metaphase I of meiosis. From the opposite end of the range, *Ownbey & Brown 2417* from Goose Valley, near Burney, Shasta County, California, has been investigated only by BEAL. The bulbs of this lot were collected too early in the season and were so weakened that they did not produce a sufficient number of buds for meiotic studies during their first year under cultivation. No significant differences have been noted between the karyotype of this collection and that of *Ownbey 2345*. This is rather remarkable in view of the possibility that the populations at the two stations doubtless have been separated for a very long time—perhaps for a million years.

C. longebarbatus var. *peckii* Ownbey.[1]

[1] **Calochortus longebarbatus** var. **peckii** Ownbey, var. nov., folio basilari incurvo relative longiore et angustiore basilariter rubro-purpureo; caule humiliore; floribus crateriformibus, petalis latioribus brevioribus prope glandulam abrupte flectis, cuneolo librato et limbo erecto; aliter similis speciei.—OREGON: grown from bulbs of *Ownbey & Ownbey 1800* from grassy margin of wet meadow, headwaters of Marks Creek, Ochoco National Forest, Wheeler County (TYPE, in the Herbarium of the State College of Washington); also from bulbs of *Ownbey & Ownbey 2360* from grassy places under pines, along North Fork of Crooked River, just above the mouth of Deep Creek, S. 27, T. 14 S., R. 22 E., Crook County. Named in honor of its discoverer, Professor MORTON E. PECK of Willamette University, who had collected it at the Marks Creek station (*Peck 17200*), and who directed the writer (OWNBEY) to the exact locality during the summer of 1938.

One familiar with herbarium material only might easily minimize the morphological characters which distinguish the variety *peckii* from typical *C. longebarbatus*, but when living material is examined, it may be recognized at nearly all stages of development. Before flowering, the relatively longer and narrower basal leaf, which is reddish at the base and arcuate inward, is characteristic. Later it may be recognized by its lower stature and especially by its bowl-shaped flowers. The latter are particularly striking. The petals, which are relatively broader and shorter than in the species, are sharply bent at the gland, with the claw horizontal and the limb vertical. This characteristic flower shape is found elsewhere in the genus only in the related but amply distinct *C. greenei*. Flowers of typical *C. longebarbatus* are obconic campanulate.

—Triploid, 30 chromosomes (fig. 3). The occurrence of each of the chromosome forms in triplicate suggests that this variety is an autotriploid. At metaphase I of meiosis, however, the association of the chromosomes into configurations other than trivalents reveals that this is not entirely the case. In most of the cells examined the chromosomes were formed into eleven or twelve groups (fig. 11), some of which were bivalents, some trivalents, and some quadrivalents. In other cells configurations containing apparently more than four chromosomes, and also an occasional univalent, may occur. In none of the meiotic material examined has it been possible to account for all the 30 somatic chromosomes with certainty.

Notwithstanding the great irregularities at meiosis, development proceeds normally until after the tetrad has broken apart to form the individual microspores. Thereafter maturation is arrested at various stages, until at anthesis between 80 and 90 per cent of the pollen is visibly imperfect. That only a small amount of the pollen which matures is actually functional was indicated when the anther contents were applied to covered stigmas of typical *C. longebarbatus*. This cytologically regular material (n = 10) from Klickitat County, Washington, produces an abundance of seed under usual conditions, but only a few abortive seeds, mostly without embryos, resulted when twelve flowers were pollinated with an excess of pollen from var. *peckii*. Furthermore, in the fifty-one fruits which have been allowed to develop on var. *peckii* during the last two seasons, not a single seed was formed, although an abundance of viable pollen must have reached the stigmas from the Klickitat County collection growing by its side. Similar observations were made

in the field in 1940, when not a single seed was found although many fruits were examined.

The probability that *C. longebarbatus* var. *peckii* is unable to reproduce itself by seed seems well enough established. To most species of the section Eucalochortus this would be a fatal handicap, for, although all of them—so far as is known—reproduce vegetatively through division of the bulb, this is far too slow a process in most cases to maintain the species. *C. longebarbatus*, however, is one of the two species of this section which regularly produce bulblets in the leaf axils at or below the surface of the ground. With this effective means of vegetative reproduction, *C. longebarbatus* var. *peckii* has not only maintained itself since its origin but has apparently been able to increase its numbers. If all individuals of this variety represent only one clone, as is here suggested, then its distribution is indeed of significance. At the present time it is known only from the two localities cited. These are about 18 miles apart and are now separated by an expanse of habitats in which the variety does not grow. Assuming that the original point of dispersal was halfway between the two known stations, it has been necessary for this variety to migrate at least 9 miles since its origin. If it were to move at an average rate of 1 inch per year in a straight line (an exceedingly generous estimate), it would take well over half a million years to migrate 9 miles. Perhaps in a case of this kind transport by rodents, or possibly by water (although the two stations are on different drainage systems), would be more important than mere growth. The probability remains, however, that *C. longebarbatus* var. *peckii* is very old. Considering this, the cytological and morphological uniformity of the plants from the two localities becomes truly remarkable. Is it possible that evolution has been at a standstill in this clone for 500,000 years? This should be expected, of course, since the genes are presumably in triplicate, and there is no provision for their reassortment through reduction division. Barring dominant gene mutations, the rate of phenotypic change should approximate the cube of the mutation rate of a given gene. This would impose a handicap of great evolutionary consequence on those characters governed by even the most labile of the genes. If the variety *peckii* is old, then meiotically-regular *C. longebarbatus* must be older. Although var. *peckii* appears to have remained constant since its origin, it seems unlikely that sexually-reproducing *C. longebarbatus* would have done likewise during the same period of time. It seems possible, therefore, that here in var. *peckii* are some of the genes which have been eliminated from *C. longebarbatus* in the last 500,000 years. Hybrids, if they can be obtained, and apparently they can, should be very interesting.

The resemblances between *C. longebarbatus* var. *peckii* and *C. greenei* may also be of significance in the interpretation of the phylogeny of the Eucalochorti. As OWNBEY (5) has pointed out, the center of dispersal of this section appears to be coincident with the ancient Klamath land area of northern California and southwestern Oregon. This does not mean that the present-day species originated on and migrated out from the Klamath area, but that at some time the ancestor or ancestors of these species occupied this area as a refuge during an unfavorable era. *C. greenei* now occurs only within that area, but *C. longebarbatus* has a much disrupted distribution, extending from Shasta County, California, to Washington. Geographically, *C. longe-*

barbatus var. *peckii* occurs between *C. greenei* and typical *C. longebarbatus* in southern Washington and northern Oregon. Its resemblance to *C. greenei* suggests that it may have retained certain genes in common with that species which have been lost by its sexually-reproducing relative. The few collections of *C. longebarbatus* from southern Oregon and northern California are all old and are inadequate for determining whether or not they are identical with the material from farther north. Living material secured in Goose Valley, Shasta County, during the summer of 1941 (*Ownbey & Brown 2417*) should be of assistance in this connection.

SECTION II. MARIPOSA

Subsection 5. Venusti

C. flexuosus Watson.—Diploid, 14 chromosomes (fig. 4). Karyotype similar to that of *C. catalinae*, with both species showing only 4 chromosomes with subterminal centromeres, and the remaining 10 have median or submedian centromeres. The two species are evidently closely related, both cytologically and morphologically.

The material of this species was collected by Mr. Ira W. Clokey (no. 5872) on gravelly slopes and hillsides at Glendale Junction, about 50 miles northeast of Las Vegas, Clark County, Nevada.

C. palmeri Watson.—Diploid, 14 chromosomes (fig. 5); 7 bivalents at metaphase I of meiosis (fig. 9). The chromosomes of this species conform closely in morphology to those of *C. splendens*, with which it is closely allied otherwise. Both show 6 chromosomes with subterminal centromeres, and the remaining 8 have similar forms and centromere positions in the two species.

The material of *C. palmeri* (*Ownbey & Ownbey 1675*) was collected in a grassy swale along the south side of Big Bear Lake, San Bernardino Mountains, San Bernardino County, California.

Subsection 7. Nuttalliani

C. kennedyi var. *munzii* Jepson.—Diploid, 16 chromosomes (fig. 6). The karyotype of this variety is scarcely distinguishable from that of the species, of which it is perhaps no more than a color form.

Bulbs of this variety were removed from herbarium specimens collected by Dr. Hugh C. Cutler (no. 4764) on a grassy plain, 8 miles southeast of Sonoita, Santa Cruz County, Arizona. No material was available for meiotic studies.

C. ambiguus (Jones) Ownbey.—Diploid, 18 chromosomes (fig. 7); 9 bivalents at metaphase I of meiosis (fig. 10). The karyotype of this species is almost identical with that of *C. gunnisoni*, and the two species are otherwise very similar. On the basis of their very close morphological resemblance, these two species, together with a variety of *C. gunnisoni*, were placed together by OWNBEY (5) to constitute the subsection Gunnisoniani. The cytological evidence now supports that derived from morphology in indicating the validity of this subsection.

The material of *C. ambiguus* was collected about 1 mile west of Cloverdale, in the southwestern corner of Hidalgo County, New Mexico, by Mr. P. J. Leyendecker. Additional material from 2 miles southeast of Sonoita, Santa Cruz County, Arizona, collected by Dr. Hugh C. Cutler, was investigated only by BEAL. There appears to be little or no karyotypic difference between the two collections.

Discussion

Including the species and varieties investigated in the present study, a total of thirty-six species and six varieties of

1973 • Specimen → Tables → protologues all or taxa for edits To check names changes of journals

Back to Top

Asian Studies

China Journal *1995-2003*
    Australian Journal of Chinese Affairs *1979-1995*
Harvard Journal of Asiatic Studies *1936-1999*
Journal of Asian Studies *1956-2001*
    Far Eastern Quarterly *1941-1956*
Monumenta Nipponica *1938-1999*
Pacific Affairs *1928-2000*
    News Bulletin (Institute of Pacific Relations) *1926-1928*

Back to Top

Botany

- American Journal of Botany *1914-1999*
- Annals of the Missouri Botanical Garden *1914-1999*
- Brittonia *1931-1999*

International Journal of Plant Sciences *1992-1999*
- Botanical Gazette *1876-1991*

Botanical Bulletin *1875-1876*

- Journal of the Torrey Botanical Society *1997-2001*
- Bulletin of the Torrey Botanical Club *1870-1996*
- Missouri Botanical Garden Annual Report *1890-1912*

New Phytologist *1902-2001*
Systematic Botany *1976-1999*

Back to Top

Ecology

- American Midland Naturalist *1909-2001*

    Midland Naturalist *1909*

American Naturalist *1867-1999*
Annual Review of Ecology and Systematics *1970-1999*
Biotropica *1969-1999*
Conservation Biology *1987-2001*
Diversity and Distributions *1998-2001*
    Biodiversity Letters *1993-1996*
Ecological Applications *1991-2000*
Ecological Monographs *1931-2000*
Ecology *1920-2000*
Evolution *1947-2001*
Functional Ecology *1987-2001*
Global Ecology and Biogeography *1999-2001*
    Global Ecology and Biogeography Letters *1991-1998*