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NOTES PRELIMINARY TO AN ACCOUNT OF ASTRAGALUS IN CALIFORNIA

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1. THE VARIETIES OF A. PULSIFERAE GRAY

Astragalus pulsiferae occurs in northeastern California and adjacent Nevada under two readily distinguishable pubescence-phases which seem to some degree correlated with dispersal and also, although more evidence is needed on this point, with habitat and environment. The typical form is villous throughout with extremely long horizontally spreading hairs (up to 1-1.6 mm. long), and is found most commonly in deep sandy soil of valley-floors, more rarely in sandy ground mantled by a pavement of broken basalt rock and pebbles. It is apparently quite limited in range, the rather few known stations lying in northeastern Sierra, eastern Plumas and central Lassen counties, California, and closely adjoining Washoe County, Nevada. Its calyx-teeth are commonly subulate-setaceous and 2-3.6 mm. long (one specimen with teeth only 1 mm. long has been disregarded, for the flowers were all exceptionally minute). Slightly to the west and northwest, from the Lake Almanor region in Plumas County to north-central Lassen and eastern Shasta counties, the herbage and pod are not more than loosely strigulose or shortly villosulous (the longest incurved-ascending hairs up to 0.5-0.75 mm. long), and the calyx-teeth are prevailingly shorter and broader, 1.4-2.1 mm. long. Little is known of the habitat of this latter form, although one collector (A. Heller) records it from "the neighborhood of trees where there is more shade and moisture, on the gravelly plain", and it must occur, judging from locality-data, at least sometimes in Yellow Pine Forest. These California plants appear to differ in no perceptible way from *A. suksdorfii* Howell (Erythea 1: 111. 1893.), a species reported hitherto only from dry pine-forest flats in Falcon Valley at the foot of Mt. Adams, Klickitat County, Washington (*Suksdorf No. 491,* June 3, July, 1883, presumed isotype; *No. 6293; No. 9640,* all WS), a locality distant nearly 350 miles northward from the nearest California station. It is reasonable to expect, however, that further collecting along the east slope of the Oregon Cascades will turn up intermediate records.

My concept of **A. pulsiferae** var. **suksdorfii** (Howell), comb. nov., is embodied in the following collections from California: Chester, Plumas County, *A. Heller No. 15179* (POM); near Prattville, Lake Almanor, *T. H. Kearney No. 79,* in 1944 (CAS); 16½ miles w. of Madeline, Lassen County., *E. K. Balls No. 14784* (CAS).

2. A NEW SPECIES FROM THE HIGH SIERRA

Astragalus ravenii, sp. nov.

A. monoensi Barneby affinis, sed omnibus partibus minor et gracilior, insuper recemis paucifloris, vexillo 6-8.5 (nec 10-13) mm., carina 4.5-5.5 (nec 6.7-8.5) mm. longis, legumine breviori maculato angustius septifero distinctissima.

Herbae alpinae perennes delicatulae, fere undique pilis appressis basifixis cinereo-strigulosae, foliolis superne laxius densiusque hirtis; caules complures tenues 1.5-10 cm. longi e radicis verticalis collo sepulto orti, per 1-6 cm. subterranei glabri, internodiis paucis emersis 2-12 mm. tantum longis; stipulae 0.8-2 mm. longae, imae char-

taceae, omnes amplexicaules inter se connatae; folia omnia petiolata 5-25 mm. longa, foliolis 3-6-jugis oblongo-obovatis vel suborbicularibus retusis 1-3.5 mm. longis; pedunculi subfiliformes 1-5.5 cm. longi, folium plerumque superantes; racemi laxe sed brevissime 2-6-flori, fructiferi vix elongati 1.5-7 mm. longi; calycis tubus campanulatus 2.5-3.3 mm., dentes subulati breves 0.6-1.2 mm. longi; petala albida, vexillo nunc dilutissime lilacino-striato, carina apicem versus violascenti; vexillum per 80-90° recurvum, late ovato-cuneatum profunde retusum (5.5) 6-8.4 mm. longum, 5-6.8 mm. latum; alae 6-7.7 mm. longae, laminis oblanceolatis vel obovatis obtusis, altera (saepissime dextra) subrecta, altera abrupte incurva margine interiori introplicata; carina 4.5-5.5 mm. longa, laminis semi-orbicularibus obtusis per 100-120° incurvis 2.7-3.4 mm. longis; legumen adscendens (humistratum), sessile, oblique ovoideum, leviter incurvum, 8-13 (17) mm. longum, 5-8.5 mm. latum, basi obtusum, apice deltoideo-rostratum, obcompressum, sutura ventrali prominula sed depressa carinatum, dorso plano-convexum, valvulis chartaceis maculatis demum stramineis parce strigulosis anguste inflexis, septo incompleto 0.3-1 mm. lato; ovulis 16-20; semina ochracea laevia opaca 1.8-1.9 mm. longa.

CALIFORNIA. Prostrate, on metamorphosed sedimentaries and volcanics, on the plateau north of Sawmill Pass, 11,250 ft. altitude, Fresno County, July 28, 1956, *Peter H. Raven No. 9863. Type* in Herb. Calif. Acad. Sci.; isotypes to be distributed.

This delicately charming little alpine *Astragalus* is related to *A. monoensis* Barneby, a species of local distribution at moderate elevations on the east slope of the Sierra Nevada in Mono County, where it is known as yet from a restricted area of pumice sands not over twelve miles in diameter and some sixty miles northward from Sawmill Pass. The two species are alike in technical characters of root-system, stipule, flower and fruit, but *A. ravenii* is smaller and frailer in all its parts, as brought out in the following key:

Stems 7-20 cm. long; hairs of the herbage up to 0.7-1 mm. long; upper leaves subsessile; leaflets 2-8 mm. long, obtuse; racemes 6-12-flowered; calyx 4.8-6.6 mm. long, the tube 3-4.6 mm., the teeth 1.2-2.1 mm. long; banner 10-13 mm., keel 6.7-8 mm. long; pod 1.5-2 cm. long, 6-9 mm. in diameter, not mottled, the septum 1.2-2.2 mm. wide; ovules 18-28; Piñon-Juniper Woodland, 7500-7900 ft. ..... *A. monoensis*

Stems 1.5-10 cm. long; hairs up to 0.35-0.55 mm. long; leaves all petioled; leaflets 1.5-3.5 mm. long, retuse; racemes 2-6-flowered; calyx 3.4-4 mm. long, the tube 2.5-3.3 mm., the teeth 0.6-1.2 mm. long; pod 8-17 mm. long, 5-8.5 mm. in diameter, the valves mottled, the septum 0.3-1 mm. wide; ovules 16-20; Alpine Fell-fields, about 11,250 ft. ..... *A. ravenii*

The new species is of interest in that it seems to throw some light on the relationships of *A. monoensis,* of which the taxonomic position in the genus has been, to the writer, altogether obscure. In its flower, as indeed in all fundamental features, *A. ravenii* is closely comparable to *A. pulsiferae,* discussed in the preceding section. The latter has been traditionally placed in section *Inflati* (=*Phaca,* sensu Rydberg), a heterogeneous assemblage of distantly related groups held together by one common character, an inflated unilocular pod, where it has remained, however, quite isolated. It has not been generally noticed that the pod of *A. pulsiferae,* although normally unilocular, is sometimes narrowly and obscurely septiferous along the dorsal suture. It now appears that *A. pulsiferae, A. monoensis* and *A. ravenii* should be associated in a group or section of their own, although I am at present at a loss to point out any really close affinity in the genus for the group so formed. *Astragalus pulsiferae* is readily distinguished at the specific level by its thinner-walled, more bladdery pod and few (3-9) ovules.

3. **Astragalus deanei** (Rydb.), comb. nov.

This species was first described as *Phaca deanei* Rydb. (in N. Amer. Fl. 24: 355. 1929.) and was based on a specimen collected in May, 1883, in Sweetwater Valley, San Diego County, by G. C. Deane. It was associated by Rydberg with *A. vaseyi* Wats. and distinguished principally by its whitish flowers and glabrate herbage. Jepson (Fl. Calif. 2: 350) treated it as *A. vaseyi* var. *deanei,* mentioning only the same differential characters; whereas Abrams (Ill. Fl. 2: 587) reduced it outright to *A. vaseyi* var. *johnstonii* Munz & McB., the large-fruiting phase of *A. vaseyi* dispersed about the head of Coachella Valley. The pod of *A. deanei,* detached from the plant, is certainly very similar to that of var. *johnstonii,* but the general growth-habit, numerous ample pinnately veined leaflets, thickened pedicels and whitish petals are more suggestive of *A. oocarpus* Gray, like it, in addition, in its cismontane range. However *A. deanei* differs greatly from *A. oocarpus* in the deciduous pod, longer banner and more strongly graduated petals, longer calyx-teeth and longer peduncles, not to mention the form of the pod, which is more strongly oblique in profile and not contracted at base into a stout obconic neck. From all forms of *A. vaseyi* the present species differs in its numerous (21-29 as opposed to 11-21) leaflets, thickened fruiting pedicels, longer better graduated petals devoid of any trace of anthocyanic pigment, and more numerous (29-40 as opposed to 12-31) ovules.

Astragalus deanei is apparently a rare and local species, to my knowledge confined to valleys and creeks tributary to the Sweetwater and upper Otay rivers in southwest San Diego County, where it is found on open brushy slopes, in oak-chaparral, sometimes on burns, mostly at elevations of 800-1000 ft. It is in flower and fruit from March to May, about two months earlier than *A. oocarpus* which, although endemic to the same county, occurs at greater elevations in the interior. The following collections have provided the basis for recognizing the specific status of *A. deanei:* Cottonwood, *Gander No. 9009;* 3 miles below Barrett, *Gander No. 3487;* Whispering Oaks near Sluane Ranch, on Sweetwater River, *Gander No. 5292* (all SD).

4. THE VARIETIES OF A. NUTTALLII (T. & G.) J. T. HOWELL

Astragalus nuttallii, sensu lato, is a variable species, especially as to growth-habit and density of vesture, and to a lesser degree as to size, though hardly at all as to shape, of the flowers and pods. In general a gradual transition can be made out from south to north between the densely long-villous extreme on the dunes of the Santa Barbara County coast into the populations occurring from San Mateo County northward, in which the pubescence of the herbage is sometimes reduced to a few short scattered hairs on the margins and midribs of the leaflets. In Monterey County, particularly between Pacific Grove and Big Sur, villosulous and glabrate states are found in close proximity, sometimes in a colony of otherwise similar plants. From Monterey Bay southward the pod is consistently villosulous, at least in youth, whereas from San Mateo County northward it is often, though not quite uniformly glabrous. Except in a small area around San Francisco the species is confined to the immediate shoreline. On rocky headlands and bluffs exposed to the prevailing on-shore winds the plants are commonly prostrate, with short internodes and leaflets crowded on shortened rachises, forming on level ground mats or low mounds, and sometimes hanging down the cliff-faces as a curtain of closely entangled stems. Wherever a little shelter is provided by a rock outcrop, by a gullied chine going down to the beach, or even by the swell of a dune, they become more vigorous and often rankly leafy, with loosely decumbent and ascending or assurgent stems, sometimes clambering over bushes. On

San Francisco Peninsula *A. nuttallii* is found not only along the ocean (as at Point Lobos) but moves inland to low sandy ground (as about Lake Merced, and as far as the Bay-shore, near South San Francisco) where it is protected from the stunting effects of wind and sea-spray, and the plants here become extraordinarily robust, with ascending or erect stems up to 1 meter tall. The growth of the stipules in such individuals is unable to keep pace with the rapid expansion of the stems, and at the lower nodes the stipular sheath is ruptured early and the stipules appear in mature specimens to have been free from the first. They are, I believe, connate in vernation, and in nearly every case the stipules at the lower nodes of the lateral branches remain permanently connate. Moreover in some vigorous examples of the prostrate and villous coastal phase the lower stipules, normally connate to maturity, have been found similarly ruptured.

In the past these fluctuating features of growth-habit, vesture and stipule have been employed, without convincing success, to characterize two or as many as four taxa in the group. Rydberg's *Phaca densifolia* and *P. unde* (as defined in North American Flora) correspond with, respectively, the less and more densely villous southerly coastal phases with pubescent pod, while his *P. virgata* is the robust San Franciscan state with pubescent pod, and his *P. franciscana* combined prostrate coastal and erect inland plants differing from the rest in glabrous fruits. More lately Howell (Marin Flora, 176) has stressed habital and stipular characters to separate two species, *A. nuttallii* and *A. franciscanus;* whereas Abrams (Ill. Fl. 2: 585) maintained a subsp. *virgatus* (approximately equivalent to *A. franciscanus*) differing from typical *A. menziesii* (=*A. nuttallii*) principally in the greener herbage. It should be mentioned in passing that Jepson treated the whole complex as a single variety of *A. vestitus* (=*A. anemophilus* Greene), from which it is readily distinguished by its large scarious dorsally glabrous stipules and nodding, differently proportioned flowers.

In a search for a firmer basis on which to separate the superficially diverse elements of the species, it was observed that the ovules, irrespective of the size of the pod, are consistently fewer from San Mateo County northward than from Monterey County southward, whether the plants concerned be copiously or sparsely pubescent or of the prostrate maritime or robust interior form of growth. It seems likely that the northern and southern branches of the species constitute biologically distinct entities, separable as follows:

Pod villosulous, sometimes glabrate in age but the ovary and forming pod always pubescent; ovules 28-36, exceptionally 22; stems commonly diffuse or prostrate, assurgent in sheltered places; herbage varying from thinly to densely villous-villosulous, green, cinereous or canescent, the leaflets commonly pubescent, exceptionally glabrous, above; strictly maritime, from Monterey Bay s. to Point Conception, perhaps (formerly) to Santa Barbara (the type-locality) ..... var. *nuttallii*

Pod glabrous or, if the pod sparsely villosulous then the plants very robust, the stems assurgent to erect; ovules (14) 16-21; herbage green or greenish-cinereous, the leaflets glabrous (exceptionally puberulent) above; both maritime and interior, San Francisco Peninsula (San Mateo and San Francisco counties); Angel I. just inside the Golden Gate; and again maritime in Marin County; reported from Mendocino County ..... var. *virgatus*

The synonymy of the varieties will be as follows:

a. var. *nuttallii*. *A. nuttallii* (T. & G.) J. T. Howell, 1948, based on *Phaca nuttallii* T. & G., 1838. *Phaca densifolia* Sm., 1814. *A. densifolius* (Sm.) Torr., 1857, not Lamk., 1783. *A. menziesii* Gray, 1864, nom. illegit. *Phaca unde* Rydb., 1929. *A. vestitus* var. *menziesii* (Gray) Jones.

b. var. **virgatus** (Gray), comb. nov., based on *A. crotalariae* var. *virgatus* Gray in Bot. Calif. 1: 149. 1876. *A. franciscanus* var. *virgatus* (Gray) Ckll., 1898. *A. franciscanus* var. *longulus* Sheld., 1894. *Phaca virgata* (Gray) Rydb., 1929. *A. menziesii* subsp. *virgatus* (Gray) Abrams, 1944. *A. franciscanus* Sheld., 1894. *A. vestitus* var. *franciscanus* (Sheld.) Jones, 1923. *Phaca franciscana* (Sheld.) Rydb., 1929.

5. THE VARIETIES OF A. MAGDALENAE GREENE

When I published the combination *A. niveus* (Rydb.) Barneby (in Leafl. West. Bot. 4: 55. 1944.) and reduced to it *A. peirsonii* Munz & McB. with the simple statement that the types of the two species appeared identical, I had overlooked the close relationship of both to *A. magdalenae* Greene. Further, I had seen only the type of *Phaca nivea* Rydb., which lacks mature fruit. Subsequently I have seen two more collections from the head of the Gulf of California which I associate with *P. nivea,* and these have much smaller pods than *A. peirsonii,* which possesses in addition some small differential characters in the foliage and seeds. The two taxa remain, however, very closely related both to each other and to *A. magdalenae,* a species which has now been traced from the Pacific Coast of Baja California across to the Gulf Coast at San Francisquito Bay; and I have come to evaluate the three taxa as forming together a single polymorphic species composed of three varieties, distinguished as follows:

a. Leaflets 15-23, all jointed to the rachis, the terminal one no longer than the contiguous pair; peduncles mostly a little longer than the leaf; pod 5-12 mm. in diameter; seeds 2.6-3.3 mm. long; maritime, from the head of the Gulf of California to the Pacific Coast of Baja California.

  b. Pods 1.5-2.6 cm. long, 16-20-ovulate; seeds 1.6-2 mm. long; petals apparently bright purple, the banner 9.4-11 mm. long; stems typically diffuse; Pacific Coast between 24° and 28° N.; one station on the Gulf Coast of the Peninsula near 28° 30′ N. ..... var. *magdalenae*

  b. Pods 1-2 cm. long, 12-14-ovulate; seeds 2.5-3.3 mm. long; petals pale, lilac-tinged, the banner 12-12.5 mm. long; stems erect, forming clumps; dunes around the head of the Gulf of California, 30°-32° N. (n. of San Felipe, Baja California, and Adair and Tepoca bays, Sonora ..... var. *niveus*

a. Leaflets (3) 9-13, the terminal one decurrent and represented by a more or less dilated production of the flattened rachis longer than the distal pair of leaflets; peduncles mostly a little shorter than the leaves; pod 1.3-2.1 cm. in diameter; seeds 4.5-5.5 mm. long; s. Colorado Desert, California ..... var. *peirsonii*

The synonymy of the varieties is as follows:

a. var. *magdalenae*. *A. magdalenae* Greene, 1888, based on *Phaca candidissima* Bth., 1844. *A. candidissimus* (Bth.) Wats., not Ledeb. *Tragacantha californica* O. Kze., not *A. californicus* (Gray) Greene.

b. var. **niveus** (Rydb.), stat. nov. *Phaca nivea* Rydb. in N. Amer. Fl. 24: 328. 1929. *A. niveus* (Rydb.) Barneby.

c. var. **peirsonii** (Munz & McB.), stat. nov. *A. peirsonii* Munz & McB. in Bull. S. Calif. Acad. Sci. 31: 67. 1932. *A. crotalariae* var. *piscinus* sensu Jeps., Fl. Calif. 2: 350. 1936 (*Jepson No. 11,720,* from Gray's Well, Algodones Sand Hills, JEPS), not *A. douglasii* var. *piscinus* Jones.

6. SOME VARIETIES OF A. LENTIGINOSUS DOUGL.

Broadly speaking, time has dealt kindly with my revision of *A. lentiginosus* (in Leafl. West. Bot. 4: 65-sequ. 1945), at least in the sense that most of the entities there defined have sufficed to accommodate a wealth of material that has come to the writer's attention since. An exception has been the case of the purple-flowered forms of the South Coast Ranges and mountains about the head of the San Joaquin Valley: var. *idriensis* Jones; var. *caesariatus* Barneby; and var. *tehatchapiensis* (Rydb.) Bar-

neby. In 1945 the first two were each known to me through only one full collection. Subsequently the range of var. *idriensis* has been extended north from San Benito County to the Mount Hamilton Range (*H. K. Sharsmith No. 1901,* WS), and has been re-collected in the type region near Idria (*Stebbins & al. No. 5055,* CAS). In the last cited the pods are small, as in the type, but the calyx-teeth reach 1.9 mm. in length, and the peduncles are about as long as the leaves; whereas the Mt. Hamilton plant, again with long calyx-teeth, has larger pods, up to 2 cm. long. It thus appears that the type of var. *idriensis* was an unusually small-flowered state, with unusually short calyx-teeth and shortened leaves, the relatively long peduncles lending a characteristic aspect to the whole. Similarly the type of var. *caesariatus,* judging from approximate topotypes and other collections from the Temblor Range in Kern and San Luis Obispo counties (*Twisselmann No. 1081, No. 1140; Munz No. 16,298,* all CAS), was an equally uncommon extreme remarkable for its very large flowers and long calyx-teeth. The pods in the Temblor Range still seem to average larger than in more northern stations, but the overlap in longitudinal and diametric measurements is considerable.

So soon as the material from the Temblor Range northward is referred to one and the same entity, var. *idriensis* is assigned a range of variation in corolla-size and length of calyx-teeth fully covering that known in var. *tehatchapiensis,* which seems merely to carry var. *idriensis* southward, with ordinarily but not exclusively short calyx-teeth, into the San Rafael Mts. of Santa Barbara County, and east through the Mt. Piños region to the Tehachapi Mts. So construed, var. *idriensis* becomes a somewhat polymorphic entity composed of several minor variants distinguished at best by a small set of interlocking and variously combined characters. It occupies an eminently natural area, however, conforming to a well established pattern of plant-distribution in the Coast Ranges.

7. **Astragalus sepultipes** (Barneby), stat. nov.

This species was first described as *A. andersonii* var. *sepultipes* Barneby (in El Aliso 2: 209. 1950.), a disposition which indicates its relationship but does scant justice to its numerous distinctive characters, now better known from additional herbarium material and study in the field (Whitney Portal road, Inyo County, *Alexander & Kellogg No. 2819,* WS; below Whitney Portal, *Barneby No. 11,327,* CAS, NY, POM; Piñon Creek, Inyo County, *Mark Kerr in 1939,* CAS).

Astragalus andersonii and *A. sepultipes* are distinguished as follows:

Root-crown superficial; stems densely white villous-tomentose at base; pubescence of the herbage dull, more or less cottony-villous; calyx 6.2-8.2 mm. long, its tube 3.5-4.3 mm. long, 2.7-3.6 mm. in diameter, the teeth 2.4-4.3 mm. long; banner 9.5-14.5 mm., keel 6.6-9 mm. long; ovules (10) 12-16; Lassen and e. Placer counties, California, s. through s. Washoe and Ormsby counties, Nevada, and reentering California in the Mono Lake region, Mono County ..... *A. andersonii*

Root-crown subterranean, the stems buried for a space of (0.5) 1-5.5 cm., glabrous at base; pubescence silky, somewhat lustrous; calyx 8.6-13 mm. long, its tube 5.1-6.5 mm. long, 3.6-4.2 mm. in diameter, the teeth 3.5-6.5 mm. long; banner (12.7) 14.5-17.5 mm., keel (10) 10.2-12.2 mm. long; ovules (14) 16-20; e. slope of Sierra Nevada in Inyo County..... *A. sepultipes*

8. THE VARIETIES OF A. RATTANI GRAY

In an earlier paper (in El Aliso 2: 211. 1950.) I had occasion to remark on the racial situation in *A. rattani,* although I had at that time insufficient material on which

to base satisfactory conclusions. A more adequate sample of the species shows a definite break, already indicated by Jepson (Fl. Calif. 2: 379), between the plants of the inner and the outer North Coast Ranges, and permits the segregation of the species into two varieties:

Calyx 3.7-5 mm. long; banner (9.2) 10-12 mm., keel 6.3-8.1 mm. long; pod (2.1) 2.3-5 (5.7) cm. long; ovules (11) 14-20; outer Coast Range, Humboldt, Mendocino and n. w. Lake counties. Petals uniformly pink-purple (exceptionally all white) with slightly paler wing-tips..... var. *rattani*

Calyx 2.5-3.4 mm. long; banner 7.2-9.6 mm., keel 3.8-5.1 mm. long; pod (1.5) 1.8-3 cm. long; ovules 8-12; inner Coast Range and w. edge of Sacramento Valley, s. Lake, Napa, w. Colusa and w. Tehama counties. Petals commonly bicolored, only the distal third of the banner and the keel-tip purple-maculate; rarely uniformly purple as in the preceding..... var. *jepsonianus*

Astragalus rattani Gray var. **jepsonianus**, var. nov., floribus minoribus et legumine breviori ut supra in clave expositis a var. *rattani* diversa.

CALIFORNIA. Walter Springs, Napa County, April 30, 1939, *J. T. Howell No. 14,625. Type* in Herb. Calif. Acad. Sci. *No. 269836*. Representative: Middletown, Lake County, *M. S. Baker No. 12,940* (CAS), *C. B. Wolf No. 1894* (POM). Lake-Colusa County line on road to Williams, *Eastwood & Howell No. 5684* (CAS).