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NOTES ON SELECTED GENERA RELATED TO *ERIOGONUM* (POLYGONACEAE: ERIOGONOIDEAE)

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ABSTRACT

The subtribe Eriogonineae consists of seven genera including the largest genus of the subf. Eriogonoideae, *Eriogonum*. Revisions have been published on four of the genera and two more modest treatments are presented here for *Dedeckera* and *Gilmania*.

KEY WORDS: Polygonaceae, taxonomy, *Dedeckera, Gilmania*, California.

INTRODUCTION

Current revisionary studies of the eriogonoid genera of Polygonaceae began in 1961 with the discovery of a series of wild buckwheat species that would eventually prove to be undescribed. It was as a naive undergraduate that the initial efforts were made to comprehend the genus *Eriogonum* under the tutelage of John Thomas Howell, George J. Goodman, Arthur Cronquist and Arthur H. Holmgren. Upon entering the exalted air of graduate school, first in a master's and then a doctoral program, the same group continued to help with Stanley L. Welsh assuming the principal role of advisor and Conrad V. Morton chief critic. The result was a revision of *Eriogonum* that, much to the disgruntlement of many, is still unpublished. Those years, as almost any professor will rightly claim later, were golden ones in terms of productivity.

Since 1964 numerous papers were published treating *Eriogonum*. With the discovery of the genus *Dedeckera* (Reveal & Howell 1976), greater attention was paid to the genera related to it, and a series of revisions were published with Barbara J. Ertter (Reveal & Ertter 1977a, b, 1980; Ertter 1980). An administrative change above the departmental level in the late 1970s made it impossible to work on western American botany and most efforts on the Eriogonoideae came to an end. Another change in the mid 1980s made it possible once again to concentrate on western plants and this time it is being done with a vengeance!

The current remarks are devoted to those genera related to *Eriogonum* belonging to the subtribe Eriogonineae. Revisionary treatments of *Chorizanthe* and its related genera (subtribe Hollisteriineae) are presented elsewhere in this volume of *Phytologia* (Reveal 1989c; Reveal & Hardham 1989) as are comments on the two genera of the tribe Pterostegeae (Reveal 1989a, b). With this paper, and those mentioned above, all of the eriogonoid genera will have been revised except *Eriogonum* and the perennial species of *Chorizanthe* which are fundamental to any understanding of the evolutionary history of the subfamily.

Taxonomy

The subfamily Eriogonoideae is divided into two tribes, Eriogoneae (fifteen genera) and Pterostegeae (two genera). The former is further divided into subtribes, Eriogonineae (seven genera) and Hollisteriineae (eight genera). The Eriogonineae may be characterized as those genera of the tribe with numerous flowers in turbinate to campanulate involucres or at a node. In this taxon the involucres are infrequently awned (*Oxytheca, Goodmania* and then the awns are long, slender and always straight). Although not consistent in either subtribe, the embryo is curved in the Eriogonineae (the exception being *Eriogonum* subgenus *Oligogonum*) and typically straight in the Hollisteriineae (the exceptions being three species in *Chorizanthe* and the species of *Systenotheca, Centrostegia, Dodecahema, Aristocapsa* and *Hollisteria*). The Hollisteriineae is reviewed elsewhere (Reveal 1989c).

Polygonaceae Juss. subtribe **Eriogonineae** Roberty & Vautier, Boissiera 10: 84. 1964. – Type: *Eriogonum* Michx., according to Art. 22.4 of the ICBN.

Polygonaceae cohort Eriogonastreae Roberty & Vautier, Boissiera 10: 92. 1964. – Type: *Eriogonum* Michx.

Polygonaceae Juss. cohort Pterogonastreae Roberty & Vautier, Boissiera 10: 107. 1964. – Type: *Pterogonum* H. Gross.

Plants annual, biennial or perennial herbs, subshrubs or shrubs; *leaves* basal or basal and cauline, mostly broad, glabrous to densely tomentose on one or both surfaces; *inflorescences* mostly cymose to umbellate or capitate, the secondaries rarely suppressed; *peduncles* typically present, usually slender to stout and often elongated; *involucres* turbinate to campanulate or sometimes cylindrical, the teeth short and erect or lobed and typically reflexed, infrequently awned with long slender spines, occasionally the involucre reduced to a series of (2-3) 5-6 awned or non-awned involucral bracts; *flowers* (2) 7-200 per involucre or 5-30 at a node, rarely some solitary in *Dedeckera*, usually long pedicellate, the tepals narrow to broad, glabrous to tomentose; *achenes* mostly globose with a curved (rarely straight) embryo; $n = 9, 11, 12, 16, 17, 18, 20, 22, 40$.

Widespread in North America from eastern Alaska southward to central México eastward to the Applachian Mountains southward to central Florida, with one species disjunct in southwestern South America, the greatest concentration in the western United States and especially in California.

As here defined, the subtribe Eriogonineae is composed of seven genera, the largest being *Eriogonum* with some 240 species of annuals, biennials or perennials. This genus is widely distributed in North America being encountered from Alaska to central México and from coast to coast. It may also be found from well below sea level to above timberline. The next largest genus in the subtribe is *Oxytheca*, a taxon of seven annual species of the western United States and northern Baja California Norte, México, with one variant disjunct in Chile and Argentina. Of the five remaining genera only the monospecific genus *Dedeckera* is a perennial, and it is a well formed shrub of the desert ranges of Inyo and Mono cos., California. Two of the monospecific annual genera, *Gilmania* and *Goodmania*, are found mainly in the Mojave Desert with the former endemic to Death Valley. The latter is more widespread. It extends from the edge of the San Gabriel and San Bernardino mountains northward into the Central Valley and along the eastern edge of the Sierra Nevada into the Great Basin of west-central Nevada. To the south along the coast and in the Sonoran Desert of southern California and northwestern México the monospecific genus *Nemacaulis* is found on deep

sandy soil. To the east in the Colorado River drainage system of Wyoming southward through eastern Utah and adjacent Colorado into the Four-Corners area of New Mexico and Arizona is the bispecific annual genus *Stenogonum*. Of the fifteen genera of Eriogoneae only *Stenogonum* is not found in California.

Key to the Genera

A. Plants perennials, or if annual then the well defined involucral tube lacking awn-tipped teeth.
  B. Involucres with a distinctly tubular involucre, the lobes or teeth sometimes united only at the base; annuals to perennials widely distributed in North America. ..... 1. *Eriogonum*
  BB. Involucres reduced to a series of obscure 2-5 involucral bracts; strictly perennial; endemic to Inyo and Mono cos., California. ..... 2. *Dedeckera*
AA. Plants annual; involucres lacking or reduced to a series of involucral bracts or if present then with awn-tipped teeth.
  B. Involucres tubular with long straight spines or the bracts arranged in two whorls of three; deserts of western North America and southwestern South America.
    C. Involucral bracts arranged in 2 series of 3; flowers yellow, pubescent; southwestern Wyoming to northwestern New Mexico and northeastern Arizona. ..... 3. *Stenogonum*
    CC. Involucres tubular, all the teeth in a single whorl and awn-tipped; deserts of western North America and southwestern South America. ..... 4. *Oxytheca*
  BB. Involucres lacking or composed of a series of 5 bracts in a single whorl; plants mainly of California and northwestern México.
    C. Flowers pubescent; stamens 9; Mojave Desert northward.
      D. Involucral bracts 5, linear-lanceolate; Kern and Los Angeles cos. northward to Madera Co., California, and Mineral Co., Nevada. ..... 5. *Goodmania*
      DD. Involucral bracts lacking; Death Valley, Inyo Co., California. ..... 6. *Gilmania*
    CC. Flowers glabrous; stamens 3; coastal California from Los Angeles Co. south to central Baja California Norte eastward in the Sonoran Desert to northwestern Sonora, México. ..... 7. *Nemacaulis*

1. Eriogonum Michx.

Efforts to complete a revision of this genus continue and hopefully can be completed as part of the overall Flora North America project. State and regional treatments will be done for California (Reveal 1989d), for a new flora of Arizona and volume 2 of the *Intermountain Flora*. The latter two projects are currently in the writing stage.

2. Dedeckera Rev. & J. T. Howell, Brittonia 28: 245. 1976.–TYPE: *Dedeckera eurekensis* Rev. & J. T. Howell.

Large perennial shrubs with numerous spreading woody branches arising from a woody taproot; *leaves* cauline, alternate, exstipulate, petiolate, the leaf-blades elliptic, hirsutulous; *flowering stems* slender, annually produced from the axils of the previous year's leaves; *branches* green and hirsutulous; *inflorescences* cymose, compact to rather open, with a single, short-pedicellate flower and a single peduncle at each node, and a cluster of 5-10 sessile or subsessile flowers atop the 2-5-bracted peduncle; *bracts* foliaceous, similar to the leaves only reduced, 3-4 at the lowest node, 2-3 above, these ultimately scale-like; *peduncles* erect, slender, restricted to the axils of the branches, hirsutulous; *involucres* reduced to a series of 2-5 bracts, the lower ones arranged in two whorls (3 plus 2), the upper ones reduced to 2 bracts only; *flowers* yellowish, sessile to subsessile or short-pedicellate, not stipitate, hispidulous, the tepals 6, petaloid, slightly united basally, essentially monomorphic, narrowly lanceolate with the outer whorl of 3 slightly broader and longer than the inner; *stamens* 9,

slightly exserted at anthesis, the filaments pilose basally, the anthers yellow, oblong; *achenes* 3-angled, light reddish-brown, slightly pubescent apically, the embryo curved, in abundant mealy endosperm; $n =$ ca 12 (Wiens *et al.* 1989).

A rare, monospecific genus endemic to the desert ranges of Mono and Inyo cos., California, in the White Mountains and in the Last Chance Range south to the northern Panamint Range, reportedly in the Inyo Mountains.

Over the decade following the initial discovery of *Dedeckera* (named for Mary Caroline DeDecker, 1909- , field botanist and noted California conservationist) in the Last Chance Range (Reveal & Howell 1976), its distribution has been expanded to the north onto the western slopes of the White Mountains and to the east onto the Panamint Range.

The original interpretation that *Dedeckera* lacked an involucre is now changed. The bracts subtending the cluster of flowers (five at the lower nodes, two to three above) are here considered to be involucral bracts similar to those found in *Stenogonum*. The lower ones, for example, are arranged in two whorls of three subtending two. In the upper flowers the bracts are reduced to just two and it appears that the outer whorl of three has been lost. Its placement in the tribe Eriogoneae has not been altered, and it is considered to be derived from a basal subgenus of *Eriogonum* and thus a member of the subtribe Eriogonineae. Nonetheless, *Dedeckera* is a highly specialized paleoendemic member of the tribe and essentially phylogenetically isolated from the remainer of the taxon. Its unusually low number of flowers per inflorescence (which can be solitary in some instances) and a chromosome number of about $n =$ 12 adds to its isolation.

The genus may be readily recognized by its numerous dense inflorescence of involucrally bracted, pale-yellow, clustered, densely hispidulous flowers, its hirsutulous vegetation and its shrubby, perennial habit.

1. **Dedeckera eurekensis** Rev. & J. T. Howell, Brittonia 28: 246. 1976.–TYPE: Last Chance Range, in a rocky canyon (now Dedeckera Canyon) ca 3 airline mi SE of Eureka Valley sand dunes and 3.5 airline mi NW of Marble VABM 7559, in T10S, R40E, on steep limestone, north-facing, rocky slopes associated with *Atriplex*, *Eriogonum* and *Prunus* at about 4000 ft elev, Inyo Co., California, 29 Jul 1975, *Reveal et al. 3909* (holotype: US!; isotypes: ASU, B, BRY, CAS, DAO, DEDECKER, F, GH, JEPS, K, LA, LE, MARY, MICH, MIN, MO, MONTU, NEB, NESH, NY, OKL, RENO, TEX, UT, UTC!).

Large, densely branched shrubs 0.2-0.7 (1) m tall, 0.5-2 m across, with numerous, gray, woody branches arising from a stout, woody root; *leaves* green to yellowish-green, hirsutulous, the leaf-blade narrowly to broadly elliptic, (0.7) 1-1.5 cm long, (4) 5-8 (13) mm wide, thinly pubescent on both surfaces, the hairs longer and more dense along the entire margin, the apex acute to obtuse, the base tapering to a 2-5 mm long petiole; *flowering stems* greenish, erect or nearly so, leafy, 2-7 (10) cm long, hirsutulous; *branches* numerous, mostly alternately arranged; *inflorescences* densely cymose, 1-4 (6) cm long, mostly trichotomously branched with a single, short-pedicellate flower and a single peduncle at each node; *bracts* of the inflorescence foliaceous and similar to the leaves except reduced in size toward the apex, the 3-4 bracts of the lowermost node 0.5-1.2 (1.7) cm long, the 2-3 bracts of the upper nodes much reduced and ultimately scale-like, up to 6 mm long; *peduncles* erect, slender, greenish, the lower one 4-6 (7) mm long, the upper ones greatly reduced; *involucres* reduced to a series of 2-5 involucral bracts, these lanceolate to broadly lanceolate, 1-2 mm long, 0.4-0.6 mm wide, the 5 bracts common on all peduncles except for 2-3 on the uppermost peduncles, the lower ones arranged in 2 whorls with the outer ones broader and longer than the inner ones;

flowers yellow at anthesis, becoming paler after fertilization and before darkening to a reddish-yellow in fruit, 1.8-3 (3.5) mm long at anthesis, becoming 2.5-4 mm long in fruit, sessile or subsessile on peg-like pedicels in clusters of 7-10 atop the lower peduncles and 5-7 at the tips of the ultimate peduncles, the single flower at the base of the peduncle on a short, slender pedicel 0.3-1 mm long, the tepals narrowly lanceolate, the inner 3 slightly narrower and shorter than the outer 3, thickened and keeled along the midrib, densely hispidulous without, sparsely hairy within mainly along the midrib, united only at the very base; *stamens* 9, the filaments 1-2 mm long, pilose basally, the anthers oblong, 0.2-0.3 mm long; *achenes* light reddish-brown, 2-3 (3.5) mm long, the narrowly globose, distinctly 3-angled base tapering to a slightly hispid 3-angled beak; $n =$ ca 12 (Wiens *et al.* 1989).

Local and infrequent on limestone talus slopes along the western slope of the White Mountains from Coldwater Canyon in Mono Co. south to near the Poleta Canyon area of Inyo Co., disjunct to the Last Chance Mountains mainly southeast of the Eureka Valley sand dunes and onto the northern ridges of the Panamint Range, and reportedly in the Inyo Mountains, from 4000-7200 ft elev; flowering from Jun-Aug, fruiting until Oct.

Specimens Examined. – UNITED STATES. CALIFORNIA: Inyo Co.: unnamed canyon, E of E. Line Street in Bishop, 20 May 1982, *Chamberlain 458a* (CAS); canyon 5 mi E of Bishop, 14 Jul 1982, *Chamberlain 498a* (CAS); Last Chance Mountains, limestone canyon ("Dedeckera Canyon") S of Eureka Dunes, 6 Jun 1976, *C. Davidson 4249* (ENCB, F, RSA, SD); Last Chance Mountains, SE of Eureka Valley sand dunes, 4 Jul 1975, *DeDecker 3892* (CAS, DEDECKER, RSA); Dedeckera Canyon, Last Chance Mountains, SE of Eureka Valley sand dunes, 10 May 1977, *DeDecker 4400* (DEDECKER); Dedeckera Canyon, Last Chance Mountains, 3 mi SE of Eureka Valley sand dunes, 9 May 1978, *DeDecker 4657* (DEDECKER); Last Chance Mountains, 3 mi SE of Eureka Valley sand dunes, 27 Jun 1978, *DeDecker 4740* (CAN, DEDECKER, NY, SBBG); Last Chance Mountains, along the summit, 2.25 mi W of NW corner of Death Valley National Monument, 7 Jul 1978, *DeDecker 4745* (DEDECKER, NY, RSA); Last Chance Mountains, 3 mi SE of Eureka Valley sand dunes, 13 Sep 1978, *DeDecker 4794* (CAS, DEDECKER, GH, UC, UT); unnamed canyon E of Bishop, White Mountains, 24 Aug 1984, *DeDecker 5700* (UNLV, UT); canyon E of Bishop on or above the Forest Service line, 26 Jun 1980, *DeDecker & Strohm 5073* (DEDECKER, UC); Panamint Range, Eureka Valley drainage, E of jeep corridor from Saline Valley, 10 Aug 1980, *Kay 5144* (DEDECKER, UT); S end of Eureka Valley, 5 May 1977, *A. Major s.n.* (UCR); White Mountains, 1.6 mi NW of Poleta Mine at the base of the canyon slope, 18 Jun 1984, *Morefield 2118* (ASC, MNA, NY, RSA, UNLV); White Mountains, 1.2 mi SE of Southern Belle Mine in Gunter Creek Canyon, 18 Jun 1984, *Morefield 2124* (ASC, MICH, MNA, NESH, NY, RSA, UNLV); 0.7 mi up Dedeckera Canyon, 3 mi SE of the main Eureka Valley Sand Dunes, 2 Jun 1987, *Morefield & Ehrendorfer 4499* (MARY); NE flank of Dry Mountain, Last Chance Range, 4 Nov 1982, *Rowlands s.n.* (UCR); 2.4 km NE of E. Line Street in Bishop, between Silver Canyon and Poleta Canyon, 24 Jun 1980, *Strohm 560* (UC); first canyon N from Poleta Canyon, White Mountains, 3 Jul 1981, *D.W. Taylor 7886* (UC); canyon 2 mi NE of the E end of E. Line Street in Bishop, 7 Aug 1983, *Vasek & DeDecker s.n.* (UCR). Mono Co.: Gunter Canyon, White Mountains, 28 Jun 1984, *DeDecker 5596* (DEDECKER, UNLV); Coldwater Canyon, White Mountains, 5 Jul 1985, *DeDecker 5821* (DEDECKER, SBBG, UNLV, UT); White Mountains, 1 km up Coldwater Canyon, near the water intake, 6 Jul 1985, *DeDecker & Wiens 5981* (CPH, NY, UT); Cold Water Canyon, White Mountains, 5 Jul 1987, *Elias & Morefield 10369* (RSA); White Mountains, Coldwater Canyon, 15 Jun 1985, *Giuliani s.n.* (UT); Lower Coldwater Canyon, White Mountains, 24 Aug 1984, *Junak & DeDecker 2264* (SBBG, UNLV); White Mountains, 3.5 mi up Coldwater Canyon, 19 Jun 1984, *Morefield 2126* (ASC, MICH, NY, RSA); White Mountains, 0.5 mi up Coldwater Canyon, 19 Jun 1984, *Morefield 2132* (ASC, MICH, NESH, NY, RSA).

The geographical range of *Dedeckera*, as predicted originally (Reveal & Howell 1976), has expanded beyond the narrow confines of a single canyon on the western slope of the Last Chance Range. That canyon, now officially called "Dedeckera Canyon," is still the home of a large population. Novak and Strohm (1981) reported the species from the Poleta Canyon area of the White Mountains in Inyo County, with Morefield (1985) extending the range northward to the Coldwater Canyon area in Mono County. In his note, Morefield reported *Dedeckera* from the Panamint Range but did not cite specimens. He learned of the range extension from Mary DeDecker who saw shrubs while flying in a helicopter. Since then, one

of her associates has managed to document one of the sites and it is reported above.

More recently (Wiens *et al.* 1986) observed pollination in *Dedeckera*. They described the normal maturation of flowers as it occurs in the majority of the Eriogonoideae, which is protandrous with the anther releasing pollen typically a full day before the stigma is receptive. Cross-pollination is possible during the second day as the open flowers display the anthers in an outward array away from the erect stigmas. That night, however, when the flowers close, the anthers come in direct contact with the stigma, and if pollen grains are still present, self-pollination may occur. It is not uncommon for the tepals in the Eriogoneae to change in color after fertilization (a feature seen in *Dedeckera*), following which the sepals then tightly enclosing the maturing achene.

Seed production is exceedingly low according to Wiens and his colleagues (1989) and they reported that successful seed set is only 2.5%. The cause of the low seed set is probably "genetically mediated embryonic abnormalities." This is reduced even further by low viability, poor germinability and post-germination development failure. Nonetheless, populations of *Dedeckera* show a high degree of heterozygosity (27%) probably due to the extreme habitats where the species occurs. These researchers report that individual shrubs are long lived (140 years or more) and that the vegetative fitness seen is due to the highly heterotic genotypes found both intra- and interpopulationally.

The genetic factors associated with the low successful seed set in *Dedeckera* (Wiens *et al.* 1989) might be augmented by environmental conditions. Given the large number of flowers produced on each shrub (several thousand each year), the relatively large number of shrubs in most of the populations, and the restricted habitat where this plant can exist, it might be that a seed set of 2.5% is actually sufficient for this calcareous plant to survive long term. The arid habitat where *Dedeckera* is found is only rarely subjected to natural fire, flash flooding or other natural events so that given the long life of an individual shrub, dramatic population losses might well be rare. Also, consider the numbers. If an individual shrubs produced 1000 flowers year, and an individual lived an average of 100 years, then over that time some 100,000 flowers would have been formed. If only 2.5% of these set seed, some 2500 seeds would have been formed. Assuming only a ten percent survivability (250 seeds left) and of those only one percent grew into a plant of reproductive age, then there would be a positive replacement rate of two and a half plants per existing plant. Given the nature of the desert, this rate of long-term reproduction is not unacceptable. The actual number of flowers produced per mature shrub is probably closer to 10,000 per plant than 1000 as used here. It is proposed that when the reproductive biology of other long-lived desert shrubs is investigated low seed set in such species will not be found to be rare.

Nonetheless, from these studies, it is clear that the original "home" of *Dedeckera* was likely in an environment unlike that where it is found presently. If the genus arose from some early ancestral basal group within *Eriogonum*, then that original habitat was probably more akin to that found presently in the northern part of the Intermountain Region or in the mountanous regions of central Idaho.

Wiens *et al.* (1986) observed several insect visitors on the flowers of *Dedeckera* and several were found with pollen. They concluded that sarcophagid flies and other short-tongued scavenger flies "are probably the most numerous insect visitors that could effect pollination." Secondary pollinators are wasps and syrphid flies. Similar observations and conclusions have been reached on pollination of *Eriogonum*, although ants are a significant factor in alpine situations.

3. Stenogonum Nutt.

Since this genus was reestablished (Reveal & Ertter 1977a), *Stenogonum flexum* has been found in New Mexico (*Spellenberg & Corrall 8222* (NMC)). Additional isotypes of *S. flexum* (*M.E. Jones s.n.*, near Cameron, Coconino Co., Arizona, 10 Jun 1890) have been seen at DS, F, G and US!

4. Oxytheca Nutt.

The revision of this genus by Ertter (1980) is excellent and only a few additional notes relating to the distribution of type material is presented here.

Additional isotypes of *Oxytheca dendroidea* var. *hillmanii* (*M.E. Jones 4044*), a synonym of subsp. *dendroidea*, were found at BR, DS, LE and SBBG! Isotypes of *Brisegnoa chilensis*, the basionym of *O. dendroidea* subsp. *chilensis*, beyond those reported by Ertter (1980) were seen at B, BR, G, and LE! Two additional isotypes of the var. *tonsiflora* are at B and BA! The type of *O. parishii* is the widely distributed *Parish & Parish 993*; the following additional isotypes were found: BR, CM, G, LE, MIN, NEB, NDG and WS!

The isotypes of *Oxytheca parishii* var. *cienegensis*, *Reveal & Reveal 4781*, have only recently been distributed to ARIZ, B, BM, BRY, CAS, COLO, F, GH, K, LA, MARY, MICH, MO, OSC, RM, RSA, TEX, US, UTC and WIS. The holotype is at NY! Additional isotypes of the var. *goodmania*, *Parish & Parish 1241*, were noted at BR, G, ISC, LE, WS and WU!

Two additional isotypes of *Oxytheca abramsii*, the basionym of *O. parishii* var. *abramsii*, were found at E and G, with one isotype of *O. trilobata* seen at ISC! A second isotype of *O. emarginata* was seen at DS!

Since Ertter (1980) published her thesis, specimens of *Oxytheca watsonii* have been found in Inyo Co., California, all from near Santa Rosa Hills near the junction of California Highway 190 and Saline Valley Road: *Dedecker 5337* and *5932* (DEDECKER); *Dedecker et al. 5226* (DAV, DEDECKER); and *Stone 316* (CAS, MARY, RSA).

Ertter (1980) discussed the problems with the type of *Oxytheca caryophylloides* noting that two different dates are associated with *Parish & Parish 1097*. During the present study two additional labels were found. Ertter properly concluded that the one dated simply "Aug 1881" must be considered the type. The four variations are: San Bernardino Mountains, Aug 1881, *Parish & Parish 1097* (CM, F, G, GH, ISC-holotype, MIN, MPU, NY, PH, RSA, US, W, WU); 15 Aug 1882 (BM, DS, F, ISC, MIN, NY, P, PH, UC, US, VT, WS); Aug 1882 (B, BR); without a date (NDG).

5. Goodmania Rev. & Ertter

Ertter (1981) corrected my mistake of associating the wrong herbarium abbreviation with Parry's types (ISC, not IA). Since our segregation of *Goodmania* from *Oxytheca*, the following collections have come to my attention, bring the total number of known collections to 72.

UNITED STATES. CALIFORNIA: Inyo Co.: E end of Twenty Mule Team Canyon, Furnace Creek Wash, Death Valley National Monument, 26 Apr 1978, *J.T. Ball 8-228* (UT). Kern Co.: Lancaster Boulevard, S of Rosamond, 28 Apr 1974, *T. Gordon 214* (DAV). Los Angeles Co.: 1 mi W of California Highway 14 along California Highway 138, 18 Apr 1980, *Keil & Holland s.n.* (OBI); Antelope Valley, along G Street 0.2 mi E of 60th Avenue, 17 May 1988, *Reveal 6797* (MARY); Antelope Valley, along G Street at 40th Avenue, 17 May 1988, *Reveal 6799* (BM, BRY, CAS, MARY, MO, NY, OSC, RM, RSA, US, UTC, WIS); corner of G and Division Street W of California Highway 14 in Lancaster, 13 Apr 1988, *Villasenor s.n.* (MARY). NEVADA: Mineral Co.: Alkali Valley, N side of

Alkali Lake, 12 Jul 1983, *Tiehm & Lavin 8140* (ASU, MIN, NEB, NESH, NY, RSA, UT, UTC).

The range extension reported by Tiehm (1984) is the most important addition. According to a note, Samuel B. Parish stated that "Parry's type was collected in the drip of the railroad water tank at Lancaster, Antelope Valley." The GH isotype is dated Sep 1881 while the ISC holotype is dated 188- and bears a label with "Gymnogonum spinescens, Parry n. gen." on it. An isotype is at CAN as well as at ISC.

6. **Gilmania** Cov., J. Wash. Acad. Sci. 26: 210. 1936. *Phyllogonum* Cov., Contr. U.S. Natl. Herb. 4: 190. 1893, non Bridel (1827).–TYPE: *Phyllogonum luteolum* Cov.

Spreading annual herbs with several stems arising from a thin taproot; *leaves* basal and cauline, laminar and arranged in threes throughout, exstipulate, narrowly petiolate below, becoming sessile above, the leaf-blade oblong to broadly elliptic or obovate, glabrous or with only a few scattered hairs mainly on the entire margin; *flowering stems* mostly trichotomous branched; *branches* slender, yellowish-green, glabrous or thinly pubescent with slightly curled hairs; *inflorescences* cymose, dichotomously branched with a cluster of flowers at each node, the secondaries often suppressed; *bracts* lacking; *peduncles* lacking; *involucres* lacking; *flowers* on elongated pubescent non-stipulate pedicels, yellow, thinly pubescent with long curly hairs, the tepals 6, petaloid, lanceolate, united only at their very base; *stamens* 9, mostly included, the filaments yellow, pilose only at the very base, the anthers yellow, oval; *achenes* brownish, 3-angled, glabrous, with a short, stout beak, the embryo curved, in abundant mealy endosperm.

A narrowly restricted monospecific genus known only from the Death Valley area in Death Valley National Monument, Inyo Co., California, from -50 ft below sea level to 1500 ft elev; flowering from Feb-Apr (May).

When initially described by Coville (1893), he knew the genus only from two collections: a type that consisted of two individuals, and a second collection of a similar size. When he realized *Phyllogonum* (Greek *phyllon*, leaf, and *gony*, knee, alluding to the cauline leaves) was a homonym and proposed *Gilmania* (M. French Gilman, 1871-1944, Death Valley naturalist), Coville (1936) concluded that *Gilmania* was a genus that likely had a limited evolutionary future. He did recognize that individuals of *Gilmania* managed to flower and fruit every year, but that yearly, millions of seeds were lost from the seedbank. While this is likely true (albeit to a lesser degree than suggested by Coville), there is no doubt that when conditions are right, hundreds of thousands of individuals of *Gilmania* carpet the foothills surrounding Death Valley, each in turn producing thousands of seeds. In this fashion, millions of seeds are reintroduced into the seedbank.

The origin of *Gilmania* must lie within the confines of *Eriogonum* subgenus *Ganysma*. There is no modern species or species complex within that subgenus, however, that appears to be its point of origin. It is suggested that *Gilmania* and *Goodmania* may have come from a closely related complex, but what, if any relationship might exist between the two is unclear.

1. **Gilmania luteola** (Cov.) Cov., J. Wash. Acad. Sci. 26: 210. 1936. *Phyllogonum luteolum* Cov., Contr. U.S. Natl. Herb. 4: 190. 1893. *Eriogonum luteolum* (Cov.) M.E. Jones, Contr. W. Bot. 11: 15. 1903, non E. Greene (1896).–TYPE: Furnace Creek Canyon, Funeral Mountains, Death Valley National Monument, Inyo Co., California, 7 Apr 1891, *Coville 584* (holotype: US!).

Spreading annual herbs 3-12 (15) cm high; *leaves* broadly elliptic to obovate, 0.5-1.5 cm long, 3-8 (10) mm wide, glabrous or sparsely pubescent with long hairs at least on the lower surface or near the point of attachment on the petiole, the petiole glabrous or thinly pubescent, 0.5-2 cm long in the basal rosette, 0.3-1.5 cm long at the lower nodes and gradually becoming sessile in the uppermost clusters, expanding basally and clasping the branch, the 3 petiole bases fused around the branch; *branches* slender, yellowish-green, glabrous or sparsely pubescent; *inflorescences* cymose and often with the secondaries suppressed, with a cluster of flowers at the node, becoming rather densely clustered apically with nearly sessile leaves and flowers; *flowers* on long, slender thinly pubescent pedicels 2-5 (7) mm long, yellow, 1-1.5 mm long in anthesis, 1.5-2 mm in fruit, thinly pubescent without mainly along the obscure midrib and margin, densely so within at the point of fusion of the tepals forming a small disklike nectary at the base of the filaments, the tepals lanceolate, all of equal size at anthesis, the inner three elongating in fruit, united only at the very base; *stamens* 9, the filaments 1-1.2 mm long, pilose basally, the anthers oval, 0.2-0.3 mm long; *achenes* yellowish-brown to reddish-brown, shining, glabrous, 1.5-2 mm long, the globose base tapering gradually to a stout, slightly 3-angled beak.

Locally rare to common on alkaline, often barren slopes and flats in Death Valley, Death Valley National Monument, Inyo Co., California, from -50 ft below sea level to 1500 ft elev; flowering from February-April (May).

Specimens Examined. – UNITED STATES. CALIFORNIA: Inyo Co., Death Valley National Monument: Funeral Mountains, 1.5 mi SE of Travertine Springs, 27 Apr 1983, *Annable 609* (RSA, UNLV); mud hills S of Golden Canyon, 2 Apr 1980, *Armstrong s.n.* (RSA, SD); Furnace Creek, 1940, *Carpenter s.n.* (JEPS, SD); Death Valley, 17 Apr 1939, *Clokey 5852* (ASU, BKL, BM, BR, BRY, CAN, CAS, CM, DS, F, G, GB, GH, IDS, ISC, K, MARY, MICH, MIN, MO, MONTU, NO, NY, OKL, ORE, OSC, RENO, RM, RSA, SD, SMU, TEX, UC, US, USFS, UT, UTC, W, WILLU, WIS, WS, WTU); Furnace Creek, 2.5 km E of Furnace Creek Ranch, Funeral Mountains, 7 Apr 1891, *Coville & Funston 584* (DS, US); Death Valley, Golden Canyon, 27 Mar 1940, *Eastwood & Howell 7720* (CAS); Volcanic Drive, 27 Mar 1940, *Eastwood & Howell 7726* (CAS, DS, F, GH, NY); foot of Furnace Mountains, S of Furnace Creek, 20 Apr 1935, *Gilman s.n.* (US); foot of Furnace Mountains, near mouth of Golden Canyon, 20 Apr 1935, *Gilman 1375* (US); near mouth of Golden Canyon, 20 Apr 1935, *Gilman 1377* (RSA); hill E of Teck Springs, 27 Apr 1935, *Gilman 1424.5* (DS); Death Valley, Artists Drive, 4 May 1935, *Gilman 1520* (US); Golden Canyon area, 10 Dec 1939, *Gilman 4005* (CAS, POM); Artists Drive, 10 Dec 1939, *Gilman 4006* (CAS, POM); Artists Drive near the turnoff to Artists Palette, Black Mountains, 25 Apr 1983, *Gustafson & Herbst 2531* (RSA); Artists Drive, Black Mountains, 16 Mar 1973, *Holmgren & Holmgren 6309* (BRY, NY, UTC); 20 Mule Team Canyon, 17 Mar 1940, *Hood 40-20k* (LA); small canyon E of Furnace Creek, 26 Mar 1939, *Jaeger s.n.* (DS); Furnace Creek, Funeral Mountains, 2 May 1917, *Jepson 6921* (JEPS); Artists Drive, 6 mi S of Furnace Creek, 24 Mar 1947, *Keck 5740* (DS, UC); Volcanic Drive, 23 Feb 1940, *Leach s.n.* (ORE); Golden Canyon, 3 Apr 1939, *H. Lewis s.n.* (LA); Gold Canyon, 24 Apr 1969, *Myrick 2091* (SBBG); S of Furnace Creek Ranch, 4 Apr 1939, *Nelson & Nelson 3443* (DS, RM, UC); Furnace Creek, 18 May 1915, *Parish 10008* (GH, MO, NY, RSA, SBBG, UC, US, USFS); along California Highway 190, 0.2 mi N of Golden Canyon Road, 12 Apr 1968, *Pinkava et al. 12734* (ASU); Breakfast Canyon, 30 Apr 1976, *Reveal 4368* (CAS, GH, MICH, MO, OKL, TEX); Desolation Canyon, 30 Apr 1976, *Reveal 4369* (CAS, GH, MO, TEX); Artists Drive, Funeral Mountains, 19 Apr 1940, *Ripley & Howell 2955* (NY); Zabriskie Point, 20 Apr 1947, *Roos 3502* (UCR); 2 mi above Zabriskie Point, 30 Mar 1976, *Schramm et al. 233* (UCR, UNLV); Golden Canyon, 10 Apr 1940, *Shanteau 28* (ORE, UC); near Artists Palette, 30 Apr 1976, *Tiehm & Mason 2034* (RENO); Artists Drive, Black Mountains, 18 Apr 1973, *Trowbridge 3191* (SFSU); Zabriskie Point, 5 Apr 1983, *Welsh & Welsh 21505* (BRY); Gowers Gulch, Corkscrew Canyon, 10 Apr 1980, *Welsh et al. 19422* (BRY, NY); Artists Drive Road, Black Mountains, 18 Apr 1973, *Wester 302* (WIS).

Gilmania luteola, often called "golden carpet," is a reliable indicator of precipitation in the Death Valley area. In a "good" year the slopes and canyons of the Funeral Mountains are in fact carpeted with individuals of *Gilmania*.

7. Nemacaulis Nutt.

No significant new data needs to be added to the earlier treatment of this genus (Reveal & Ertter 1977b) although numerous collections have been added to institutional holdings so that some 270 collections are now known. Additional isotypes of *Nemacaulis denudata* var. *gracilis* were found at BM, K, MIN, MSC, OKL, and US! The LAM isotype is now at RSA.

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