Kern County: *I. L. Wiggins 9558,* 14.5 miles west of Kramer; *M. Cave* in 1947, west of Mojave; *F. W. Peirson 11409,* south slope of Tehachapi Range north of Mojave. San Bernardino County: *P. A. Munz & R. D. Harwood 3548,* Bonanza, Providence Mts.




Map 8. Distribution of *Gilia tenuiflora.*

## 5. GILIA TENUIFLORA Benth.

(Maps 1, 8; Fig. 11; Plate I-G)

Erect to somewhat spreading plant with one main stem or several arising from a dense cluster or rosette of prostrate or semi-erect basal leaves. Strong secondary branches forming in well developed plants. Stems slender except in *G. t. amplifaucalis,* and glabrous or cobwebby-pubescent or glandular at base. Basal leaves lightly cobwebby-pubescent, rarely glabrous, serrate or pinnately or bipinnately lobed with narrow rachis 0.4-1.5 mm. wide (or sometimes a little wider in *G. t. arenaria*), and short linear lobes. Cauline leaves similar to the basal but shorter and with lobes arising near base. Uppermost leaves reduced to minute bracts, entire or with a small pair of lobes at base. Inflorescence diffuse to somewhat congested with 1-4 flowers borne above a bract on very unequal to slightly unequal pedicels. Calyx glandular or cobwebby-pubescent, 3.3-5.8 mm. long, growing with the capsule and becoming nearly as long to slightly longer than the capsule at maturity. Corolla 3-4 times as long as the calyx, the tube exserted from calyx, and gradually flaring so as to form a narrow to rather broad orifice. In color, the corolla tube and throat purple, sometimes striated, sometimes with a white region below the sinuses of the lobes; orifice white; lobes pinkish-violet throughout. Stamens unequal, the shortest just at orifice and the longest well exserted but a little shorter than corolla lobes, or only slightly exserted in *G. t. arenaria.* Capsule ovoidal or oblong-ovoidal. N=9.

*Range.*—South Coast Range and Santa Rosa Island, California.

KEY TO THE SUBSPECIES OF GILIA TENUIFLORA

Corolla lobes narrow, 2.1-4.2 mm. wide; throat narrow, the orifice 2.2-3.8 mm. wide; inflorescence diffuse; stems slender, usually with several main branches from base.

- Longest stamens well exserted; style long, the stigma lobes maturing beyond level of stamens; capsule small, 3.5-5.0 mm. long; plants tall. Flood plains and washes of Coast Range ..... a. *tenuiflora*
- Longest stamens slightly exserted from orifice; style short, the stigma lobes maturing among the stamens; capsule large, 5.0-6.2 mm. long; plants small. Sand dunes of Monterey Bay ..... b. *arenaria*

Corolla lobes broad, 4.0-5.8 mm. wide; throat full, the orifice 3.7-5.0 mm. wide; inflorescence somewhat congested; stems stout with usually one central leader.

- Corolla tube and throat together 6.7-11.0 mm. long; 2-4 flowers borne above a bract; style maturing beyond level of stamens. Upper Salinas River valley ..... c. *amplifaucalis*
- Corolla tube and throat together 13.0-14.5 mm. long; 1-2 flowers borne above a bract; style maturing among the stamens. Santa Rosa Island .... d. *hoffmanni*

### 5a. G. TENUIFLORA subsp. TENUIFLORA.

*Gilia tenuiflora* Benth., Bot. Reg. 19, sub t. 1622, 1833, (isotype seen).
*Gilia arenaria,* subsp. *leptantha* var. *Aliciae* Brand, Pflzr. 250: 103, 1907, (Santa Lucia Mts., neotype seen).

Small to moderately large plant 15-40 cm. tall; habit erect but becoming somewhat spreading as secondary branches develop. Stems alternately branched, glabrous below middle and glandular pubescent in the inflorescence, the glandular hairs stipitate, often several cells long. Basal leaves 2-6 cm. long, somewhat strap-shaped, rachis narrow, 1-2 mm. wide and with 4-6 pairs of short lobes, or bipinnately lobed with very narrow rachis (0.5-1.0 mm. wide) and narrow, delicately dissected lobes. Cauline leaves narrow like the basal and the lobes very short. Inflorescence diffuse with very slender branches and long internodes; 2-4 flowers borne above a bract. Pedicels very unequal, the shortest 2-4 mm. in length, the longest 10-16 mm. long

and 2½ to 8 times as long as the shortest, elongating very little or none as capsules mature. Calyx 3.3-4.3 mm. long, elongating so as to equal or exceed the mature capsule, lightly cobwebby-pubescent; herbaceous portions of calyx dark green or reddish, very narrow, being less wide than the sinus membrane, and acuminate. Corolla 11.5-15.8 mm. long with slender tube (0.5-0.8 mm. wide), flaring into a moderately narrow throat and orifice (3.0-3.8 mm. wide); tube and throat together 8-12 mm. long; lobes narrow (2.5-4.2 mm. wide and 4-5 mm. long). Longest stamens well exserted with filaments 1.5-2.5 mm. long. Style well exserted but not exceeding the corolla in length, stigma lobes 1.3-2.0 mm. long, reflexing beyond the level of the longest stamens. Capsule ovoidal, small, 3.5-5.0 mm. long.

*Range.*—Sandy washes, canyons and flood plains, from 1500 to 2100 ft. South Coast Range from the Santa Cruz Mts. to La Panza Range, mostly in the Salinas River drainage; Santa Cruz County to San Luis Obispo County, California. Sym-

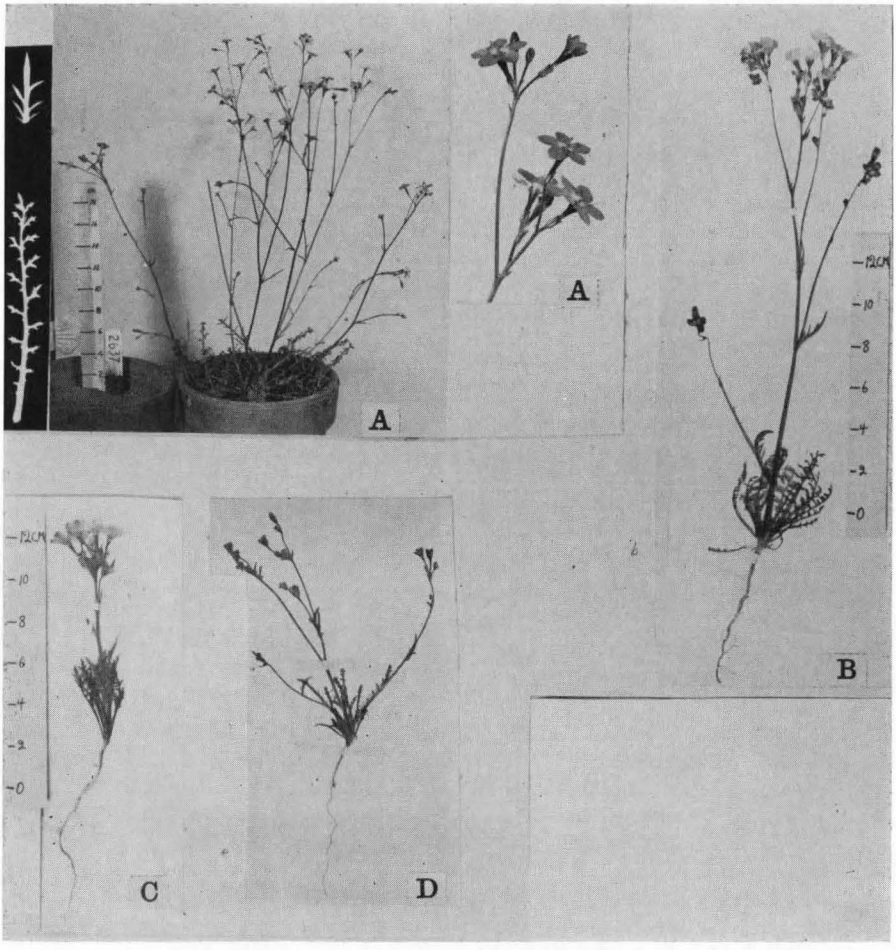



Fig. 11. *Gilia tenuiflora.* A) *G. t. tenuiflora* from Arroyo Seco, Monterey County. B) *G. t. amplifaucalis* from Paso Robles, San Luis Obispo County. C) *G. t. hoffmanni* from Santa Rosa Island. D) *G. t. arenaria* from Monterey, Monterey County.

patric with *G. t. arenaria* at Seaside near Del Monte, Monterey County. Flowering from April to June.

*Type.*—*D. Douglas,* "California," probably from Monterey County. Royal Botanic Gardens, Kew. An isotype is in the University of California Herbarium, No. 163760.

The type of *G. arenaria* subsp. *leptantha* var. *Aliciae* Brand was *Eastwood 12* from the Santa Lucia Mts. of Monterey County. This specimen, which was in the Berlin Herbarium, was probably destroyed during World War II. Another specimen from the same region, annotated *"Aliciae"* in Brand's handwriting, is designated as neotype. It is: *A. Eastwood,* May 1-12, 1897, Stony Creek, San Miguelito Ranch, Santa Lucia Mts., Monterey County, California. California Academy of Sciences Herbarium 410.

*Representative Specimens.*—CALIFORNIA. Monterey County: *V. & A. Grant 9149,* south of Jamesburg cutoff on road to Greenfield; *J. T. Howell 29067,* Hastings Reservation, Santa Lucia Mts.; *R. A. Plaskett,* in 1899, Jolon. San Benito County: *C. H. Quibell 884,* Griswold Hills, Panoche Country. San Luis Obispo County: *V. & A. Grant 9371,* 8 miles west of Simmler; *A. Eastwood,* June 16, 1902, bed of Santa Maria River on San Luis Obispo-Santa Barbara County line.

**5b. G. tenuiflora** subsp. **arenaria** (Benth.) A. & V. Grant, comb. nov.

*Gilia arenaria* Benth., Bot. Reg. 19, sub t. 1622, 1833, (isotype seen). *G. arenaria* subsp. *leptantha* var. *eu-arenaria* Brand, Pflzr. 250: 103, 1907. *G. tenuiflora* var. *arenaria* Jeps., Fl. Calif. 3: 178, 1943.

Small plant 6-17 cm. tall, with erect central stem and usually several other main stems spreading out from the base above a cluster of basal leaves. Stems stiffish, strict, with few branches, densely glandular pubescent throughout, the glandular hairs several cells in length, or stems sometimes cobwebby-pubescent at the base. Basal leaves 1.5-4.0 cm. long, strap-shaped and serrate or pinnately short-lobed with narrow rachis, rachis 0.5-2.5 mm. wide. Cauline leaves as broad as or broader than the basal. Young inflorescence somewhat congested at ends of branches and few flowered with 1-2 flowers borne above each bract; later, as capsules mature, the inflorescence becoming loose due to elongation of internodes. Pedicels densely glandular, unequal, the shorter ones 0.5-2.0 mm. long and the longer ones 4.5-11.5 mm. long, elongating little or none as capsules mature. Calyx 3.4-4.2 mm. long in flower but elongating to exceed the maturing capsule, lightly to densely glandular pubescent; herbaceous portions of calyx as broad as or broader than the membranous portions. Corolla 11.7-13.9 mm. long with slender tube (0.5-0.8 mm. wide) flaring into narrow throat and orifice (2.2-3.4 mm. wide); tube and throat together 8.3-9.6 mm. long, puberulent; lobes narrow (2.1-3.7 mm. wide) and short (3.0-4.6 mm. long). Stamens very short, maturing just at orifice, or the longest slightly exserted with filaments 0.9-1.6 mm. long. Style shorter than corolla, the stigma lobes reflexing just within or slightly exserted from the orifice and beneath or at level of stamens; stigma lobes 1.5-1.8 mm. long. Capsule oblong-ovoidal, comparatively large, 5.0-6.2 mm. long.

*Range.*—Sand dunes, Monterey Bay, California. Flowering in April and early May.

*Type.*—*D. Douglas,* "California." Royal Botanic Gardens, Kew. An isotype is in the University of California Herbarium, No. 163770.

*Representative Specimens.*—CALIFORNIA. Monterey County: *A. D. E. Elmer 3556,* Pacific Grove; *A. A. Heller 6651,* Seaside; *L. Benson 6475,* 5 miles north of Monterey.

**5c. G. tenuiflora** subsp. **amplifaucalis** A. & V. Grant, subsp. nov.

Erect plant 16-24 cm. tall with one stout main stem branching alternately and arising from a cluster of basal leaves, or in grassy habitats the lower stems leafy up

to the middle rather than with a definite basal cluster of leaves. Stems glabrous at base and lightly glandular pubescent in the inflorescence. Basal leaves with narrow rachis, 0.5-1.5 mm. wide and with 4-8 pairs of lobes; lobes short, 1-3 mm. long, linear or sometimes with a few secondary lobes or teeth. Cauline leaves cobwebby-pubescent, bearing fewer and shorter lobes than the basal leaves, these lobes arising closer to the base. Inflorescence moderately congested and showy. Pedicels short, unequal, the shortest about 1-2 mm. long and the longer 3-12 mm. long, elongating only slightly or none as capsules mature. Calyx 4.0-5.8 mm. long, elongating to exceed the mature capsule, lightly cobwebby-pubescent; herbaceous portions of calyx green or reddish, very narrow, about the same width or narrower than the sinus membrane, and acuminate. Corolla 13.4-17.5 mm. long with slender to moderately stout tube 0.5-1.1 mm. wide, flaring into a full throat with orifice 3.8-5.0 mm. wide; tube and throat together 6.7-11.0 mm. long; lobes broad (4.0-5.5 mm. wide and 4.0-6.3 mm. long). Longest stamens well exserted with filaments 3.8-4.0 mm. long. Style well exserted, a little shorter than to longer than corolla; stigma lobes 2.3-2.5 mm. long, reflexing beyond level of longest stamens. Capsule ovoidal, 4.5-5.3 mm. long.

Caulis crassus et fere singularis; inflorescentia aliquanto densa, 2-4 flores supra bracteis omnibus; corolla 13.4-17.5 mm. longa, tubus et faux 6.7-11.0 mm. longi; lobus 4.0-5.5 mm. latus et 4.0-6.3 mm. longus, faux ampla, in foramine 3.8-5.0 mm. lata; stylus supra staminibus exsertus.

*Range.*—Upper Salinas River Valley to Cholame Valley; Monterey and San Luis Obispo counties, California. Flowering from late March through April.

*Type.—J. T. Howell 24216,* 3 miles east of Paso Robles, San Luis Obispo County, California, April 24, 1948. Rancho Santa Ana Botanic Garden Herbarium 43372.

*Representative Specimens.*—CALIFORNIA. Monterey County: *R. C. Wilson 531,* 3 miles northwest of McKay. San Luis Obispo County: *A. Eastwood and J. T. Howell 2015,* Cholame; *L. Seitz,* April 25, 1927, Atascadero; *M. E. Wall,* April 24, 1933, Santa Margarita.

**5d. G. tenuiflora** subsp. **hoffmanni** (Eastwood) A. & V. Grant, comb. nov.

*Gilia Hoffmanni* Eastw., Leafl. West. Bot. 2: 283, 1940, (type seen).

Small erect plant 6-12 cm. tall, with a stout stem arising above a densely leafy base. Stem unbranched except above middle in the inflorescence, rather densely glandular pubescent above the basal leaves, the hairs several cells in length, glabrous near base, and cobwebby-pubescent in the leaf axils. Basal leaves soft in texture, green or reddish with anthocyanin, pinnately lobed with narrow rachis (0.4-0.8 mm. wide), with 4-8 pairs of lobes 1.2-4.0 mm. long, broadly linear, blunt with a point. Uppermost bracts entire. Inflorescence somewhat congested, with 1-2 flowers above a bract. Pedicels densely glandular-pubescent, short, the members of a pair slightly unequal, 0.5-3.2 mm. long, elongating very little as capsules mature. Calyx 4.6-5.7 mm. long in flower but elongating to exceed the capsule, moderately to densely glandular pubescent or sometimes in the first formed flower cobwebby-pubescent; herbaceous portions of calyx broader than the membranous portions between, often reddish with anthocyanin. Corolla 18-20 mm. long with a long and moderately stout tube, 0.6-1.0 mm. wide, flaring into a short throat and moderately broad orifice, 3.7-5.0 mm. wide; tube and throat together 13.0-14.5 mm. long; lobes large, 4.5-6.5 mm. long, broadly oval, 4.8-5.8 mm. wide. Stamens well exserted, the longest filaments 2.6-3.6 mm. long. Style shorter than corolla, the stigma lobes 2.3-2.7 mm. long and reflexing just above orifice and beneath the longest stamens. Capsule oblong-ovoidal, longer than 6.5 mm. (completely mature capsules not seen).

*Range.*—Santa Rosa Island, Santa Barbara County, California. Known only from the type locality. Flowering in April.

*Type.*—*R. Hoffmann,* April 8, 1930, sandy soil, East Point, Santa Rosa Island, California. California Academy of Sciences Herbarium 178717.

*Representative Specimen.*—CALIFORNIA. Santa Barbara County: *P. A. Munz and R. Hoffmann 11730,* Santa Rosa Island.

### 6. GILIA INCONSPICUA (Smith) Sweet

(Map 9; Fig. 12; Plate I-K)

Small to medium sized erect plant, 10-30 cm. tall with one or several main stems arising from among basal and lower cauline leaves. Stems leafy below middle, cobwebby-pubescent toward base, lightly glandular-pubescent above; first flowering stem in well developed plants often exceeded in length by the secondary, somewhat spreading and flexuous stems. Basal and lower cauline leaves few to numerous, cobwebby-pubescent, often densely so, pinnately to bipinnately lobed, with a narrow rachis 1.0-2.5 (-3.0) mm. wide. Cauline leaves deeply pinnately lobed with 3-5 or more linear lobes, or sometimes the lobes with secondary teeth, and lobes longer than the width of the rachis. Inflorescence loose to somewhat congested with 1-5 flowers borne above a bract. Calyx and pedicels glandular with a scattering of black or yellow glandular dots, or the calyx cobwebby-pubescent; at maturity calyx subequal to or exceeding the capsule. Corolla 5.5-11.3 mm. long, 2-3 times as long as the calyx, the tube gradually flaring outward to form a narrow throat and orifice. In color the corolla tube purple or pale violet or possibly yellow in some races, throat yellow with purple spots in upper part at base of each corolla lobe, lobes light pinkish-violet, drying blue. Stamens unequal, the shortest just at orifice, the longest well exserted but exceeded by the corolla lobes. Style exserted from orifice, stigma lobes reflexing about at level of longest stamens. Capsule ovoid to oblong ovoid. N=9.

*Range.*—Interior plains of western North America from Washington and Idaho to western Colorado, Arizona, and California.

KEY TO THE SUBSPECIES OF GILIA INCONSPICUA

Calyx 2.6-4.6 mm. long; corolla lobes 1.6-4.5 mm. long. Common.
- Capsule oblong-ovoidal, narrow at base and widening toward middle; corolla lobes 1.6-2.0 mm. long. Widespread ..... a. *inconspicua*
- Capsule ovoidal, broad near base, narrowing above; corolla lobes 2.0-4.5 mm. long. Southern Sierra Nevada ..... b. *interior*

Calyx 2.0-2.5 mm. long; corolla lobes 1.4-2.8 mm. long. Uncommon ..... c. *austrooccidentalis*

#### 6a. G. INCONSPICUA subsp. INCONSPICUA

*Ipomopsis inconspicua* Smith, Exotic Bot. 1: 25 & t. 14, 1804, (photograph of type and illustration seen). *Ipomeria inconspicua* Nutt., Gen. N. Amer. Pl. 1: 125, 1818. *Gilia inconspicua* Sweet, Hort. Britt., ed. 1, 286, 1827.

*Cantua parviflora* Pursh, Fl. Amer. Sept. 2: 730, 1814, (same type as *Ipomopsis inconspicua* Smith). *Gilia parviflora* Spreng., Syst. Veg. 1: 626, 1825.

*Gilia inconspicua* Dougl. ex Hook., Bot. Mag. 56: t. 2883, 1829, (upper Columbia River, isotype and illustration of type seen).

Inflorescence branches strict with a long lateral pedicel 10-20 mm. long arising at a narrow angle 1-8 mm. beneath a terminal flower and 1-3 flowers borne remotely above each bract. Calyx 2.7-4.6 mm. long, the lobes acuminate, usually exceeding the capsule at maturity. Corolla orifice about as wide as the calyx, lobes 1.6-2.0 mm. long. In color the corolla tube pale violet, or possibly pale yellow. Capsule oblong-ovoidal, 4.5-7.7 mm. long, narrow at base, widening toward middle; capsule valves splitting apart to about middle but without reflexing at tips.

*Range.*—Sandy plains, washes and river benches, from 900 to 6500 feet. Eastern Washington, eastern Oregon and northeastern California, east to Gunnison County,

Colorado, and south to Maricopa County, Arizona. Flowering from April to June.

*Type.*—Plants grown at Sion House, (London?), by Thomas Hoy in 1793 from seeds obtained by an unknown collector in America. A specimen of the upper parts of the plants, bearing the legend "Sion gardens, W. Hoy, 1796," is preserved in the Herbarium of the Linnean Society, London. A colored drawing of what appears to be the same strain was made by Mr. Sowerby in November, 1793, from plants grown that year at Sion House. This illustration is published in James Smith's *Exotic Botany,* vol. 1, t. 14, 1804.

The confused nomenclatural history of *Gilia inconspicua* can be briefly summarized as follows. In the year 1793 some *Gilia* plants were grown in England from seeds obtained from America and a piece of one branch, omitting important details of the basal part of the plant, was sketched by a botanical artist. The exact source of the seeds was not recorded. In 1804 Sir James E. Smith described the new species as *Ipomopsis inconspicua* and published the drawings. William J. Hooker redescribed it in 1829 under the name *"Gilia inconspicua* Douglas MSS." on the basis of living plants grown in England in 1827 from seeds sent by David Douglas. Hooker also accompanied his notes with a colored drawing. The Douglas collection, according to Hooker, was made in "sandy barrens on the Southern branches of the river Columbia, on the Northwest coast of America, growing under the shade of *Purshia* . . . and . . . *Artemisia.*" It was Hooker's opinion that the strain collected by Douglas matched well the original strain grown in 1793 from an unstated source, and that the latter accordingly must have also originated in the Columbia River region.

For over a century botanists were content to apply the name *Gilia inconspicua* to a small-flowered, narrow-leaved Cobwebby Gilia of widespread distribution in western North America. The appropriate specific name proposed by Smith came to have

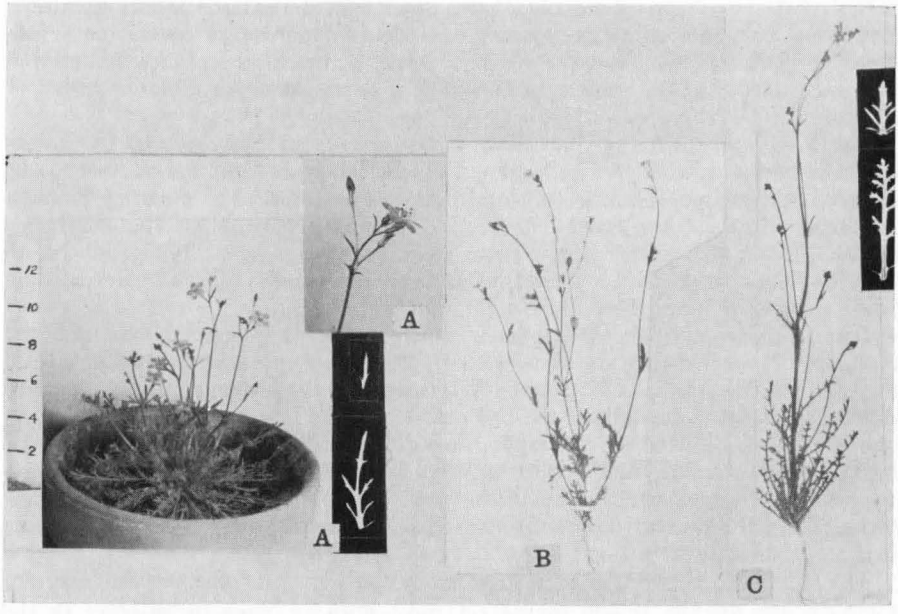



Fig. 12. *Gilia inconspicua.* A) *G. i. interior* from Kern Valley, Kern County. B) *G. i. inconspicua* from Challis, Custer County, Idaho. C) *G. i. austrooccidentalis* from Cuyama Valley, Santa Barbara County.

very general usage. Then in 1942 Mason put the name out of circulation by designating it a *nomen confusum.* In the next year a section of Jepson's *Flora of California* appeared in which the radically different course was adopted of using the name *Gilia inconspicua* in place of *Gilia millefoliata* for that coastal sand-dune species. Both of these authors justified their recommendations by well reasoned arguments.

The principal point emphasized by both Mason and Jepson was that the early botanical collectors of the late 18th century had not yet penetrated into the interior sagebrush plains of North America, where the small-flowered Cobwebby Gilia occurs. The original seed collection which was grown in England in 1793 must therefore have come from the coastal region. But the Cobwebby Gilia does not occur west of the Cascades. Consequently the Douglas collection from an interior locality has no bearing on the typification of the species described by Smith. Since the only locality given for Smith's species was "America," its exact source must remain uncertain unless the description and figure published by Smith can be identified with some natural population.

Jepson's attempt to make this identification led him, as we have already seen, to the conclusion that *Gilia inconspicua* is equivalent to *Gilia millefoliata* of coastal California and Oregon. Jepson designated a specimen of *Gilia millefoliata* (*Tracy 1921* from Samoa, Humboldt Bay) as a lectotype of *Gilia inconspicua* in the sense of Smith but not of Douglas. Mason's analysis of Smith's description and illustration led him to the more inconclusive result that *Gilia inconspicua* might correspond to either the North American *G. millefoliata* or the South American *G. laciniata* or *G. valdiviensis.* In view of this uncertainty, Mason's proposal that *Gilia inconspicua* be regarded as a *nomen confusum* was logical.

It should be emphasized that the conclusions reached by Mason and Jepson were conditioned by the state of taxonomic knowledge concerning the genus *Gilia* in the period of 1942 and 1943. Undoubtedly the genus was more poorly known then than it is today. Furthermore, a large amount of herbarium material of *Gilia* from Washington and Oregon, which was perhaps not inspected by either Jepson or Mason, has now been studied by the present authors. The time has come for a new appraisal of the status of *Gilia inconspicua.*

The lingering possibility that the original material of *Gilia inconspicua* might have been derived from Mexico, as suggested by Pursh, or from South America, as believed possible by Mason, instead of from the Northwest as assumed by Hooker, is eliminated by Smith himself in an early article dealing with the species. In this article Smith (1819) specifically states that *inconspicua* is a "Native of North America." As we shall see later, the characteristics of the plants as revealed in Smith's illustration and Hoy's type support this statement.

After comparison of the descriptions, illustrations and types corresponding to the Smith and Hooker names, we agree with Hooker that the *inconspicua* of Smith and that of Douglas are the same species. We disagree with Jepson's opinion that two distinct species, one coastal and the other interior, were involved; and with Mason's opinion that the illustrations correspond to a different entity than the Douglas specimens. Both of the latter students were misled by differences between the two figures (Jepson) or between the figure and the specimens (Mason) which we now know to be within the normal range of variation of the small-flowered Cobwebby Gilia in the Columbia River region.

The difference between the two figures in the length of the corolla tube, for example, corresponds to the natural polymorphism of *Gilia inconspicua* in the Northwest. The differences between the two figures in the degree of development of the upper cauline leaves may be correlated partly with the age of the plants and

partly with the environmental conditions under which they were grown. *Gilia inconspicua* in the Northwest often tends to be leafy in any case, contrary to the California populations of this species known to Jepson and Mason, and this leafiness is most evident in immature plants. Smith's drawing depicts an immature plant, whereas Hooker's illustration is of a mature plant. Furthermore, the Hoy specimen of 1796 is evidently a greenhouse plant, whereas the Douglas type is a plant grown in nature. We have found one and the same strain of *Gilia inconspicua* to develop larger leaves when grown in the greenhouse than when grown in nature. The emphasis placed by Jepson on the leafiness of the Smith plant, in support of his contention that *Gilia inconspicua* is equivalent to *Gilia millefoliata,* does not take these facts into consideration.

That *Gilia inconspicua* in the sense of Smith is *not Gilia millefoliata,* as believed by Jepson and considered possible by Mason, is clearly indicated by the small size of the corolla tube and throat, the narrow corolla lobes, the absence of purple spots in the throat, and the solitary flowers. There is in fact no coastal *Gilia* in North America possessing the characteristics shown by Smith's illustration.

Our conclusion, based on the inspection of the Smith and Hooker types, figures and descriptions, is that the plants under consideration are the small-flowered Cobwebby Gilia of the arid interior region of the Northwest. This conclusion can be readily confirmed by comparing the illustrations side by side with herbarium specimens of this species. When this exercise is carried out it becomes apparent that *Gilia inconspicua* is just what Hooker and most later botanists during over a century have supposed that it was, namely the widespread, small-flowered, narrow-leaved species of Cobwebby Gilia.

The question remains of how this interior species could have come into the hands of collectors before any botanist had travelled into the Columbia River basin. One possibility is that seeds of *Gilia inconspicua* were washed downstream in flood waters and were cast up on a sand bar or sandy bank far west of their normal range of distribution, even perhaps near the mouth of the river, and here formed an ephemeral population which was found by some early collector. The chain of circumstances is not as far-fetched as might at first appear.

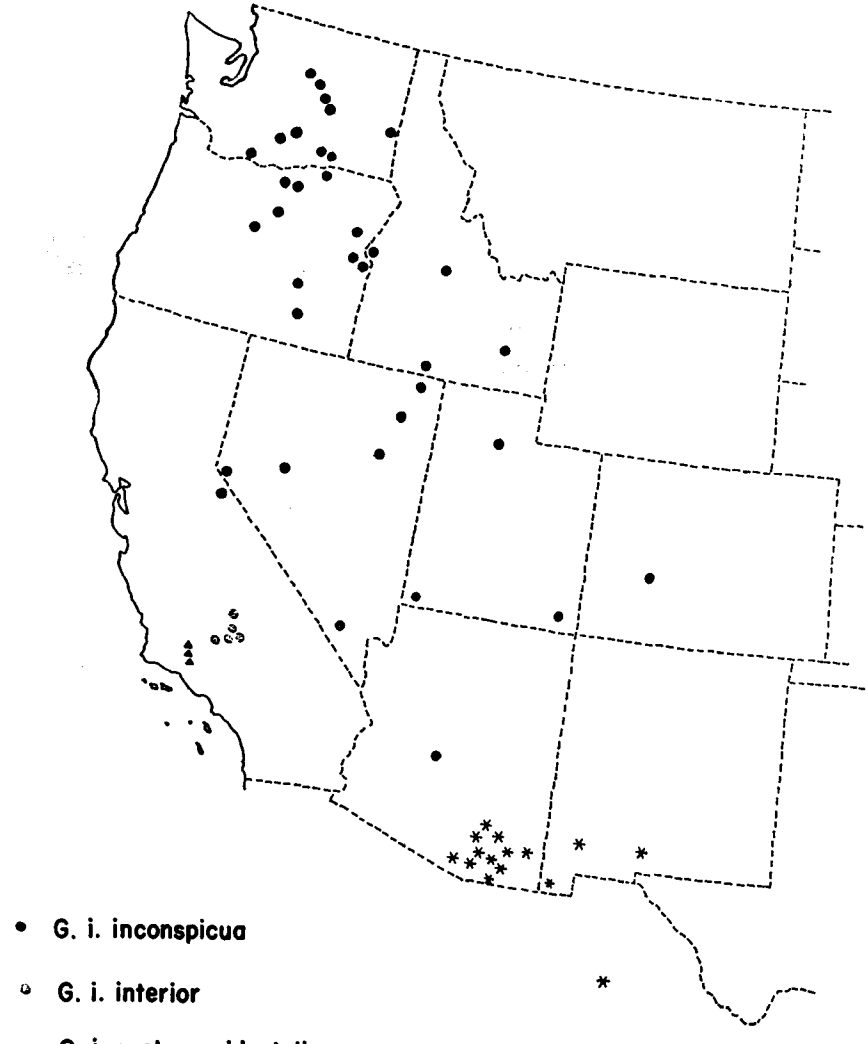
J. P. Tracy found the subalpine species, *Gilia capillaris,* growing on the flood plains near the mouth of Jager Creek in Humboldt County, California, at an elevation of 200 feet. We found *Gilia leptantha vivida,* another high montane taxon, growing on a sand bar in Tehachapi Creek in the lower foothills of the Tehachapi Mountains at the very edge of the San Joaquin Valley. H. M. Hall collected the pine-belt species, *Gilia diegensis,* on the lower Santa Ana River near Riverside at an elevation of 1000 feet, and Ruth Cooper found another pine-belt entity, *Gilia leptantha leptantha,* in Mill Creek Canyon near the chaparral zone in the San Bernardino Mountains. Data given on herbarium labels indicate that *Gilia inconspicua* forms transitory populations on the sandy banks of the Columbia River.

There is circumstantial evidence that the seeds of the original strain of *Gilia inconspicua,* grown in England in 1793 and described by Smith in 1804, were obtained by someone on Vancouver's voyage to the Northwest. In October of 1792 Captain Broughton of the Vancouver expedition took a boat up the Columbia River as far as the present site of Vancouver, Washington (Vancouver, 1801, vol. 3, ch. 3). *Gilia inconspicua* ranges along the Columbia River today as far west as Bingen, which is only 60 miles upstream from Vancouver, Washington.

The fact that the Columbia River expedition took place in October would account for the absence of a herbarium specimen of *Gilia inconspicua.* By that month the plants would have been dried up and in seed. If the seeds were collected in October

of 1792, their delivery to England was assured, inasmuch as Captain Broughton took command of a new ship in England on October 3, 1793 (Broughton, 1804). It is likely that Broughton would have arrived in England from America a month or two before assuming a new command. The plants of *Gilia inconspicua* illustrated in Smith's *Exotic Botany* were in an immature state in November of 1793. This species can be grown from seed to early flowering in three months or less.

The identity of the original collector of *Gilia inconspicua* will probably always




Map 9. Distribution of *Gilia inconspicua* and *G. mexicana*.

remain unknown. If the plants washed down to the mouth of the Columbia River, the collection might have been made by Archibald Menzies, the naturalist of the expedition. According to a list furnished by Newcombe (1923, p. 137), *Gilia inconspicua* was among the plants collected by Menzies. *Gilia inconspicua* was then described (as an *Ipomopsis*) by Smith, who is known to have worked over the Menzies collections (op. cit., p. xviii).

If, on the other hand, the plants were found some distance up the river, the collection must have been made by some other person. The journal of the voyage indicates that Menzies remained with the main party while Broughton explored the lower reaches of the Columbia River (Susan McKelvey, personal communication). Captain Broughton or some member of his exploring party, however, could have been commissioned to collect seeds.

On the hypothesis that the collector of the type material of *Gilia inconspicua* was a member of Vancouver's voyage, we can account for the original collection of the seeds in their native haunts, for the absence of a pressed specimen from nature, for the immediate delivery of the seeds to England, for their culture in the winter of 1793, and for the species eventually being described by Smith, all within the framework of known historical relations. If this hypothesis cannot be accepted, there is no alternative explanation of the origin of the type material which can take its place.

When Wm. Hooker claimed that the plants of *Gilia inconspicua* collected by Douglas on the Columbia River were conspecific with the type of that entity described earlier by Smith, he spoke from personal knowledge of the plants. Hooker's opinion, which was lightly set aside by Mason and Jepson, is fully vindicated by the facts as revealed by a comparison of Hooker's description, figure and type with those of Smith. Smith's material also probably came from the Columbia River, and could have been collected there in 1792 by Menzies, Broughton, or some other member of Vancouver's voyage.

*Representative Specimens.*—WASHINGTON. Whitman County: *H. St. John & F. L. Pickett 6109,* Palouse Falls. Franklin County: *H. H. Hindshaw 22,* Pasco. Yakima County: *V. T. Heidenreich 281,* Ahtanum Ridge, Yakima Indian Reservation. Klickitat County: *W. N. Suksdorf 11175,* Bingen. IDAHO. Custer County: *C. L. Hitchcock & C. V. Muhlick 8968,* Challis. Bannock County: *E. Palmer 50,* Pocatello. OREGON: Morrow County: *J. B. Leiberg 15,* Lexington. Wheeler County: *A. Cronquist 9902,* 10 miles northwest of Mitchell. Malheur County: *J. B. Leiberg 2001,* Snake River. NEVADA. Clark County: *I. W. Clokey 7644,* Charleston Mts. UTAH. Salt Lake County: *M. E. Jones 9842,* Lake Point. San Juan County: *C. A. Purpus 6541,* LaSalle Mts. Washington County: *M. E. Jones 9817,* St. George. COLORADO. Gunnison County: *C. F. Baker 254,* Crystal Creek, Gunnison watershed. CALIFORNIA. Mono County: *V. & A. Grant 9673,* Walker River.

### 6b. G. inconspicua subsp. interior (Mason & A. Grant) A. & V. Grant, comb. nov.

*Gilia tenuiflora* subsp. *interior* Mason & A. Grant, Madroño 9: 217, 1948, (type seen).

Inflorescence diffuse with long internodes and usually only 1 flower, sometimes 2, borne above each bract. Pedicels 6-31 mm. long, or the shorter of a pair 1.5-2.5 mm. long. Calyx 2.6-3.6 mm. long, the lobes acute, almost equalling to just exceeding the mature capsule. Corolla orifice usually a little wider than the calyx; lobes 2.0-4.5 mm. long. In color the corolla tube and sometimes the base of the throat purple. Capsule ovoidal, 3.4-6.0 mm. long, widening out abruptly from base; capsule valves splitting apart about to middle with or without reflexing at tips.

*Range.*—Sandy soil above river, from 2500 to 5600 feet. Kern River drainage system, Kern and Tulare counties, California. Flowering in April and May.

*Type.*—*H. L. Mason 8340,* Walker Pass, Kern County, California, April 30, 1935. University of California Herbarium 748761.

*Representative Specimens.*—CALIFORNIA. Kern County: *V. Grant 9217,* Greenhorn Mts.; *V. & A. Grant 9112,* east of Weldon in Kern Valley; *G. T. Robbins 3294B,* Kern River 1 mile east of Isabella. Tulare County: *V. & A. Grant 9269,* Johnsondale.

**6c. G. inconspicua** subsp. **austrooccidentalis** A. & V. Grant, subsp. nov.

Inflorescence strict to somewhat congested with 2-5 flowers borne above a bract. Pedicels very unequal, a lateral one arising 1-3 mm. below a terminal flower and becoming 3-10 times as long as the terminal pedicel. Calyx 2.0-2.5 mm. long, enlarging to almost twice this at maturity of the capsule, but equalled or exceeded by the capsule. Corolla orifice about as wide as calyx, lobes 1.4-2.8 mm. long. In color the corolla tube purple. Capsule broadly ovoidal to subglobular, widening abruptly from base, 5.0-6.8 mm. long.

Inflorescentia saepe densa; calyx 2.0-2.5 mm. longa; lobi corollae 1.4-2.8 mm. longi.

*Range.*—Sandy flats, from 2000 to 4000 feet. Cuyama Valley in the South Coast Range; southeastern San Luis Obispo County, southern Santa Barbara County, and northern Ventura County, California. Flowering in April.

*Type.—V. & A. Grant 9365,* Ballinger Canyon, Cuyama Valley, Santa Barbara County, California, April 27, 1954. Rancho Santa Ana Botanic Garden Herbarium 86603.

*Representative Specimens.*—CALIFORNIA. Santa Barbara County: *V. Grant 9379-iii,* Ballinger Canyon, Cuyama Valley. Ventura County: *V. & A. Grant 9100,* Cuyama Valley on Ojai road; *V. & A. Grant 9103,* upper Cuyama Valley.

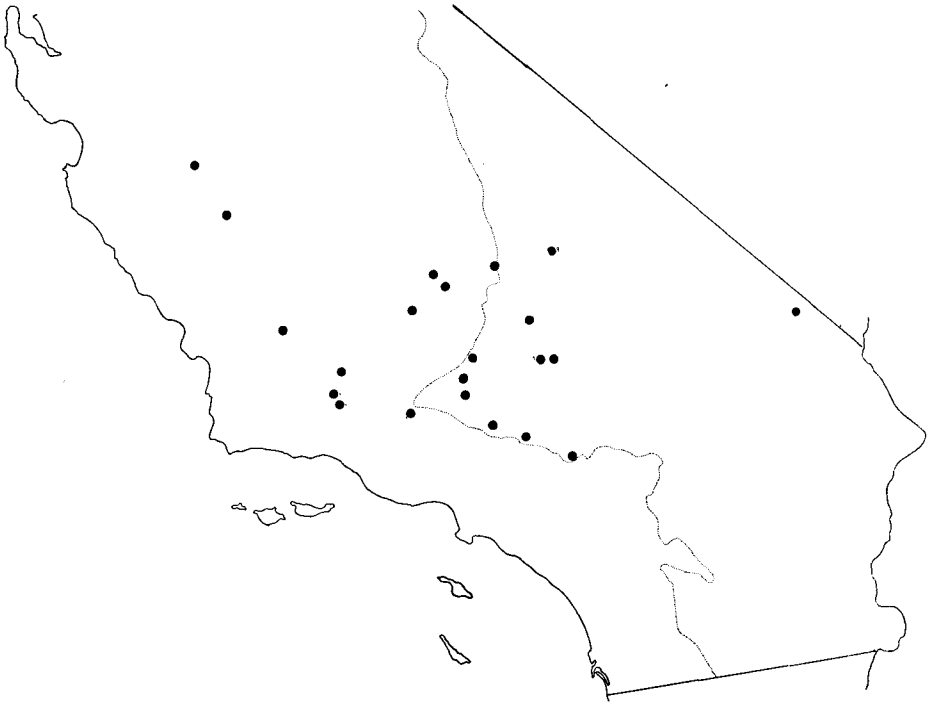
**7. Gilia minor** A. & V. Grant, sp. nov.

(Map 10; Fig. 13)

Small plant with 3-8 stems arising from cluster of basal leaves and branching alternately above. First formed stems erect, 6-22 cm. long, others usually longer, 8-24 cm. long, and flexuous, spreading widely and ascending at ends, cobwebby-pubescent below middle, lightly glandular above. Basal leaves 1.5-4.0 cm. long, lightly cobwebby-pubescent, bright green, thin, pinnately lobed from about the middle with 4-6 pairs of lobes, rarely somewhat bipinnatifid, entire toward base; rachis narrow, 0.7-1.2 mm. wide, the lobes short, 1.4-5.0 mm. long, and narrowly linear, 0.5-0.9 mm. wide. Cauline leaves similar to the basal but becoming progressively shorter and less dissected with ascent up the stem, terminal lobe elongate, the lateral lobes arising closer to base of leaf. Uppermost leaf-like bracts entire or with one pair of lobes at base. Inflorescence strict with 1-2 flowers borne above a bract. Pedicels strongly unequal, the shortest of a pair 1.0-3.7 mm. long, the longer 2-5 times longer (3.2-11.0 mm. long), and all pedicels increasing in length as capsules mature. Calyx lightly to densely glandular-dotted, 2.0-3.2 mm. long in flower, enlarging as the capsule matures but becoming only about ½ to ¾ as long as the capsule at maturity. Corolla small, 4.2-7.8 mm. long, 2 to 2¼ times as long as the calyx, the tube and often part of the throat included in the calyx. In color the upper corolla tube dark violet; throat dark violet, or yellow and veined with dark violet, or yellow with a dark violet spot in upper part below each lobe; lobes pale violet. Stamens very short, barely exserted from orifice. Style short, the stigma lobes reflexing at orifice or just within. Capsule oblong-ovoidal, 5-7 mm. long. N=9.

1-2 flores supra bracteis; flos parvus, 4.2-7.8 mm. longus, tubus in calyce inclusus; stamina brevissima, in foramine matura; lobi stigmatis in planibus staminium maturi.

*Range.*—Sandy flats and washes, from 1000 to 3500 feet, rarely washing down to 200 feet. South Coast Range valleys, Kern Valley and Kern Canyon in the southern



Map 10. Distribution of *Gilia minor.*

Sierra Nevada, and Mojave Desert from Antelope Valley to the New York Mts.; San Benito County to Ventura and Los Angeles counties, through Kern County, to southern Inyo and eastern San Bernardino counties, California. Flowering in March and April.

*Variation.*— Flower size and color are variable, and sometimes different types may be found within a single population. Thus in Ballinger Canyon, Cuyama Valley, in southern Santa Barbara County, both violet and white-flowered individuals with varying corolla lengths were found.

*Type.—V. & A. Grant 8851,* north of Kramer junction, Mojave Desert, San Bernardino County, California, April 10, 1950. Rancho Santa Ana Botanic Garden Herbarium 67600.

*Representative Specimens.*— CALIFORNIA. San Benito County: *Ch. H. Quibell 899,* Griswold Hills, Panoche country. San Luis Obispo County: *C. B. Wolf 3568,* north of Santa Maria River. Santa Barbara County: *P. A. Munz 13614,* Cuyama Valley; *V. & A. Grant 9097, 9098, 9099, 9364-2, 9369,* Cuyama Valley. Los Angeles County: *V. & A. Grant 9092,* south of Gorman. Kern County: *V. & A. Grant 9111,* Isabella; *P. A. Munz 10049,* Willow Springs; *V. & A. Grant 8817,* north of Mohave; *J. T. Howell 24259,* north of Mohave. Inyo County: *V. & A. Grant 9350,* Homewood Canyon, Argus Mts.

### 8. Gilia mexicana A. & V. Grant, sp. nov.

(Map 9; Fig. 14)

Erect annual, 10-33 cm. tall, usually with several rather leafy main stems arising from among a well developed rosette or tuft of basal and lower cauline leaves. Main stems slender, somewhat flexuous, grayish with cobwebby pubescence below the

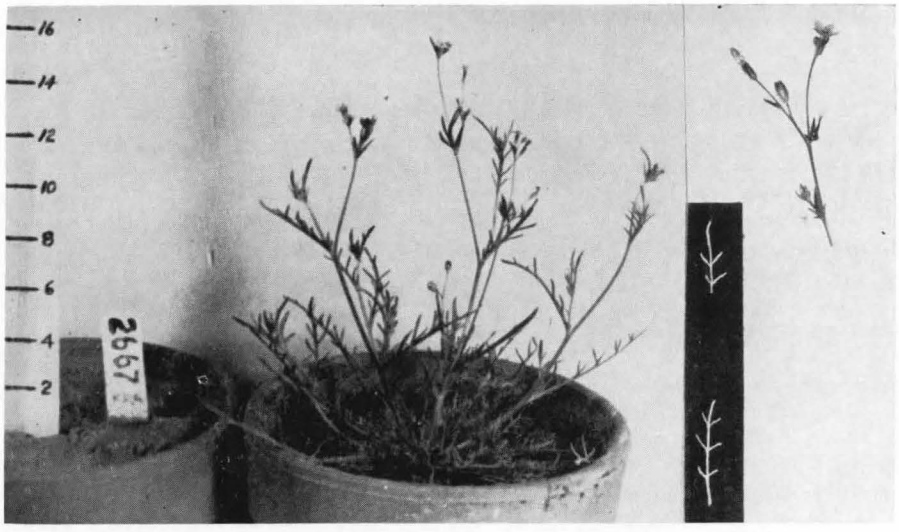



Fig. 13. *Gilia minor* from Kramer junction, San Bernardino County.

middle, lightly pubescent with minute glandular hairs in the inflorescence. Basal leaves cobwebby pubescent, pinnately or bipinnately lobed with narrow rachis 0.8-1.3 mm. wide and with equally narrow and linear lobes, the primary lobes 4.5-6.5 mm. long and the secondary ones a little shorter. Lower cauline leaves well developed like the basal ones, ⅓ to as long as the internodes in lower half of stem, becoming progressively shorter with ascent up the stem. Uppermost leaf-like bracts linear and entire or with a small pair of lobes at base. Inflorescence mostly near ends of branches, the internodes short, one or two flowers borne above a bract. Pedicels unequal, a lateral pedicel arising 1-4 mm. below a terminal flower and becoming 5-12 mm. long, 2-5 times longer than the terminal pedicel at maturity. Calyx 2.5-4.0 mm. long, equalling or slightly exceeding the capsule at maturity, glabrous or sparsely pubescent with minutely glandular or cobwebby hairs, the lobes acute. Corolla small, 4.5-8.0 mm. long, the tube usually included and the throat sometimes included in the calyx, or the corolla up to twice the length of the calyx. Corolla color judging from dried specimens probably pale yellow in tube and throat and pale violet in the lobes. Stamens short, maturing at orifice or slightly exserted. Style slightly exserted, the stigma lobes reflexing at level of stamens. Capsule narrowly ovoidal, small, 4.5-5.5 mm. long.

Inflorescentia diffusa; flores ad termines caulium dispositi; capsula oblongo-ovoidea.

*Range.*—Northern part of the Mexican Plateau; from Pima and Pinal counties, Arizona, to the Organ Mts., New Mexico, and south to the State of Chihuahua. Flowering in March and April.

*Variation.*—*Gilia mexicana* and *G. ophthalmoides australis* occupy the same territory and on this basis are placed in separate species. They seem to intergrade over a broad front, however, and if future studies reveal that the separation between them is merely geographical after all, that is ecological or zonal within their common area, *mexicana* should be reduced to a subspecies of *G. ophthalmoides.*

*Type.*—*R. H. Peebles & H. J. Fulton 11469,* between Patagonia and Sonoita,

Santa Cruz County, Arizona, May 5, 1935. University of Arizona Herbarium 89149.

*Representative Specimens.*—ARIZONA. Pima County: *J. J. Thornber* in 1905, Santa Rita Mts. Cochise County: *Ch. Mohr* in 1890, Fort Huachuca. NEW MEXICO. Grant County: *M. E. Jones 25682,* Gila River near Silver City. Dona Ana County: *E. O. Wooton* in 1900, Organ Mts. CHIHUAHUA. *C. V. Hartman 596,* San Diego.

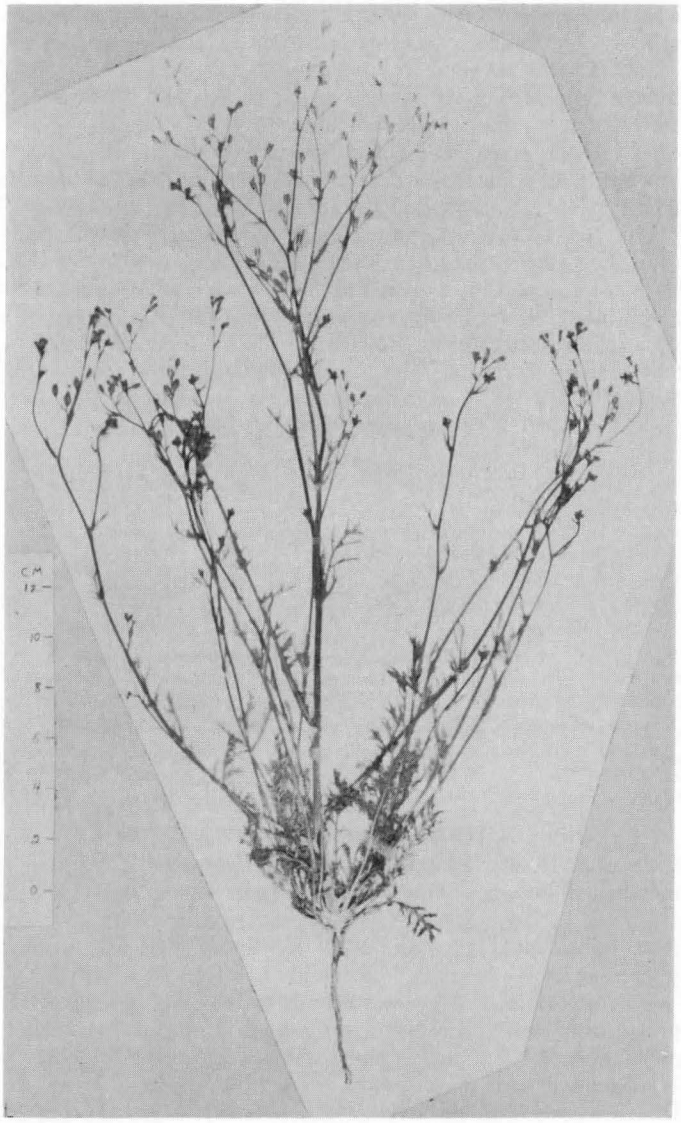


Fig. 14. *Gilia mexicana* from Santa Cruz County, Arizona.

## 9. GILIA OPHTHALMOIDES Brand

(Map 11; Fig. 15; Plate I-D)

Erect plant with slender stems. Stems cobwebby-pubescent at base and glabrous to glandular above. Basal rosette of leaves compact to loose, or lacking and then the stems leafy up to middle. Lower leaves cobwebby-pubescent, pinnately to bipinnately lobed with narrow rachis; lobes long or short but longer than the width of the rachis. Cauline leaves gradually reduced in ascent up stem with lobes arising closer to base of leaf and the terminal lobe becoming elongated. Bracts glandular, cobwebby-pubescent or glabrous, entire or with a small pair of lobes at base. Inflorescence diffuse and inconspicuous to more dense and showy, with 1-8 flowers borne above a bract. Pedicels unequal, glabrous to sparsely glandular. Calyx glabrous to lightly pubescent, with cobwebby hairs or glandular dots, the lobes long-acuminate (except in *G. o. clokeyi*), growing to almost equal or exceed the capsule. Corolla 1½ to 5½ times the calyx; proportions varying according to the subspecies. In color the corolla fairly constant throughout; the tube light violet striated with paler veins; throat yellow except near orifice where pale blue-violet; lobes light pinkish-violet or pink on upper sides and often with a slightly deeper blotch or streaks of violet near base of each lobe on lower surfaces. Stamens equal or unequal, slightly exserted or the longer well exserted, shorter than or rarely equalling the corolla lobes. Capsule ovoidal, often with a broad base and narrow apex, to globular. N=18.

*Range.*—California to Wyoming, Colorado and New Mexico.

### KEY TO THE SUBSPECIES OF GILIA OPHTHALMOIDES

Corolla tube long, well exserted from calyx.

Corolla small, 7-12 mm. long; stamens unequal, the longest well exserted; stigma lobes maturing at stamen level. California, Nevada and Utah.....a. *ophthalmoides*

Corolla large, 12-27 mm. long; stamens subequal, slightly exserted; stigma lobes maturing well beyond stamens. Arizona.....c. *flavocincta*

Corolla tube short, included in calyx.

Herbage light green, the basal leaf pubescence not apparent to naked eye; leaf lobes long, more than 3 times the rachis width; corolla 7.5-18.0 mm. long. Southern Arizona and New Mexico.....d. *australis*

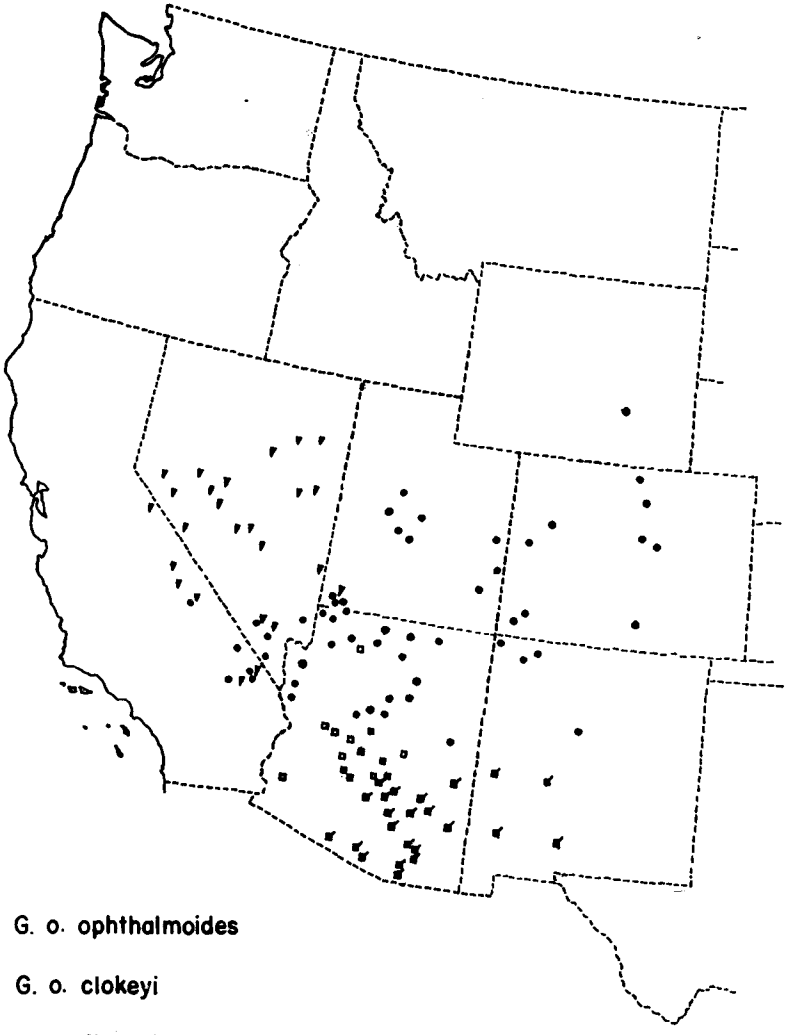
Herbage grayish-green, the grayish pubescence of basal leaves apparent to naked eye; leaf lobes short, 1-2 times as long as rachis width (with exceptions); corolla 4.3-9.3 mm. long. Widespread but not in southern Arizona.....b. *clokeyi*

### 9a. G. OPHTHALMOIDES subsp. OPHTHALMOIDES

*Gilia ophthalmoides* Brand, Pflzr. 250: 108, 1907, (type seen).

Much branched plant with numerous stems from near base and a dense to loose rosette of basal leaves. Stems 15-30 cm. long, rather densely cobwebby-pubescent at base, glandular-pubescent above. Basal leaves moderately to densely cobwebby-pubescent, finely to coarsely bipinnately lobed with narrow rachis, 1.0-2.5 (-4.0) mm. wide, and with primary lobes 2-3 times as long as the width of the rachis; leaf segments cuspidate, roundish and blunt or sometimes somewhat acuminate, varying in width from 1-2 mm. Cauline leaves much reduced immediately above basal rosette or sometimes the lower well developed and much like the basal leaves. Inflorescence diffuse with 1-2 flowers borne above a bract, lateral pedicels and upper internodes elongate. Pedicels lightly glandular, very unequal, the terminal pedicels short, 1.5-5.5 mm. long in fruit, the lateral much longer, 6-20 mm. long in fruit. Calyx 2.5-4.5 mm. long, glabrous or sparsely glandular. Corolla small with a slender, often elongate form, 7-12 mm. long, 2-3 times as long as the calyx; tube filiform, 0.5-0.6

(-0.8) mm. wide and 1¼ to 2 times as long as calyx (or tube sometimes included in calyx), expanding gradually and slightly to form a narrow throat and orifice 1.5-2.6 mm. wide; lobes short, 1.4-2.8 mm. long, and narrow, 0.8-1.8 mm. wide. Stamens unequal, the shortest maturing at orifice and the longest well exserted, ½ to as long as corolla lobes. Style short, the stigma lobes reflexing just above orifice. Capsule ovoidal with a broad base and narrow apex or subglobular, 3.5-6.8 mm. long.




Map 11. Distribution of *Gilia ophthalmoides*.

*Range.*—Sandy places in desert mountains, from 3800 to 8500 feet. Eastern California through Nevada to Washington County, Utah. Flowering from May to July.

*Variation.*—Extreme *G. o. ophthalmoides* has a long exserted filiform corolla tube, 0.4-0.6 mm. wide, and a short throat. A race in the Wassuk Range in Nevada has a short tube, included in the calyx, and a proportionately long throat.

*Type.*—*C. A. Purpus 5990,* washes, Gold Mt., 5000-6000 ft., Esmeralda County, Nevada, in 1898. California Academy of Sciences Herbarium 491.

*Representative Specimens.*—CALIFORNIA. San Bernardino County: *J. & L. Roos 4460,* New York Mts.; *P. A. Munz, I. M. Johnston & R. D. Harwood 4253,* Providence Mts. Inyo County: *M. F. Gilman 3328,* Telescope Peak, Panamint Mts.; *V. & A. Grant 9431,* Westgard Pass, White Mts.; *E. C. Jaeger* in 1939, Teufel Canyon, Inyo Mts. Mono County: *P. A. Munz 13617,* hot springs southeast of Bridgeport. NEVADA. Clark County: *E. C. Jaeger* in 1926, Mine Road, Charleston Mts.; *P. A. Munz 16802,* Hidden Forest Canyon, Sheep Range. Mineral County: *P. Train 3997,* road to Tip Top Mine south of Montgomery Pass P. O.; *P. Train 4121,* Mt. Grant, Wassuk Range. UTAH. Washington County: *F. W. Gould 1838,* 3 miles east of Pine Valley.

**9b. G. ophthalmoides** subsp. **clokeyi** (Mason) A. & V. Grant, comb. nov.

*Gilia Clokeyi* Mason, Madroño 6: 202, 1942, (type seen).

Small to medium sized plant 8-17 (-35) cm. tall with one main leader or several stems from base. Stems slender, moderately to densely cobwebby-pubescent near base, glandular pubescent above and lightly glandular-pubescent in the inflorescence. Basal rosette of leaves compact and dense, or basal rosette loose and indistinct with few basal leaves and the lower stems leafy. Lower leaves grayish-green with cobwebby pubescence, pinnately to bipinnately lobed, rachis narrow, 1-2 mm. wide, lobes roundish and blunt to somewhat acuminate, short, usually no longer than twice the rachis width. Inflorescence diffuse with branching often divaricate. Pedicels unequal, the terminal one 1-5 mm. long and the lateral 8.5-19.0 mm. long and 2-4 times as long as the terminal. Calyx 2.3-4.5 mm. long, glabrous to lightly glandular-dotted or cobwebby-pubescent, the lobes abruptly acute or acuminate, equalling the capsule at maturity and remaining attached after capsule dehisces and drops. Corolla 4.3-9.3 mm. long, 1½ to 2½ times as long as calyx; corolla tube included in or to 1½ times the calyx, expanding slightly to form a moderately broad throat and orifice 1.5-2.8 mm. wide; lobes 1.0-2.8 mm. long. Stamens usually unequal, the shortest maturing at orifice and the longest exserted, about half as long as corolla lobes. Style short, the stigma lobes reflexing at orifice or just above and at stamen level. Capsule globular to ovoidal, 3.0-6.5 mm. long.

*Range.*—Sandy places in deserts and desert mountains, from 1500 to 7300 feet. Southeastern California through southern Nevada and northern Arizona to Utah, Wyoming, Colorado and northern New Mexico. Flowering from April to June.

*Variation.*—Extreme *G. o. clokeyi* has very small flowers one-half longer than the calyx on divaricately branching pedicels; the capsules are globular; and the leaf lobes are very short and blunt. In Washington County, Utah, the corolla tube becomes longer at higher elevations and *G. o. clokeyi* apparently intergrades with *G. o. ophthalmoides.* In northern Arizona and Colorado the corolla is a little larger, leaf lobes often longer, and calyx lobes tend to be acuminate, so that the distinction between *G. o. clokeyi* and *G. o. australis* is less evident. However the grayish pubescence of the basal leaves and lower stems and the diffuse inflorescence indicates that these populations are related to *G. o. clokeyi.*

*Type.*—*I. W. Clokey 8599,* north base of limestone ledge, 1200 M, Charleston Mts., Clark County, Nevada, March 31, 1940. University of California Herbarium 937325.

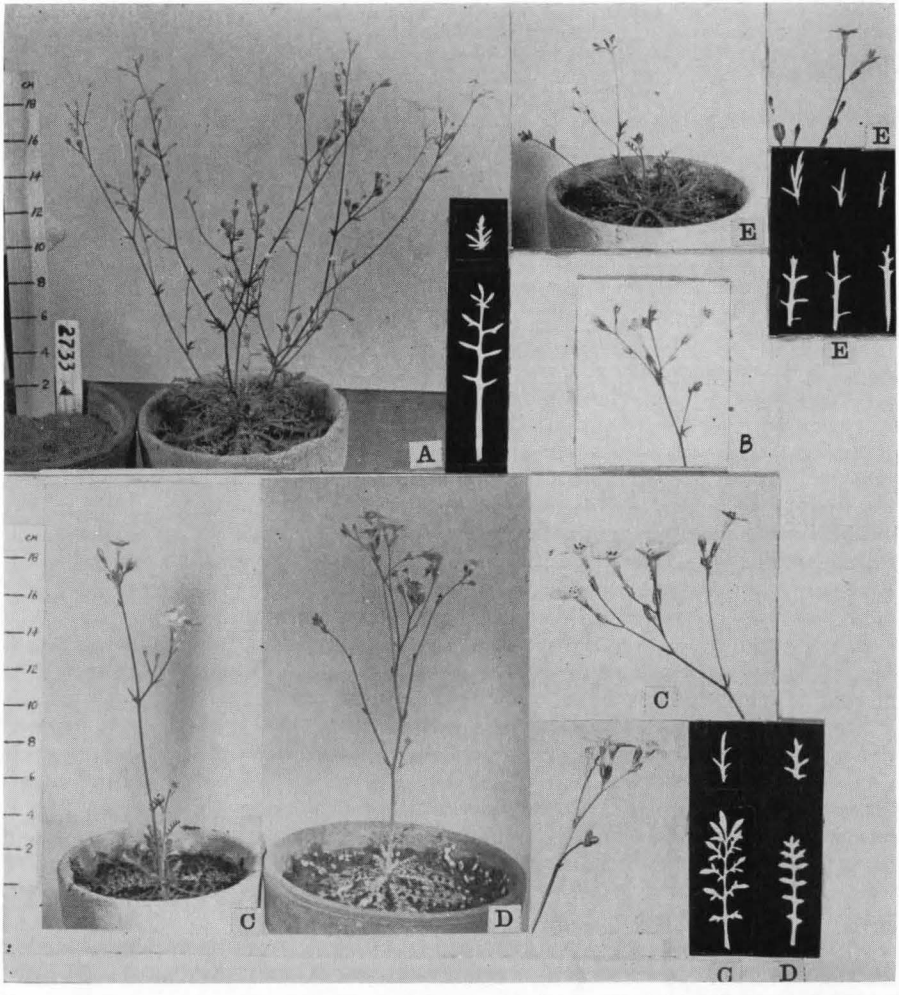



Fig. 15. *Gilia ophthalmoides* and *G. transmontana.* A) *G. o. clokeyi* from Mountain Pass, San Bernardino County. B) *G. o. ophthalmoides* from Westgard Pass, Inyo County. C) *G. o. flavocincta* from Apache Trail, Maricopa County, Arizona. D) *G. o. australis* from Canyon del Oro, Pima County, Arizona. E) *G. transmontana* from Cuyama Valley, Santa Barbara County.

*Representative Specimens.*—CALIFORNIA. San Bernardino County: *C. B. Wolf 10500,* between Horsethief and Beck Springs, Kingston Mts.; *V. & A. Grant 9060,* Mountain Pass, 13 miles east of Baker. NEVADA. Clark County: *M. E. Jones 9993,* Good Springs; *E. K. Balls & R. Straw 19276,* Kyle Canyon, Charleston Mts.; *I. W. Clokey 7641,* Kyle Canyon, Charleston Mts.; *P. A. Munz 14910,* Gypsum Cave, Las Vegas. ARIZONA. Mohave County: *E. McClintock 52-436,* Torroweap Valley; *T. H. Kearney & R. H. Peebles 13202,* between Mesquite and Littlefield. Coconino County: *L. N. Goodding 63-49,* west of Houserock Valley. NEW MEXICO. San Juan County: *C. F. Baker 536,* Aztec; *O. M. Clark 16204,* Farmington. UTAH. Washington County: *F. W. Gould 1703,* Diamond Valley, 11 miles north of St. George. Millard County: *W. P. Cottam & C. McMillan 9606,* Oak City Canyon, Canyon Mts.; *M. E. Jones* in 1911, Deseret. Sanpete County: *W. W. Eggleston 10130,* northwest of Ephraim. COLORADO. Gunnison County: *C. F. Baker 254,* Crystal Creek, Gunnison watershed. Gar-

field County: *W. A. Weber 3325,* 5 miles north of Rifle on Government Creek. Jefferson County: *I. W. Clokey 4246,* Golden; *E. J. Johnston 848,* Lyons. Larimer County: *C. S. Crandall* in 1891, Spring Canyon. Southern Colorado: *C. F. Baker 537,* Arboles. WYOMING. Carbon County: *L. N. Goodding 121,* The Chimneys, Pedro Mts.

**9c. G. ophthalmoides** subsp. **flavocincta** (A. Nels.) A. & V. Grant, comb. nov.

*Gilia flavocincta* A. Nelson, Amer. Jour. Bot. 21: 577, 1934, (neotype seen).

Tall plant with one to three main stems from base. Herbage light green. Stems 10-45 cm. long, slender, often quite leafy up to the middle when basal rosette is not well developed, sparsely pubescent with cobwebby hairs in lower parts, becoming lightly glandular to subglabrous above and in the inflorescence. Basal and lower cauline leaves pinnately or bipinnately lobed, the rachis and lobes usually very narrow, 0.4-1.2 mm. wide; lobes linear, often long and filiform. Inflorescence showy, the branching somewhat dichotomous, concentrated near ends of main branches, with 2-8 flowers borne above a bract and in bloom at nearly the same level due to varying lengths of internodes and pedicels. Pedicels 3-23 mm. long, sparsely glandular-pubescent. Calyx 4.0-5.0 mm. long with long slender acuminate lobes, sparsely glandular to cobwebby-pubescent or glabrous. Corolla 12-27 mm. long with elongate slender form; corolla tube narrow, 0.8-1.0 mm. wide, long exserted from calyx and flaring gradually into a narrow throat; combined length of tube and throat 3½ to 5½ times the width of the orifice; orifice width 1.8-5.6 mm.; lobes narrowly oval and about as long as the throat. Stamens slightly exserted from orifice, subequal. Style long exserted, the stigma lobes maturing well beyond the stamen level. Capsule 5.0-6.7 mm. long, ovoidal with a broad base and narrow apex.

*Range.*—Sandy places in desert mountains; from 2300 to 5280 feet. Yuma, Maricopa, Gila, Yavapai and Coconino counties, Arizona. Flowering from the middle of February to early May.

*Variation.*—Although the corolla size varies within wide limits, the long exserted slender tube is characteristic even in the smaller-flowered individuals with only a few exceptions. In the northern part of the range of *G. o. flavocincta,* small-flowered plants may be found which fit the description of *G. o. australis* in having a short tube and short style. If the geographical position of this race is taken into account, however, it more probably represents an independently derived autogamous form of *G. o. flavocincta* than a widely disjunct population of *G. o. australis.* It is so regarded in the present treatment.

In the region where *G. o. australis* and *G. o. flavocincta* approach one another geographically, intermediate and variable populations occur, which are discussed under *G. o. australis.*

*Type.*—A. Nelson cited the following specimen as the type. *A. Nelson 11228,* Canyon Lake, Apache Trail, Maricopa County, Arizona, March 20, 1930. Rocky Mountain Herbarium. However, Dr. C. L. Porter, curator of that herbarium, was unable to find the specimen after two thorough searches, and attempts to find it in other western herbaria including Dr. Nelson's private collection have likewise been unsuccessful. Until such time as the type can be located it seems desirable to appoint a neotype. An excellent collection for this purpose, from the type locality, is the following. *R. H. Peebles 10754,* Canyon Lake, Apache Trail, Maricopa County, Arizona, March 16, 1935. Pomona College Herbarium 224835. Due to a quite adequate description, there is no question concerning the identity of *Gilia flavocincta* A. Nels.

*Representative Specimens.*—ARIZONA. Yavapai County: *R. H. Peebles & G. J. Harrison 4123,* Prescott; *L. Benson & R. A. Darrow 10883,* between Burro Creek and Santa Maria River; *R. A. Darrow* in 1941, Bumblebee. Gila County: *K. F. Parker & D. Smith 8231,* Apache

Trail. Maricopa County: *V. & A. Grant 9297,* west of Wickenburg; *J. W. Gillespie 5459,* Stewart Mt. near Salt River; *R. H. Peebles 10754,* Canyon Lake, Apache Trail; *J. T. Wright* in 1951, McDowell Mts. Pinal County: *D. D. Porter & R. H. Peebles 711,* Santan Mt.; *D. D. Porter 743,* Picacho; *R. H. Peebles 11039,* Sacaton Mts. Yuma County: *H. B. Crandell 160,* Kofa Mts.

**9d. G. ophthalmoides** subsp. **australis** A. & V. Grant, subsp. nov.

Small to medium sized plant with one to numerous main stems from base. Herbage light green in color, usually not obviously pubescent to naked eye. Stems lightly cobwebby-pubescent in lower parts, lightly glandular or glabrous above and in inflorescence, 10-30 cm. long, slender and flexuous, leafy below middle with basal cluster of leaves loose, not compact. Lower leaves lightly cobwebby-pubescent, pinnately or bipinnately lobed, with rachis and lobes narrow, 0.8-2.0 mm. wide, lobes usually narrowly linear. Cauline leaves like the basal about to middle of plant. Inflorescence often rather congested in flower but loose in fruit, diffuse to somewhat congested near ends of branches with 1-4 flowers borne above a bract. Pedicels glabrous or lightly glandular, unequal, the terminal one 1.5-5.0 mm. long in fruit, the lateral 3-14 mm. long in fruit and subequal to or up to 3 times as long as the terminal pedicels. Calyx 2.8-4.7 mm. long. Corolla 7.5-18.0 mm. long, 1¾ to 3½ times as long as the calyx; tube 0.8-1.0 mm. wide, included in or slightly exserted from calyx, expanding slightly to broadly so as to form a narrow to full throat and orifice, 2.0-7.0 mm. wide; lobes 2.0-6.4 mm. long, narrowly to broadly oval. Stamens subequal, slightly exserted, less than half as long as corolla lobes. Style short, the stigma lobes reflexing at stamen level, or in largest-flowered form the style well exserted, maturing beyond stamen level. Capsule ovoidal, 4.6-6.7 mm. long, broad at base and narrowing toward apex.

Folia virides, pubes foliorum inferiorum non evidens; lobi foliorum longi; corolla 7.5-18.0 mm. longa.

*Range.*—Desert canyons and slopes, from 2750 to 4300 feet, rarely as low as 1600 feet. Southern Arizona and southwestern New Mexico. Flowering from late March to May.

*Variation.*—Plants with large flowers (corolla 8-18 mm. long), representing intergrades with *G. o. flavocincta,* are found in the Superstition Mts. between Superior and Apache Trail. They differ strikingly from *G. o. flavocincta* in their short tube, which is included in the calyx, and in the comparatively long throat. These features relate them to *G. o. australis,* whereas the large size of the corolla and the long exserted style indicate relationship to *G. o. flavocincta.*

In other parts of its range *G. o. australis* also shows some variation in corolla size, but this variation is within the limits of a small corolla from 7.5 to 9.0 mm. long. The leaf form varies from narrowly linear to broader with coarser dissection.

Apparent intergradation with *G. mexicana* is discussed under the latter species.

*Type.*—*J. J. Thornber,* March 26, 1905, Sabino Canyon, Santa Catalina Mts., Pima County, Arizona. University of Arizona Herbarium 27239.

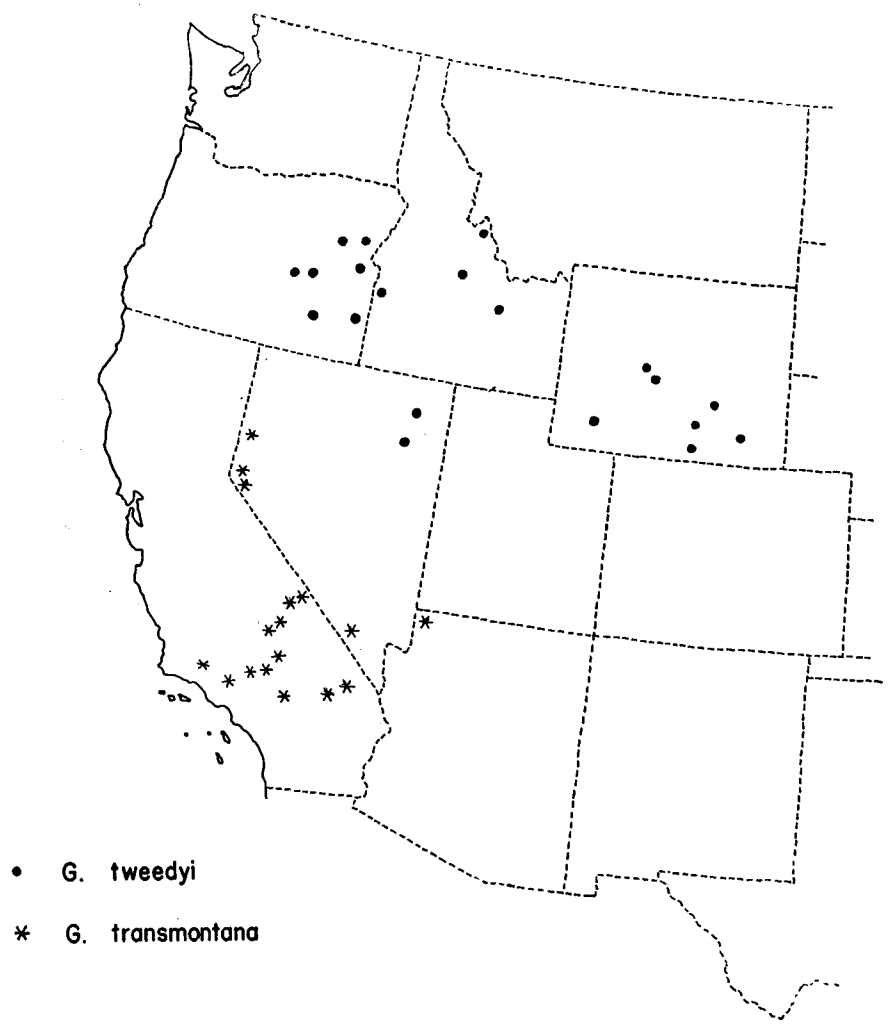
*Representative Specimens.*—ARIZONA. Pima County: *O. Norwell 1803,* 15 miles north of Tucson; *F. R. Fosberg 7781,* foothills of Baboquivari Mts. 10 miles northwest of Sells. Cochise County: *L. M. Pultz & W. S. Phillips 1602,* Mescal. County unknown: *M. E. Jones 25679,* Rodeo; *J. J. Thornber* in 1905, upper Gila Valley; *D. Griffiths 3698,* Dudleyville. NEW MEXICO, Socorro County: *E. S. Castetter 2116,* Evergreen Ranch Arroyo, near Socorro.

## 10. GILIA TWEEDYI Rydberg

(Map 12; Fig. 16)

*Gilia Tweedyi* Rydberg, Bull. Torrey Bot. Club 31: 634, 1904, (type seen). *G. minutiflora* var. *Tweedyi* Brand, Pflzr. 250: 92, 1907.

Small low-growing annual with erect central leader and a number of secondary




Map 12. Distribution of *Gilia tweedyi* and *G. transmontana*.

and somewhat decumbent stems 5-20 cm. long developing from near the base. Basal leaves few, not forming a dense tuft or rosette, lower stems leafy, cobwebby-pubescent. Basal and lower cauline leaves cobwebby-pubescent, pinnately lobed, with a narrow rachis 1.0-1.5 mm. wide and linear lobes which are longer than the width of the rachis. Upper cauline leaves pinnately lobed and well developed, only the uppermost reduced to small bracts. Inflorescence branches strict with a long, lateral pedicel 11-16 mm. long at maturity, arising at a narrow angle 1.6-3.7 mm. beneath a terminal flower, so that 1-2 flowers are borne remotely above each bract. Calyx sparsely and pedicels more densely pubescent with yellow glandular dots; calyx elongating to exceed the mature capsule; calyx lobes acuminate. Corolla 4.0-6.4 mm. long, ¼ to ½ longer than the calyx, with corolla tube and part of throat included in the

calyx. In color the corolla tube white, throat yellow, and lobes very pale violet. Stamens very short, maturing at orifice. Style short, the stigma lobes maturing at level of stamens. Capsule oblong-ovoid, narrow at base and broadest at middle, 4.5-6.6 mm. long and a little less than twice as long as wide. N=18.

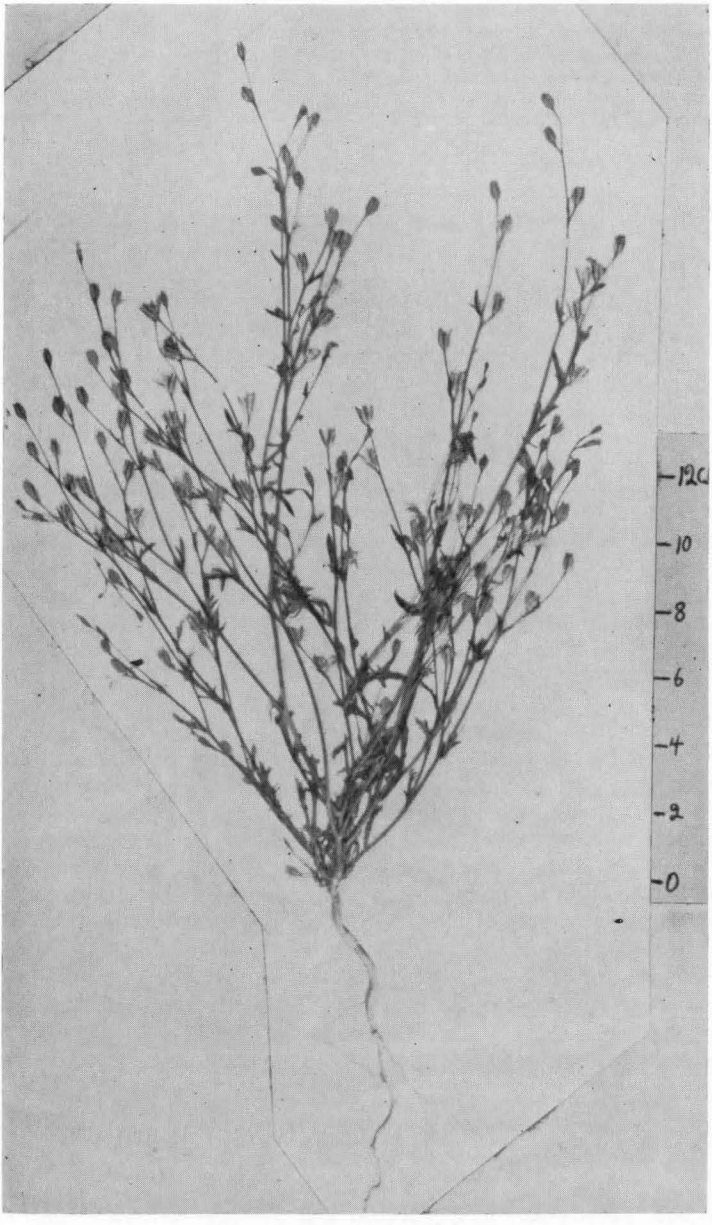



Fig. 16. *Gilia tweedyi* from 40 miles southeast of Riverton, Fremont County, Wyoming.

*Range.*—Sandy soil of draws and river banks, from 4000 to 8000 feet. Wyoming to eastern Oregon and northeastern Nevada. Flowering in June and early July.

*Type.*—*F. Tweedy 4422,* Encampment, Carbon County, Wyoming, June 20, 1901. New York Botanical Garden Herbarium.

*Representative Specimens.*—WYOMING. Fremont County: *C. L. Porter 4957,* 40 miles southeast of Riverton. Carbon County: *V. & A. Grant 9725,* above North Platte River 12 miles east of Encampment; *V. & A. Grant 9727,* Shirley Mts. IDAHO. Lemhi County: *R. J. Davis 2735,* and *R. J. Davis* in 1935, Salmon. Butte County: *C. L. Hitchcock & C. V. Muhlick 8872,* Leslie. NEVADA. Elko County: *M. E. Jones 9820,* Empire City; *A. Eastwood & J. T. Howell 274,* between Elko and Wells. OREGON. Harney County: *B. Maguire & A. H. Holmgren 26483-A,* Squaw Butte Experiment Station.

**11. Gilia transmontana** (Mason & A. Grant) A. & V. Grant, comb. nov.

(Map 12; Fig. 15)

*Gilia ochroleuca* subsp. *transmontana* Mason & A. Grant, Madroño 9: 215, 1948, (type seen).

Erect to spreading, 10-32 cm. tall. In well developed plants several main stems arise from near base. Stems cobwebby-pubescent near base, leafy below the middle, usually without a well marked basal rosette of leaves. Lower leaves cobwebby-pubescent, pinnately lobed with narrow rachis 0.8-1.5 (-2.2) mm. wide and linear lobes 3.5-11.0 mm. long, sometimes with a few secondary lobes or teeth. Upper leaves pinnately lobed but reduced, the uppermost entire or with two short lobes from base. Inflorescence branches strict to somewhat divaricately branched, the flowers remote to somewhat crowded with 1-5 flowers borne above a bract. Calyx glabrous or lightly glandular-dotted or lightly cobwebby-pubescent, enlarging to enclose the mature capsule or exceeded by the capsule; calyx lobes acute and the sinus membrane sometimes full and folded, forming keels. Corolla small, 3.7-7.9 mm. long, 1½ to 2½ times as long as the calyx, the tube and sometimes the throat included in the calyx. In color the corolla tube violet or white, throat yellow, lobes pale violet or white. Stamens short, subequal, slightly exserted from orifice. Style short, the stigmas maturing at level of stamens. Capsule subglobular to ovoidal, 3.5-6.0 mm. long, and as wide as or narrower than long. N = 18.

*Range.*—Sandy or gravelly soil of river beds, valleys and plains; from 2000 to 6500 feet. From Santa Barbara County, California, through the Mojave Desert to Washoe County, Nevada, and Mohave County, Arizona. Flowering in late March to early May.

*Variation.*—The specimens interpreted as belonging to *G. transmontana* by the present authors, and used as a basis for drawing the above descriptions of morphology and geographical distribution, may actually belong to more than one natural entity. The information is not yet at hand, however, for dealing with the variations in *G. transmontana* in a satisfactory way. Only the most representative specimens are cited below.

*Type.*—*B., R. & C. B. Maguire 4923,* sand of river bed, Beaver Dam River, Mohave County, Arizona, April 3, 1934. University of California Herbarium 553752.

*Representative Specimens.*—CALIFORNIA. Santa Barbara County: *V. & A. Grant 8696,* Cuyama Valley; San Bernardino County: *E. C. Jaeger* in 1939, Goldstone, Granite Mts. Kern County: *A. Grant 9558-B,* El Paso Mts. Inyo County: *V. & A. Grant 8866-C,* Little Lake; *V. & A. Grant 9352,* Wildrose Canyon; *M. F. Gilman 2315,* Keane Canyon, Funeral Mts., Death Valley. NEVADA. Clark County: *I. W. Clokey 7638,* Kyle Canyon, Charleston Mts.

C. GILIA LATIFLORA GROUP

Stems stout and stiffish, erect, glabrous and glaucous at base. Basal rosette of leaves prostrate in mature plants, basal leaves strap-shaped with broad whitish mid-

vein. Cauline leaves broadly clasping at base, narrowing to a pointed apex, margins toothed with teeth shorter than rachis width, or margins entire. Inflorescence diffuse or congested. Pedicels unequal. Calyx moderately glandular. Corolla throat moderately to very full, lobes moderately to very broad. Corolla throat white with yellow spots, orifice and base of lobes white. Stamens unequal, the longest exserted, but not very long. Capsule oblong-ovoidal.

### 12. Gilia diegensis (Munz) A. &. V. Grant, comb. nov.

(Maps 1, 13; Fig. 17)

*Gilia inconspicua* var. *diegensis* Munz, Man. S. Calif. 395 & 599, 1935, (type seen).

Plant erect, 10-40 cm. tall with stout central leader arising above a dense cluster of basal leaves, alternately branched, frequently with several other long stems arising from base. Stems glabrous and glaucous at base and above, becoming glandular-pubescent in the inflorescence, or lightly glandular-pubescent at some point above the basal leaves and increasingly glandular in upper part of plant. Basal leaves gray-green, glabrous to lightly cobwebby-pubescent on ventral side, 1-7 cm. long, strap-shaped, sinuately toothed or pinnately lobed and the lobes toothed on the margins, rachis 1-6 mm. wide. Cauline leaves much shorter than the basal, strap-shaped, near the base as broad or broader than basal leaves and narrowing toward the apex, sinuately toothed or sometimes entire. Uppermost leaf-like bracts 2-5 mm. long, entire or toothed near base. Inflorescence congested or loose with 2-3 flowers above a bract. Pedicels unequal in length, a lateral one arising 1.0-5.5 mm. below a

Map 13. Distribution of *Gilia diegensis*.

terminal flower and becoming 2-5 times as long as the terminal pedicel, pedicels elongating as capsules mature. Calyx lightly to moderately glandular-pubescent, 3.0-5.2 mm. long in flower, elongating to slightly exceed capsule; herbaceous portions of calyx broader than the membrane between. Corolla 8.2-12.0 mm. long, exceeding the calyx a little more than twice; tube narrow to moderately stout, 0.5-1.3 mm. wide, included in to slightly exserted from calyx; throat short, 2.0-3.4 mm. long, usually about ½ as long as tube and abruptly widening into the narrow to moderately broad orifice; lobes 2.5-4.4 mm. long, rather narrow, about ⅔ to ¾ as wide as long. In color the corolla tube and lower throat purple, upper throat yellow, lobes light violet. Stamens unequal, the shortest filaments 0.5-1.2 mm. long, the longest 1.0-2.0 mm. long, and slightly exserted from orifice. Style shorter than corolla, stigma lobes 1.0-2.0 mm. long, reflexing just above orifice at level of maturing stamens or just beyond and canted to lower side of flower. Capsule ovoidal, 4.0-6.7 mm. long. N=9.

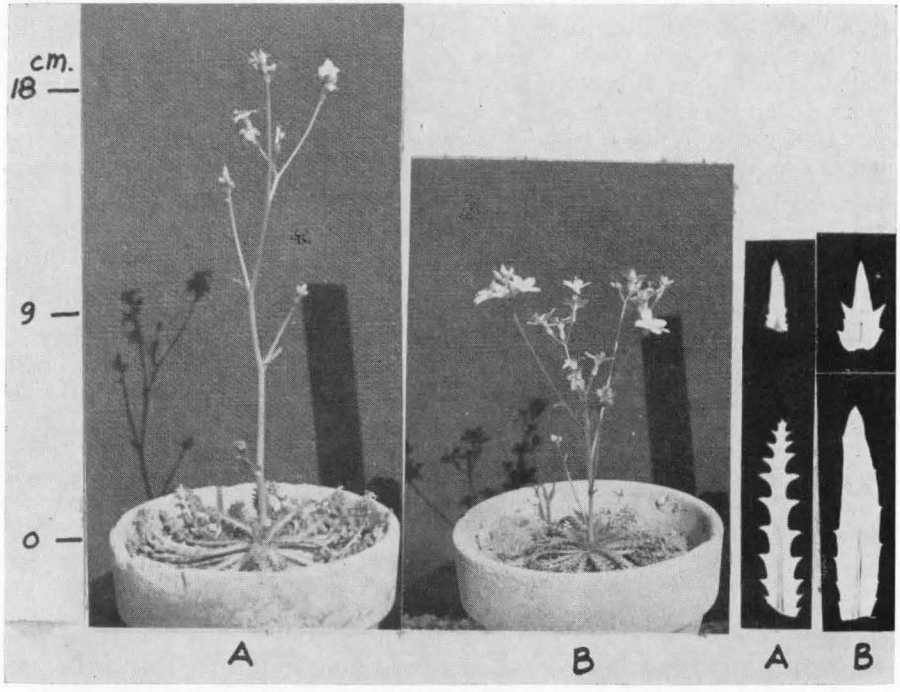



Fig. 17. *Gilia diegensis*. A) race from Cuyamaca Mts., San Diego County. B) race from Anza, Riverside County.

*Range*.—Sandy slopes in clearings among oaks or pines, from 1800 to 7200 feet. Interior mountains from Los Angeles County to Ensenada, occasional near the coast; southern California and northern Baja California. Flowering from April to June.

*Variation*.—Corolla size is sometimes variable within a population. Thus both medium and small flowered individuals were found growing together in the Cuyamaca Mts. On Santa Rosa Mt. individuals with large flowers, a wide throat and orifice, and broad corolla lobes, and individuals with the contrasting combination of

floral characters were found intermixed in the same population.

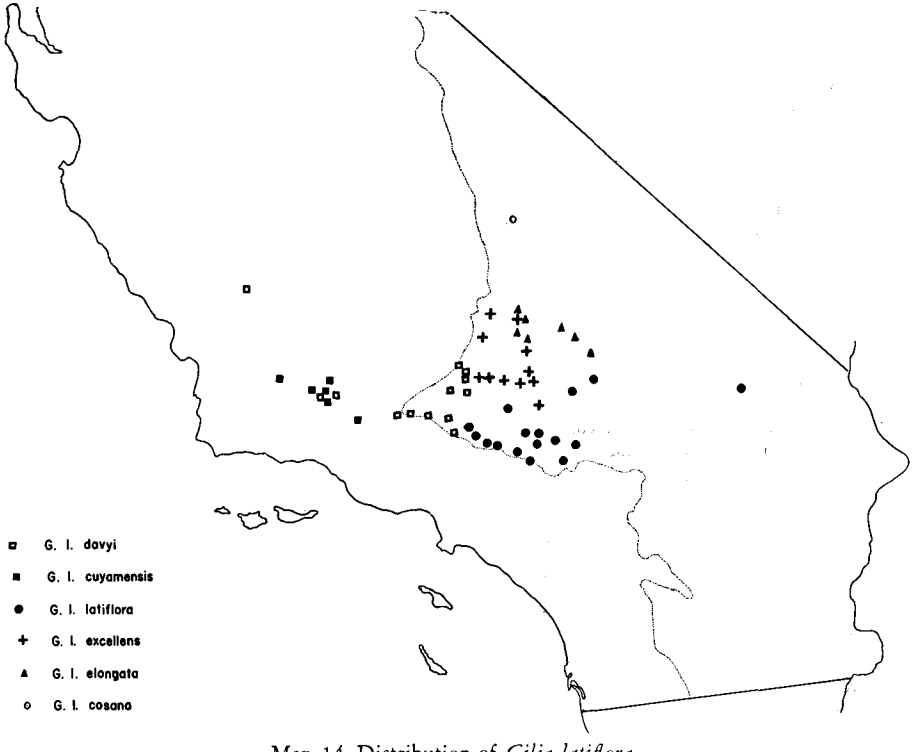
*Type.*—*P. A. Munz 9694,* under pines, 5000 ft., Laguna Mts., San Diego County, California, May 16, 1925. Pomona College Herbarium 97287.

*Representative Specimens.*—CALIFORNIA. Los Angeles County: *C. B. Wolf 1597,* Castaic. San Bernardino County: *F. W. Peirson 4133,* Cajon Pass; *V. & A. Grant 9606,* below Oak Glen, San Bernardino Mts. Riverside County: *H. M. Hall 4949,* Fairmount Park; *F. W. Peirson 4137,* Hemet Valley; *V. Grant 9398,* Santa Rosa Mt. San Diego County: *M. E. Jones 3107,* Fallbrook; *P. A. Munz 10386,* Palomar Mt.; *V. & A. Grant 9227,* Cuyamaca Mts.; *W. W. Eggleston 19751,* Jacumba Springs. BAJA CALIFORNIA. *P. A. Munz 9515,* 13 miles southeast of Tecate.

### 13. GILIA LATIFLORA Gray

(Maps 1, 14; Fig. 18; Plate I-F, L, M, N)

Plant erect, 6-40 cm. tall, with one central leader arising from the prostrate or semi-prostrate basal rosette of leaves, or with several to numerous main stems from the base. Stems glabrous and glaucous at base, or cobwebby-pubescent in three subspecies, glandular in the middle portions, and glandular to glabrous in the inflorescence. Basal leaves lightly to densely cobwebby-pubescent, strap-shaped, sinuately toothed to pinnately lobed, the rachis narrow or broad. Cauline leaves much shorter than the basal leaves, but often with a wider rachis, broad at base and tapering to a point, shallowly to deeply serrate with teeth no longer than the width of the rachis, or sometimes entire. Uppermost leaves reduced to minute glandular bracts. Inflorescence slightly congested to loose; pedicels slightly to very unequal, the lateral




Map 14. Distribution of *Gilia latiflora.*

pedicels exceeding the terminal one. Calyx sparsely to moderately glandular, or sometimes cobwebby-pubescent in the first one or two flowers on a plant. Corolla usually quite large, the tube and throat combined being 2-6 times the length of the calyx, the throat abruptly to gently expanded, and the lobes broadly oval. Corolla color and color pattern different for each subspecies; the upper throat, orifice and base of lobes white in all forms except extreme *G. l. davyi* where the upper throat is yellow and violet. Stamens unequal, the shortest maturing just at orifice or slightly exserted, and the longest slightly to well exserted but shorter than corolla lobes. Style a little shorter than to slightly longer than corolla, and stigma lobes reflexing well beyond the stamens. Capsule ovoidal to oblong-ovoidal. N=9.

*Range.*—Mojave Desert and South Coast Range, California.

*Variation.*—Variation in habit and leaf form is due in part at least to soil, light and moisture conditions. Plants growing in the shade of shrubs have longer internodes at the base so that the stems are leafy and a basal rosette of leaves is scarcely if at all evident. In the open and where moisture is comparatively abundant, as in low spots or at roadside shoulders, the basal rosette is well developed. Under such conditions the leaves grow larger and often display a moderately complex dissection, and flowering continues over an extended period. In less favorable habitats maturity is reached early, the basal leaves may not exceed 1 cm. in length, dissection will be limited to a few shallow teeth, and the basal leaves may dry up while the few flowers are still in bloom.

KEY TO THE SUBSPECIES OF GILIA LATIFLORA

Stems glabrous and glaucous near base; corolla 9.7-23.0 mm. long. Not found northeast of Mohave, Kern County.
- Corolla throat entirely yellow and white or more than one-half yellow and white, suffused at base with purple from tube; corolla colors pale.
  - Calyx 2.3-3.3 mm. long; corolla 9.7-15.5 mm. long. River valleys of the South Coast Range ..... a. *cuyamensis*
  - Calyx 4.1-5.1 mm. long; corolla 15-20 mm. long, Mojave Desert ..... b. *latiflora*
- Corolla throat purple like the tube in the lower half or three quarters; corolla colors rich ..... c. *davyi*

Stems cobwebby-pubescent near base; corolla 21-31 mm. long (except smaller in *G. l. cosana* which is rare). Mostly northeast of Mohave, Kern County.
- Corolla tube and throat together 14-20 mm. long; tall erect plants. El Paso and Rand Mts. and hills to the east.
  - Corolla form stout and full (tube and throat length: orifice width= 1.4-2.4); corolla lobes comparatively long, the corolla 2½ to 3½ times longer than the lobes ..... d. *excellens*
  - Corolla form slender (tube and throat length: orifice width=2.4-5.6); corolla lobes comparatively short, the corolla 3 to 6 times longer than the lobes ..... e. *elongata*
- Corolla tube and throat together 7.5-8.5 mm. long; low spreading plants. Coso Mts. ..... f. *cosana*

**13a. G. latiflora** subsp. **cuyamensis** A. & V. Grant, subsp. nov.

Small plant 6-25 cm. tall with erect central stem or several main stems spreading out from the base. Stems usually glabrous at base and becoming increasingly glandular-pubescent above and in the inflorescence. Basal leaves moderately cobwebby-pubescent, 1.5-3.5 cm. long, strap-shaped and sinuately toothed or short-lobed, sometimes slightly bipinnatifid, rachis 1-2 mm. wide, lobes 1-4 mm. long. Lower cauline leaves about ¼ as long as the basal leaves, serrate or entire. Uppermost bracts entire, 1-2 mm. long. Inflorescence loose with 3-4 flowers borne above a bract.

Pedicels moderately to densely glandular-pubescent, slightly to quite unequal, a lateral one arising 1-8 mm. beneath a terminal flower and becoming 2-5 times as long as the terminal pedicel, elongating only slightly if at all as capsules mature. Calyx 2.3-3.3 mm. long, elongating in fruit so as to equal or slightly exceed the mature capsule. Corolla 9.5-15.5 mm. long with a slender tube, 0.4-1.0 mm. wide, which is exserted from the calyx; tube and throat combined 2½ to 3 times as long as the calyx; throat narrow and flaring gently from tube, or broad and abruptly expanded, the orifice 3-6 mm. wide; lobes shorter than the throat and narrow to quite broad (2.0-6.3 mm. wide). In color pattern the tube and lower throat purple, upper throat yellow and white, lobes white at base, light violet beyond. Stigma lobes 1.5-2.5 mm. long. Capsule plump, subglobular to ovoidal, 3.5-4.5 mm. long.

Herba 6-26 cm. alta; caules ad basim glabri et glauci; calyx 2.3-3.3 mm. longus; corolla pallida, 9.5-15-5 mm. longa, in fauce flava et alba, ad basim purpureo suffusa.

*Range.*—Sandy washes and flats, from 2000-5000 ft. Cuyama Valley and Lock-

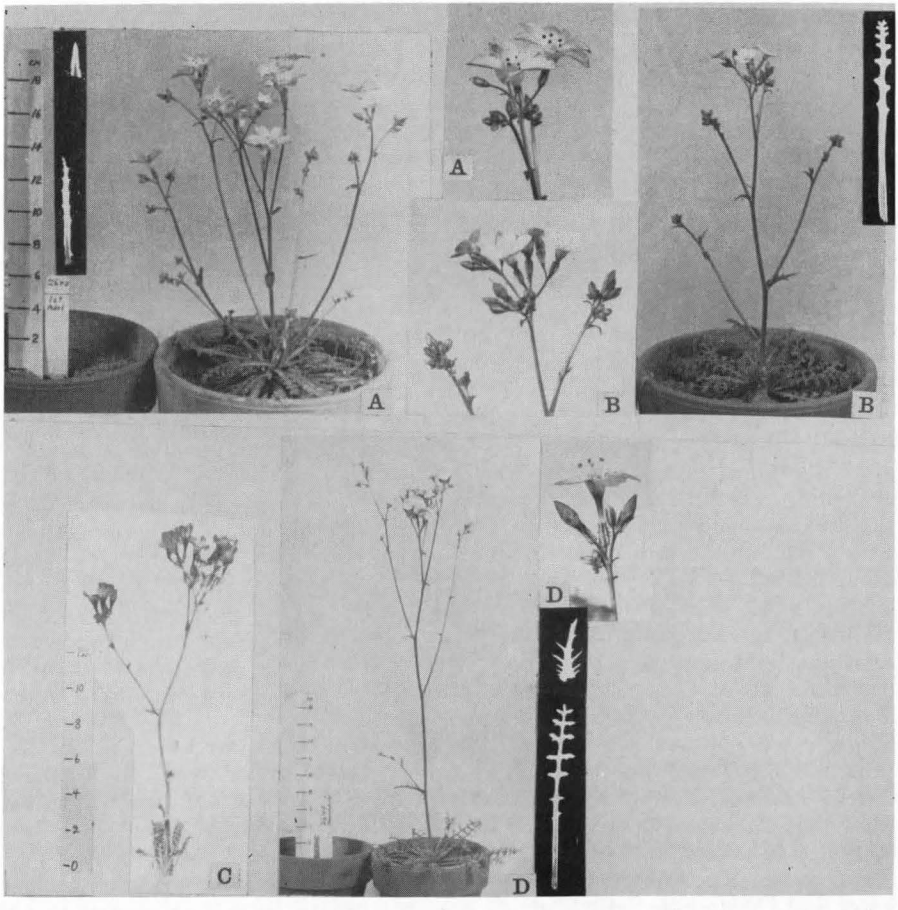



Fig. 18. *Gilia latiflora.* A) *G. l. latiflora* from Adelanto, San Bernardino County. B) *G. l. cuyamensis* from Cuyama Valley, Santa Barbara County. C) *G. l. davyi* from Gorman, Los Angeles County. D) *G. l. excellens* from the El Paso Mts., Kern County.

wood Valley, South Coast Ranges, in San Luis Obispo, Santa Barbara, Kern and Ventura counties, California. Sympatric with *G. l. davyi* in Cuyama Valley; *A. Eastwood,* May 4, 1896, contains a mixture of both taxa on the same sheet. Flowering from April to June.

*Variation.*—There is variation in the width of the corolla throat and orifice and in the width of the corolla lobes. The forms with a full throat, wide orifice and wide lobes are usually also possessed of a stiff erect habit with long internodes. This race is found, for example, in the level open country south of Maricopa. A race exhibiting a contrasting set of characteristics occurs in Lockwood Valley. Here the corolla is more slender in form, the stems are much branched, both at the base and above, and the internodes are short. The type collection represents a population which is intermediate and variable for the foregoing characteristics. This corresponds to the fact that the type locality, Cuyama Valley, is geographically and environmentally intermediate between Lockwood Valley and the Maricopa region.

*Type.*—*V. Grant 9363,* Ballinger Canyon, Cuyama Valley, Santa Barbara County, California, April 27, 1954. Rancho Santa Ana Botanic Garden Herbarium 86602.

*Representative Specimens.*—CALIFORNIA. San Luis Obispo County: *V. Grant 9370,* Cuyama Valley. Ventura County: *V. Grant 9420,* Lockwood Valley. Kern County: *J. Davidson 4618,* south of Maricopa.

13b. G. LATIFLORA subsp. LATIFLORA.

*Gilia tenuiflora* var. *latiflora* A. Gray, Proc. Amer. Acad. 8: 278, 1870, (type seen). *G. latiflora* Gray, Syn. Fl. N. Amer. 2 (1): 147, 1878. *G. tenuiflora* subsp. *latiflora* Brand, Pflzr. 250: 102, 1907.

Erect plant 10-33 cm. tall, often becoming somewhat spreading with one to numerous main stems and with well-developed secondary branches. Stems glabrous and glaucous at base, and lightly to moderately glandular about the middle or above. Basal leaves 2-7 cm. long, strap-shaped, sinuately toothed to pinnately lobed with serrate lobes, lightly cobwebby-pubescent; rachis 0.8-3.5 mm. wide, the lobes 1.0-5.5 mm. long. Cauline leaves much shorter than the basal ones, the lower cauline leaves usually about ¼ as long as the basal leaves, almost entire. Uppermost bracts entire, 1-2 mm. long. Inflorescence loose with 2-4 flowers borne above a bract. Pedicels lightly glandular-dotted, very unequal, a lateral one arising 1-4 mm. beneath a terminal flower and becoming 2-9 times longer than the terminal pedicel, elongating very little as capsules mature. Calyx 4.0-5.0 mm. long, accrescent, but slightly exceeded by mature capsule. Corolla 15-22 mm. long with a slender tube 0.9-1.5 mm. wide which is exserted 0.5-2.5 mm. beyond the calyx; tube and throat combined 2.2-3.2 times the calyx; throat full and abruptly expanded, the orifice 6-9 mm. wide; lobes broad, 5.0-8.0 mm. wide, 5.8-8.5 mm. long, a little longer than the throat. In color pattern the tube purple, striated with paler veins, the purple sometimes suffusing into base of throat; throat yellow below and white veined with pale violet above; lobes white at base, pale violet at tips. Stigma lobes 2.0-3.2 mm. long. Capsule oblong-ovoidal, 6.0-9.0 mm. long.

*Range.*—Sandy washes and flats, from 2500-3600 ft. Mojave Desert in Los Angeles and San Bernardino counties, California. Generally following the drainage systems leading out from the north base of the San Gabriel and San Bernardino Mts., thus Rock Creek wash, Little Rock Creek and the Mojave River and their tributaries as far east as the Mojave River sink. Flowering in April and May.

*Variation.*—The extreme form of *G. l. latiflora,* as found along the lower Mojave River from Victorville east, tends to have pale-colored corollas with a very full throat which is yellow at the base, a narrow corolla tube, small calyx, and diffuse inflorescence. The race of the western Mojave Desert from Palmdale to the eastern

end of Antelope Valley is distinguished by brighter colored corollas with a smaller throat which is purple at the base, broader corolla tubes, larger calyces, and denser inflorescences. The Palmdale race intergrades to the south and east with the Victorville race and to the north with *G. l. davyi*. The above statements refer to general trends, individual populations being polymorphic for the characters mentioned.

*Type.*—*Fremont* in 1844, Mojave Desert in what is now Los Angeles County, California. Gray Herbarium. This specimen is chosen from among those cited by Gray, on account of the representation of all parts of the plant, as the lectotype.

*Representative Specimens.*—CALIFORNIA. Los Angeles County: *P. A. Munz and T. Craig 12927,* 10 miles south of Muroc; *V. & A. Grant 9327,* south of Lancaster; *V. & A. Grant 9123,* foothills south of Palmdale; *F. W. Peirson 2832,* Little Rock Creek; *V. Grant 9583,* between Littlerock and Pearblossom. San Bernardino County: *V. & A. Grant 9586,* between Mojave River and Santa Fe tracks on road from Hwy 66 to Lucerne Valley; *P. A. Munz, 13088,* Apple Valley; *V. & A. Grant 8672,* 4 miles west of Adelanto; *P. A. Munz and D. Keck 7925,* 10 miles west of Barstow; *C. Wolf 10205,* 7 miles south of Kelso.

### 13c. G. latiflora subsp. davyi (Milliken) A. & V. Grant, comb. nov.

*Gilia Davyi* Milliken, Univ. Calif. Publ. Bot. 2: 30, 1904, (type seen). *G. arenaria* subsp. *exilis* var. *Davyi* Brand, Pflzr. 250: 104, 1907. *G. tenuiflora* var. *Davyi* Mason ex Jepson, Man. Fl. Pl. Calif. 798, 1925.

Erect plant 10-30 cm. tall with one stout stem, and later developing strong secondary branches, or sometimes with three or more main stems from the base. Stems glabrous and glaucous at base but becoming more or less glandular about the middle and lightly to densely glandular in the inflorescence. Basal leaves 2-7 cm. long, pinnately or bipinnately lobed with narrow rachis, 0.5-4.0 mm. wide, and the primary lobes 1.0-10.0 mm. long, or sometimes basal leaves strap-shaped and sinuately toothed. Cauline leaves characteristically broader and much shorter than the basal, pinnately toothed; the basal rosette usually well set off from the lower cauline leaves, but the latter may often resemble the former so as to give a more leafy appearance to the lower stems. Uppermost bracts entire, 1.5-4.0 mm. long. Inflorescence congested to somewhat loose with 2-4 flowers borne above a bract. Pedicels subequal to unequal, a lateral one arising 1-5 mm. below a terminal flower and becoming 1-4 times as long as the terminal pedicel at maturity. Calyx 4.0-6.6 mm. long, equalling or exceeding the capsule at maturity. Corolla 18-24 mm. long with stout tube, 1.2-1.8 mm. wide, which is exserted 0.2-3.2 mm. beyond the calyx or rarely included; tube and throat combined 2-3 (rarely 4) times the calyx; throat full and gently to abruptly expanded, the orifice 7.2-12.0 mm. wide; lobes 5.5-9.7 mm. wide, 6-11 mm. long, thus slightly narrower than long. In color pattern the corolla tube and lower ½ to ¾ of throat purple, upper throat yellow or yellow and violet, the orifice white, the lobes white at base and violet beyond. Stigma lobes 2.0-4.0 mm. long. Capsule oblong-ovoidal, 6.5-9.0 mm. long.

*Range.*—Open fields and sandy flats, from 2500 to 4000 ft. Antelope Valley and north along the western edge of the Mojave Desert as far as Tehachapi Pass; in the bordering foothills of the Tehachapi, San Gabriel and Liebre Mts.; occasional in the South Coast Range from Cuyama Valley to Cholame; Los Angeles, Kern, Santa Barbara and San Luis Obispo counties, California. Sympatric in Cuyama Valley with *G. l. cuyamensis*. Flowering from March to May.

*Variation.*—The most extreme form of *G. l. davyi* is marked by the following characteristics: a stout corolla tube flaring gently into a long throat; the corolla colored deep purple from the tube into the upper throat; broad green calyx lobes; a quite congested inflorescence with pedicels less than 5 mm. long and almost equal in length. This form is best developed in the foothills of the Tehachapi, San Gabriel

and Liebre Mts., and is well represented also in upper Antelope Valley. The populations of the western Mojave Desert intergrade into *G. l. latiflora.* The palest colored flowers are found east of the town of Mohave.

The populations of Antelope Valley and the western Mojave Desert are polymorphic for corolla length and proportions. For example, a mass collection from a large population 4 miles south of Gorman in upper Antelope Valley shows conspicuous variations in corolla length, width of corolla parts, proportionate length of corolla tube, and the amount of purple in the throat. The extreme form of *davyi* as characterized above is represented in this and other similar populations along with variants in the direction of *G. l. latiflora.*

*Type.—J. B. Davy 2178,* Antelope Valley, Los Angeles County, California, May 9-24, 1896. University of California Herbarium 23563.

*Representative Specimens.*—CALIFORNIA. Santa Barbara County: *P. A. Munz 13627,* Cuyama Valley on Ojai road 3 miles south of Santa Maria hwy. Kern County: *P. A. Munz 16337,* 4.9 miles south of Hwy. 166 on Hwy. 384 towards Mt. Pinos; *D. Keck 2275,* Tehachapi Pass; *P. A. Munz 13645,* 25 miles northwest of Adelanto; *P. A. Munz 10061,* 10 miles south of Mojave; *E. K. Balls and L. Lenz 14484,* 5.5 miles north of Willow Springs. Los Angeles County: *E. K. Balls and L. Lenz 14470,* 1 mile east of Quail Lake, Antelope Valley; *V. & A. Grant 9122,* Leona Valley, north side of San Gabriel Mts.; *V. Grant 9580,* head of Antelope Valley; *V. & A. Grant 9095,* Tejon Pass 4 miles south of Gorman.

### 13d. G latiflora subsp. excellens (Brand) A. & V. Grant, comb. nov.

*Gilia tenuiflora* subsp. *latiflora* var. *excellens* Brand, Pflzr. 250: 103, 1907, (type seen).

Tall erect plant, 16-40 cm. tall with stout central leader, or occasionally with several main stems arising from base. Stems cobwebby-pubescent near base, becoming glandular above, gradually less glandular above the middle, and sparsely glandular to glabrous in the inflorescence. Basal leaves densely cobwebby-pubescent, bipinnately lobed with narrow rachis, 1.0-2.2 mm. wide, primary lobes 1.5-10.0 mm. long, extending out at right angles to rachis or slightly to strongly recurving toward base of leaf, or rarely basal leaves strap-shaped and sinuately toothed; secondary teeth or lobes 0.5-1.2 mm. long and best developed on basal side of lobe. Cauline leaves much shorter, those immediately above the basal rosette 1/2 to 1/6 as long as the basal leaves, and deeply to shallowly toothed from base to the narrowing apex, or toothed at base and entire beyond. Uppermost bracts 1-2 mm. long, entire, or with a pair of short teeth at base. Inflorescence somewhat congested with about four flowers in a cluster above a bract. Pedicels lightly glandular to glabrous, slightly unequal, a lateral one arising 1-4 mm. beneath a terminal flower and becoming 2-4 times as long as the terminal pedicel, elongating very little in fruit. Calyx 4.7-7.0 mm. long, accrescent, but often exceeded by the mature capsule. Corolla 21.0-30.2 mm. long, with stout tube 1.2-2.0 mm. wide, which gradually flares into a full throat and broad orifice 7.1-9.5 (-11.2) mm. wide; tube and throat combined 2-4 times as long as the calyx; lobes large, about as broad as long, and about 1/3 as long as the total corolla length. In color pattern the corolla tube and lower throat purple or reddish-violet, striated with paler veins; upper throat white with 5 yellow spots and pale violet veins; lobes white at base and pale violet or pale pinkish-violet beyond. Stigma lobes 3.0-4.4 mm. long. Capsule oblong-ovoidal, 7.3-8.5 mm. long.

*Range.*—Coarse granitic soil of rolling hills and plains, from 2500 to 3000 ft. Mojave Desert in the El Paso Mts., Rand Mts., Kramer Hills and southern Sierra Nevada, ranging south and west almost to the town of Mohave; northwestern San Bernardino County and eastern Kern County, California. Flowering in April.

*Variation.*—The populations are polymorphic. In the northern part of the range of this subspecies, in addition to the "typical" individuals, one finds some plants

with long narrow corollas and proportionately short lobes (*A. Grant 9561* from the El Paso Mts.); in the southern and western parts of the range there occur variants with short broad corollas and large lobes (*P. A. Munz 13649* from east of Mohave) or with deeper coloration and a greater amount of purple in the throat (*V. & A. Grant 9088* from north of Mohave). The populations in the Rand and El Paso ranges thus contain variants resembling *G. l. elongata,* and those between Kramer and the southern Sierra Nevada include variants resembling *G. l. latiflora* and *G. l. davyi.*

The most extreme expression of the tendency toward shorter and broader corollas is found in the Kramer Hills just south of Kramer. Here the short corolla tube is included in or slightly exserted from the calyx. The orifice and corolla lobes are extremely broad (orifice 13.2 mm. wide, lobes 11.4 mm. wide), and leaf form is somewhat strap-shaped and sinuately toothed as in *G. l. latiflora* and lacks the longer lobes seen elsewhere in subspecies *excellens.* On the other hand, the length and proportionate width of the corolla exceed that found in *G. l. latiflora,* and the large calyx and proportionately short pedicels are likewise unlike *G. l. latiflora.* This seems, therefore, to be an intermediate form between *excellens* and *latiflora,* but due to the fact that the morphological gap between it and *latiflora* is greater than that between it and *excellens,* it seems best to place it in the latter subspecies.

*Type.*—*K. Brandegee* in June 1884, Cameron, Kern County, California. California Academy of Sciences Herbarium 499.

*Representative Specimens.*—CALIFORNIA. San Bernardino County: *A. A. Heller 7667,* Kramer; *A. Grant 9563,* 15 miles north of Kramer Junction. Kern County: *I. L. Wiggins 9711,* 10 miles east of Mohave; *E. K. Balls 8586,* road to Mohave near jct. of Garlock and Randsburg roads; *A. Grant 9561,* El Paso Mts. north of Johannesburg.

**13e. G. latiflora** subsp. **elongata,** A. & V. Grant, subsp. nov.

Tall erect plant 13-32 cm. tall with central leader, alternately branched, or occasionally with several main stems arising from base. Stems cobwebby-pubescent near base, becoming glandular above, then gradually less glandular above the middle, and sparsely glandular to glabrous in the inflorescence. Basal leaves densely cobwebby-pubescent, pinnately to bipinnately lobed with narrow rachis 1.7-2.9 mm. wide; primary lobes 2.4-5.9 mm. long, usually pointing forward toward apex, or sometimes recurved toward base of leaf; secondary lobes when present 1.0-2.2 mm. long or reduced to short teeth. Cauline leaves usually much shorter than the basal ones, those immediately above the basal rosette being ½ to ¼ as long as the basal leaves with a rachis of about the same width, tapering toward the narrow apex, the margin shallowly to deeply toothed at base and often entire above the middle. Uppermost bracts 1.0-2.5 mm. long, entire, or with a pair of teeth at base. Inflorescence somewhat congested to loose with 3-8 flowers borne above a bract. Pedicels glabrous, or with glands just beneath the flowers, slightly to strongly unequal, a lateral pedicel arising 0.5-2.5 mm. beneath a terminal flower and becoming 1.5-15.0 times as long as the terminal pedicel, elongating very little in fruit. Calyx 4.1-6.1 mm. long, elongating to equal or almost equal the mature capsule. Corolla 21.0-34.5 mm. long with slender tube 0.8-1.5 mm. wide; tube gradually flaring into a narrow throat with orifice 3-8 mm. wide; tube and throat combined (2.5-) 3-6 times as long as the calyx; lobes about 1/4 to 1/6 as long as the total corolla length, and nearly or quite as wide as long. In color pattern the corolla tube and lower throat dark to lighter purple striated with paler veins; upper throat passing from yellow to white above, veined in pale violet; orifice and base of lobes white, becom-

ing pale violet or pale pinkish-violet beyond. Stigma lobes 2.8-4.0 mm. long. Capsule oblong-ovoidal, 5.6-8.0 mm. long.

Herba 13-32 cm. alta; caulis ad basim araneoso-lanatus; corolla 21.0-34.5 mm. longis, tenuis, lobi breves.

*Range.*—Sandy slopes and washes, from 2300 to 3300 ft. In the Rand Mts. and the El Paso Mts. east to the Black Rock Hills north of Barstow, Mojave Desert; northwestern San Bernardino County and northeastern Kern County, California. Flowering from early April to the middle of May.

*Variation.*—The polymorphism exhibited by the populations indicates an influx of genes from *G. latiflora excellens* and *G. cana speciosa.* In the El Paso Mts. individuals vary in their corolla proportions from a long narrow form with proportionately short lobes (extreme *elongata*) to a shorter broader form with proportionately longer lobes (approaching *excellens*). Stamen length varies from moderately well exserted to very short (approaching *G. cana speciosa*).

*Type.*—*F. W. Peirson 2985,* near Seaberg's Well, 28 miles north of Barstow, San Bernardino County, California, May 13, 1922. Rancho Santa Ana Botanic Garden Herbarium 71871.

*Representative Specimens.*—CALIFORNIA. Kern County: *V. & A. Grant 9559,* railroad crossing on Hwy. 395 in El Paso Mts. San Bernardino County: *I. M. Johnston 6538,* between Crutts P. O. and Copper City; *A. Grant 9562,* south of Atolia in Rand Mts.

### 13f. G. latiflora subsp. cosana A. & V. Grant, subsp. nov.

Plants low, the central leader exceeded in length by the secondary stems which spread out from base and ascend at ends. Stems 10-18 cm. long, densely matted with cobwebby pubescence near base, glandular above and in the inflorescence. Basal rosette small and dense, the leaves grayish with dense covering of cobwebby pubescence, 2 to 3½ cm. long, bipinnate with short thick rounded but cuspidate lobes. Cauline leaves deeply toothed to near the apex. Inflorescence diffuse, 1-2 flowers borne above a bract. Pedicels glandular, unequal with a lateral one arising 1.5-4.5 mm. below a terminal flower and becoming 9-12 mm. long, 2-6 times as long as the terminal pedicel. Calyx 3.0-3.5 mm. long, minutely glandular, about equalling the capsule at maturity. Corolla 12-13 mm. long with tube about ½ longer than calyx and about equal to throat; throat rather full with orifice 3.8 mm. wide; lobes about 3.8 mm. long and a little narrower than long. In color the corolla tube purple, lower throat yellow, but exact color of upper throat and lobes uncertain. Stamens exserted, unequal, the longest about ⅓ as long as corolla lobes. Style well exserted, the stigma lobes reflexing above level of stamens. Capsule ovoidal, 4.5-6.0 mm. long.

Planta humilis; caulis ad basim arachneoso-lanatus; tubus et faux corollae 7.5-8.5 mm. longi.

*Range.*—Coso Mts., Inyo County, California. Known only from the type collection.

*Type.*—*F. V. Coville & F. Funston 910,* near Crystal Spring, 6000 feet, Coso Mts., Inyo County, California, June 12, 1891. U. S. National Herbarium 27913.

## 14. GILIA SINUATA Dougl.

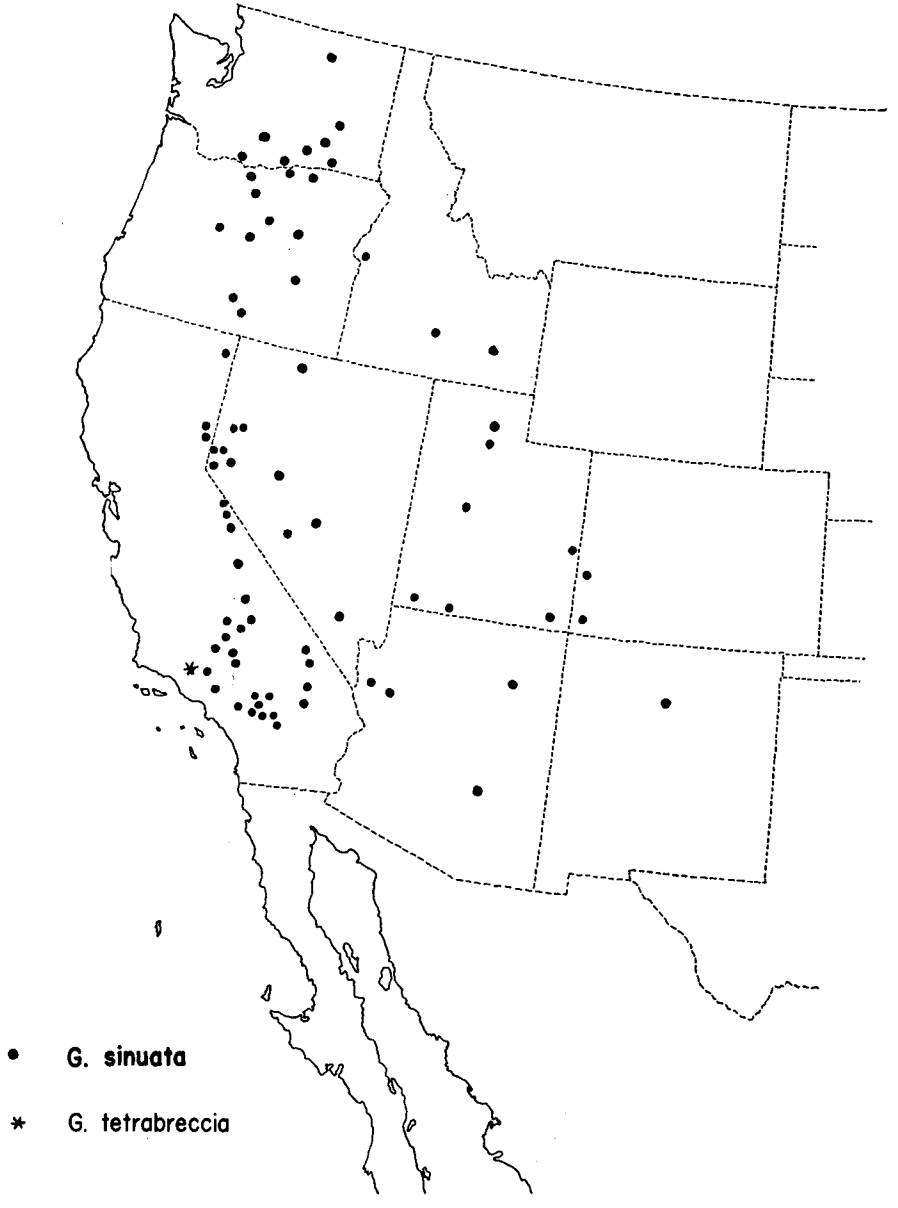
(Map 15; Fig. 19)

*Gilia sinuata* Dougl. ex. Benth., DC, Prodr. 9: 313, 1845, (photograph of type seen). *G. inconspicua* var. *sinuata* Gray, in Brewer & Watson, Bot. Calif. 1: 498, 1876. *G. inconspicua* subsp. *sinuata* Brand, Pflzr. 250: 103, 1907. *G. tenuiflora* var. *sinuata* Jepson, Fl. Calif. 3: 179, 1943.

*Gilia arenaria* subsp. *leptantha* var. *borealis* Brand, Pflzr. 250: 103, 1907, (Umatilla, Oregon, lectotype seen).

*Gilia inconspicua* subsp. *eu-inconspicua* var. *variegata* Brand, Pflzr. 250: 105, 1907, (Kanab, Utah, lectotype seen).

Stiffly erect plant with one main stem or several stems arising above basal rosette of leaves. Stems glabrous and glaucous at base, rarely with a few cobwebby hairs, and moderately glandular pubescent above the middle. Basal leaves cobwebby-pubescent on upper sides, strap-shaped, grayish-green with a wide whitish vein down the center, somewhat succulent; rachis 2-6 mm. wide at broadest point; lobes




Map 15. Distribution of *Gilia sinuata* and *G. tetrabreccia.*

toothed, or short lobed and then the lobes toothed on margins; teeth cuspidate. Cauline leaves much reduced immediately above the basal rosette, but in width as broad or broader than the basal leaves, having a broad clasping base and narrowing gradually to a pointed apex; margins toothed and the teeth shorter than the width of the rachis, rarely as long as the width of the rachis; or cauline leaves sometimes entire. Inflorescence with 1-3 flowers borne above a bract, loose to somewhat congested or glomerate in flower, loose in fruit as pedicels elongate. Pedicels very unequal in fruit, the terminal one 0.8-1.4 mm. long, and the lateral (3.0-) 6.0-9.0 mm. long. Calyx lightly to densely glandular, the lobes not acuminate but abruptly short-cuspidate, 2.5-3.7 mm. long, growing to equal or barely exceed the mature capsule. Corolla 6.9-11.4 mm. long, and $2\frac{1}{2}$ to $3\frac{1}{2}$ times the calyx; corolla tube well exserted from calyx and $\frac{1}{4}$ to $\frac{1}{2}$ longer than the calyx; corolla throat short, moderately narrow with orifice 1.7-3.0 (-3.8) mm. wide; lobes 1.4-3.2 mm. long, as long as throat or a little longer. In color the corolla tube purple striated with pale veins, throat yellow, or rarely suffused with purple from the tube at the base, lobes pale violet or pinkish or almost white. Stamens very short, maturing at orifice, pollen white or blue. Style short, the stigma lobes reflexing at level of stamens. Capsule ovoidal, 4.2-7.0 mm. long. N=18.

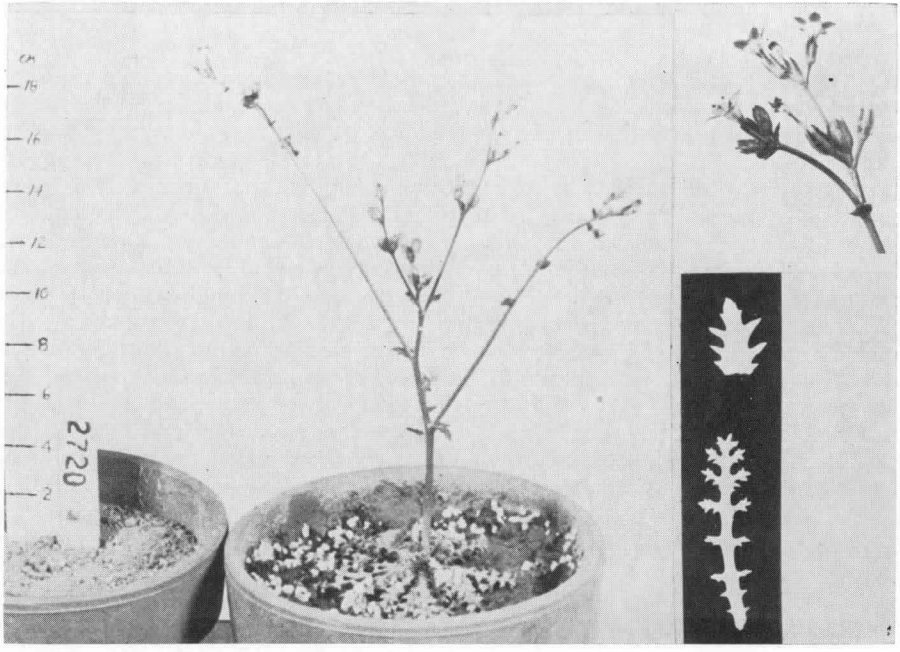



Fig. 19. *Gilia sinuata* from Phelan, San Bernardino County.

*Range.*—Sandy desert plains from 500 to 6000 feet. Mojave Desert of California east to New Mexico and western Colorado, north to eastern Washington, and northeast to Idaho. Flowering from late March to May in southern parts of the range and at lower elevations, and from May to July in the north and at higher elevations. In the Mojave Desert often appearing in dry years when other species of Cobwebby Gilia are absent.

*Variation.*—Large-flowered plants are found in shaded habitats as under pines or junipers in sandy soil of river benches in the northern part of the range. Seeds from small-flowered plants from the desert grown in cultivation produce flowers as large as those found in nature in the above mentioned habitat. The proportions of the flowers remain relatively constant in this case.

There is, however, also some geographical variation in flower proportions. In the San Bernardino Mts. of southern California the common form of *Gilia sinuata* has flowers with a proportionately larger calyx. The corolla here is 2½ times the calyx rather than 3 to 3½ times the calyx as it usually is elsewhere.

There is some variation in pubescence of the stem, a few collections having shown a scattering of cobwebby hairs low on the ordinarily glabrous stem. Some of these rare cases known to the authors were on plants growing in the shade of pines. Since the more common habitat is open sunny places the presumption arises that the abnormal type of pubescence represents a phenotypic modification due to habitat conditions.

*Type.*—*D. Douglas* in 1826, "barren sands near Oakanagon on the Columbia River," Okanogan County, Washington. Royal Botanic Gardens, Kew.

It is necessary to designate lectotypes for two varieties proposed by Brand. After comparison of a number of the cotypes with the original descriptions the following specimens are chosen as lectotypes. For *Gilia arenaria* var. *borealis* Brand: *T. J. Howell,* Columbia River near Umatilla, Umatilla County, Oregon, May 1, 1882. University of Oregon Herbarium. For *Gilia inconspicua* var. *variegata* Brand: *M. Jones 5280,* red sand, Kanab, 5300 ft., Kane County, Utah, May 22, 1894. Pomona College Herbarium 74118.

*Representative Specimens.*—WASHINGTON. Adams County: *A. Cronquist 6474,* Washtucna. Franklin County: *C. V. Hitchcock & C. V. Muhlick 8193,* Hanford. Klickitat County: *W. Suksdorf 6479,* Columbus. OREGON. Morrow County: *A. Cronquist 6283,* Boardman. Umatilla County: *T. J. Howell* in 1882, Umatilla. CALIFORNIA. Plumas County: *V. Grant 9668,* Halleluja junction. Mono County: *V. Grant 9613,* Benton Station. Inyo County: *C. L. Hitchcock 6270,* Lone Pine; *V. & A. Grant 8865,* Little Lake. Kern County: *A. Grant 9557,* El Paso Mts.; *J. T. Howell 24236,* between Kernville and Isabella. San Bernardino County: *I. W. Clokey 5774,* Adelanto; *V. & A. Grant 8662,* Adelanto; *P. A. Munz & D. D. Keck 7926,* Barstow; *C. B. Wolf 10523,* Kingston Mts. IDAHO. Lincoln County: *V. & A. Grant 9742,* Shoshone. NEVADA. Washoe County: *P. Train 3589,* Pyramid Lake road. Douglas County: *W. A. Archer 6048,* 10 miles southwest of Carson City. Ormsby County: *M. E. Jones 9825,* Carson City. UTAH. Washington County: *F. W. Gould 1661,* Diamond Valley. Kane County: *M. E. Jones 5280,* Kanab. COLORADO. Mesa County: *W. A. Weber 3878,* Colorado National Monument. Montrose County: *L. J. Brewster,* Dry Creek Canyon. ARIZONA. Mohave County: *T. H. Kearney & R. H. Peebles 13093,* Kingman.

### 15. GILIA CRASSIFOLIA Benth.

(Map 16; Fig. 20)

The *Gilia crassifolia* group consists of erect annuals up to 30 cm. tall with a prominent basal rosette of leaves; the basal leaves are mostly strap-shaped with short lobes; the cobwebby pubescence of the lower stems and leaves is a little coarser than in other members of the section; the inflorescence is somewhat congested; the corolla is small, 5-12 mm. long, with the tube about equalling the throat; in color the corolla is white tinged with pinkish-violet; the stamens are shorter than the corolla lobes, viz. are less than 4 mm. long; the style is included; the capsule is 5-7 mm. long; and chromosome numbers of N=18 and N=36 are known.

*Gilia crassifolia* sens. lat. ranges through the Andes of Argentina and Chile and the adjoining arid plains from 24° to 47° S. Latitude, or from the Salta Province in the north to the Santa Cruz Territory in the south. The altitudinal range is also very

wide, being as low as 250 meters in the southern plains and as high as 4000 meters in the central Andes (820 to 13,120 feet). The plants are in flower between October and February.

The group includes a number of variations which cannot as yet be treated taxonomically in a satisfactory way. The elder and younger Philippis described many segregate species, such as *G. lanuginosa, G. andicola, G. intermedia, G. lanigera, G. modesta* and *G. copiapina,* but their treatment has not been followed by subsequent authors. Reiche (1910) recognized two species and five taxa for Chile, namely *G. crassifolia, G. c. modesta, G. c. andicola, G. c. copiapina,* and *G. lanuginosa;* while Borsini (1942) recognized only one entity, *G. crassifolia,* in Argentina. More than one taxon is certainly involved. Until their boundaries have been worked out, however, it seems advisable to follow Borsini and place the whole group of South American Cobwebby Gilias in the collective species, *Gilia crassifolia.*

Map 16. Distribution of *Gilia crassifolia sens. lat.*

D. GILIA BRECCIARUM GROUP

Stems stout and spreading, cobwebby-pubescent at base. Basal rosette of leaves semi-erect in mature plants, basal leaves irregularly and coarsely dissected with narrow to moderately broad rachis. Cauline leaves slightly or not at all clasping, deeply lobed, the lobes longer than width of rachis, terminal lobe broad and elongate. Inflorescence glomerate. Pedicels subequal to unequal. Calyx heavily glandular. Corolla throat gradually flaring to abruptly expanded, lobes narrow or broad. Corolla throat dark purple in lower part like the tube, white above with bright


Fig. 20. *Gilia crassifolia* from Tecka, Chubut Territory, Argentina.

yellow spots, orifice and base of lobes white. Stamens unequal, the longest well exserted. Capsule broadly ovoidal.

### 16. GILIA BRECCIARUM Jones

(Map 17; Fig. 21; Plate I-P)

Plant erect with one main leading stem, or plant spreading with numerous decumbent stems from near base. Stems 8-35 cm. long, leafy, both stems and leaves dark green, stems and leaves densely cobwebby-pubescent at base or up to middle, glandular above and in the inflorescence. Basal rosette semi-erect, loose, often not clearly defined due to well developed lower cauline leaves. Basal and lower cauline leaves bipinnate to tripinnate, somewhat irregularly cut; rachis 1.5-3.0 mm. wide; lobes about the same width or a little narrower, and as long as or longer than the width of the rachis. Upper cauline leaves shorter, pinnately lobed with a broad rachis, the terminal lobe usually elongate and much broader than the lateral lobes. Bracts glandular, entire or with 1-2 pairs of lobes. Inflorescence glomerate with 2-5 flowers in a glomerule and 1-3 flowers subtended by a bract. Pedicels moderately to heavily glandular, subequal to unequal, short, 1-3 mm. long, or sometimes the lateral pedicels to 11 mm. long in *G. b. neglecta* and *G. b. argusana.* Calyx with broad herbaceous lobes connected by narrower sinus membranes, moderately to densely glandular, enlarging to enclose the capsule. Corolla small or large, 7-20 mm. long, 2 to 3½ times the calyx, with a narrow to very full throat. In color the corolla tube and usually the lower throat dark purple, upper throat and orifice white with yellow spots, limb violet; or a common form of *G. b. brecciarum* has a paler tube and white limb. Stamens unequal, short to very long. Style short or very long. Capsule large, broadly ovoidal, 4.0-6.8 mm. long. N=9.

*Range.*—Southeastern Oregon through Nevada to southern California.

KEY TO THE SUBSPECIES OF GILIA BRECCIARUM

Stamens and style short, maturing at orifice of throat or slightly exserted; corolla small, 7-11 mm. long, lobes short, 1.8-3.7 mm. long. Widespread.....a. *brecciarum*

Stamens and style long exserted; corolla larger, 8.5-20.0 mm. long, lobes large, 2.8-5.7 mm. long. Southern Sierra Nevada and Mojave Desert.

Corolla tube included in or slightly exserted from calyx; corolla form full and stout (length of tube and throat together about 1½ to 2 times the width of the orifice). Sierra Nevada and adjacent desert plains.....b. *neglecta*

Corolla tube well exserted from calyx; corolla form long and slender (length of tube and throat together 2-3 times the width of the orifice.) Desert mountains .....c. *argusana*

16a. G. BRECCIARUM subsp. BRECCIARUM

*Gilia brecciarum* Jones, Contrib. West. Bot. 12: 54, 1908, (type seen).
*Gilia inconspicua* subsp. *sinuata* var. *deserti* Brand, Pflzr. 250: 105, 1907, (Spooner, Douglas County, lectotype seen).
*Gilia modocensis* Eastw., Leafl. West. Bot. 2: 283, 1940, (near Jess Valley, Modoc County, type seen).

Plant habit erect or decumbent. Corolla small, 7.0-11.0 mm. long, 2 to 2½ times the calyx; throat and orifice narrow to broad; tube and throat together 4.8-7.8 mm. long; orifice 1.6-4.0 mm. wide; lobes short, 1.8-3.7 mm. long, and narrow to rather broad, 1.4-3.0 mm. wide. Corolla lobes violet or white. Stamens and style short, maturing at orifice or slightly exserted, the stigma lobes maturing at the level of the stamens.

*Range.*—Sandy slopes in the yellow pine, pinyon, sagebrush and desert communities; from 4000 to 7500 feet, or as low as 1000-2500 feet in the South Coast Range. Southeastern Oregon in Lake and Harney counties; northeastern California from Modoc to Plumas County; through Nevada; southern California in the southern end of the South Coast Range and along the southwestern border of the Mojave Desert. Flowering from April to June, sometimes into July.

*Variation.*—In Nevada and northeastern California white-flowered populations are at least as common as violet-flowered ones; plant habit varies from erect to decumbent; and both large and small flowered forms are found. In the South Coast Range of California, at McKittrick and in Ballinger Canyon, the habit is decumbent, the flowers are small, and their color is violet. On Mt. Pinos in this same area both erect and decumbent forms occur, and the flowers vary in both size and proportions within the limits described above. One population was observed here with both white and blue-flowered individuals intermixed. On neighboring Liebre Mt. a large erect form with large violet flowers occurs.

*Type.*—*M. E. Jones 10009,* Contact, Nevada, July 26, 1901. Pomona College Herbarium 74817.

As lectotype for *G. inconspicua* var. *deserti* Brand, the following specimen is selected: *C. F. Baker 1140,* Spooner, 2155 M, Douglas County, Nevada, June 23, 1902. California Academy of Sciences Herbarium 435. This specimen is one of several cited by Brand, conforms to the short description of *deserti,* and was annotated as such by him.

*Representative Specimens.*—OREGON. Lake County: *L. E. Detling 4231,* Adel. Harney County: *L. F. Henderson 8924,* Alvord; *L. F. Henderson 8926,* Castle near Burns; *M. E. Peck 14160,* Alberson. NEVADA. Eureka County: *L. Benson 6739,* 15 miles southwest of Carlin. Lander County: *F. S. Goodner & W. H. Henning 219,* Kingston Canyon. Washoe County: *M. E. Jones 10283,* Reno; *P. Train 3618,* Lawton Springs between Verdi and Reno. Ormsby County: *M. E. Jones 9822,* Carson City; *M. Canby 178,* Steamboat Springs. Mineral County: *P. Train 4121,* Mt. Grant, Wassuk Range. Esmeralda County: *M. F. Gilman 3183,* Grapevine Mts. CALIFORNIA. Modoc County: *A. Eastwood & J. T. Howell 8073,* Likely to Jess Valley.

Plumas County: *V. Grant 9669,* north of Halleluja Junction on Hwy. 395; *V. Grant 9665,* 17 miles north of Reno near Sierra-Plumas county line. Kern County: *C. A. Purpus 5014,* hillsides near Erskine Creek, 4000-5000 ft. Santa Barbara County: *V. Grant 9365,* Ballinger Canyon, Cuyama Valley. Ventura County: *R. D. Harwood 193,* Frazier Mt.; *V. & A. Grant 16049,* Public Camp Grounds, Mt. Pinos. Los Angeles County: *P. A. Munz 4421,* Sandbergs, Liebre Mt.; *V. & A. Grant 9119,* south side of Antelope Valley on road to Lake Hughes. San Bernardino County: *G. Campbell 18387,* between Morongo Valley and Twentynine Palms.

**16b. Gilia brecciarum** subsp. **neglecta** A. & V. Grant, subsp. nov.

Plant habit erect with one or several stout stems from the base and developing strong secondary branches. Leaf dissection irregular and coarse. Corolla 8.5-15.0 mm. long; corolla form full and stout, the tube included in to slightly exserted from the calyx, and the throat broadly expanded forming an orifice which is broad in relation to the length of the flower; tube and throat together are about 1½ to 2 times as long as the orifice is wide; orifice 4.5-5.2 mm. wide; corolla lobes broadly oval. In color the corolla tube and lower half of throat dark purple; upper throat, orifice and base of lobes white, with bright yellow spots in upper throat; lobes light violet. Stamens unequal, the longest ⅓ to ⅔ longer than the shortest and long exserted, nearly as long as to slightly longer than the corolla lobes. Style long exserted, the stigma lobes reflexing at the level of or beyond the longest stamens.

Corolla 8.5-15.0 mm. longa, lata, tubo in calyce incluso vel leviter exserto; longitudo tubi et faucis latitudine faucis 1.5-2 x longior.

*Range.*—Sandy slopes in the mountains and desert plains, from 2400 to 7000 feet. Tehachapi Mts., southern Sierra Nevada, and bordering parts of the Mojave Desert; Kern and Inyo counties, California. Flowering in April and May, or into June.

*Variation.*—The most extreme development of *G. b. neglecta* is found in the area between the town of Mohave and Kern Valley. Here the corolla proportions are rather uniformly broad, and the purple tube color extends well into the throat so that the purple eye in the throat is most striking. From just north of Red Rock Canyon to northern Inyo County the populations are polymorphic, varying in corolla proportions from a fairly extreme *neglecta* type to a more slender-flowered form. The latter approaches in its corolla proportions *G. b. argusana* but differs in having a short corolla tube.

*Type.*—*V. & A. Grant 9109-B,* several miles east of Old Isabella in Kern Valley, Kern County, California, April 22, 1952. Rancho Santa Ana Botanic Garden Herbarium 67718.

*Representative Specimens.*—CALIFORNIA. Kern County: *V. & A. Grant 9089,* 4 miles out of Mohave on road to Tehachapi; *A. A. Heller 7837,* Tehachapi; *V. & A. Grant 9114,* east side of Kern Valley on Hwy. 128. Inyo County: *V. & A. Grant 9355,* Olancha Canyon; *R. S. Ferris 7444,* mouth of Lone Pine Creek; *M. Kerr* in 1933, Snake Hill 5 miles west of Independence.

**16c. G. brecciarum** subsp. **argusana** A. & V. Grant, subsp. nov.

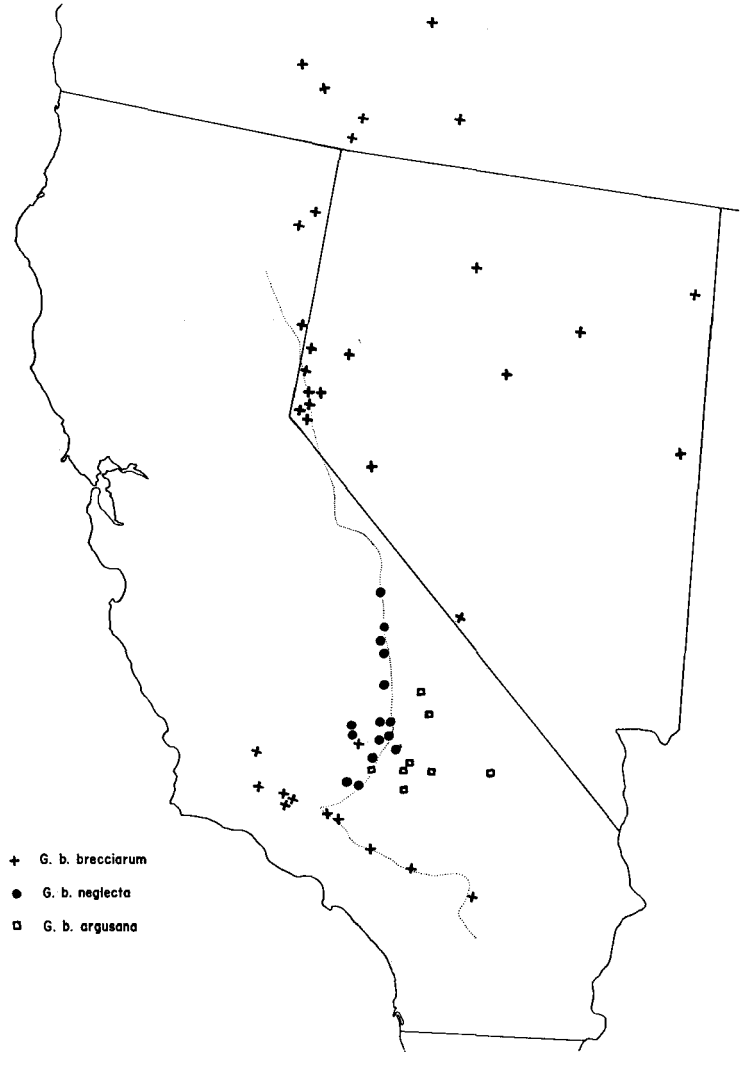
Plant habit erect with one or several stems from the base and developing long secondary branches. Leaf dissection somewhat finer than in *G. b. neglecta,* the lobes narrower and more deeply cut in general. Corolla 9.5-20.0 mm. long; corolla form long and slender, the tube well exserted from calyx, and throat slightly expanded to form an orifice 2.2-6.0 mm. wide, the orifice being narrow in relation to the length of the flower; tube and throat together about 2-3 times as long as the width of the orifice; lobes narrowly to broadly oval. In color the corolla tube and base of throat dark purple; throat above the purple base white with bright yellow spots;

orifice and base of lobes white; lobes light violet. Stamens and style as in *G. b. neglecta.* Capsule broadly ovoidal, 5.5-8.0 mm. long.

Corolla 9.5-20.0 mm. longa, tenuis, tubo ex calyce exserto; longitudo tubi et faucis latitudine faucis 2-3 x longior.

*Range.*—Desert mountains, from 2100 to 5800 feet. Mojave Desert from Red Rock Canyon and the El Paso Mts. northeast to Darwin and east to the Avawatz Mts.; Kern, Inyo and San Bernardino counties, California. Flowering from late March to the middle of May.

*Variation.*—In Red Rock Canyon and again in the Argus Mts. the corolla throat is very short, the tube filiform, the lobes narrow, and the purple color of the corolla




Map 17. Distribution of *Gilia brecciarum.*

tube terminates near the base of the throat so that the purple eye in the flower is small. In the El Paso Mts. and around Granite Wells the corolla form is more robust with a stout tube and long, rather full throat, and the purple tube color extends into the lower part of the throat so that the purple eye in the flower is more prominent. Although the width of the orifice in these full-throated populations is as great as in extreme *G. b. neglecta,* the tube and throat are much longer with the result that the corolla proportions are similar to those of extreme *G. b. argusana.*

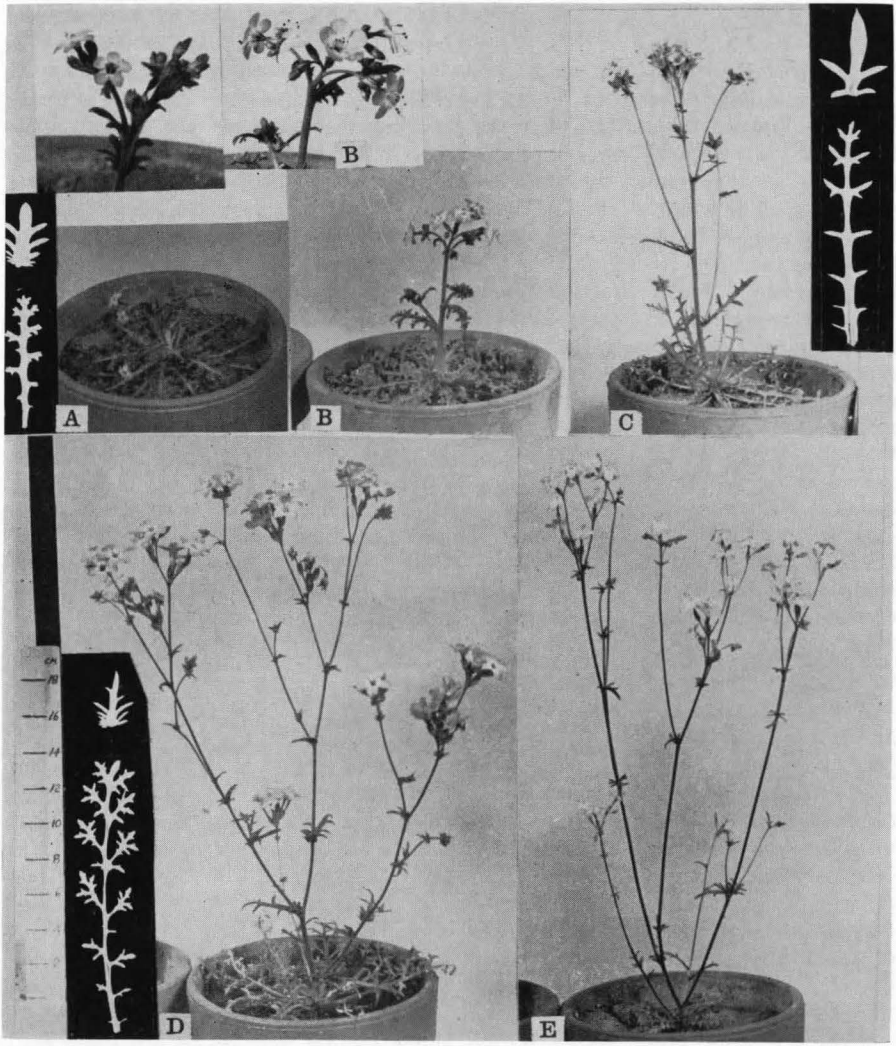



Fig. 21. *Gilia brecciarum.* A) *G. b. brecciarum* from Mt. Pinos, Ventura County. B) *G. b. neglecta* from Olancha Canyon, Inyo County. C) *G. b. neglecta* from Short Canyon, Kern County. D) *G. b. argusana* from the El Paso Mts., Kern County. E) *G. b. argusana* from the Argus Mts., Inyo County.

*Type.—V. & A. Grant 9347,* Homewood Canyon, about 8 miles north of Trona, Argus Mts., Inyo County, California, April 20, 1954. Rancho Santa Ana Botanic Garden Herbarium 86590.

*Representative Specimens.*—CALIFORNIA. Kern County: *V. & A. Grant 8856,* near Searles Station, El Paso Mts.; *A. A. Heller 7686,* Randsburg; *E. K. Balls 9181,* 13 miles south of Inyokern on Hwy. 395; *P. A. Munz 12446,* Red Rock Canyon. San Bernardino County: *E. K. Balls 8589,* 4 miles south of Atolia on Hwy. 395; *V. & A. Grant 8854,* several miles north of Kramer junction; *F. W. Peirson 4139,* Granite Wells.

### 17. Gilia tetrabreccia A. & V. Grant, sp. nov.

(Map 15)

Large spreading plant with many decumbent stems from base or habit erect. Stems 15-40 cm. long, densely cobwebby-pubescent near base, and moderately to densely glandular above and in the inflorescence. Basal rosette compact with the lower cauline leaves much reduced, or basal rosette loose and the lower cauline leaves well developed. Lower leaves densely cobwebby-pubescent, finely to rather coarsely dissected, pinnate or bipinnate, rachis 1.2-3.5 mm. wide, primary lobes as wide as rachis or narrower, lobe length greater than the rachis width. Middle cauline leaves shorter, deeply dissected to the apex like the basal leaves, or having a broader rachis and the lobes arising near the base, the terminal lobe then longer and broader than the lateral lobes. Bracts toothed or entire, heavily glandular. Inflorescence somewhat congested in flower, becoming loose in fruit as pedicels elongate; 1-2 flowers borne above a bract. Pedicels heavily glandular, very unequal at maturity of capsule, the terminal pedicel 0.5-2.5 mm. long and the lateral becoming 4.5-10.0 mm. long. Calyx densely glandular, about 3.5 mm. long, enlarging to exceed the mature capsule, tips of lobes often becoming recurved; lobes acuminate and broader than the membrane in the sinuses. Corolla small, 6.5-7.8 mm. long; the tube included in or slightly exserted from the calyx; throat about as long as the lobes, orifice 2.2-2.5 mm. wide; lobes oval, about 2 mm. long. In color the corolla tube dark purple, throat and base of lobes white with lemon yellow spots, lobes violet. Stamens slightly unequal, very short, 0.2-0.8 mm. long, maturing at orifice or slightly exserted. Style short with stigma lobes reflexing among stamens at orifice. Capsule broadly ovoidal, 4.4-6.0 mm. long. N=18.

Pediculus dense glandulosus; calyx dense glandulosus; flos parva et inconspicua; stylus brevis; planta tetraploidea.

*Range.*—Sandy slopes in the Yellow Pine belt, from 5200 to 7000 feet. Mt. Pinos and upper Lockwood Valley, Ventura County, California. Flowering in May and June.

*Variation.*—Both a decumbent and an erect form can be distinguished. The decumbent form has many stems spreading out horizontally from the base. It occurs mainly below 6500 feet. The erect form, which has an upright central leader with secondary branches in the upper part of the plant, occurs mainly above 6500 feet. A large population on a steep hill at about 6500 feet elevation was observed to have decumbent individuals at one level and erect plants at a higher level within view of the former. Intermediate types with an erect leader but with long secondary branches were growing near the prostrate plants. At 7000 feet only erect plants were found.

*Type.—V. & A. Grant 16042,* 9 miles above Stauffer junction on Mt. Pinos road, 6500 feet, Ventura County, California, June 14, 1951. Rancho Santa Ana Botanic Garden 67288.

*Representative Specimens.*—CALIFORNIA. Ventura County: *C. B. Wolf 6987,* southwest

end of Lockwood Valley; *V. & A. Grant 16041,* Mt. Pinos road 8 miles above Stauffer junction; *V. Grant 9410,* road to summit of Mt. Pinos near junction with paved road.

## SUMMARY

The Cobwebby Gilias are classified into one section, four species groups, 17 species, and 44 taxa (subspecies). Newly described are the one section, the four species groups, four of the species, and 15 of the subspecies. New combinations are made for two other species and 12 other subspecies. Each taxon is circumscribed, described, illustrated, and mapped. A synopsis of the system of classification adopted is given in Table 2.

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