The sterile hybrid between *Gilia millefoliata* and *G. achilleaefolia*, from which tetraploid F₂'s have spontaneously arisen on two occasions, has yielded information along several lines. A study of this hybrid reveals some of the cytological and environmental conditions under which natural and garden polyploids may be expected to arise. Analysis of segregation in the allotetraploid derivatives contributes to our understanding of the genetic basis of the differences between the parental species. The allotetraploid derived from this cross, finally, provides information concerning the origin and constitution of a natural occurring tetraploid species of *Gilia* (*G. clivorum*). The latter problem is being taken up elsewhere (Grant, in press), while the second problem is currently under investigation. The purpose of this paper is to describe variations in meiosis in this hybrid as correlated on the one hand with differences in the frequency of appearance of polyploids (polyploidy rate, as defined in a subsequent paragraph), and on the other hand with differences in environmental conditions.

Materials and Methods.

*Gilia millefoliata* Fisch. et Mey. and *G. achilleaefolia* Benth. are two species of annual flowering-plants native to coastal California. They belong in the same section of the genus (sect. *Eugilia*), which is in turn a member of the family Polemoniaceae. *Gilia millefoliata* is a prostrate maritime plant with self-pollinating flowers which inhabits sand dunes along the cool and cloudy coast line of northern California and southern Oregon (Fig. 1). The more erect and larger flowered *Gilia achilleaefolia* (Fig. 1) occurs on open sunny hillsides and in canyons of the South Coast Range from San Francisco Bay to Santa Barbara County, California. This species is self-compatible but more or less outcrossed by bees.
The strains used in this study were grown from seeds collected in the wild. The strain of Gilia millefoliata came from Point Reyes Peninsula north of San Francisco Bay. Specimens of this plant have been deposited in several California herbaria under the author's collection numbers 7909 and 8419. Four strains of Gilia achilleaefolia were used, which can similarly be identified by reference to the collection numbers. They are: (1) San Luis Obispo, No. 8557; (2) Moraga Canyon, Contra Costa County, No. 8505; (3) Kings Mt., San Mateo County, No. 8903; and (4) Corte Madera Ridge, Marin County, No. 8878. [The Kings Mt. and Corte Madera strains actually belong to the entity known as Gilia multicaulis, which is, however, conspecific with G. achilleaefolia (Grant, unpublished).] The seeds were sown in the middle of winter in a well aerated seed bed consisting of a mixture of Georgia peat, clean potting soil and sponge rock. Germination was prompt, and as soon as the seedlings became large enough to prick out, they were transferred to 2" pots. They were moved once more in early spring, either to the experimental field or to 6" pots of good soil in the greenhouse. Given plenty of water, the plants bloomed throughout the spring and early summer.

The plants used as female parents were enclosed in breeding cages in the greenhouse and were emasculated daily. Pollinations were made preferably in the early forenoon before the bees had robbed the male parents in the experimental field of their daily production of pollen. Colored yarns tied to the peduncles served to identify the different crosses. Records were kept of the number of flowers pollinated in each combination, the number of capsules and seeds formed, and the number of F1 hybrids obtained.

Pollen fertility was estimated from lactophenol mounts of pollen grains stained with aniline blue. The plump, well-stained grains were counted as good, and the empty shrunken grains as inviable.

Satisfactory cytological preparations were obtained by using carmine smears. Floral buds were fixed at about noon on warm days in 3:1 ethanol-propionic acid, and later stored in 70% ethanol. The pollen mother cells were stained in propionic-carmine and counterstained with methyl green. The preparations were made permanent by the infiltration of euparol under the cover slip in the presence of alcohol vapor, as recommended by Bradley (1948). Acetic acid, as normally used in aceto-carmine smears causes a darkening of the cytoplasm in Gilia, but this difficulty is remedied by the substitution of propionic acid in both fixative and stain.

Meiotic figures were drawn at bench level with a camera lucida. The scale is indicated in Figs. 2—37 by the double arrow, which measures 10 microns. In drawings of first metaphase cells, bivalents are shown black, univalents are shown in outline, and multivalents are stippled. Metaphase and anaphase chromosomes have frequently been spread apart slightly in drawing.

Crossability.

Gilia millefoliata crosses readily with G. achilleaefolia from San Luis Obispo. Fifteen flowers of millefoliata crossed by achilleaefolia yielded 215 seeds and scores of hybrids. Achilleaefolia flowers crossed to millefoliata pollen, however, produced no seeds. This reciprocal difference is correlated with a difference in the length of the style, which is long in achilleaefolia and short in millefoliata.

Cross-pollinations between millefoliata and the three other strains of achilleaefolia yielded only abortive seeds, though from 10 to 30 flowers