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A revision of Cryptantha subgenus Oreocarya

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A REVISION OF CRYPTANTHA SUBGENUS OREOCARYA

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This dissertation, by Larry C. Higgins, is accepted in its present form by the Department of Botany of Brigham Young University as satisfying the dissertation requirement for the degree Doctor of Philosophy.

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INTRODUCTION

The genus Cryptantha subgenus Oreocarya consists of perennial or biennial herbs centered in western North America and belongs to the tribe Eritrichieae of the subfamily Boraginoideae of the family Boraginaceae. The subgenus has long been recognized for its taxonomic difficulty. This is due to the variability of the species and the lack of distinctive vegetative characters. Experience has shown that characters of the fruiting and floral structure provide the only satisfactory basis for precise specific differentation. The complexity of this subgenus plus the large number of species described since Payson's monograph (1927), have made a thorough study of the group necessary. It is hoped that the present revision of the North American species of this subgenus will partially meet this need.

The author first became interested in Oreocarya while doing field work preliminary to the preparation of a thesis on the Flora of the Beaverdam Mountains. Because of the difficulty encountered in classifying the plants of this group and at the suggestion of Dr. Stanley Welsh, the present study was undertaken.

Acknowledgments

The author is particularly indebted to Dr. Stanley Welsh for his suggestion of the problem and his guidance and interest. Thanks is due my wife for her active cooperation. Appreciation is likewise to James Reveal for many valuable suggestions and constructive criticism;

to Drs. Glen Moore, Stephen Wood, and Dayna Stocks for critical reading of the manuscript. Appreciation is also given to the Society of Sigma Xi and Brigham Young University for their financial help which made it possible to do the necessary field work. Special thanks is given to the curators of the herbaria listed in the following section, for making specimens available for study. Whatever authenticity this study may possess is due in large part to the 4,300 sheets they made available for study, including the vast majority of types.

Materials and Methods

The materials used in this study were largely dried and pressed specimens from a number of institutional herbaria in the western hemisphere, together with the authors collections from stations within the western United States. Because of the large number of specimens examined during the course of this investigation, citation of all specimens has been omitted, and only a few representative ones for each taxon are included. Type specimens of all taxa were recieved on loan and were subsequently photographed and all photographs deposited in the Brigham Young University Herbarium.

Collections were made by the author during the spring and summer months of 1967, throughout Utah and northern Arizona. Additional collections were made in Wyoming, Colorado, Montana, Washington, Oregon, Idaho, Nevada, California, Arizona, and Utah during the spring and summer of 1968.

The measurements of large structures such as height, leaves, and inflorescence was by the use of a 15 cm ruler. Plant height was measured from the base of the stem to the tip of the inflorescence. Stem length was measured from the base of the stem to the first flower.

The measurements of small structures such as calyces, flowers, and nutlets was facilitated by the use of an ocular micrometer fitted to a binocular microscope.

The taxonomic presentation in this revision follows a conventional pattern and requires only a few explanatory notes. The meaning of some special terms will be found in the section dealing with morphology. The number in Arabic numerals following the description of each species or variety denotes the total number of collections studied in preparation of the text. The figure in small Roman numerals immediately following in parentheses denotes the number of these collections made by the author. The purpose of this breakdown is to indicate his relative familiarity with the taxon as a living organism.

Herbaria from which specimens have been seen, with the abbreviations by which they areferred to in the text are as follows, fide Lanjow and Staffleu (1964).

ARIZ University of Arizona Herbarium, Tuscon, Arizona.

ASC Arizona State College, Flagstaff, Arizona.

BRY Brigham Young University, Provo, Utah.

CAS California Academy of Sciences, San Francisco, California.

COLO University of Colorado, Boulder, Colorado.

CS Colorado State University, Fort Collins, Colorado.

DIX Dixie Junior College, St. George, Utah.

GH Gray Herbarium, Harvard University, Cambridge, Mass.

IDS Idaho State College Herbarium, Pocatello, Idaho.

LA University of California, Los Angeles, California.

LL Lundell Herbarium, Renner, Texas.

MNA Museum of Northern Arizona, Flagstaff, Arizona.

MONT Montana State University, Bozeman, Montana.

ND-G Greene Herbarium, University of Notre Dame, Indiana.

ND University of Notre Dame, Notre Dame, Indiana.

NY New York Botanical Garden, New York, New York.

ORE University of Oregon Herbarium, Eugene, Oregon.

PH Philadelphia Academy of Natural Sciences, Phila., Penn.

POM Pomona College Herbarium, Claremont, California.

RM Rocky Mountain Herbarium, Laramie, Wyoming.

RSA Rancho Santa Ana Botanic Garden, Claremont, California.

UC University of California, Berkeley, California.

US United States National Museum, Washington D.C.

UT University of Utah Herbarium, Salt Lake City, Utah.

UTC Intermountain Herbarium, Logan, Utah.

WTU University of Washington Herbarium, Seattle, Washington.

History of the subgenus Oreocarya

The first species belonging to this group to be described was Cynoglossum glomeratum Nutt. in Fras., nom. nud. (Cryptantha celosioides), the type of the subgenus. This was collected by Bradbury in "Upper Louisiana" in 1810, and was described by Pursh (1814), at which time he cited the Fraser Brothers Catalogue as the source of his name. The citation should thus read: C. glomeratum Nutt. ex Pursh, Fl. Am. Sept. 2:729. 1814. It was transferred to Myosotis by Nuttall (1818). Torrey (1828), described a second species, Myosotis suffruticosa (C. jamesii). A third species was described (M. leucophaea), and also assigned to Myosotis by Douglas in Lehm. (1830).

With the appearance of the tenth volume of De Candolle's Prodromus (1846), C. glomeratum and M. leucophaea were placed in the

genus Eritrichium and so started a treatment which stood until 1885.

Asa Gray (1875), published the results of his first study of the eritrichioid borages of western America. Following De Candolle he referred all the species to Eritrichium section Pseudo-myosotis. Four species and three varieties were recognized in Gray's revision.

Bentham and Hooker (1876), published that part of their Genera Plantarum treating the Boraginaceae. These authors, accepting the work of De Candolle and Gray, added still more diverse elements to the all-ready overburdened genus Eritrichium. The species of Cryptantha were placed under that genus and considered generically indistinguishable from plants now classified under Plagiobothrys and Eritrichium.

The genus Eritrichium became so heterogenous and varied that its breakup was inevitable. This began with Gray's notable paper (1885), A Revision of some Boragineous Genera, in which the species of Cryptantha were transferred to the section Pseudo-krynitzkia of Krynitzkia, with the exception of K. setosissima which was placed in the section Pterygium. Eight species were recognized by Gray that now are placed in the subgenus Oreocarya.

In a series of papers published by Greene (1887), the American representatives of De Candolle's Eritrichium were segregated in detail. First, the genus Allocarya was formed to include the species Gray had treated as Krynitzkia section Myosotidea. Then Piptocalyx was reinstated, to include the species with circumscissile calyces, also two new genera, Eremocarya and Oreocarya were formed. The first, Eremocarya, was based upon the plant of southwestern United States described as E. micranthum by Torrey (1859), and the second, Oreocarya, upon nine species of Eritrichium section Pseudo-krynitzkia and part of Krynitzkia

section Pterygium, described by Gray (1885). Greene (1896), described eight new species, and redescribed several old ones. Later Greene (1899), described two new species and still later (1901) two more.

The period from 1896 to 1916 is chiefly characterized by the addition of thirty five species proposed as new, mainly by Marcus Jones (1891, 1895, 1910), Alice Eastwood (1903, 1913), And Per Axel Rydberg (1905, 1906, 1909, 1913).

Macbride (1916), wrote the first comprehensive revision of the subgenus Oreocarya which included fourty-five species, all separated by means of a dicotomous key. Specimens also were cited, and a short discussion of each species was included.

Ivan M. Johnston (1924), questioned the status of the genus Oreocarya, and was of the opinion that both Oreocarya and Cryptantha should be combined under Cryptantha. Payson (1927), transferred all species previously known under Oreocarya to Cryptantha. His treatment included fourty-five species, and contained keys to the species and a list of synonymy for each species plus descriptions, specimen citations, and discussions.

Brand in 1927, proposed the new genus Hemisphaerocarya, which included all those species of the subgenus Oreocarya in which the fruit is hemispherical. Cryptantha jamesii and four of its close relatives formed the basis for this genus.

Since 1927 most of the new species which have appeared in the literature have been proposed by Johnston (1932, 1937, 1939, 1940), and Higgins (1968, 1969).

General Morphology

The plant consists of a taproot, varying in degree of branching,

and a simple or branched caudex, the apex of which bears a rosette of leaves and gives rise to the flowering stem. The stem pattern may differ considerably between species, but fundamentally it consists of an axis, usually foliate (or bracteate), with branches bearing several helicoid cymes.

The majority of species live for several years and are easily classified as perennials. In C. setosissima and C. virgata, however, the plants are biennial with one prominent rosette giving rise to a central flowering stem.

Stems: The stems are herbaceous, usually arising from a much branched woody caudex. However, in some species such as C. virgata and C. setosissima the stems are simple and erect. Most species are very similar with respect to the character of the stem and so stems can be used only to a limited extent in the differentation of species.

Leaves: The leaves are very similar in all species, varying only in length and width. They range from linear in C. jamesii var. laxa and C. shackletteana, to spatulate, or as is most common, oblanceolate. In all species the margins are entire, and the apices acute, obtuse, or subretuse. The blade is most often gradually narrowed into a long, slender, ciliate-margined petiole.

Inflorescence: The inflorescence is an open, rounded leafy-bracteate thyrsus or a helicoid cyme. The individual cymules are prevailingly scorpioid, but sometimes glomerate or loosely racemose. In some species the inflorescence is characteristically narrow, while in others as C. thyrsiflora, it is very broad and open. In one species, C. virgata, the floral bracts are extremely long and greatly exceed the individual glomerate cymules.

Sepals: The calyx is five-parted to the base, with the lobes all equal and linear, lanceolate, or ovate. In the more primitive species of this subgenus the lobes are only slightly accrescent in fruit, and in the advanced species greatly enlarged. The pedicel of the mature calyx may be nearly sessile or very short, or up to 10 mm long in the case of C. fulvocanescens var. echinoides.

Trichomes: The hairs of Cryptantha are all simple, unicellular, and more or less silicious. The more silicious hairs are either smooth and somewhat transparent, or more or less roughened by encrustations and then somewhat opaque. The bristles vary notably in attitude (whether appressed, retrorse, or ascending), length, and rigidity. Some species are characteristically setose or hispid and others conspicuously silky-strigose, but most of the different forms are so much alike in pubescence that the differences are unnoticed by one unfamiliar with the group.

Associated with the bristle-like trichomes on the stem and leaves are the pale, blistery structures called pustules. These are composed of a circle of slightly elevated silicified, opaque, tessellately arranged epidermal cells surrounding the base of the trichome. They show much variety in frequency and size, varying from totally absent to decidedly abundant, and up to a diameter of four millimeters.

The terms used in botanical literature to describe the many diverse types of pubescence are employed by various authors in different contexts. The following list of terms is presented to allow precision in interpretation of pubescence types.

Hirsute: with long, moderately stiff hairs.

Hispid: with long, very stiff hairs.

Setose: with short, rather stiff hairs.

Strigose: with short, appressed hairs usually in one direction.

Tomentose: hairs medium to short, curled and interwoven.

Corolla: The corolla limb is nearly always white and rotate-salverform or campanulate, but is distinctly yellow in two species. However, in many of the white-flowered plants the tube is light-yellow. The relative length of the corolla tube to the calyx lobes ia an important diagnostic character. The corollas vary from 2-20 millimeters in length, but are quite constant for any given species. The tube bears at its apex five rounded or emarginate fornices, 0.5-1.5 millimeters long, that are conspicuously papillose to nearly glabrous. Near the base of the tube a ring of crests is usually present, but may be lacking, especially in the long-flowered species.

Style: The length of the style as well as the position of the stamens in the corolla tube is of little specific value in most of the long-flowered species, since most of them are distinctly dimorphic in these characters. However, in C. oblata, a long-flowered species, the stamens are always located at the middle of the tube and the style exceeds the mature fruit by 3 to 5 millimeters. In the short-flowered species the distance by which the style exceeds the fruit is of some value in distinguishing species.

Fruit and nutlets: The fruit of Cryptantha consists of four or fewer elongate, ventrally grooved nutlets affixed to a usually elongate gynobase. In shape the nutlets vary from broadly ovate or triangular-ovate to narrowly lanceolate. The dorsal surface occasionally is somewhat flattened, but is commonly more or less convex, although in C. virginensis it is somewhat obtuse with a medial dorsal ridge. The

sides of the nutlets in most species are acute, but can be quite obtusely angled, or as in C. setosissima the margin is drawn out into a broad, greatly developed wing. Surface characteristics of the nutlets are also of diagnostic value. The surface of the nutlet may be smooth and shiny as in C. confertiflora, C. flava, C. barnebyi, C. semiglabra, or may be variously roughened. In species such as C. breviflora, C. cana, and C. fulvocanescens the roughenings consist of small, numerous, low, rounded, or sharp projections, a condition here described as muricate. Other species, such as C. stricta, C. flavoculata, and C. celosioides have the surface covered with long or short, irregular or transverse ridges called rugae.

Although four nutlets are commonly produced, one or more of them may fail to develop. This abortion can prevail throughout a plant or be restricted largely to either its younger or older parts. This suggests that abortions might be partially connected to the nutrition of the plant as influenced by seasonal conditions.

The nutlets are all homomorphic, in contrast to those in the annual species of the subgenus Krynitzkia, which contains many species possessing heteromorphic nutlets. The ventral groove or scar of the nutlet can be open or closed, and can be simple or forked below. The margin surrounding the scar is entirely lacking or is greatly elevated as in C. flavoculata and C. bakeri.

Distribution and Ecology

Oreocarya, as circumscribed in the present treatment, is principally western North American in distribution. Only one taxon (C. gnaphalioides), or possibly two others, namely C. argentea and C.

amplexicaulis, are found in South America (Chile), while all others occur in western North America. Payson (1927) stated, "It would seem reasonable to suppose that the genus originated in the southwestern part of North America and in its perennial primitive form spread to the desert regions of Chile and Argentina. In that region it became fifferentiated into three main groups. The most primitive of these invaded North America as Cryptantha in the limited sense of recent American floras." With this opinion the present author cannot entirely agree. A more reasonable hypothesis is that the group had its origin in southwestern North America. In its primitive form (probably similar to C. jamesii var. multicaulis), spread to the desert regions of Chile and Argentina. In that region it became differentiated into Geocarya, an advanced group with highly specialized, cleistogamous flowers. The majority of the group that remained in western North America became specialized and gave rise to the subgenus Krynitzkia. The subgenus Krynitzkia in turn spread to South America and the specialized subgenus Cryptantha developed from it.

The center of distribution in North America is eastern Utah and western Colorado, with the greatest concentration of species extending from southwestern Wyoming and northwestern Colorado to southeastern California.

Members of the subgenus Oreocarya occupy for the most part xerophytic habitats at middle elevations. The species of Oreocarya grow in widely different ecological situations and in a wide elevational range. Few species are able to tolerate direct competition with other herbs, or endure the shade of overhanging trees or shrubs. The prairie species C. cana and C. caespitosa, appear unable to tolerate the sod-

grass climax vegetation, but flourish only on the shaly ridges or gravelly outcrops which here and there break through the prairie sod. Some species are found growing on sandy deserts, e.g. C. jamesii var. disticha, on alpine talus slopes, e.g. C. weberi, C. crymophila, C. thompsonii, and some on clay knolls or desert playa, e.g. C. virginensis, C. rugulosa, and C. semiglabra which are associated with Atriplex. Apparently no species is able to tolerate a moist, undrained soil. The ability to grow and reproduce in difficult environments has enabled members of the group to colonize a wide variety of raw and newly exposed, often unpromising habitats. It is perhaps this ability, together with the selective action of the environment upon pioneer populations, that has produced the large number of species and at the same time the patterns of narrow endemism which are a feature of the subgenus.

The species are commonly found on almost any barren hillside. Many are restricted to soils that are so strongly impregnated with mineral salts that few other plants are able to compete with them. They are particularly at home on loose hillsides, talus slopes, shale outcrops, and heavy, detrital, clay soils.

Over fifty percent of the species are narrowly restricted in some specific ecological niche or edaphic situation. Some of them are limited to a single hillside, others to a particular mountain range, and still others are restricted to some isolated basin.

The greatest number of endemics are found in the cold desert regions of Utah and Colorado. C. grahamii and C. barnebyi are restricted to the Green River Shales of the lower Uintah Basin, being the most conspicuous plants on the shales. C. stricta is a very narrow endemic

also of the Uintah Basin, but is limited to heavy clay habitats on the north rim of the basin. Other endemics such as C. elata, C. aperta, C. breviflora, C. wetherillii, C. longiflora, and C. rugulosa grow on highly saline soils. Gypsiferous soils of western Colorado and eastern Utah are the home of C. paradoxa, while in this same general region C. tenuis and C. osterhoutii are almost always confined to sandy soil.

Endemic species also occur in mesic environments. For example, the Wasatch Formation of western Garfield County, Utah, is the habitat of the narrowly endemic C. ochroleuca. The volcanic talus slopes along the Salmon River in central Idaho is the habitat of C. salmonensis. Montane and warm desert regions include the habitats of other endemics.

Dispersal mechanisms within the subgenus are almost entirely unknown. One species, C. setosissima, has broadly winged nutlets, but the size of the wing in relation to nutlet size is such that it may have little or no value in dispersal. It seems probable that long distance dispersal by means of some animal vector is the most reasonable answer to dispersal of propagules in this group. However, the species of Cryptantha are not known to be grazed or eaten by animals, and thus the potential of animals in their dispersal is unknown. It is apparent that much additional information must be obtained to account for the broad distribution of members of this group of plants.

Seasonal differences in the flowering period are highly variable in the subgenus, and have probably served in the isolation of species within the group. For example, C. jonesiana is closely related to C. fulvocanescens but flowers much earlier. By early May C. jonesiana has completed flowering and produced fruit, while C. fulvocanescens has only started to flower. Seasonal isolation between other closely

related species is known (e.g. C. virginensis and C. hoffmannii, C. spiculifera and C. interrupta, and between C. humilis and C. propria).

Heterostyly, (regularly associated with outbreeding populations), has been developed in several groups in the evolution of the subgenus. Some of the widely distributed species such as C. flavoculata and C. fulvocanescens are distinctly heterostyled, on the other hand some of the very narrow endemics such as C. ochroleuca, C. compacta, and C. jonesiana are homostyled and possibly self pollinated. Outbreeding in the subgenus is probably also facilitated by various insects. Butterflies and beetles have been noted visiting several of the species, and undoubtedly serve as pollinating agents.

Generic relations and Phylogeny

The genus Cryptantha is a member of the tribe Eritrichieae and is apparently derived from the Lithospermeae through some form similar to the North American species of Antiphytum, Johnston (1925).

The primitive fruit was probably similar to that of the Hydrophyllaceae, being two or imperfectly four-loculed, capsular, and terminated by a lobed style. The lobed style consistently occurs in those subfamilies of the Boraginaceae which are considered primitive, i.e. the Heliotropioideae, Ehretioideae, and Cordioideae. Within the subfamily Boraginoideae the style is lobed or bears geminate stigmas only in the tribe lithospermeae.

The nutlets have resulted from a pinching in of the pericarp walls to form lobes of the fruit each containing one ovule. The stages of this development may be appreciated by a comparative study of the fruit of Heliotropium or better still, of Coldenia. Coldenia canescens has an unlobed fruit bearing a decidedly terminal style, Coldenia

nuttallii has the lobing evident and the style attached to the pericarp between and below the apices of the nutlets. In Coldenia litoralis the lobing is almost complete and the style is affixed almost upon the receptacle. Evidently the development of nutlets has proceeded by the deepening downward of the lobing from the apex and inward from the sides by the pinching in of the pericarp between the carpels. This finally results in an apparent basal attachment of the nutlets, and a gradual lowering of the style base between the nutlets until is is at last directly and firmly affixed upon the receptacle, Johnston (1925).

The nutlets of the annual as well as the perennial species of Cryptantha are characterized by the presence of a medial ventral groove, which is caused by the non-fusion of the pericarp walls. This development appears to have been brought about by the gradual encroachment of the pericarp over the surface of the sharply cut triangular attachment scar such as those in the Lithospermeae. This encroachment gradually narrows the attachment surface of the nutlet and forms a groove which is usually somewhat forked at the base. In Cryptantha the groove may be narrow but not completely closed. In Amsinckia, Plagiobothrys, etc. the groove is entirely closed and its location is marked by a ridge of fused pericarpel tissue which bears the scar.

According to Johnston (1925), it seems quite probable that the subgenus Oreocarya has been derived from some form of Antiphytum, a genus of Lithospermeae evidently derived from some ancestral plant similar to Lithospermum. The subgenus Oreocarya is the most primitive in the genus, probably having given rise to the other subgenera of Krynitzkia, Cryptantha, and Geocarya, of which the latter two possess cleistogamous flowers. Oreocarya seems also to have given rise to

Plagiobothrys, a genus which appears then to have evolved Amsinckia. The principal derivative of Oreocarya, however, appears to be Hackelia, for Oreocarya appears to be connected with Cynoglossum through Hackelia.

According to Johnston (1925), and Payson (1927), the subgenus Krynitzkia is a specialized offshoot of Oreocarya. Oreocarya consists of rather coarse perennials or sometimes biennials with usually persistent calyces and homomorphic nutlets. However, in the subgenus Krynitzkia, composed mostly of annuals, the calyces are deciduous and the nutlets somewhat heteromorphic. In the present group the question of primitive or of advanced condition is of much interest. In the present work the species have been grouped together mainly on the basis of similar morphological characters. After reviewing the works by Johnston (1924, 1925), and Payson (1927), plus this current research a phylogenetic summary is presented below. These conclusions are not final and may be subject to change after additional research.

Nutlets: In the hypothetical, primitive plant the nutlets evidently were smooth on both surfaces and ovate in outline. The scar of the nutlet was straight and narrow without an elevated margin. Nutlets also were attached at a very low position on the gynobase. As specialization took place the nutlets were roughened first on the dorsal and then on the ventral surface. The nutlets became more lanceolate, with the scar developing an elevated margin, and becoming open and contorted. The nutlet of the supposedly advance plant also became attached at a higher point on the gynobasic style.

Corolla: The primitive plant had corollas which were short and never exceeded the lobes of the calyx. This primitive corolla had low rounded fornices, and crests at the base of the tube. As specializa-

tion took place the corolla became longer until it greatly exceeded the lobes of the calyx. This long tube apparently developed along several different lines in the evolution of the group. Styles of various lengths (heterostyly), are regularly associated with long tubes. This is also an advanced characteristic, styles of uniform length being primitive.

Calyx segments: Broadly ovate or lanceolate sepals that were slightly accrescent were primitive, while those which are narrowly lanceolate or linear, and conspicuously accrescent in fruit are advanced.

Inflorescence: The primitive inflorescence was confined to the upper part of the stem, and was composed of a few, conspicuously elongated, scorpioid cymules. As development proceeded the cymules became shorter and the inflorescence tended to cover more and more of the stem.

Stem: The question of the primitive nature of the perennial or annual habit is of much interest. Morphologists, in general, seem to be of the opinion that the perennial habit is more primitive than the annual habit, or biennial habit. The author is inclined to agree with this generalization. The primitive species in this group were perennial with slender unbranched stems, while the less enduring ones with very short branched stems are specialized.

Leaves and pubescence: The linear oblanceolate leaf is more primitive than the broader ovate or spatulate types. An extremely setose indument on the leaf is considered to be a mark of specialiaztion, and in like manner a conspicuously sericeous and uniform covering is a specialization in another direction.

The North American species of the subgenus Oreocarya are thought to be monophyletic, but showing several major lines of development. In the present treatment the species groups are not given any taxonomic rank, but are of the rank of sections. As a substitute for the section the term group is employed. The perennial species placed in the subgenus Oreocarya are evidently the most primitive in the genus. The most primitive of these is C. jamesii var. multicaulis. The variety multicaulis has so many primitive characteristics that it may be used to visualize the ancestor from which the other subgenera developed. The author tends to agree with Payson(1927), in his postulation that the primitive Oreocarya species evolved in four different directions. The species of the main section Oreocarya remained perennial and developed a tendency toward larger flowers and shorter cymes. This larger flowered group is probably monophyletic in the sense that a single primitive ancestor gave rise to several basic types and these in turn produced species as we know them. Development in another direction produced annuals very early in the history of the genus. This group is recognized as the subgenus Krynitzkia, with its reduced flowers, heteromorphic nutlets, and elongate cymes. The subgenus is probably polyphyletic, the species in Krynitzkia apparently having arisen independently from several perennial ancestors. The other two subgenera, Geocarya and Cryptantha had primitive perennial ancestors and probably developed along the same lines as Krynitzkia, since the species in these subgenera are similar in appearance to Krynitzkia. Geocarya is probably monophyletic. Evidence for this is indicated in the peculiar morphology of the cleistogamous flowers. The subgenus Cryptantha, may have developed along several lines from Krynitzkia.

The groups that occur within the subgenus Oreocarya are characterized, discussed, and arranged in a phylogenetic scheme (fig. 1).

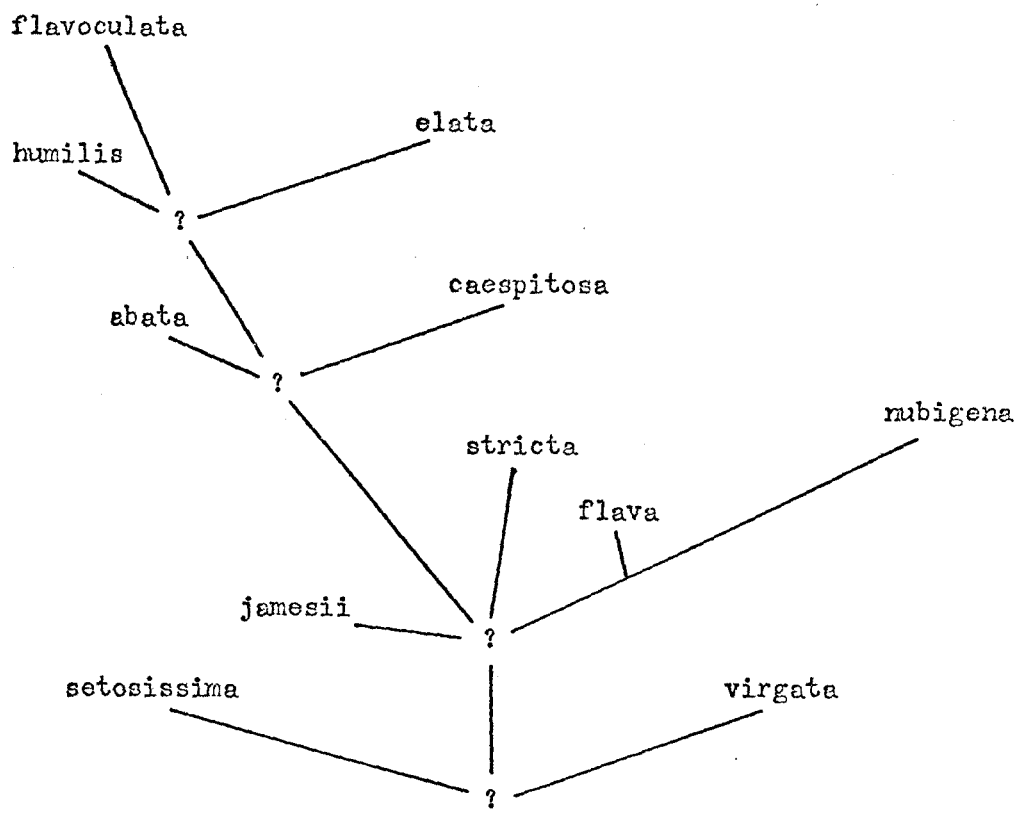


Fig. 1. A proposed phylogenetic arrangment of the groups within the subgenus Oreocarya.

The jamesii group: This group is composed of five species and seven varieties mostly confined to the eastern and southeastern section of the range of the subgenus (fig. 2). It is characterized by the hemispherical fruit, with the nutlets smooth on all surfaces, or rugose and tuberculate, but not at all muricate on the dorsal surface. Ventral surface of the nutlet quite or nearly smooth, with the scar narrow, straight, and closed, and without an elevated margin. The species within the jamesii group form a natural unit. Cryptantha jamesii has more primitive characters (smooth hemispherical nutlets, short corolla

tube with crests at the base, low fornices, oblanceolate leaves, strigose pubescence, and elongate cymes), than any other species in the subgenus, and is probably similar to the hypothetical, ancestral form. C. palmeri, although very closely related to C. jamesii, shows the advanced characteristics of crests lacking at the base of the tube, accrescent sepals, and longer style. C. crassipes is to be considered more advanced than C. palmeri on the basis of the capitate inflorescence roughened nutlets, and the longer style, which are all considered as specialized characters.

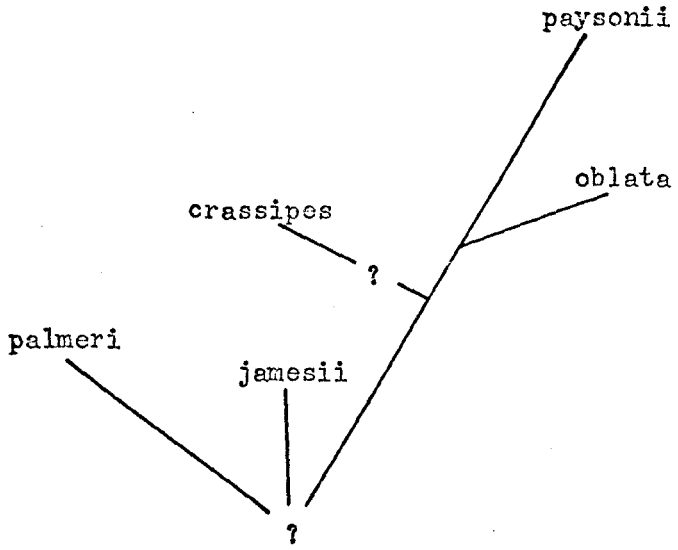


Fig. 2. A proposed phylogenetic arrangment of the species within the jamesii group.

It seems probable that long corolla tubes are derived from shorter ones, and that heterostyled flowers are derived from uniform flowers. On this basis C. oblata is more specialized than C. jamesii. C. paysonii probably very recently has evolved from C. oblata, but is more specialized because of the strongly heterostyled flowers and the more capitate inflorescence.

The flava group: The flava group is composed of seven species, most of which are confined to Utah and northern Arizona (fig. 3). The basic syndrome of characters includes the compressed nutlets which are smooth on both surfaces, and the closed scar which lacks an elevated margin. This group is recognized as being closely related to the jamesii group primarily on the basis of the smooth nutlets. The species within this group, however, become more difficult to place because lines of development are more obscure. C. salmonensis is probably the most primitive in this group because of its short corolla and uniform style length. All other species within the group possess corollas that exceed the lobes of the calyx. C. confertiflora is a widely distributed

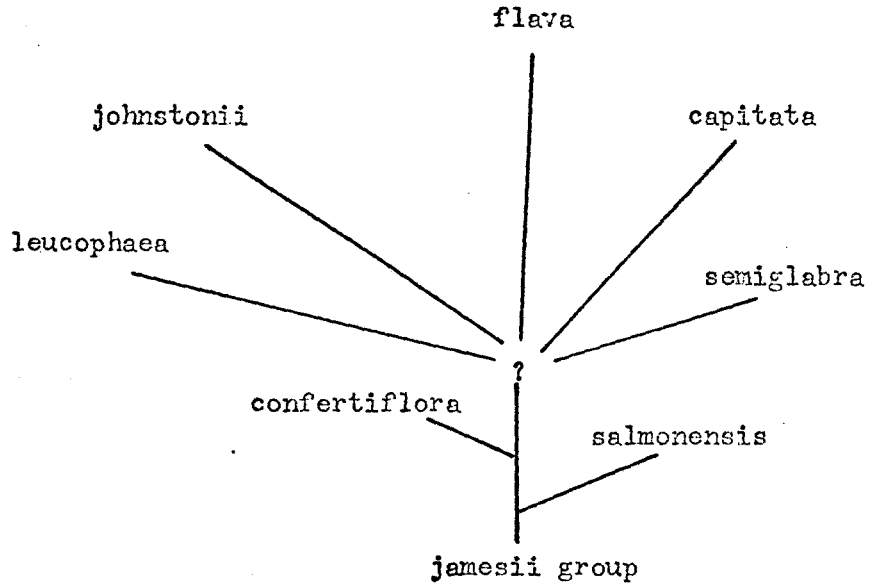


Fig. 3. A proposed phylogenetic arrangment of the species within the flava group.

species of the hot desert regions of Utah, Arizona, Nevada, and California, and may have through selective forces of the environment given rise to most of the other species, many of which are narrow endemics, confined to a particular kind of habitat. C. semiglabra, C. capitata,

and C. johnstonii are closely related to C. confertiflora, but probably because of their ability to inhabit peculiar soil types have been selected out and isolated from that species. C. leucophaea, a species of eastern Washington, which inhabits sand dunes along the Columbia River, was for a time included within the concept of C. confertiflora by Parish. It is believed, however, to be more advanced because of the longer inflorescence, conspicuous foliar bracts, and narrowly linear leaves. The author, at one time, was inclined to combine C. flava and C. confertiflora because of a few intermediates where the ranges of the two species overlap. However, with additional research the number of intermediates were found to be so few that the two taxa are best treated as separate species.

The stricta group: The stricta group contains two species, C. stricta and C. barnebyi, both restricted to the Uintah Basin of Utah (fig. 4). The stricta group probably had its origin from the flava

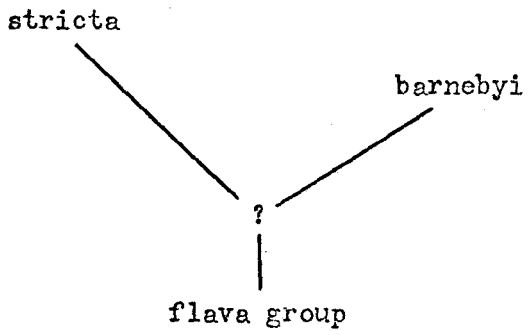


Fig. 4. A proposed phylogenetic arrangment of the species within the stricta group.

group. The very setose or hispid indument, stout stems, and the smooth ventral surface of the nutlets separate this group from that of flava. C. stricta is considered more advanced than C. barnebyi because of the

roughened dorsal surface of the nutlet.

The nubigena group: This group is composed of four species, all of high alpine or montane areas of California, Oregon, and Idaho (fig. 5). The basic characteristics of the group involve the lanceolate nutlets, which are smooth on the ventral surface and roughened dorsally. This group probably had its origin from the flava group through some form similar to C. confertiflora. The three species, C. nubigena, C. subretusa, and C. hypsophila are so closely related that it is difficult to afford them complete specific rank, but because of the wide geographical separation and the slight differences in morphology they are treated as distinct species. C. crymophila is probably more advanced than the other three species because of the larger nutlets, more accrescent sepals, and the longer foliar bracts. It was apparently derived from some form similar to C. nubigena.

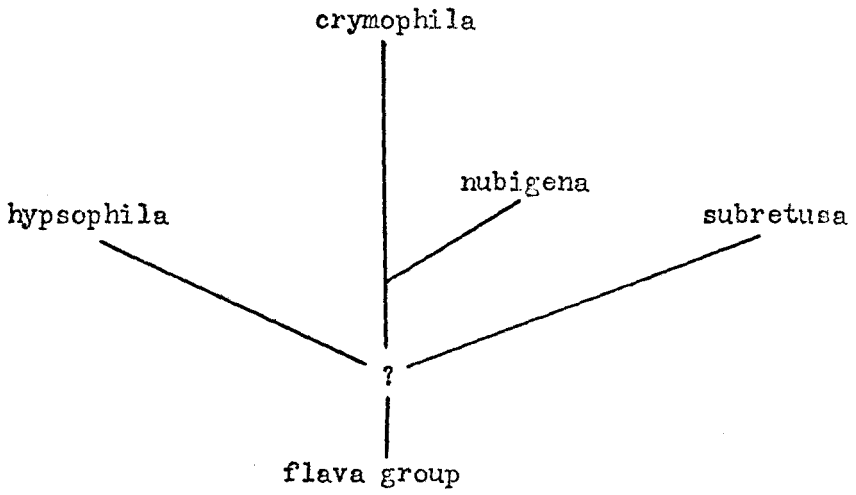


Fig. 5. A proposed phylogenetic arrangment of the species within the nubigena group.

The abata group: This group is mainly confined to the southwestern part of the range of the subgenus. It contains five species

which are characterized by rugose or tuberculate nutlets, with the ventral scar open and triangular, and usually surrounded by a slightly elevated margin (fig. 6). These characters are all much more advanced than those displayed by the jamesii group, so is probably not closely related to that group. All the species in this group occur in the Sonoran Desert except for C. abata. C. hoffmannii is probably a recent derivative from C. virginensis. The two species appear to be distinct even though they are quite similar in general appearance. C. hoffmannii flowers much later and has non-fragrant flowers. The relationship of the other three species is not so obvious, however, they appear to have been derived from some common ancestor similar to abata.

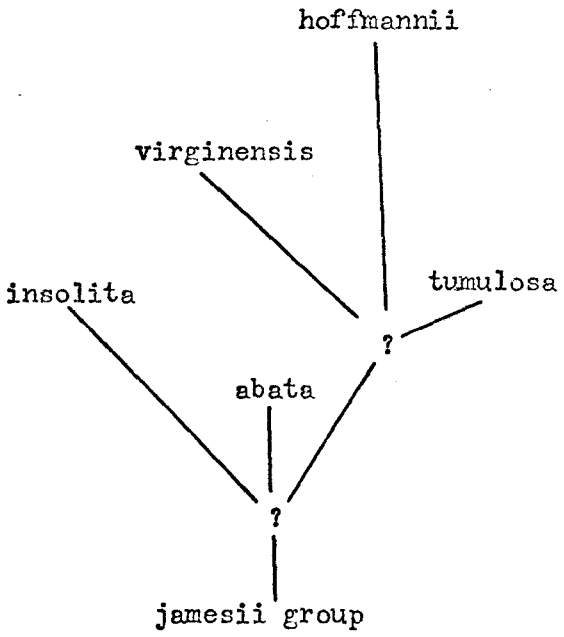


Fig. 6. A proposed phylogenetic arrangment of the species within the abata group.

The caespitosa group: This group contains two species, both of

which are apparently derived from the abata or possibly the humilis group. The distribution of this group is bicentric. C. caespitosa is a very hummock forming species found throughout southern Wyoming growing on clay hillsides, while C. ochroleuca is a narrow endemic growing on gypsiferous soil in western Garfield County, Utah. The two species probably had a common ancestor similar to C. caespitosa.

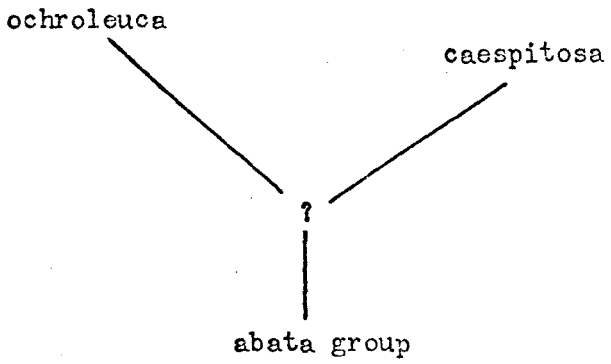


Fig. 7. A proposed phylogenetic arrangment of the species within the caespitosa group.

The humilis group. The humilis group is composed of eight species and five varieties (fig. 8). The basic syndrome of characters in this group includes the conspicuously muricate nutlets, and a scar with a tendency to be open and therefore triangular at the base. Two basic lines of development can be seen within this group; one in which the species possess two kinds of hairs, and nutlets which have short rugae between the murications; the other line has leaves which are usually silky-strigose, and only murications on the nutlets. C. cana and C. breviflora are members of this second group. C. jonesiana and C. fulvocanescens are considered advanced because of the long corolla tubes, and more elongated nutlets.

The elata group. The elata group is composed of thirteen species

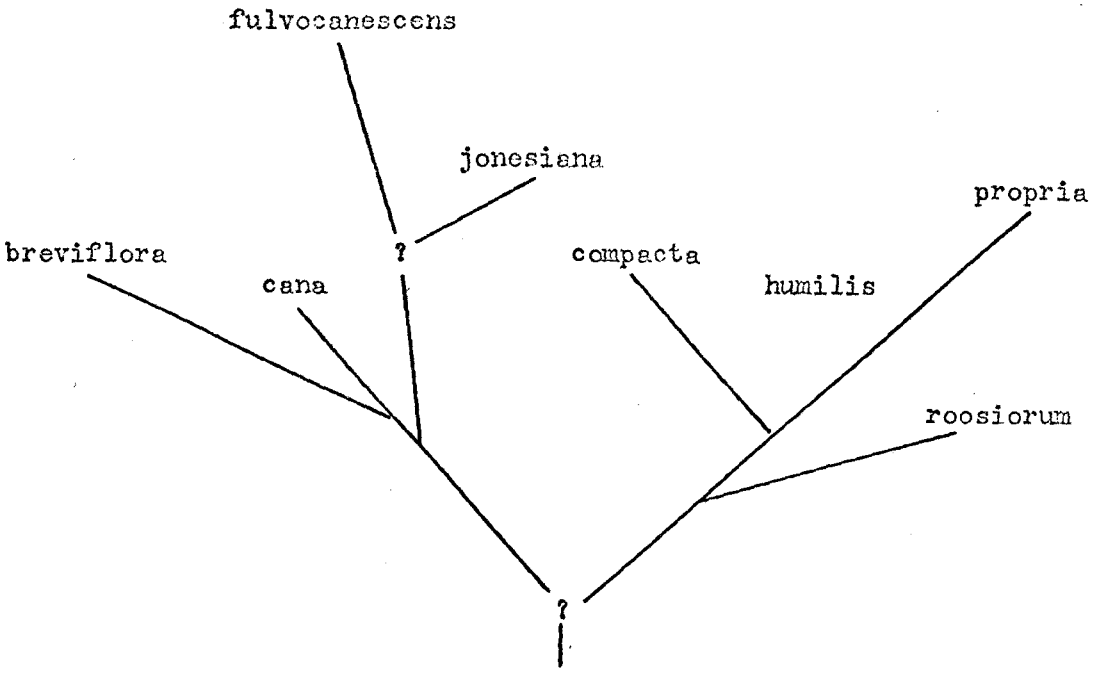


Fig. 8. A proposed phylogenetic arrangment of the species within the humilis group.

covering a wide geographical and altitudinal range (fig. 9). The basic syndrome of characters includes nutlets which are always roughened dorsally and distinctly rugose or tuberculate, or both, and often muricate also; ventral surface smooth or variously roughened; scar straight, closed or nearly so, margins not elevated; corolla tubes never longer than the calyx lobes, except in C. rollinsii. The species in this group are so similar in overall appearance and characteristics that lines of development are obscured. C. aperta and C. thyrsiflora seem to form a natural unit which possess broad inflorescences and ovate tuberculate nutlets. C. interrupta, C. spiculifera, C. shackletteana, and also C. rugulosa seem to form a natural unit, and are probably very closely related to each other. The lanceolate nutlets which have similar markings tend to substantiate this hypothesis. C. celosioides a widespread and heteromorphic species apparently gave rise to C. sobolifera and C.

thompsonii. The other species in this group are more obscure in their evolutionary history, probably because they are very narrow endemics which have specialized out on peculiar soil types.

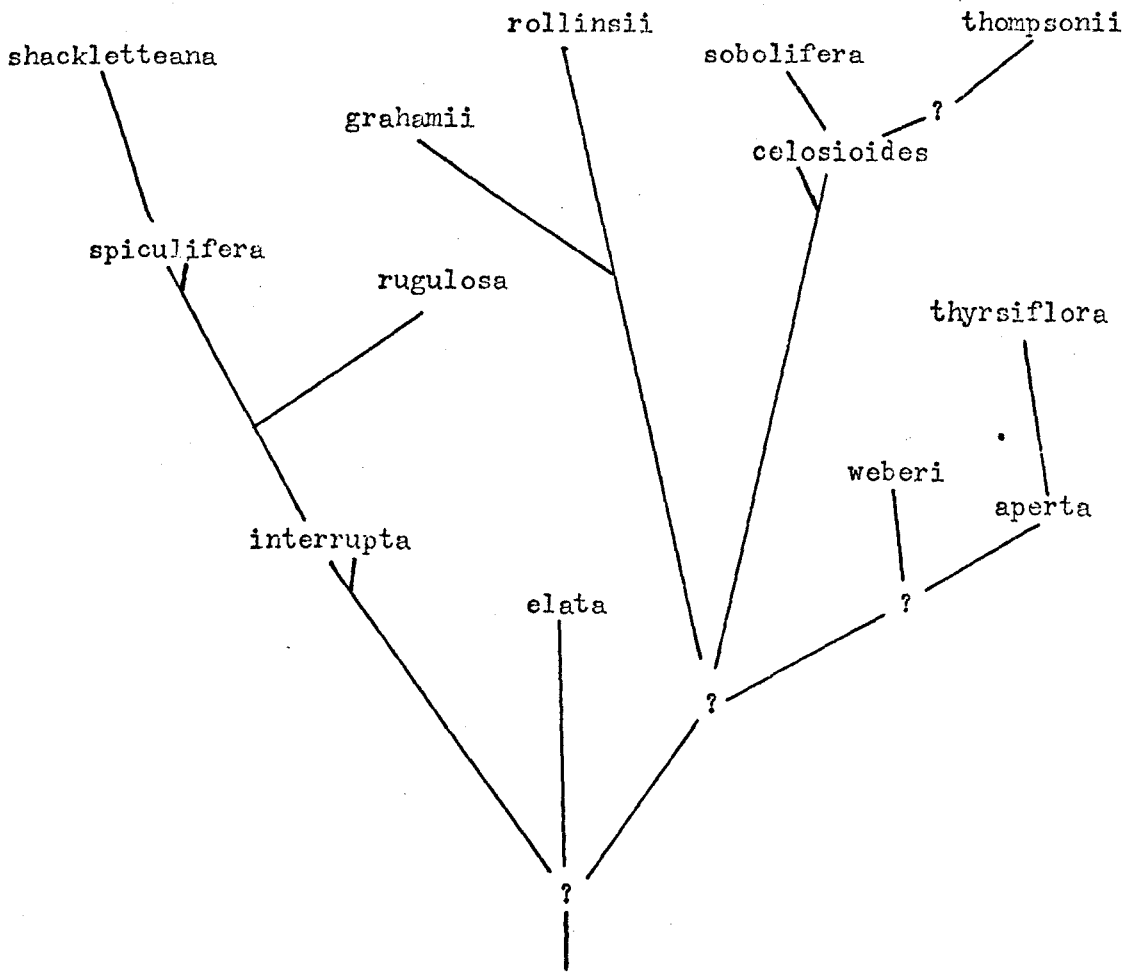


Fig. 9. A proposed phylogenetic arrangment of the species within the elata group.

The flavoculata group. The flavoculata group is composed of eight species, most of which are confined to eastern Utah and western Colorado (fig. 10). The basic syndrome of characters includes the deeply and conspicuously rugose and tuberculate, sometimes muricate or foveolate nutlets. Scar, except in C. bakeri, at least slightly open and then showing a tendency to be constricted above the base, margin usually elevated. The species of this highly developed group form so natural

a unit that there is little doubt that they had a common origin. C. osterhoutii and C. tenuis are two very closely related species, but the longer corolla tube and style of C. tenuis evidently make it more advanced. C. flavoculata and the closely related species C. paradoxa, C. bakeri, and C. mensana are the most advanced in the subgenus, and undoubtedly very closely related. C. wetherillii and C. longiflora are somewhat intermediate between this group and the elata group, but seem to be more closely related to the flavoculata group on the basis of the nutlet characteristics.

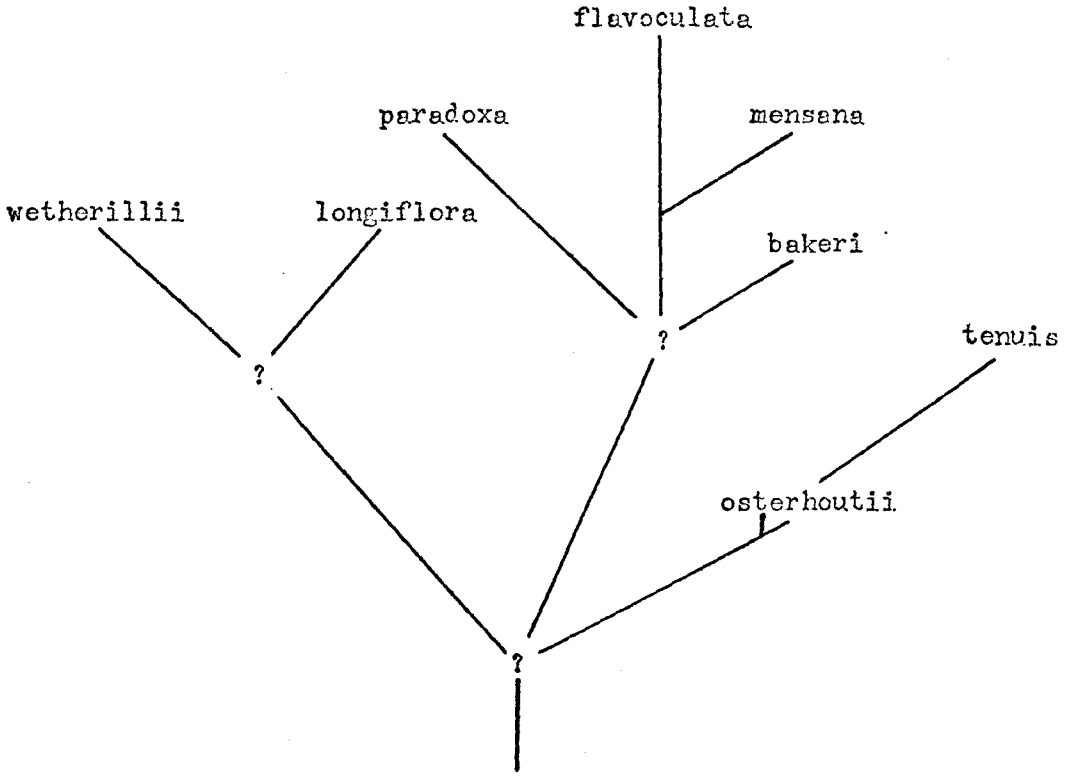


Fig. 10. A proposed phylogenetic arrangment of the species within the flavoculata group.

The virgata group. This monotypic group is so different from the other basic groups that it is separated from them in this treatment. The characteristics which distinguish this distinctive group are: the stout, strict, usually simple, fistulose stems, and the long spicate

inflorescence, with the greatly elongated foliar bracts.

The setosissima group: This monotypic group is restricted to montane areas throughout southern Utah, Arizona, and southern Nevada. The basic syndrome of characters includes the simple erect stems, broadly winged nutlets, and ovate calyx segments.

Cytology

Very little cytological work has been done on the subgenus Oreocarya. Delbert Wiens at the University of Utah began a study of the morphology of the group, but because of the difficulty he had in being able to get seeds to germinate the study was abandoned. He did, however, make chromosome counts on several of the species in this subgenus. The number in all species for which counts were made was n equals twelve. These species were C. virgata, C. jamesii, C. thyrsiflora, C. flava, C. bakeri, and C. fulvocanescens. Taylor and Brockman counted the chromosomes in C. celosioides (C. macounii) and determined the number to be n equals nine. There are some discrepancies in the basic number of this subgenus, which points out the fact that much additional study is needed on the cytology of this group.

TAXONOMY

Cryptantha Lehm. subgenus Oreocarya (Greene) Higgins

Perennial or biennial herbs with a conspicuous setose, hirsute, or strigose indument (except in C. jamesii var. pustulosa and C. semiglabra). Leaves entire, oblanceolate, spatulate or linear. Stems solitary from the root or caespitose, commonly unbranched below the inflorescence, 0.2-12 dm tall. Inflorescence a continuous or glomerate cluster of elongating or reduced, simple or branched, bracteate or nearly ebracteate, two-ranked, unilateral, scorpioid cymes. Calyx segments distinct, usually conspicuously accrescent. Corollas white or yellow, salverform or campanulate; limb 4-17 mm broad; tube equalling or exceeding the calyx. Stamens included in the tube, anthers sessile or nearly so. Style shorter, equalling or much exceeding the mature fruit; stigma entire. Nutlets from nearly circular in outline to narrowly lanceolate, margined or winged, smooth or variously roughened on the different surfaces, attached to the gynobase at a point 1/3 to 4/5 of the distance from the base to the apex of the nutlet. Scar of nutlets various, open or closed and margin elevated or plane. Subgeneric type: C. celosioides (Eastw.) Payson.

Key to the Species of Cryptantha Subgenus Oreocarya

1. Corolla tube elongate, distinctly surpassing the calyx; flowers usually heterostyled (2).
1. Corolla tube short, scarcely if at all surpassing the calyx; flowers not heterostyled (20).
    2. Nutlets smooth and shiny (3).

2. Nutlets more or less roughened or wrinkled at least on the dorsal surface (9).

3. Corolla yellow (4).

3. Corolla white (5).

4. Inflorescence an elongate, cylindrical thyrse; nutlets lanceolate, with acute margins, usually only 1 developing . . . . . 7. C. flava

4. Inflorescence consisting of a large terminal cluster with 1 or more remote, at naturity frequently stalked, much smaller lateral clusters; nutlets broadly ovate, with winged margins, all 4 usually maturing . . . . . 6. C. confertiflora

5. Inflorescence capitate, 0.1-0.4 dm long; corolla limb 6-8 mm broad, the tube little surpassing the calyx; nutlets lanceolate; native to northern Arizona and southern Utah . . . . . 8. C. capitata

5. Inflorescence elongate, 0.4-4 dm long; corolla limb 8-17 mm broad, the tube distinctly surpassing the calyx except in C. barnebyi; nutlets ovate (6)

6. Ventral surface of the leaves glabrous; native to north-central Arizona and southwestern Utah . . . . . 10. C. semiglabra

6. Ventral surface of the leaves strigose or setose-hispid (7).

7. Corolla limb 13-17 mm broad, crests at base of tube absent; nutlets 3-3.5 mm long; native to San Rafael Swell . . 9. C. johnstonii

7. Corolla limb 8-11 mm broad, crests at base of tube conspicuous; nutlets 3.5-4.5 mm long (8).

8. Corolla tube 5-7 mm long, the limb companulate; leaves broadly oblanceolate, setose-hispid; stems stout; endemic to the Uintah Basin, Utah . . . . . 11. C. barnebyi

8. Corolla tube 8-10 mm long, the limb spreading; leaves linear

or narrowly lanceolate, strigose with few or no pustulate hairs; stems slender; native to Washington. 12. C. leucophaea

9. Nutlets uniformly muricate or papillose, or sometimes in C. jonesiana also with some inconspicuous ridges (10).

9. Nutlets more or less rugose or tuberculate, or sometimes with a few inconspicuous murications (11).

10. Leaves oblanceolate, strigose with pustulate hairs small or lacking; corolla 7-10 mm long, fornices elongate; native to southeastern Utah, northwestern New Mexico, western Colorado, and northeastern Arizona . . . . . 34. C. fulvocanescens

10. Leaves spatulate, hispid with pustulate bristles; corolla 10-15 mm long, fornices low and broad; native to the San Rafael Swell, Utah . . . . . 35. C. jonesiana

11. Ventral or inner surface of the nutlets smooth or nearly so (12).

11. Ventral surface of the nutlets distinctly roughened (15).

12. Plants biennial; corolla campanulate, crests at base of tube evident; nutlets lanceolate; native to the Uintah Basin, Utah . . . . . 49. C. rollinsii

12. Plants perennial; corolla salverform, crests at base of the tube lacking; plants of Texas and New Mexico (13).

13. Inflorescence capitate; nutlets 3.3-3.8 mm long; leaves densely white strigose or subtomentose . . . . . 5. C. crassipes

13. Inflorescence elongate; nutlets 2.5-3.2 mm long; leaves strigose and setose-hispid (14).

14. Corolla tube 7-10 mm long; calyx lobes 5-7 mm long in anthesis; plants not heterostyled; nutlets conspicuously tuberculate and short rugose; native to Texas. 3. C. oblata

14. Corolla tube 12-14 mm long; calyx lobes 7-9 mm long in anthesis; plants strongly heterostyled; nutlets finely tuberculate or rugose; native to New Mexico and western Texas. . . . . 4. C. paysonii

15. Leaves conspicuously pustulate ventrally; corolla tube 12-16 mm long; calyx segments 7-10 mm long in anthesis; native to west-central Colorado and east-central Utah . . 51. C. longiflora

15. Leaves sparsely if at all pustulate ventrally; corolla tube 5.5-12 mm long; calyx segments 3.5-7 mm long in anthesis (16).

16. Inflorescence 0.1-0.4 dm long; corolla tube 10-12 mm long; margin of nutlets not in contact; plants less than 1.2 dm tall; eastern Utah and western Colorado. 54. C. paradoxa

16. Inflorescence 0.5-3 dm long; corolla tube 5-10 mm long; margin of nutlets in contact or nearly so; plants usually over 1.2 dm tall (17).

17. Scar of nutlets surrounded by an elevated margin but tightly closed; style 1-2 mm long; calyx 3.5-4 mm long in anthesis; native to southern Utah, southwestern Colorado, and northeastern Arizona. . . . . 55. C. bakeri

17. Scar of nutlets conspicuously open; style 3-8 mm long; calyx 4.5-7 mm long in anthesis (18).

18. Scar of nutlets conspicuously open and surrounded by a definite elevated margin; widespread. 57. C. flavoculata

18. Scar of nutlets slightly open and with only an inconspicuous elevated margin if any (19).

19. Leaves linear-spatulate; nutlets sharply and deeply rugose; corolla tube 5.5-7 mm long, fornices low and broad; native to southeastern Utah. . . . . 52. C. tenuis

19. Leaves obovate or broadly oblanceolate; nutlets with rounded ridges and tubercles; corolla tube 7-10 mm long, fornices long papillose; native to eastern Utah. . . . . 50. *C. wetherillii*

20. Nutlets smooth on their dorsal surface, not rugose, muricate or tuberculate (21).

20. Nutlets more or less roughened, muricate, rugose or tuberculate at least on the dorsal surface (26).

21. Fruit depressed globular, nutlets not in contact by their margins (22).

21. Fruit conical, ovoid or lanceolate, nutlets in contact by their margins or nearly so (23).

22. Crests at base of corolla tube conspicuous; calyx not conspicuously accrescent; widespread. . . . . 1. *C. jamesii*

22. Crests at base of corolla tube obsolete; calyx conspicuously accrescent; western Texas and northern Mexaco. 2. *C. palmeri*

23. Stout, strictly erect plants with many elongated and conspicuous bracts in the inflorescence; southeastern Wyoming and central Colorado. . . . . 20. *C. virgata*

23. Smaller, usually caespitose plants with few or inconspicuous bracts in the inflorescence; native to west of the continental divide (24).

24. Corolla tube 5-7 mm long; style 5-6 mm long; calyx 5-7 mm long; endemic to the Uintah Basin, Utah. . 11. *C. barnebyi*

24. Corolla tube 2-4 mm long; style 0.5-2 mm long; calyx 2.5-4 mm long (25).

25. Nutlets ovoid; corolla tube 3-4 mm long, limb 7-10 mm wide; plants of central Idaho. . . . . .13. *C. salmonensis*

25. Nutlets narrowly lanceolate; corolla tube 2-2.5 mm long, limb 3.5-5 mm wide; native to the high sierras in southern California. . . . . 15. C. nubigena

26. Ventral surface of the nutlets smooth or nearly so (27).

26. Ventral surface of the nutlets rugose or variously wrinkled (40).

27. Nutlets bordered by a conspicuous wing; robust plants 5-10 dm tall, with long ebracteate spikes. . . . . 19. C. setosissima

27. Nutlets never conspicuously winged, sometimes with an acute margin simulating a narrow wing; plants usually lower and caespitose; inflorescence bracteate (28).

28. Inflorescence a virgate spike-like thyrsus with all but the uppermost floral bracts much longer than the short cymes; nutlets broadly ovate, sparcely rugose or smooth; native to Wyoming and Colorado. . . . . 20. C. virgata

28. Inflorescence various but seldom if ever so spike-like, and at least the upper floral bracts reduced to short bracts which slightly if at all exceed the cymes or racemose branches (29).

29. Corolla tube 7-9 mm long; calyx 6-9 mm long in anthesis (30).

29. Corolla tube 2-6 mm long; calyx 2.5-6 mm long in anthesis (31).

30. Inflorescence capitate, 0.2-0.8 dm long; nutlets ovate; leaves densely white strigose or subtomentose; native to the Big Bend Region of Texas. . . . . 5. C. crassipes

30. Inflorescence elongate, 0.6-2 dm long; nutlets lanceolate; leaves setose-hispid; native to Utah. . . 49. C. rollinsii

31. Inflorescence very broad and rounded in outline; native to the eastern slope of the Rocky Mountains. . . . 36. C. thyrsiflora

31. Inflorescence narrower; plants west of the Continental Divide (32).

32. Fruiting calyx 9-14 mm long; nutlets 4-6 mm long (33).

32. Fruiting calyx 4-9 mm long; nutlets 2.5-3.8 mm long (34).

33. Nutlets lanceolate, the scar narrowly subulate but open at the base; native to Alpine and Tuolumne Counties California.

18. C. crymophila

33. Nutlets more ovate, the scar broader and cuneate at the base; plants of the high mountains in Kittitas and Chelan Counties Washington. . . . . 46. C. thompsonii

34. Nutlets 2-2.3 mm long, the scar cuneate or narrowly triangular; plants of Saguache and Hinsdale Counties Colorado. . . . . 40. C. weberi

34. Nutlets 2.6-3.7 mm long, scar closed or narrowly linear and open only at the forked base (35).

35. Plants conspicuously setose-hispid; nutlets transversely rugose and tuberculate; plants of Colorado, Utah and Nevada (36)

35. Plants strigose or setose, but not as above; nutlets usually tuberculate or short rugulose; plants of the high mountains in California, Oregon, Idaho and Montana (37).

36. Nutlets scarcely or not at all muricate between the rugae; strictly erect, conspicuously hispid perennials from northwestern Colorado and northeastern Utah. . . . 14. C. stricta

36. Nutlets distinctly muricate or tuberculate between the rugae and near the margins; erect perennials from western Utah and eastern Nevada. . . . . 41. C. rugulosa

37. Nutlets with tubercles but no conspicuous transverse ridges, or sometimes nearly smooth; native to California. . 15. C. rubigena

37. Nutlets with evident ridges on the dorsal surface; plants of northern California, Oregon, Idaho and Montana (38).

38. Style 1.8-2.5 mm long; soboliferous perennials from western Montana. . . . . 47. C. sobolifera

38. Style 0.5-1.5 mm long; plants of Idaho and Oregon (39).

39. Leaves oblanceolate, acute or obtuse, spreading bristly setose; style 1.2-1.5 mm long; central Idaho. . . . . .17. C. hypsophila

39. Leaves spatulate, subretuse or obtuse, subtomentose or strigose; style 0.5-1 mm long; Oregon, northern California and northwestern Nevada. . . . . 16. C. subretusa

40. Nutlets conspicuously muricate, or in C. humilis also with a few irregular ridges (41).

40. Nutlets not exclusively muricate, but rugose or tuberculate, also with a few murications between the ridges (44).

41. Leaves distinctly subtomentose or tomentose, also setose in C. humilis (42)

41. Pubescence of the leaves silky-strigose or strigillose but not subtomentose or tomentose (43).

42. Plants 0.3-1 dm tall; leaves 0.5-2.5 cm long; calyx 2-2.5 mm long in anthesis; corolla tube 1.8-2.2 mm long; native to Millard County, Utah. . . . . 30. C. compacta

42. Plants 0.4-2.5 dm tall; leaves 2.5 cm or longer; calyx 3-5 mm long in anthesis; corolla tube 3-5 mm long; plants widespread, Colorado to California. . . . . 28. C. humilis

43. Plants densely caespitose, caudex multicipital; leaves linear oblanceolate; native to eastern Wyoming and adjacent Nebraska and Colorado. . . . . 31. C. cana

43. Plants scarcely or only moderately caespitose; leaves broadly oblanceolate or spatulate; native to the Uintah Basin in northeastern Utah. . . . . 32. C. breviflora

44. Scar of nutlets open some distance above the base (45).

44. Scar of nutlets closed or nearly so, without a conspicuous triangular opening toward the base (58).

45. Scar somewhat constricted some distance below the middle of the open portion (46).

45. Scar triangular and not constricted below the middle (47).

46. Elevated margin of the scar definitely limited; pustules present on both leaf surfaces; central Utah. 56. C. mensana

46. Elevated margin indefinitely limited; pustules present only on dorsal surface of the leaves. . . . 53. C. osterhoutii

47. Some tendency to an elevated margin evident around the scar (48).

47. No tendency to an elevated margin around the scar (52).

48. Cymules elongating and so the inflorescence broad; biennial or short-lived perennials; nutlets usually with an evident dorsal ridge (49).

48. Cymules shorter and the inflorescence narrow; long-lived perennials; nutlets with only a slight dorsal ridge if any. (51).

49. Surface of the leaves with inconspicuous appressed bristles; inflorescence open, with only a few elongate cymules, 7-14 cm long terminating the stem; endemic to near Las Vegas, Nevada. 22. C. insolita

49. Surface of the leaves conspicuously setose-hispid with spreading bristles; inflorescence open, at least at maturity (50).

50. Calyx lobes 7-12 mm long in fruit; nutlets 3-4.5 mm long; prominately carinate on the dorsal side; southwestern Utah to southern California. . . . . 23. C. virginensis

50. Calyx lobes 5-7 mm long in fruit; nutlets 2.5-3 mm long, with only an indistinct central ridge toward the apex; eastern California and western Nevada. . 24. C. hoffmannii

51. Nutlets indefinitely tuberculate and rugose; California and southern Nevada. . . . . 21. C. tumulosa

51. Nutlets definitely tuberculate or rugose; native to Utah and eastern Nevada. . . . . 25. C. abata

52. Style not exceeding the mature nutlets by more than 0.5 mm; plants usually less than 1.3 dm tall (53).

52. Style exceeding the mature nutlets by 1 mm or more; plants usually taller than 1.3 dm (56).

53. Corolla tube 3-4 mm long; nutlets 3-3.5 mm long (54).

53. Corolla tube 2-2.6 mm long; nutlets 2.3-3 mm long (55).

54. Ventral surface of nutlets deeply rugose and tuberculate; native to southern Utah and eastern Nevada. . 25. C. abata

54. Ventral surface of nutlets indefinitely muricate; native to southern Wyoming. . . . . .26. C. caespitosa

55. Inflorescence less than 2 cm long; calyx segments 3-4 mm long in fruit; plants 0.1-0.3 dm tall; endemic to Inyo County, California. . . . . 29. C. roosiorum

55. Inflorescence 2.7 cm long or longer; calyx segments 4-6 mm long in fruit; plants 0.2-1.3 dm tall; endemic to Garfield County, Utah. . . . . 27. C. ochroleuca

56. Leaves setose-pustulate and tomentose; nutlets muricate or with a few short rugae. . . . . 28. C. humilis

56. Leaves finely strigose and appressed setulose; pustulate hairs lacking or inconspicuous on the ventral surface of the leaves; densely caespitose perennials (57).

57. Leaves linear to narrowly oblanceolate; corolla tube 3-3.3 mm long; nutlets inconspicuously tuberculate and rugulose; native to Alaska. . . . . 44. C. shackletteana

57. Leaves oblanceolate to spatulate; corolla tube 3.5-4.5 mm long; nutlets muricate and irregular rugose; native to Oregon and western Idaho. . . . . 33. C. propria

58. Upper surface of the leaves uniformly appressed strigose and without pustulate hairs (59).

58. Upper surface of the leaves with two distinct kinds of hairs; pustulate at base (63).

59. Nutlets sharply rugose and tuberculate, scar surrounded by an elevated margin. . . . . 55. C. bakeri

59. Nutlets not so sharply rugose or tuberculate; scar not surrounded by an elevated margin (60).

60. Leaves linear or narrowly oblanceolate, 2-13 cm long, 0.1-0.5 cm wide; native to Alaska. . . . 44. C. shackletteana

60. Leaves shorter and broader; plants from farther south (61).

61. Corolla tube 2-2.5 mm long; style exceeding nutlets by 1 mm or less; endemic to Garfield County, Utah. . . 27. C. ochroleuca

61. Corolla tube 3.5 mm long or longer; style exceeding nutlets by more than 1 mm (62).

62. Densely caespitose perennial from a multicipital caudex; native to eastern Oregon and western Idaho. 33. C. propria

62. Less evident or not at all caespitose; native to Utah, Colorado, and Wyoming. . . . . 38. C. sericea

63. Mature calyx exceeding the nutlets by 2-4 mm; inflorescence broad-topped; western Colorado and eastern Utah. . . . . 37. C. elata

63. Mature calyx exceeding the nutlets by 4-8 mm (64).

64. Nutlets tuberculate, scarcely if at all rugose (65).

64. Nutlets more or less rugose (69).

65. Ventral surface of the nutlets smooth or nearly so; native to high mountains in western Montana. . . . . 47. C. sobolifera

65. Ventral surface of the nutlets distinctly roughened (66).

66. Plant 1-2 dm tall; native to western Colorado and eastern Utah (67).

66. Plants 2 or more dm tall (68).

67. Corolla tube 2.6-3 mm long; calyx segments 2.8-3 mm long in anthesis; nutlets 2-2.6 mm long; endemic to Mesa County, Colorado. . . . . 39. C. aperta

67. Corolla tube 3.5-5 mm long; calyx segments 5-7 mm long in anthesis; nutlets 3-3.8 mm long; native to Uintah County, Utah 48. C. grahamii

68. Nutlets broadly lanceolate; murications lacking or indefinite; inflorescence slightly open to very broad; widespread, from North Dakota to Washington and Oregon. 45. C. celosioides

68. Nutlets narrowly lanceolate; murications or tuberculations very definite; Elko County, Nevada. . . . 42. C. interrupta

69. Scar of the nutlets somewhat open at the base. 28. C. humilis

69. Scar of the nutlets closed or nearly so (70).

70. Inflorescence very broad and open; plants native on the eastern slope of the Rocky Mountains, from southern Wyoming to northern Texas. . . . . 36. C. thyrsiflora

70. Inflorescence narrower; plants more northerly in range (71).

71. Leaves narrowly oblanceolate, strongly setose-ciliate on the margins; stems slender; native to western Washington and Oregon, and Idaho. . . . . 43. C. spiculifera

71. Leaves usually broader, oblanceolate to spatulate, the margins not strongly setose-ciliate; stems more robust (72).

72. Inner surface of the nutlets conspicuously rugose or tuberculate; widespread. . . . . 45. C. celosioides

72. Inner surface of the nutlets smooth or nearly so (73).

73. Leaves soboliferous, oblanceolate to spatulate, setose; native to high mountains of western Montana. . . . . 47. C. sobolifera

73. Leaves not soboliferous, spatulate, subretuse, subtomentose; native to northern California and Oregon. . . 16. C. subretusa

1. Cryptantha jamesii (Torr.) Payson

Perennials, 1-6 dm tall; stems 1-many, 0.4-4 dm long, glabrous to conspicuously hirsute; leaves linear to broadly oblanceolate, obtuse to acute, 2-15 cm long, 0.2-1.5 cm wide, glabrous to hirsute, usually pustulate dorsally, ventral surface lacking pustules or the pustules very inconspicuous; inflorescence open, cymules usually elongating, tomentose to setose-hirsute, floral bracts inconspicuous to very conspicuous; calyx segments ovate-lanceolate, acute, in anthesis 3-4 mm long, in fruit 5-7 mm long, subtomentose to setose-hirsute, (or sometimes nearly glabrous); pedicels 1-3 mm long; corolla white, the tube 2.5-3 mm long, crests at base of tube conspicuous, fornices light-yellow, emarginate, 0.5-1 mm long, limb 5-8 mm broad; style exceeding mature fruit 1-3 mm; fruit oblate-ovoid, 1-4 nutlets maturing, ovate-lanceolate, margins acute, 2-2.5 mm long, 1.5-2 mm wide, the margins not in contact,

both surfaces smooth and glossy, scar straight, closed, extending from the base to near the apex, elevated margin lacking.

Key to the varieties of C. jamesii

1. Ventral surface of the leaves glabrous, the petioles not ciliate-margined, nor tufted at the base. . . . . 1g. var. pustulosa

1. Ventral surface of the leaves strigose or setose, the petioles ciliate-margined; leaves tufted at the base (2).

2. Stems simple, not branched above the base (3).

2. Stems branched from the base as well as above (5).

3. Stems 1-4.4 dm long, usually twice as long as the basal tuft of leaves. . . . . 1a. var. multicaulis

3. Stems 0.2-0.9 dm long, usually not exceeding the basal tuft of leaves (4).

4. Floral bracts exceeding the cymules; stems low, decumbent; Nevada and California. . . . . 1d. var. abortiva

4. Floral bracts not exceeding the cymules; stems erect or nearly so. . . . . 1c. var. setosa

5. Stems decumbent; plants of the Great Plains. . 1f. var. jamesii

5. Stems erect; plants west of the Continental Divide (6).

6. Leaves linear; cymules 8 cm long or longer, very lax; native to southern New Mexico, Texas, and Mexico. . . . 1b. var. laxa

6. Leaves oblanceolate; cymules usually much shorter than 8 cm long, and more congested. . . . . 1e. var. disticha

1a. var. multicaulis (Torr.) Payson

Cryptantha jamesii (Torr.) Payson var. multicaulis (Torr.) Payson, Ann. Mo. Bot. Gard. 14:244. 1927.

Eritrichium multicaule Torr. in Marcy, Exploration Red River, 262. 1854.

Oreocarya multicaulis (Torr.) Greene, Pitt. 3:114. 1896.

Oreocarya suffruticosa (Torr.) Payson var. multicaulis (Torr.) Payson, Univ. Wyo. Publ. Bot. 1:171. 1926.

Hemisphaerocarya suffruticosa (Torr.) Brand var. multicaulis (Torr.) Brand, Fedde, Rep. Spec. Nov. 24:60. 1927.

Perennial, 2-5.5 dm tall, branched from the base, simple above; stems slender, 1-4.4 dm long, weakly strigose-setose; leaves mostly basal, oblanceolate, 5-15 cm long, 0.4-1 cm wide, dorsal surface strigose and appressed setose, or sometimes setose-hirsute, pustulate, ventral surface uniformly strigose or subtomentose, without pustules, or the pustules small and inconspicuous, the petioles conspicuously ciliate on the margins; inflorescence open, 0.5-1.5 dm long, bracts inconspicuous. Collections: 300 (0); representative: Jones 4007 (ARIZ, GH, US, UTC); J. M. Tucker 2771 (GH, ORE); R. C. Rollins 2429 (GH, US, UTC); B. Maguire 11975 (ARIZ, UTC); O. B. Metcalfe 70 (ARIZ, GH, ND-G, US).

Holotype: Fendler 636, collected in New Mexico near Santa Fe, 1847, NY. Isotypes at GH, US.

Distribution: Southern Colorado and eastern New Mexico, south to western Oklahoma and Texas into northern Mexico, north through central Arizona to southern Utah. Growing on a wide variety of soils, 4,500 to 8,000 feet. Map No. 1. April to September.

The original description of E. multicaule Torr., was based on a collection from near Santa Fe with setose-hirsute pubescence. This same bristly form also occurs in the White Mountains and southward to

the Santa Catalina Mountains of Arizona. A strigose or subtomentose form occurs about Flagstaff, also into southwestern New Mexico, and north into southern Utah. In northern Arizona var. multicaulis may be confused with var. setosa. It can be separated from var. setosa by the longer stems, becoming twice the length of the basal tuft of leaves, and the individual cymes which are longer and more perfectly developed. On its eastern boundary it may be confused with var. jamesii, but differs in the simple stem which is never branched above the base, more perfectly developed cymes, and the more dense strigose pubescence.

1b. var. laxa (Macbr.) Payson

Cryptantha jamesii (Torr.) Payson var. laxa (Macbr.) Payson, Ann. Mo. Bot. Gard. 14:246. 1927.

Oreocarya multicaulis var. laxa Macbr. Contr. Gray Herb. 48:35. 1916.

Hemisphaerocarya laxa (Macbr.) Brand, Fedde, Rep. Spec. Nov. 24: 60. 1927.

Perennial, 2.5-4.5 dm tall; stems branched from the base and upward, stout, 1-3 dm long, strigose and spreading setose; leaves linear, 4-12 cm long, 0.2-0.5 cm wide, dorsal surface coarsely strigose and pustulate, ventral surface finely strigose, and with a few inconspicuous pustulate hairs, the petioles long ciliate margined; inflorescence very broad and open, lax, 0.7-2.5 dm long, the foliar bracts inconspicuous. Collections: 13 (0); representative: L. C. Hinckley 3480 (GH); V. Harvard s.n. (US); E. L. Reed 3450 (US); E. O. Wooton 401 (NY).

Holotype: Pringle 776, collected in Chihuahua Mexico on sand hills near Paso Del Norte, 20 September, 1886, GH. Isotypes LL, ND-G.

Distribution: Southern New Mexico, western Texas, and northern Mexico in the state of Chihuahua. Limited to sand dune areas. Map No. 1. June to November.

This narrow-leaved variety is apparently confined to the sandy, dune areas of Mexico and southern New Mexico. It may be confused with var. jamesii in western Texas and southern New Mexico, but usually can be separated from that variety by the stout, erect stems, the narrower leaves, and the longer, more perfectly developed cymes. From variety multicaulis it differs in the stems which are branched above the base, and the very narrow leaves scattered along the stems.

1c. var. setosa (Jones) Johnst. ex Tidestr.

Cryptantha jamesii (Torr.) Payson var. setosa (Jones) Johnst. ex Tidestr. Proc. Biol. Soc. Wash. 48:42. 1935.

Oreocarya cinerea Greene, Pitt. 3:113. 1896. (Type: Southern Colorado, on the plains near Pueblo, 1873, Greene s.n.).

Krynitzkia multicaulis var. setosa Jones, Contr. West. Bot. 13:4. 1910.

Oreocarya lemmoni Eastw. Bull. Torrey Bot. Club 30:239. 1903. (Type: Arizona, without definite locality, 1884, Lemmon.)

Oreocarya multicaulis var. cinerea (Greene) Macbr. Proc. Am. Acad. 51:54. 1916.

Oreocarya suffruticosa var. cinerea (Greene) Payson, Univ. Wyo. Publ. Bot. 1:171. 1926.

Hemisphaerocarya suffruticosa var. setosa (Jones) Brand, Fedde, Rep. Spec. Nov. 24:60. 1927.

Hemisphaerocarya cinerea (Greene) Brand, Fedde, Rep. Spec. Nov. 24:61. 1927.

Cryptantha jamesii (Torr.) Payson var. cinerea (Greene) Payson, Ann. Mo. Bot. Gard. 14:246. 1927.

Perennial, 1-3 dm tall, branched from the base, simple above; stems slender, 0.2-0.9 dm long, strigose and weakly setose; leaves mostly basal oblanceolate, obtuse, 3.5-13 cm long, 0.4-1.5 cm wide, dorsal surface finely strigose, usually conspicuously pustulate, ventral surface uniformly and densely strigose, the petioles conspicuously ciliate on the margins; inflorescence open, 0.4-2 dm long, bracts evident, especially near the base of the inflorescence. Collections: 150 (iv); representative: T. S. Brandegee B31 (NY, US); E. L. Greene s.n. (ND-G); Rydberg & Vreeland 5702 (NY, RM); D. T. Macdougal 204 (ARIZ, US); C. F. Baker 455 (GH, RM, US); L. C. Higgins 1009, 1443 (BRY).

Holotype: M. E. Jones , collected near Fort Cove, Utah, growing under junipers, 27 June, 1901, RSA. Photograph at BRY.

Distribution: South-central Colorado, northern New Mexico, northern Arizona, eastern Nevada and southern Utah. Usually found on heavy clay soils. Map No. 1. Late May to early September.

In southern Utah variety setosa reaches its best development. It is characterized by the short stems which never exceed the basal tuft of leaves. In the outlying areas on the margins of its range it freely intergrades with variety multicaulis on the south, abortiva on the west, and variety jamesii on the eastern side. Oreocarya lemmoni was separated on the basis of a more setose indument which occurs on a population of this variety about Prescott, Arizona, however, I do not believe that it is worthy of any taxonomic rank. This variety has been recognized in the past as variety cinerea, but the older name of setosa must be used, at least at the variety level.

1d. var. abortiva (Greene) Payson

Cryptantha jamesii (Torr.) Payson var. abortiva (Greene) Payson, Ann. Mo. Bot. Gard. 14:250. 1927.

Oreocarya abortiva Greene, Pitt. 3:114. 1896.

Krynitzkia multicaulis var. abortiva (Greene) Jones, Contr. West. Bot. 13:5. 1910.

Oreocarya suffruticosa var. abortiva (Greene) Macbr. Proc. Am. Acad. 51:547. 1916.

Hemisphaerocarya abortiva (Greene) Brand, Fedde, Rep. Spec. Nov. 24:61. 1927.

Prostrate, caespitose perennials, branched from the base, 0.7-2 dm tall; stems slender, weak, decumbent, 0.3-0.7 dm long, strigose, and with some weak spreading setose hairs; leaves basal, as well as scattered along the stem, linear to narrowly oblanceolate, 1.5-9 cm long, 0.3-0.9 cm wide, dorsal surface finely strigose and setose pustulate, ventral surface finely strigose and without pustules, the petioles ciliate margined; inflorescence open, 0.2-1.3 dm long, floral bracts very evident, usually exceeding the cymules. Collections: 44 (0); representative: Clokey 7280 (BRY, ND, NY, ORE, UTC); Maguire & Holmgren 26119 (NY, UTC); Parish 1480 (US); Purpus 6068 (US).

Lectotype: S. B. Parish 3694, collected in the San Bernardino Mountains, Bear Valley, 6,500 feet, 16-20 June, 1895, ND-G. Isolectotypes at GH, UC.

Distribution: Central and southern Nevada, west to the San Bernardino Mountains, north through Inyo and Mono Counties, California. Growing in sandy soils from 6,000 to 10,500 feet. Map No. 1. Late May to October.

Variety abortiva is fairly well defined geographically, and is only to be confused on its eastern boundary with var. setosa. It may be separated from that variety by the long foliar bracts which exceed the individual cymules, and the prostrate stems.

I have designated the plant in the Notre Dame Herbarium with Greene's handwritten notation Oreocarya abortiva to be the type specimen, as it agrees very well with the plant, and the maturity of the fruit which he discusses in the original description.

le. var. disticha (Eastw.) Payson

Cryptantha jamesii (Torr.) Payson var. disticha (Eastw.) Payson, Ann. Mo. Bot. Gard. 14:248. 1927.

Oreocarya disticha Eastw. Bull. Torrey Bot. Club 30:238. 1903.

Erect perennials, branched from the base as well as above; 2.5-4.2 dm tall; stems somewhat woody near the base, 1.2-2.9 dm long, strigose and weakly setose; leaves narrowly oblanceolate, 3-12 cm long, dorsal surface setose-pustulate and strigose, ventral surface strigose to setose or silky-strigose, without pustulate hairs or the pustules inconspicuous, the petioles ciliate-margined; inflorescence open, 0.5-2 dm long, the foliar bracts not conspicuous. Collections: 60 (iv); representative: A. H. Holmgren 3243 (ARIZ, BRY, UC, US, UTC); B. F. Harrison 10370 (BRY, UC); B. Maguire 18298 (UC, UTC); Eastwood & Howell 6674 (UTC); L. C. Higgins 1004 (BRY).

Holotype: A. Eastwood 90, collected in San Juan County, Utah, on Bartons Range, 13 July, 1895, CAS. Isotypes at UC, GH, US.

Distribution: Wayne and Emery Counties, Utah, southeast through southwestern Colorado, northwestern New Mexico, northeastern Arizona in Apache, Navajo, and Coconono Counties, north to Garfield Co., Utah.

Usually found growing on sand dunes or sandy slopes and ridges, 4000 to 7,500 feet. Map No. 1. Late April to September.

The variety disticha seems to be intermediate between variety multicaulis and var. jamesii. It can be separated from the former by the more woody stems which are branched above the base, from var. jamesii by the erect stems, the leaves which are subglabrescent, and the more perfectly developed cymules. The character of a single nutlet is of no value, as one to four nutlets may be found on the same plant.

lf. var. jamesii

Cryptantha jamesii (Torr.) Payson var. jamesii.

Myosotis suffruticosa Torr. Ann. Lyc. N.Y. 2:225. 1827, not Cryptantha suffruticosa Piper, Proc. Biol. Soc. Wash. 32: 42. 1919.

Eritrichium jamesii Torr. in Marcy, Expl. Red River, 262. 1854.

Krynitzkia jamesii (Torr.) Gray, Proc. Am. Acad. 20:278. 1885 in part.

Oreocarya suffruticosa (Torr.) Greene, Pitt. 1:57. 1887.

Hemisphaerocarya suffruticosa (Torr.) Brand, Fedde, Rep. Spec. Nov. 24:60. 1927.

Hemisphaerocarya suffruticosa var. typica Brand, Fedde, Rep. Spec. Nov. 24:60. 1927.

Decumbent perennials, 1.6-4 dm tall, branched from the base as well as above; stems decumbent, 0.6-2 dm long, strigose and weakly setose; leaves linear to oblanceolate, 2.5-8 cm long, 0.3-0.9 cm wide, the dorsal surface coarsely strigose and appressed setose pustulate, ventral surface uniformly strigose and without pustules, the petioles ciliate-margined; inflorescence open, 0.4-1.4 dm long, floral bracts evident but not

conspicuous. Collections: 193 (i); representative: P. A. Rydberg 1514 (GH, ND-G, NY, US); A. Nelson 477 (GH, ND-G, NY, US); C. L. Porter 3951 (BRY, GH, RM); J. H. Christ 954 (CS, GH); L. C. Higgins 1527 (BRY).

Holotype: James s.n., barren deserts high upon the Platte, NY.

Distribution: Wyoming and South Dakota, south through Nebraska, Kansas, and western Oklahoma, west through northern Texas and western New Mexico, and north through Colorado east of the Continental Divide. Growing on sandy to clay soils. Map No. 1. May to late August.

Variety jamesii is confined mainly to the area east of the Continental Divide, but with some overlap in central New Mexico and southern Colorado. In eastern New Mexico it may be confused with var. multicaulis, and very often it is quite difficult to separate the two. In south-central and southern Colorado var. jamesii may be confused with var. setosa, but can usually be separated from it by the shorter leaves which are scattered along the stem, rather than in a basal tuft.

lg. var. pustulosa (Rydb.) Harringt.

Cryptantha jamesii (Torr.) Payson var. pustulosa (Rydb.) Harringt. Man. Pl. Colo. 466, 641. 1954.

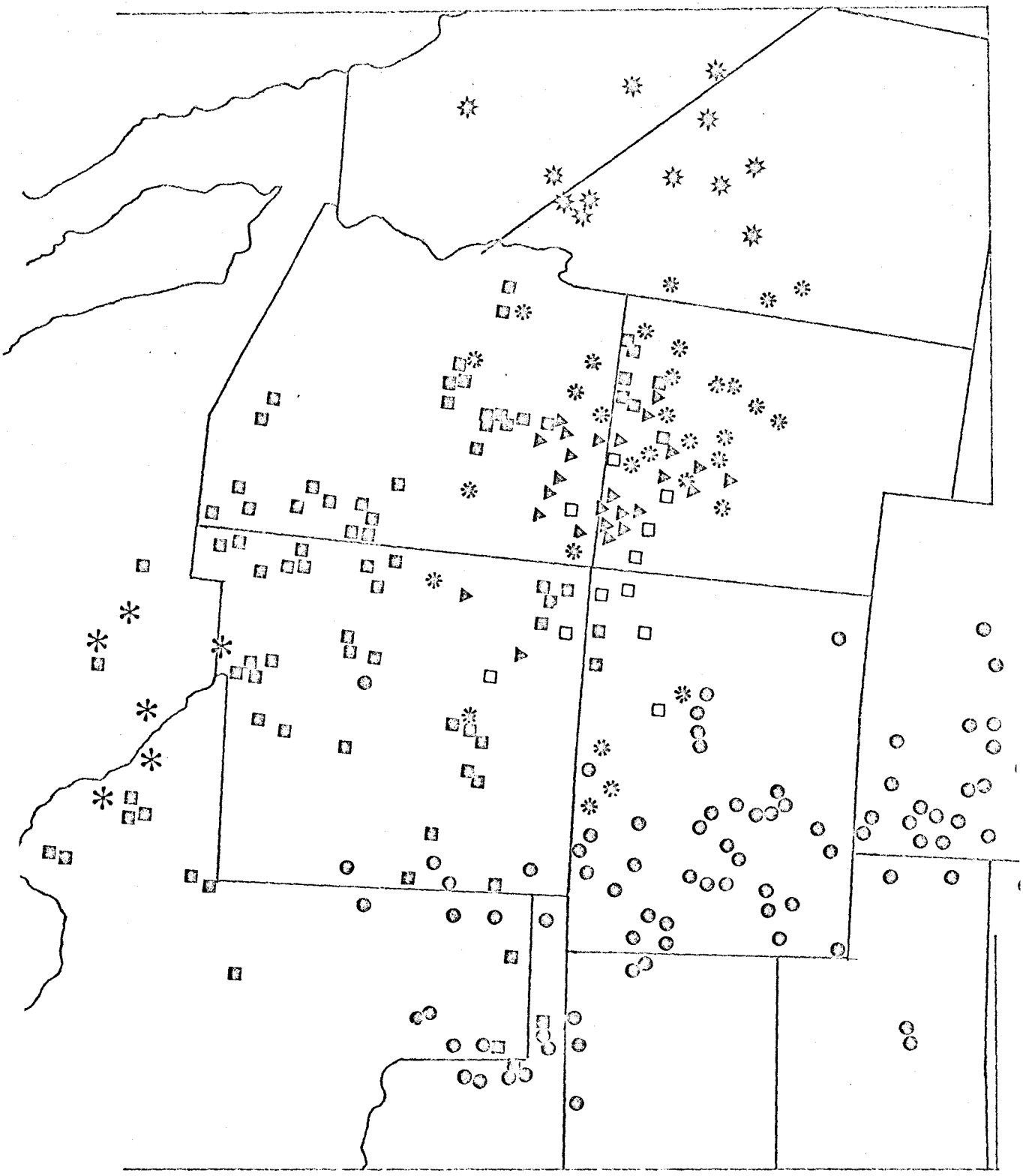
Oreocarya pustulosa Rydb. Bull. Torrey Bot. Club 40:480. 1913.

Cryptantha pustulosa (Rydb.) Payson, Ann. Mo. Bot. Gard. 14:252. 1927.

Hemisphaerocarya suffruticosa var. pustulosa (Rydb.) Brand, Fedde, Rep. Spec. Nov. 24:60. 1927.

Erect perennials, 2-5.8 dm tall, branched from the base, simple above; stems slender, 1-3.9 dm long, glabrous or finely strigose; leaves linear to broadly oblanceolate, 2-9 cm long, 0.4-1.5 cm wide, the dorsal surface appressed setose-pustulate, ventral surface glabrous, the

Map No. 1. Parts of western United States. Range of C. jamesii: ● var. jamesii; ✳ var. laxa; ▲ var. disticha; ✵ var. abortiva; ✱ var. setosa; ▣ var. multicaulis; □ var. pustulosa.



Cryptantha jamesii (Torr.) Payson

petioles not ciliate margined; inflorescence open, 0.4-2 dm long, floral bracts inconspicuous. Collections: 20 (0); representative: A. H. Holmgren & S. Hansen 3489 (BRY, NY, UTC); P. A. Rydberg & A. O. Garrett 9569 (NY, RM, UT); A. Cronquist & N. Holmgren 9372 (NY, UTC); J. Reveal & G. Davidse 926 (BRY).

Holotype: Rydberg & Garrett 9320, collected in San Juan County, Utah, on the Elk Mountains in Hammond Canyon, 31 July, 1911, NY.

Distribution: Southeastern Utah in Garfield, Kane, and San Juan Counties. Southwestern Colorado, northwestern New Mexico, and northeastern Arizona. Growing in a wide variety of soils, 4,500 to 8,500 feet. Map No. 1. Late May to late August.

This variety is quite different in general appearance from any of the other varieties in this species complex. This is due to the slender weak stems, and the lack of any pubescence on the ventral surface of the leaves. The original description characterizes the leaves as being glabrous beneath, sparingly hairy above. However, with the specimens at hand it is the upper and not the lower surface that is glabrous. The var. disticha in some cases is nearly glabrous, but always has a few hairs on the ventral surface, and is probably a connecting link between var. setosa and the present species.

2. Cryptantha palmeri (Gray) Payson

Cryptantha palmeri (Gray) Payson, Ann. Mo. Bot. Gard. 14:253. 1927.

Krynitzkia palmeri Gray, Proc. Am. Acad. 20:278. 1885.

Oreocarya palmeri (Gray) Greene, Pitt. 1:57. 1887.

Hemisphaerocarya palmeri (Gray) Brand, Fedde, Rep. Spec. Nov. 24:61. 1927.

Cryptantha coryi Johnst. Journ. Arn. Arb. 20:396. 1939.

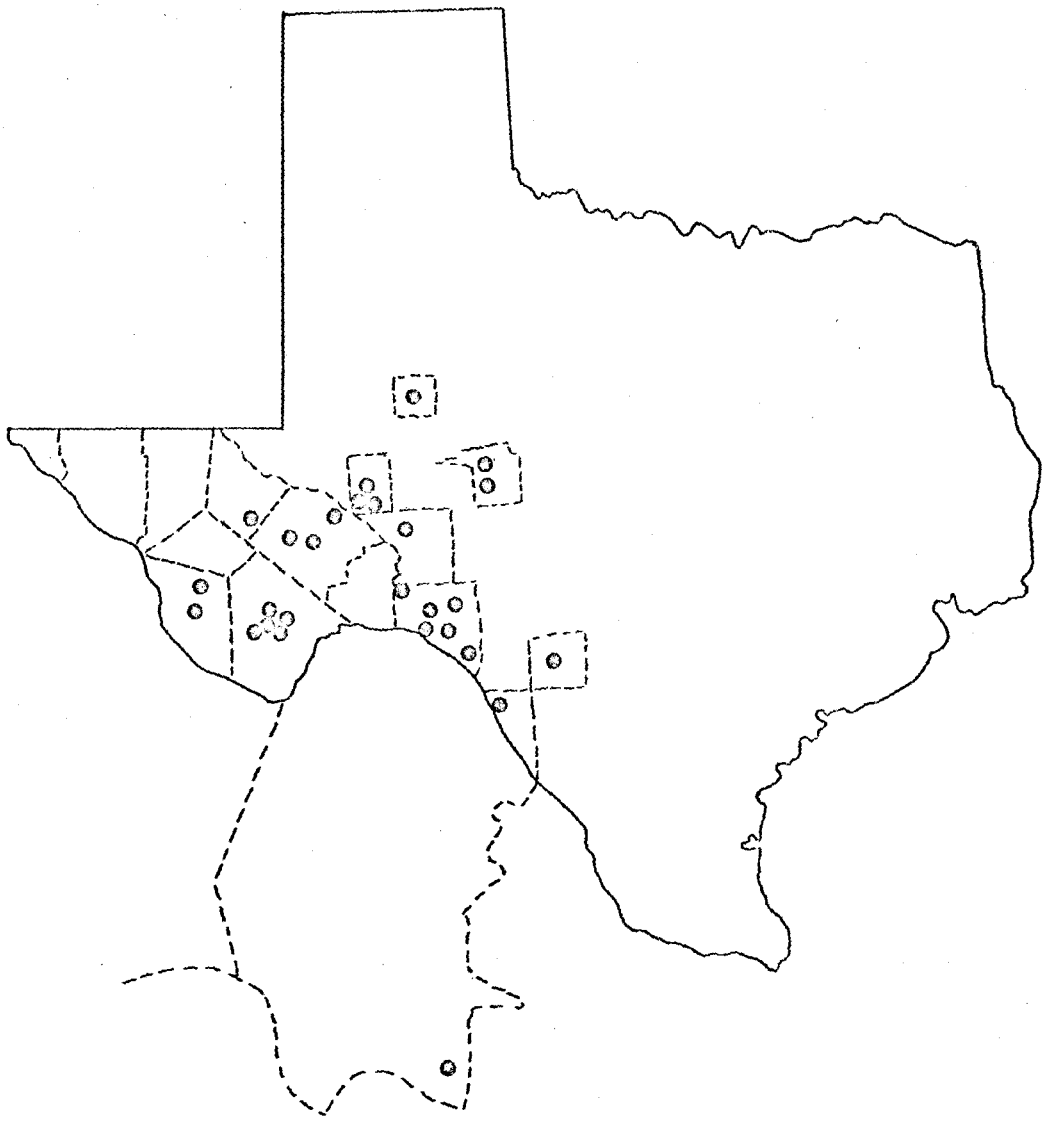
Plants biennial or short-lived perennials, 1.7-4 dm tall; stems 1-several, 0.7-3.5 dm long, spreading setose hirsute; leaves linear-lanceolate, acute, 3-16 cm long, 0.4-1 cm wide, strigose and subtomentose, pustulate hairs conspicuous on the dorsal surface, few and not evident on the ventral surface; inflorescence broad-topped due to the elongation of the cymules in age, 0.3-2.7 dm long, setose, the floral bracts inconspicuous; calyx segments lanceolate, in anthesis 4-6 mm long, in fruit becoming 7-10 mm long, setose or weakly hispid; corolla white, the tube 4-6 mm long, crests at base of tube lacking, fornices yellow, rounded, papillose, 0.5-1 mm long, limb 7-9 mm wide; style exceeding mature fruit by 2-3.5 mm; nutlets ovate, 2.5-2.8 mm long, 2-2.7 mm wide, the margins not in contact, acute, both surfaces of the nutlet smooth and glossy, scar tightly closed and without an elevated margin. Collections: 64 (O); representative: D. S. Correll & I. M. Johnston 21243 (GH, LL); V. L. Cory 31517 (GH); D. S. Correll 16333 (GH, LL); J. Reverchon 2120 (GH, ND-G); M. E. Jones 18514 (ND); E. J. Palmer 34009 (GH).

Holotype: Palmer 895, collected in Coahuila, Mexico, 40 miles south of Saltillo, March 1880, GH.

Distribution: Lower Sonoran life zone in western Texas and adjacent Mexico. Growing on limestone or gravelly to rocky hillsides, 1,000 to 4,000 feet. Map No. 2. April to Late July.

The type of C. palmeri is very immature, and because of this immaturity some confusion has come about as to which plant should bear the name of palmeri. In observing the type specimen on loan from Gray Herbarium, and the original description, which characterizes the nutlets as follows: "nuculis opacis rugosiusculis." The nutlets are subrugose only because they are immature. For this reason C. coryi is placed in

Map No. 2. Western Texas and northern Mexico. Range of C. palmeri (Gray) Payson.



Cryptantha palmeri (Gray) Payson

synonymy. Immature specimens in all the smooth-fruited species have a tendency for the nutlets to appear subrugose until they are fully matured, which is no exception in the present species.

This species may be separated from its nearest relative C. jamesii var. setosa, by its lack of crests at the base of the corolla tube, the acressent sepals, and the longer style.

3. Cryptantha oblata (Jones) Payson

Cryptantha oblata (Jones) Payson, Ann. Mo. Bot. Gard. 14:254. 1927.

Krynitzkia oblata M. E. Jones, Contr. West. Bot. 13:4. 1910.

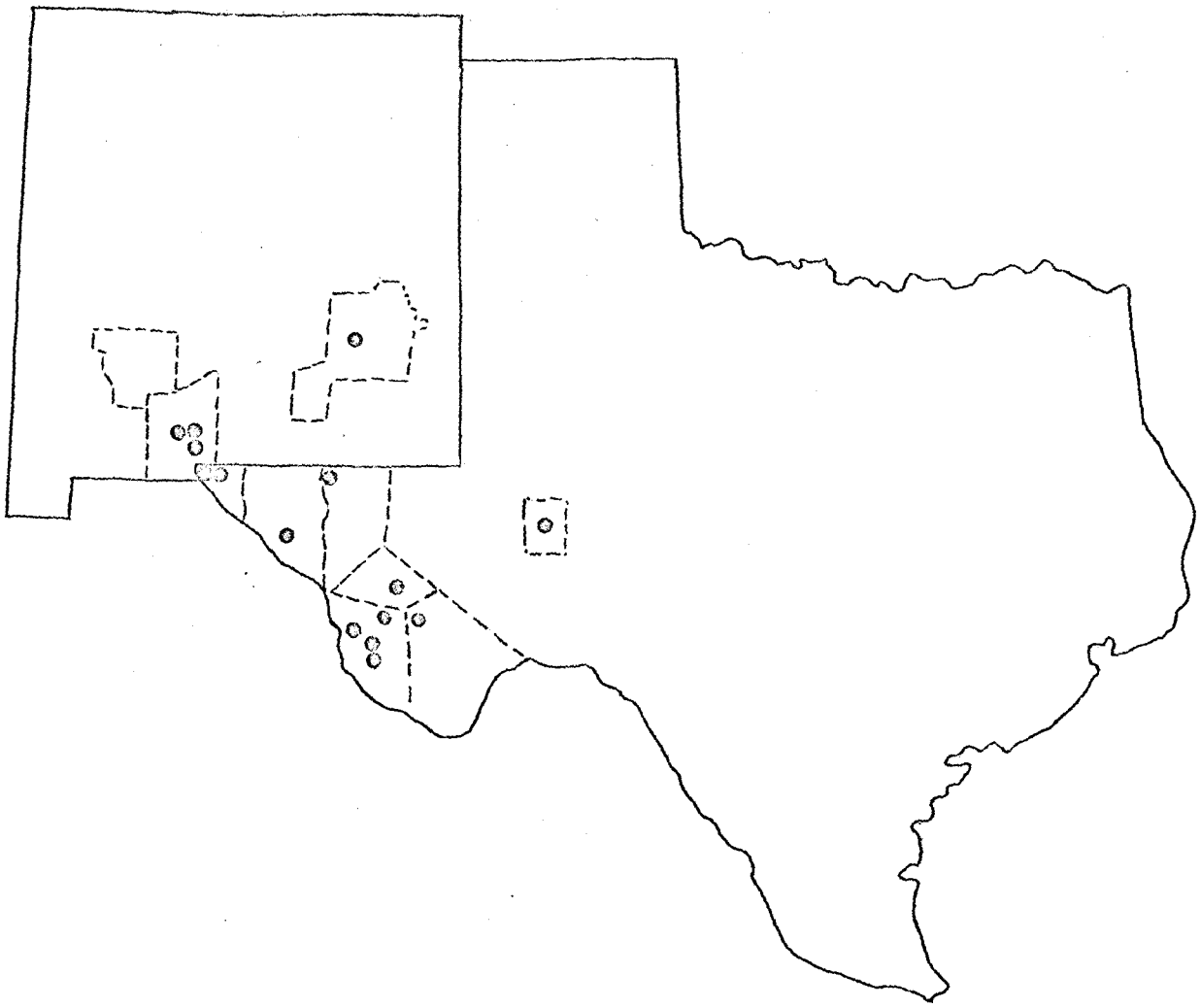
Oreocarya hispidissima Wooton & Standley, Contr. U. S. Natl. Herb. 19:545. 1915, not O. hispidissima (Torr.) Rydb.

Oreocarya oblata (Jones) Macbr. Proc. Am. Acad. 51:548. 1916.

Hemisphaerocarya oblata (Jones) Brand, Fedde, Rep. Spec. Nov. 24:61. 1927.

Caespitose perennial, 1-3.5 dm tall; stems several, 0.4-1.5 dm long, retrorsely setose and spreading hirsute; leaves oblanceolate, acute, 3-10 cm long, 0.4-1.4 cm wide, coarsely strigose and appressed setose dorsally, pustules conspicuous, ventral surface weakly strigose-setose, and with fewer pustulate hairs, the petioles ciliate margined; inflorescence somewhat open, especially in age, 0.3-2 dm long, setose-hirsute; calyx segments linear-lanceolate, 5-7 mm long in anthesis, becoming 8-10 mm long in fruit, densely setose; corolla white, tube 7-10 mm long, crests at base of tube lacking, fornices yellow, broad, papillose, limb 8-12 mm wide; style 3-5 mm longer than mature fruit; nutlets ovoid, usually all four maturing, the margins narrowly separated, acute, 2.5-3 mm long, 2-2.5 mm wide, dorsal surface rugose-tuberculate, ventral surface smooth or slightly uneven, scar closed, straight, and

Map No. 3. Parts of Texas and New Mexico. Range of C. oblata (Jones) Payson.



Cryptantha oblata (Jones) Payson

without an elevated margin. Collections: 54 (0); representative: D. S. Correll & I. M. Johnston 22036 (LL); C. L. & A. Lundell 14309 (GH, LL); G. R. Vasey s.n. (ND-G, US); W. P. Cottam 10228 (BRY, UT); G. C. Nealley 167 (ND-G, US); E. O. Wooton s.n. (ARIZ, RM, US).

Holotype: M. E. Jones 3759, collected at El Paso, Texas, 23 April, 1884, POM. Photograph at BRY. Isotypes at RM, US.

Distribution: Southcentral New Mexico, western Texas and northern Mexico. Growing on sandy or gravelly limestone soil, 1,000 to 5,000 feet. Map No. 3. Late March to September.

This species is confined mainly to the western half of trans-pecos Texas and southern New Mexico. It may be distinguished from its nearest relatives, C. palmeri and C. paysonii on the basis of the floral and nutlet characters. From the former it may be distinguished by the nutlets which are roughened on the dorsal side, and the corolla tube which definitely exceeds the calyx segments. It differs from the latter by the flowers which are not heterostyled, and the stamens which are always attached at the middle of the corolla tube, the fornices which are nearly glabrous, and the more open loosely thyrsoid inflorescence.

4. Cryptantha paysonii (Macbr.) Johnst.

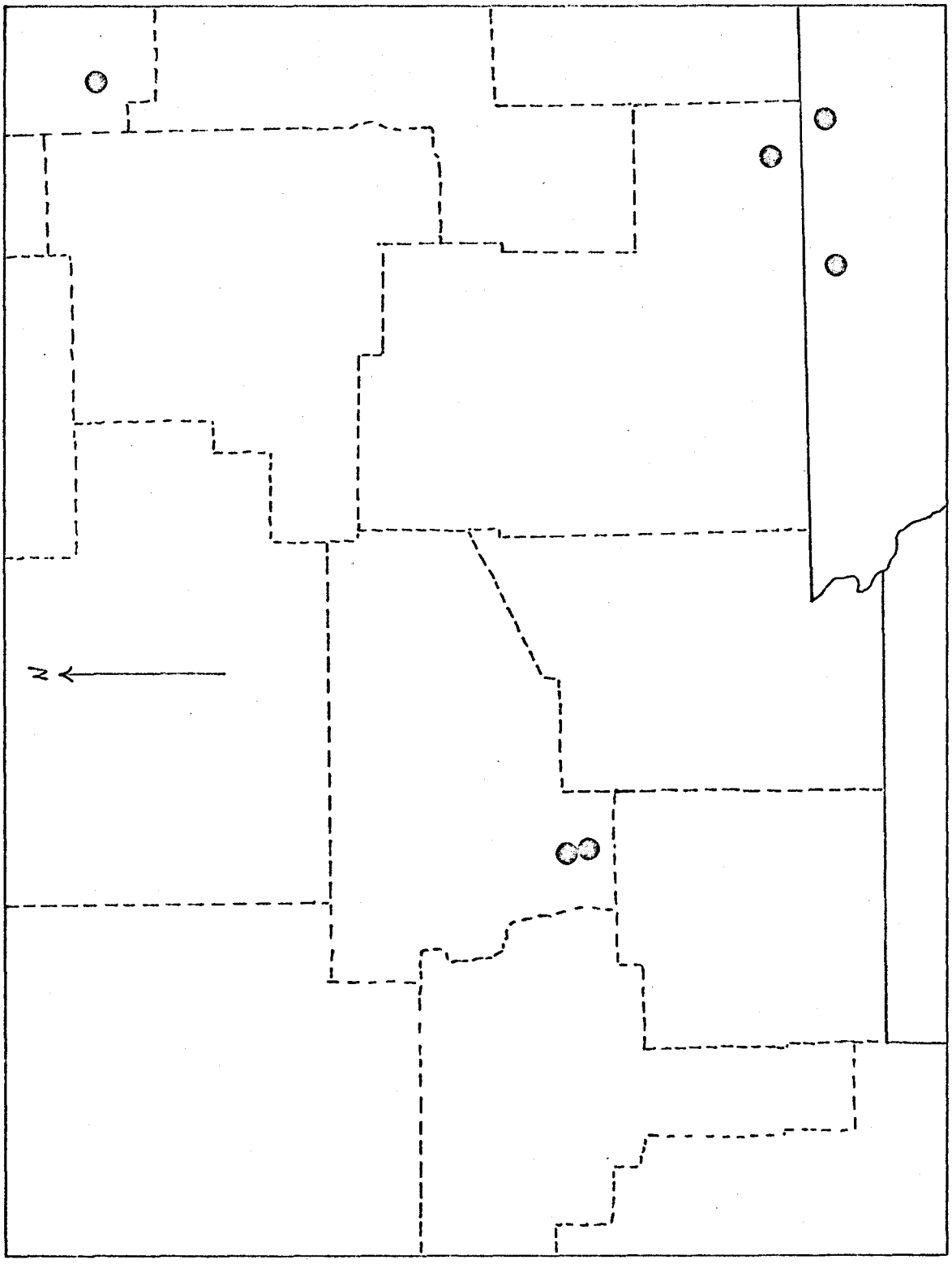
Cryptantha paysonii (Macbr.) Johnst. Wrightia 2:160. 1961

Oreocarya paysonii Macbr. Contr. Gray Herb. 48:36. 1916.

Hemisphaerocarya paysonii (Macbr.) Brand, Fedde, Rep. Spec. Nov. 24:61. 1927.

Caespitose perennials, 1.6-2.9 dm tall; stems erect, stout, 0.8-1.(dm long, strigose and more or less spreading setose-hirsute; leaves oblanceolate, obtuse to acute, 3-9 cm long, 0.5-1.5 cm broad, dorsal surface finely strigose or subtomentose, also setose with pustulate

Map No. 4. Northwestern Texas and southern New Mexico. Range of C. paysonii (Macbride) Johnston.



Cryptantha paysonii (Macbride) Johnston

hairs, ventral surface similar but with less conspicuous pustulate hairs; inflorescence subcapitate, consisting of 4-6 compact cymules, 0.5-1.2 dm long, setose; calyx segments linear-lanceolate, in anthesis 7-9 mm long, in fruit becoming 9-10 mm long, setose-hirsute; corolla white, the tube 12-14 mm long, crests at base of tube lacking, fornices yellow, rounded, densely papillose, 0.5-1 mm long, limb 10-13 mm wide; plants heterostyled; nutlets ovate, 2.7-3 mm long, 2-2.5 mm wide, usually all 4 nutlets maturing, margins narrowly winged, in contact, both surfaces finely rugulose or finely tuberculate, scar closed, straight, and lacking an elevated margin. Collections: 3 (0); representative: O. B. Metcalfe 1576 (POM, US); D. S. Correll & I. M. Johnston 22003 (LL).

Holotype: O. B. Metcalfe 1576, collected in Sierra County, New Mexico on limestone hills at Berendo Creek, 12 May, 1905, GH. Isotypes at POM, US.

Distribution: New Mexico in Debaca, Otero, and Sierra Counties, south into Culberson County, Texas. Growing on limestone soil, 4,000 to 7,500 feet. Map No. 4. April to June.

This species has been confused in the past with C. oblata, but differs from it in the larger corollas which are strongly heterostyled, the more compact inflorescence, and the nutlets which are only finely rugulose or tuberculate.

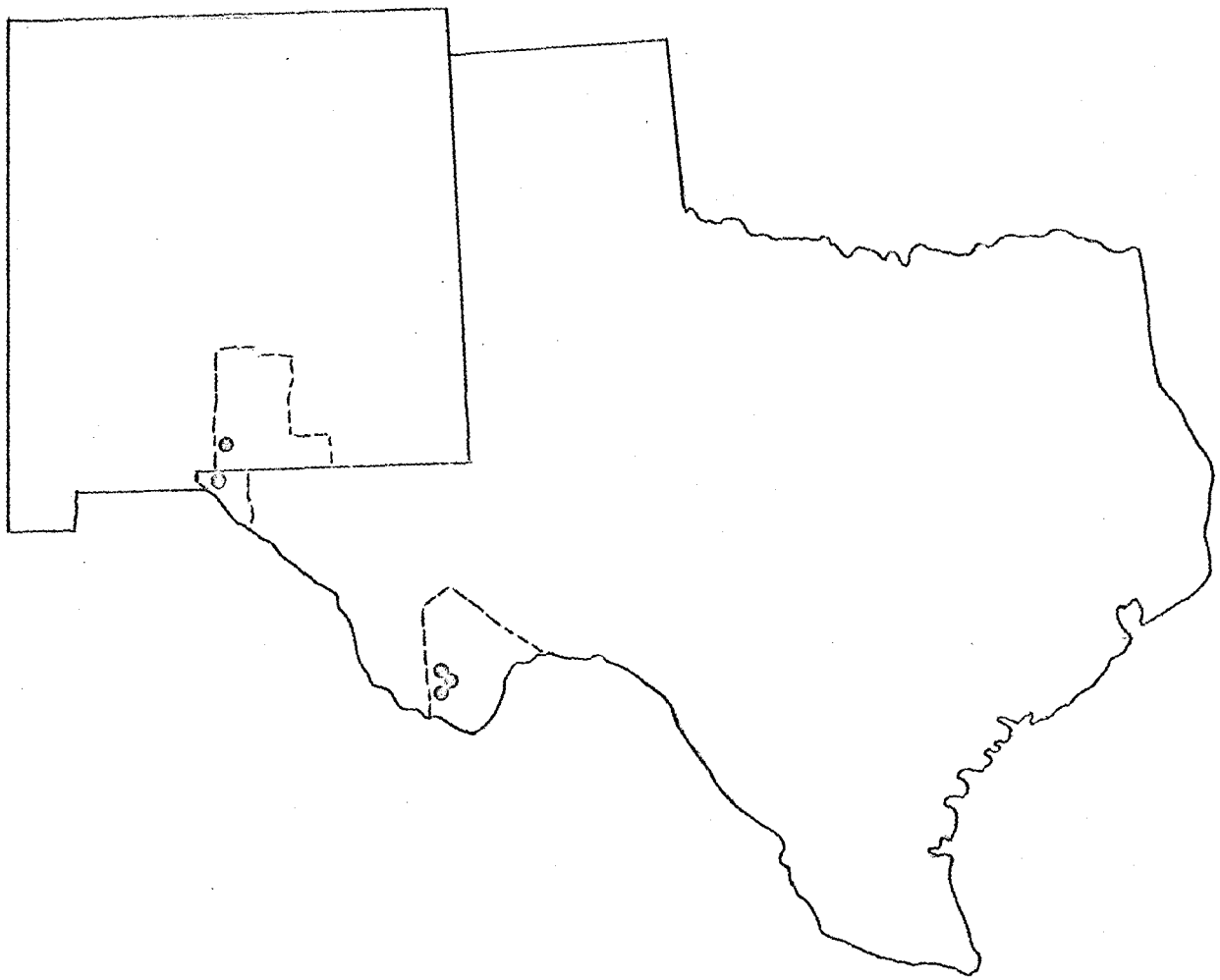
More collections of this taxon are badly needed in order to determine its exact geographical range.

5. Cryptantha crassipes Johnst.

Cryptantha crassipes Johnst. Journ. Arn. Arb. 20:397. 1939.

Plants perennial, 1.5-2.4 dm tall; stems 1-several, 1.2-1.9 dm long, setose; leaves linear-lanceolate, obtuse to acute, mostly basal,

Map No. 5. Parts of Texas and New Mexico. Range of *C. crassipes* Johnston.



Cryptantha crassipes Johnston

reduced upward, 3-6 cm long, 0.2-0.6 cm wide, densely white strigose, also setose-pustulate on the dorsal surface; inflorescence capitate, 0.2-0.8 dm long, white strigose, floral bracts inconspicuous; calyx segments linear-lanceolate, in anthesis 7-9 mm long, in fruit becoming 9-11 mm long, setose; corolla white, the tube 8-9 mm long, crests at base of tube lacking, fornices yellow, rounded, about 1 mm long, limb 9-11 mm wide; style exceeding mature fruit 4-7 mm; nutlets ovate or triangular-ovate, 3.3-3.8 mm long, 2.5-3 mm wide, dorsal surface finely rugulose, ventral surface smooth or only slightly uneven, margin acute or narrowly winged, scar closed, and without an elevated margin. Collections: 7 (0); representative: V. L. Cory 18613 (GH); D. S. Correll & I. M. Johnston 21934 (GH, LL); D. S. Correll & R. C. Rollins 23604 (LL); V. L. Cory 31585 (GH).

Holotype: V. L. Cory 18613, collected in Brewster County, Texas, 6.5 miles east of Agua Fria Springs, 13 April, 1936, GH. Photograph at BRY.

Distribution: Brewster County, Texas, in the Big Bend region. Growing on white limestone which is shaley or clayey, 1,500 to 4,500 feet. Map No. 5. Late March to early June.

This distinctive plant is closely related to C. palmeri and C. paysonii. From the former it can be distinguished by the compact capitate inflorescence, the thicker more woody caudex, and the shorter corolla tube. From C. paysonii, it differs in the shorter corolla tube, and the monomorphic flowers, the nutlets which are more compressed or flattened, and the very woody caudex.

6. Cryptantha confertiflora (Greene) Payson

Cryptantha confertiflora (Greene) Payson, Ann. Mo. Bot. Gard. 14:256. 1927.

Krynitzkia leucophaea var. alata Jones, Proc. Calif. Acad. Sci. II. 5:710. 1895. (Type: Silver Reef, Utah, on sandstone cliffs, 4,500 feet, 3 May, 1894, M. E. Jones 5144.)

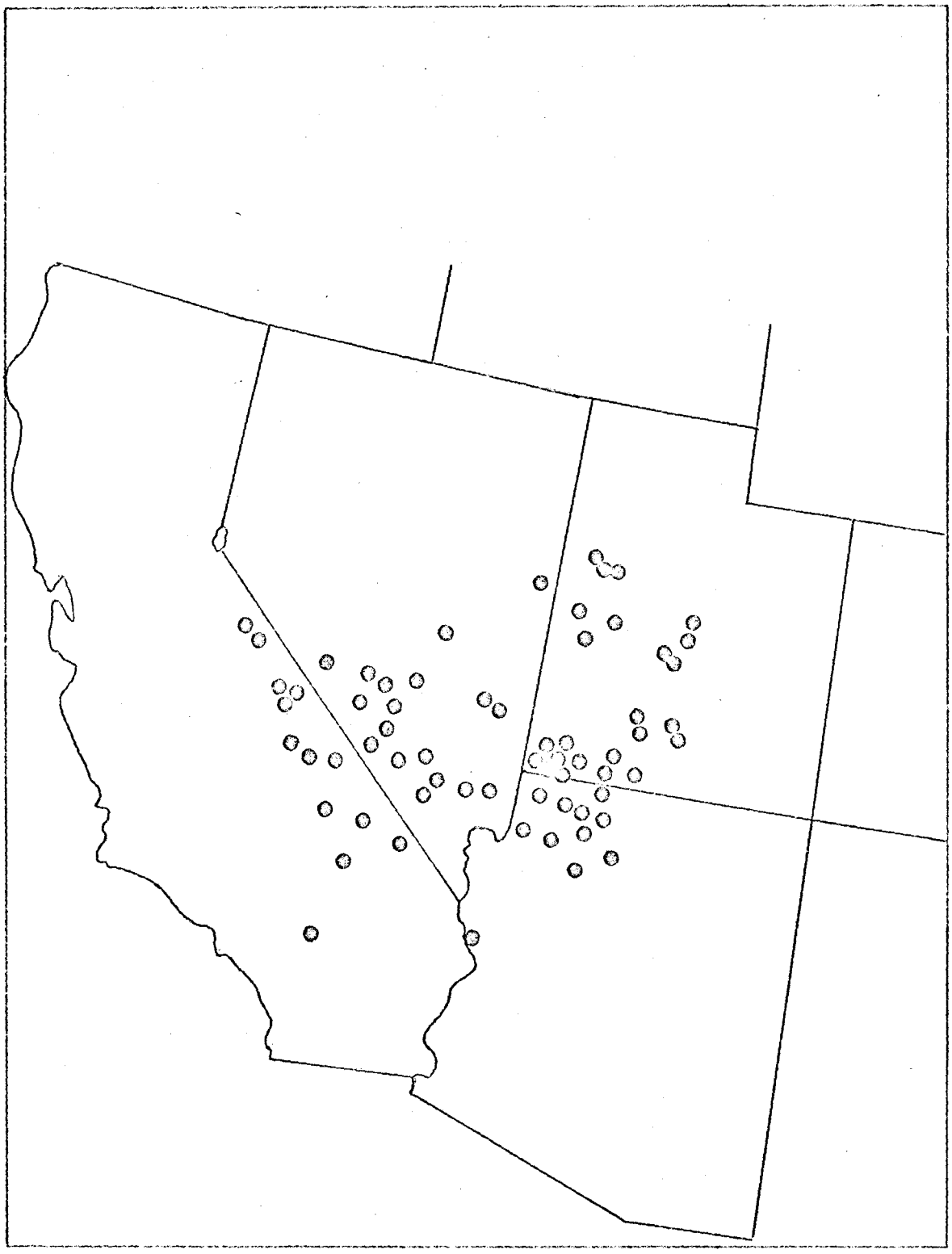
Oreocarya confertiflora Greene, Pitt. 3:112. 1896.

Oreocarya lutea Greene, Muhlenbergia 2:240. 1906. Name only. Fedde, Rep. Spec. Nov. 19:72. 1923. Description. (Type: California, Inyo County, White Mountains, 9 May, 1906, Heller 8211.)

Oreocarya alata (Jones) A. Nels. Coulter & Nelson, Man. Cent. Rocky Mts. 417. 1909; Rydb. Fl. Rocky Mts. 725. 1917.

Perennial herbs, 1.7-4.3 dm tall; stems 1-7, slender, 1.5-2.5 dm long, tomentose at the base, strigose and setose upward; leaves linear to oblanceolate, 3-12 cm long, 0.2-1.6 cm wide, acute, dorsal surface densely strigose and appressed setose with pustulate bases, ventral surface uniformly strigose, and with few or no pustules; inflorescence subcapitate, 0.3-2 dm long, strigose and with twisted setose hairs, bracts inconspicuous; calyx segments linear-lanceolate, in anthesis 6-8 mm long, in fruit becoming 10-14 mm long, strigose and spreading setose; corolla yellow, the tube 9-13 mm long, fornices broad, emarginate, about 1 mm long, crests at base of tube evident or sometimes lacking, limb 8-10 mm wide; plants distinctly heterostyled; nutlets triangular or ovate, 3.5-4 mm long, 2.5-3 mm wide, usually all 4 maturing, margins narrowly winged, in contact, surfaces smooth and glossy, scar straight, closed, and lacking an elevated margin. Collections: 117 (vi); representative: I. W. Clokey 7659 (ARIZ, LL, ND, ORE, UTC); S. B. & W. F. Parish 1316 (ND-G, US); F. W. Gould 1550 (BRY, UT, UTC); P. Train s.n. (ARIZ, ORE); L. C. Higgins 1365, 1475, 1771 (BRY).

Map No. 6. Parts of western United States. Range of C. confertiflora (Greene) Payson.



Cryptantha confertiflora (Greene) Payson

Holotype: S. B. Parish 1316, collected in San Bernardino County, California, at Cushenberry Springs on the north side of the San Bernardino Mountains, 1882, ND-G. Photograph at BRY. Isotype at US.

Distribution: Southwestern Utah, northern Arizona, southern Nevada, and west to southern and western California. Growing in a wide variety of soils, 2,000 to 8,500 feet. Map No. 6. April to July.

This distinctive, yellow-flowered species is one of the largest of the perennial species of Cryptantha, and is not common, but covers a wide distributional range. This species may be distinguished from its closest relative, C. flava, by the broader more ovate nutlets, and the longer stems with a subcapitate inflorescence.

Brand legally published the nomen nudum Oreocarya lutea Greene. He did this on the basis that the stamens were in a different position in the corolla tube. However, this taxonomic criteria is of no value in the present species because the corolla is very dimorphic in regards to this character.

Jones described a narrow-leaved form from southern Utah as a new variety, but is not worthy of any subspecific rank.

7. Cryptantha flava (A. Nels.) Payson

Cryptantha flava (A. Nels.) Payson, Ann. Mo. Bot. Gard. 14:259. 1927.

Oreocarya flava A. Nels. Bull. Torrey Bot. Club 25:202. 1898.

Oreocarya lutescens Greene, Pitt. 4:93. 1899. (Type: On hills about Aztec, New Mexico, 25 April, 1899, C. F. Baker.)

Cryptantha confertiflora var. flava Brand, Pflanzenreich (Heft. 97 4, fam. 252:90. 1931.

Cryptantha confertiflora var. lutescens Brand, Pflanzenreich (Heft. 97) 4, fam. 252:90. 1931.

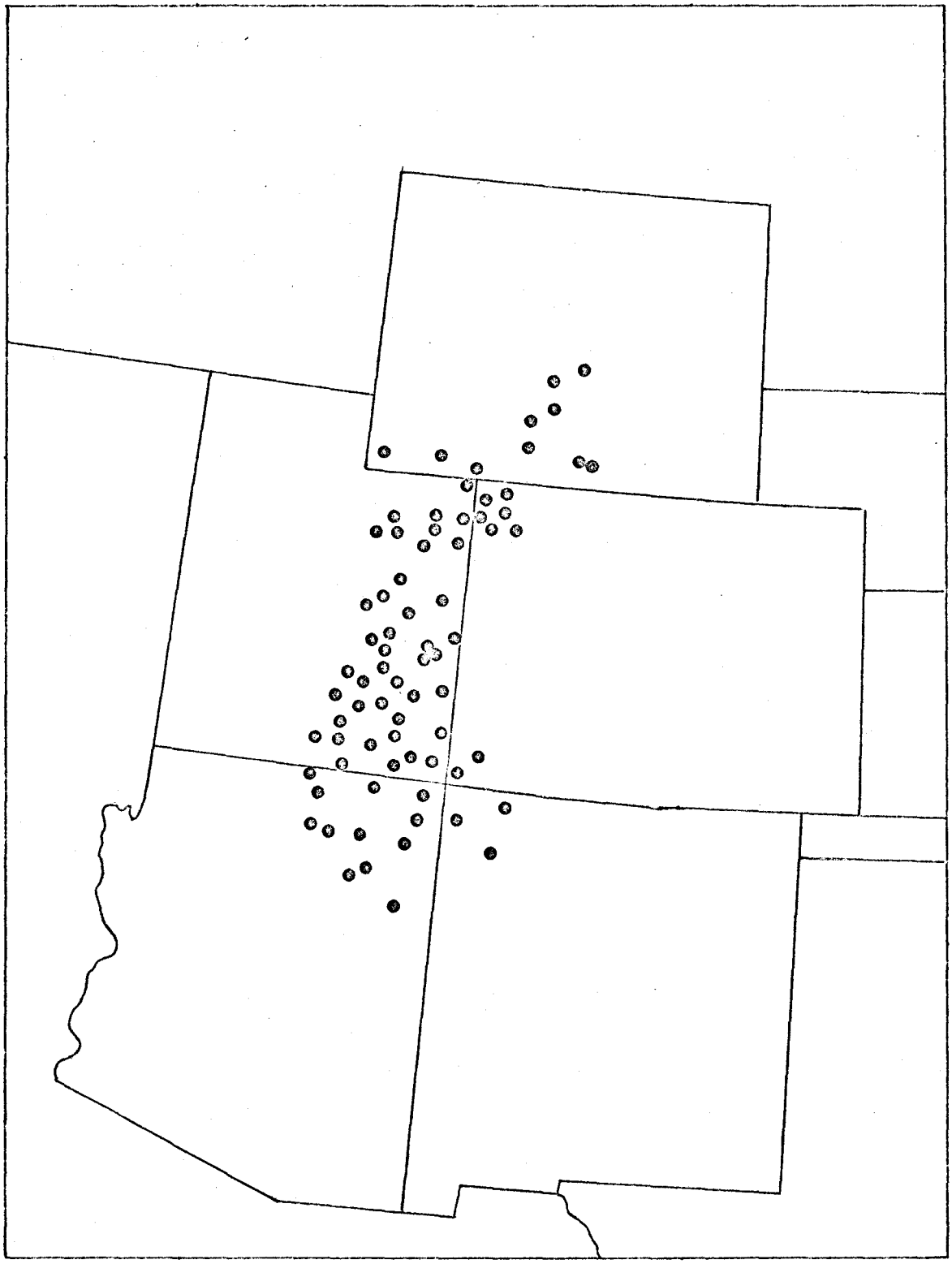
Perennial, 1.3-4 dm tall; stems many from a multiple caudex, 0.8-2.6 dm long, densely long white-hairy at the base, becoming setose and strigose upward; leaves narrowly oblanceolate to nearly linear, acute, 2-9 cm long, 0.3-0.8 cm wide, dorsal surface strigose and appressed setose with pustulate hairs, ventral surface almost uniformly strigose, and with the pustules less conspicuous; inflorescence narrow to somewhat open, 0.5-2.5 dm long, conspicuously yellow setose, the floral bracts inconspicuous; calyx segments linear, in anthesis 8-10 mm long, in fruit becoming 9-12 mm long, densely setose, with yellowish hairs, pedicells 3-5 mm long in fruit; corolla yellow, the tube 9-12 mm long, crests at base of tube absent or nearly so, fornices yellow, truncate, emarginate, 1-1.5 mm long, limb 8-10 mm broad; style exceeding mature fruit 3-7 mm (heterostyled); nutlets lanceolate, 3.4-4 mm long, 1.9-2.2 mm wide, 1-2 usually maturing, margins acute, in contact when more than 1 nutlet matures, both surfaces of nutlet smooth and glossy, scar straigh closed, elevated margin lacking. Collections: 193 (xi); representative: C. F. Baker 562 (ND-G); A. & R. Nelson 785 (ARIZ, ORE); W. A. Weber 3838 (ARIZ, COLO); W. P. Cottam 2050 (BRY); B. Maguire 18302 (UTC); L. C. Higgins 527, 998, 1057, 1073, 1082, 1105 (BRY).

Holotype: A. Nelson 3074, collected in Sweetwater County, Wyoming, at Point of Rocks, 1 June, 1897, RM.

Distribution: Southern Wyoming, south through western Colorado and eastern Utah to northern New Mexico and Arizona. Usually found growing in sandy soil, 4,000 to 7,500 feet. Map No. 7. April to August.

This yellow-flowered species is closely related to C. confertiflo but may be separated from that species by the narrowly lanceolate nutle and the longer thyrsoid inflorescence.

Map No. 7. Parts of western United States. Range of C. flava (A. Nels.) Payson.



Cryptantha flava (A. Nels.) Payson

8. Cryptantha capitata (Eastw.) Johnst.

Cryptantha capitata (Eastw.) Johnst. Journ. Arn. Arb. 21:66. 1940.

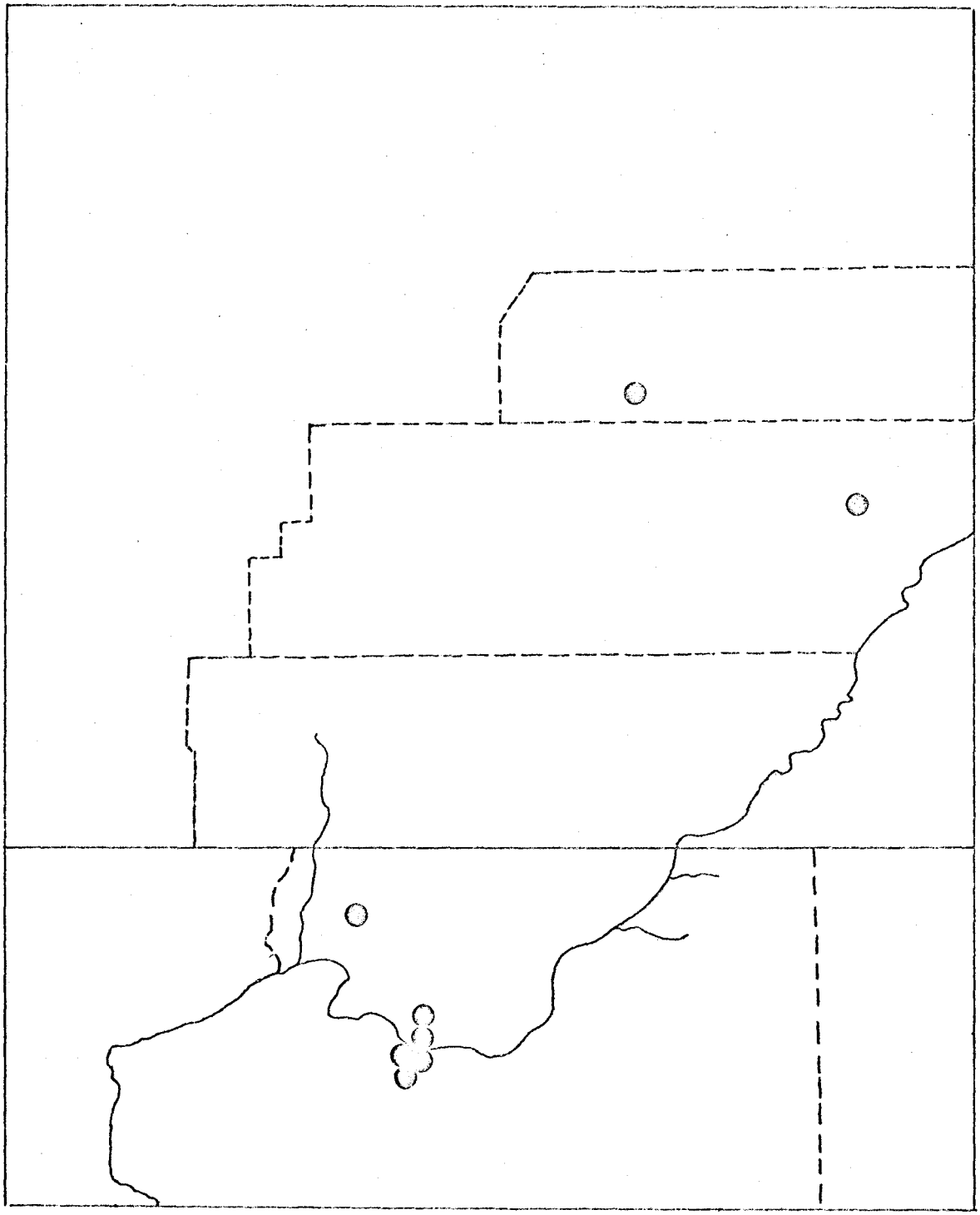
Oreocarya capitata Eastw. Leaflets West. Bot. 1:9. 1937.

Perennial, 1.5-2.7 dm tall; stems weak, 1-several, 1.2-2.4 dm long, appressed setose; leaves linear, or very narrowly oblanceolate, 3-8 cm long, 0.3-0.5 cm wide, dorsal surface appressed setose-pustulate, ventral surface uniformly strigose and without pustules; inflorescence capitate, or with 1 or 2 glomerules below the terminal cluster, 0.1-0.4 dm long, spreading white-setose; calyx segments linear-lanceolate, 7-9 mm long in anthesis, in fruit becoming 11-16 mm long, conspicuously setose-pustulate; corolla white, the tube 9-12 mm long, crests at base of tube conspicuous, fornices yellow, emarginate, about 1 mm long, papillose, limb 6-8 mm wide; style exceeding mature fruit 4-5 mm; nutlets lanceolate, 4-5 mm long, 2-3 mm wide, 2-4 usually maturing, the margins in contact, knife-like, both surfaces glossy-smooth, scar closed, straight, and without an elevated margin. Collections: 11 (0); representative: A. Eastwood & J. T. Howell 1005 (CAS, GH); A. Eastwood 5832, 5969 (CAS, GH); L. White s.n. (MNA); R. E. Collom kt26 (ASC); F. W. Pennell 21575 (ARIZ).

Lectotype: A. Eastwood 5969, collected in Coconino County, Arizona, from Hermit Trail on the south rim of the Grand Canyon, 9 April, 1917, CAS. Photograph at BRY. Isolectotype at GH.

Distribution: Southcentral Utah, and northcentral Arizona in the Colorado River drainage basin. Growing in sandy soil, 6,500 to 8,500 feet. Map No. 8. April to July.

C. capitata is probably most closely related to C. confertiflora, but differs from than species in the more capitate inflorescence, the



Cryptantha capitata (Eastw.) Johnston

narrower leaves, white flowers, with crests at the base of the tube, and usually smaller size.

Two collections by Cronquist & N. Holmgren 9299 and 9365, appear to be the same species, but the leaves are broader. These two collections came from the Henry Mountains and Aquarius Plateau in Utah.

9. Cryptantha johnstonii Higgins

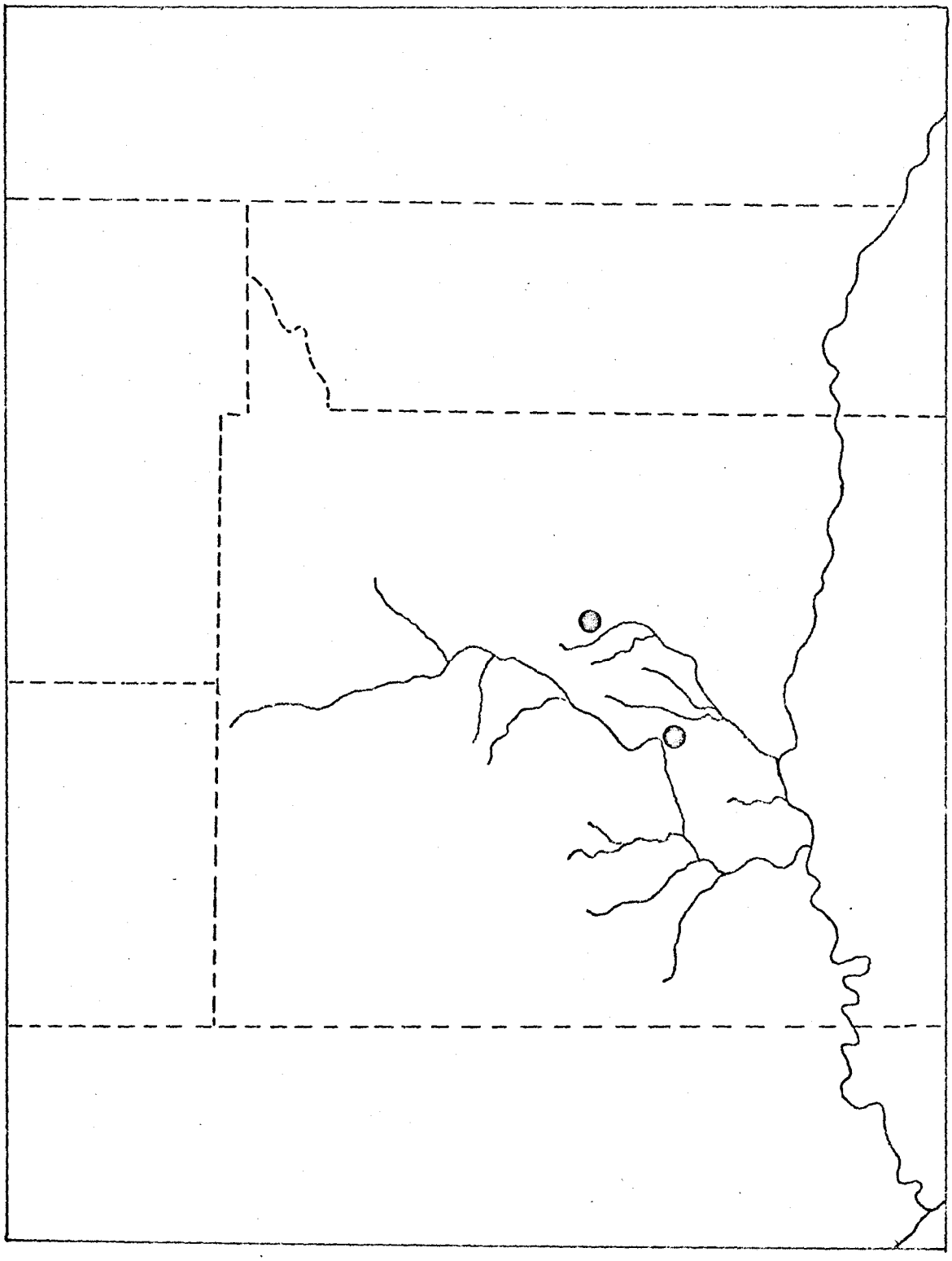
Cryptantha johnstonii Higgins, Great Basin Naturalist 28:195. 1968.

Caespitose perennial 1-2.5 dm tall; stems several, arising from the branched caudex, 0.6-1.3 dm long, very weakly strigose; leaves oblanceolate, the apices obtuse to acute, 2-6.5 cm long, 0.4-1 cm wide, dorsal surface strigose with conspicuous pustulate hairs; inflorescence somewhat open, 0.5-2 dm long; foliar bracts evident but not conspicuous, 1-2 cm long; calyx segments linear lanceolate, in anthesis 5-6 mm long, in fruit becoming 8-10 mm long, strigose and spreading white setose; pedicels 0.5-1 mm long; corolla white, the tube 12-15 mm long, flaring in the throat, crests at base of tube lacking, fornices yellow, 1-1.5 mm long, emarginate, papillose, limb 13-17 mm broad; style exceeding mature fruit 3-8 mm (heterostyled; nutlets ovate, 3-3.5 mm long, 2.3-2.7 mm wide, usually al 4 maturing, the margins acute or knife-like, in contact, both surfaces smooth and glossy, scar straight, closed, elevated margin lacking. Collections: 2 (i); representative: L. C. Higgins 1310 (BRY); B. F. Harrison 5628 (BRY).

Holotype: L. C. Higgins 1310, collected in Emery County, Utah on low rolling hills about 15 miles west of hwy. 50-6 along the road from Woodside to Castle Dale, 25 May, 1968, BRY. Isotypes at CAS, GH, NY, POM, RM, US, UTC.

Distribution: Known only from the type locality 15 miles west

Map No. 9. Emery County, Utah. Range of C. johnstonii Higgins.



Cryptantha johnstonii Higgins

of hwy. 50-6 on the San Rafael Swell, Emery County, Utah. Growing on clayey to sandy soils, 5,000 to 5,500 feet. Map No. 9. May and June.

Cryptantha johnstonii is most closely related to C. confertiflora known from western Utah, northern Arizona, Nevada, and southwestern California. It can be distinguished from that species by its smaller size, longer and more open inflorescence, white flower color, larger corolla with longer fornices and no basal crest.

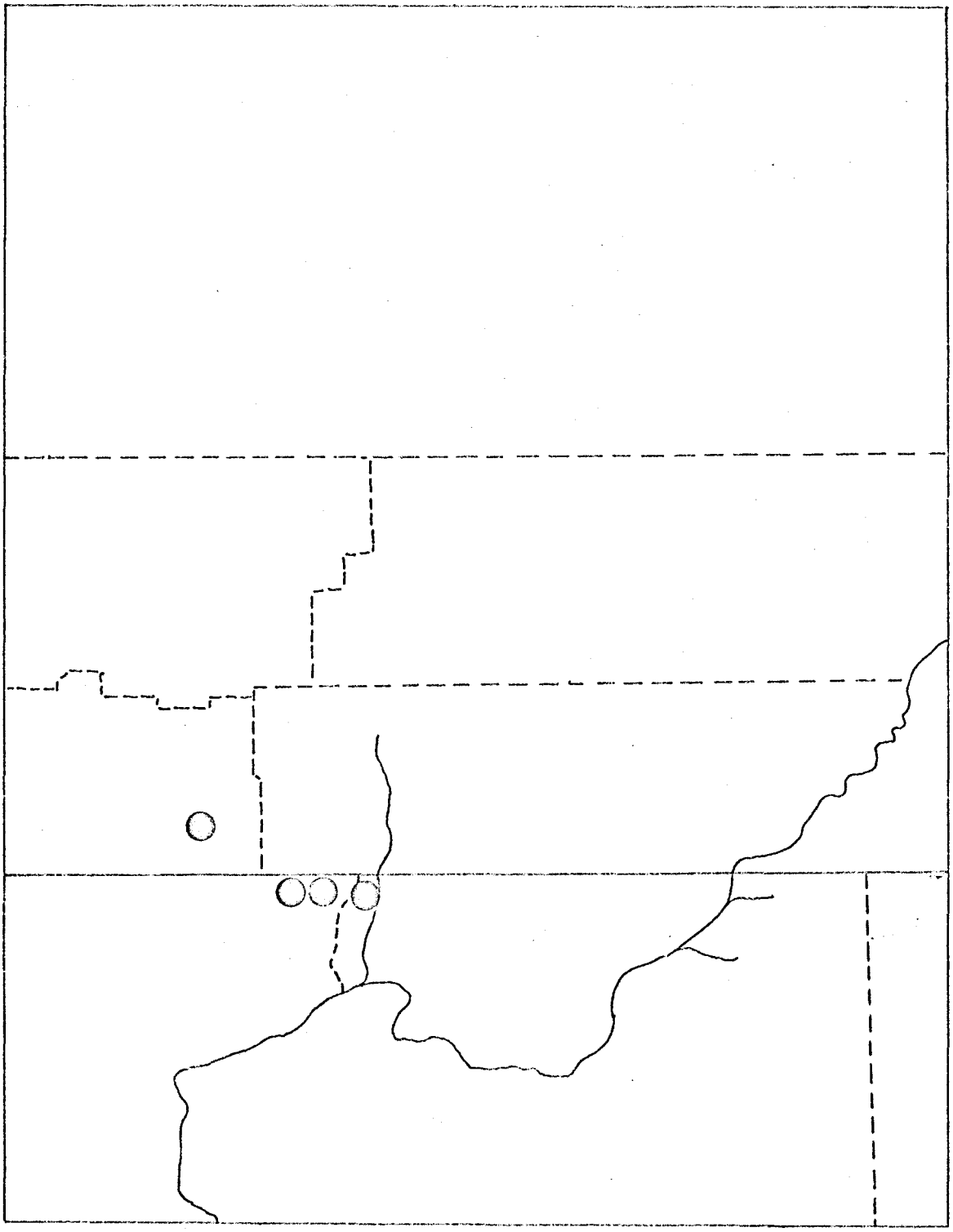
10. Cryptantha semiglabra Barneby

Cryptantha semiglabra Barneby, Leaflets West. Bot. 3:197. 1943.

Erect perennials, 2-3 dm tall; stems 1-several, 0.9-1.8 dm long, retrorsely strigose and weakly spreading setose; leaves oblanceolate, acute, 3-7 cm long, 0.3-0.6 cm wide, dorsal surface appressed setose-pustulate, ventral surface glabrous, the old leaf bases long white-hairy; inflorescence narrow, or somewhat open, 0.4-1.3 dm long, foliar bracts slightly surpassing the cymes, 1.5-2 cm long; calyx segments lanceolate, in anthesis 5-8 mm long, in fruit becoming 10-13 mm long, setose; pedicels 1-2 mm long; corolla white, the tube 10-12 mm long, crests at base of tube conspicuous, fornices yellow, rounded, 1-1.2 mm long, obscurely papillose, limb 8-10 mm wide; style surpassing the mature fruit 5-7 mm; nutlets ovate, 3.5-4 mm long, 2-2.5 mm wide, usually all 4 maturing, margins acute, in contact, both surfaces smooth and glossy, scar closed, elevated margin lacking. Collections: 5 (ii); representative: J. W. Harrison s.n. (DIX); H. D. Ripley & R. C. Barneby 8519 (UTC); D. Atwood 1525 (BRY); L. C. Higgins 1357, 1364 (BRY).

Lectotype: Ripley & Barneby 8429, collected in Coconino County, Arizona, on detrital clay hills about 2 miles east of Fredonia, 4,900 feet, 5 June, 1942, CAS.

Map No. 10. Southern Utah and northern Arizona. Range of *C. semiglabra* Barneby.



Cryptantha semiglabra Barneby

Distribution: Apparently confined to near the type locality, and north just across the state line into Washington and perhaps Kane County Utah. Growing in clay soils, 4,500 to 5,000 feet. Map No. 10. Early May to July.

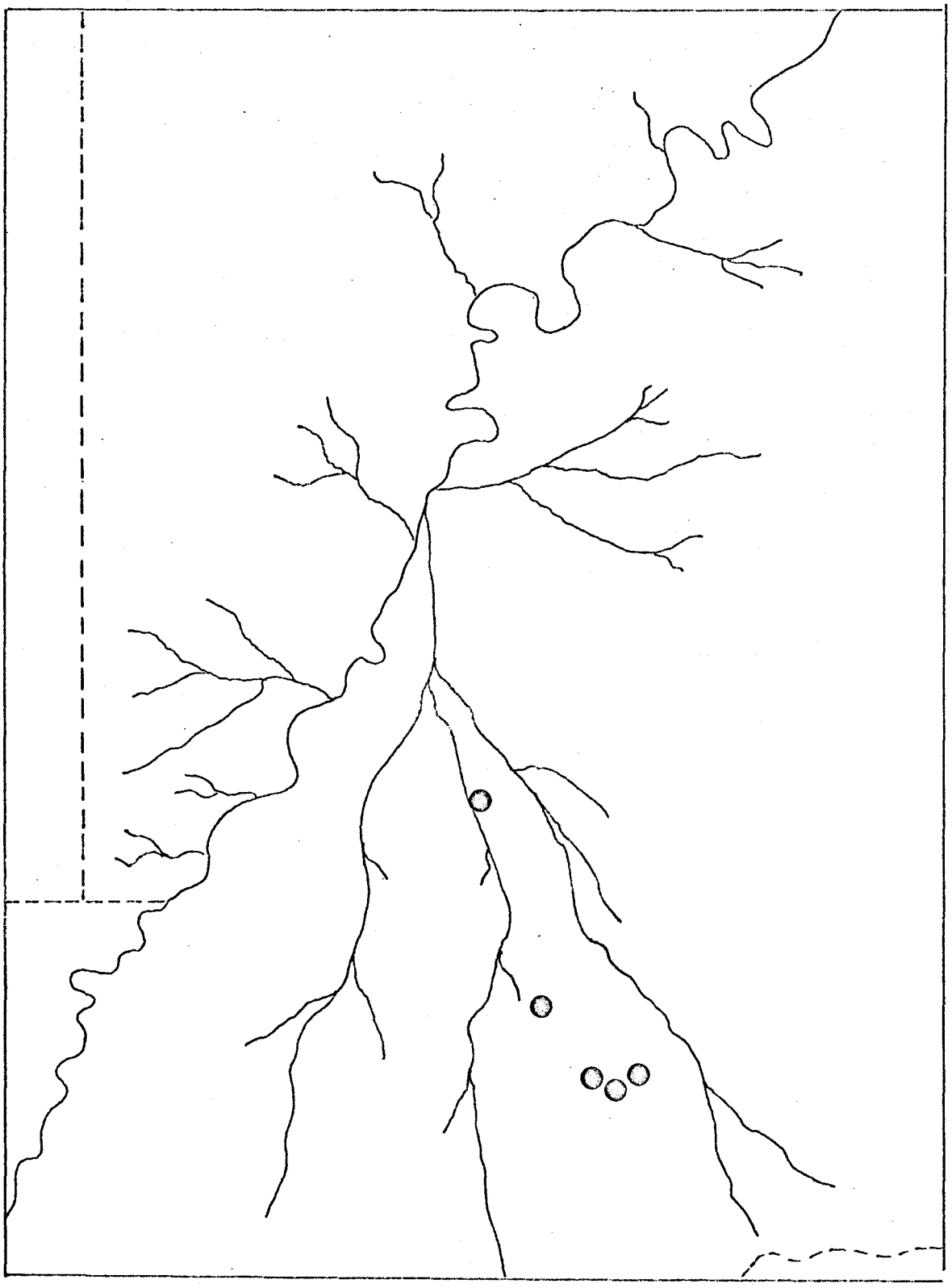
Cryptantha semiglabra is closely related to C. capitata and C. confertiflora. From the former it differs in several important aspects, the most immediate difference being the distribution of pubescence. The upper part of the caudex branches are densely clothed with long white hairs, the lower surface of the leaves are beset with stout appressed setose hairs with pustular bases, while the upper surface is glabrous. The inflorescence of a long narrow thyrsus also distinguishes it from C. capitata. From the latter it may be distinguished by the white flowers, the glabrous ventral surface of the leaves, crests at the base of the corolla tube, and the longer foliar bracts.

11. Cryptantha barnebyi Johnst.

Cryptantha barnebyi Johnst. Journ. Arn. Arb. 29:240. 1948.

Perennial, 1.5-3.5 dm tall; stems stout, erect, several, 0.8-1.2 dm long, conspicuously yellowish hispid; leaves oblanceolate, thick, acute, 5-9 cm long, 0.5-1.4 cm wide, coarsely appressed hispid pustulate on both surfaces, and with some finer hairs beneath, the petioles conspicuously ciliate; inflorescence narrow, 1-1.5 dm long, densely yellowish hispid, foliar bracts evident to conspicuous; calyx segments lanceolate, in anthesis 5-7 mm long, in fruit becoming 8-13 mm long, yellowish hirsute; corolla white or light yellow, the tube 5-7 mm long, crests at base of tube very conspicuous, fornices yellow, emarginate, distinctly papillose, 0.5 mm long, limb 8-11 mm wide; style exceeding mature fruit 5-6 mm; nutlets ovate, 3.5-4 mm long, 2.5-3 mm wide, all 4

Map No. 11. Uintah County, Utah. Range of C. barnebyi Johnston.



Cryptantha barnebyi Johnston

maturing, margins of nutlets in contact, acute, smooth and glossy on both surfaces, scar closed, straight, and without an elevated margin. Collections: 6 (iv); representative: Ripley & Barneby 8748 (GH); D. Atwood 1562 (BRY); L. C. Higgins 1584, 1587, 1599, 1601 (BRY).

Holotype: Ripley & Barneby 8748, collected in Uintah County, Utah, 30 miles south of Ouray on white shale knolls, 5,500 feet, 17 June, 1947, GH. Photograph at BRY.

Distribution: Confined to the lower part of the Uintah Basin, Uintah County, Utah. Growing on white barren shale knolls, 5,000 to 6,000 feet. Map No. 11. May to June.

This endemic species is confined to white shaley knolls, and is the only conspicuous plant on them. In the western part of its range it is found growing with C. grahamii, but still limited to white shale.

In the original description of this species the corolla was described as being long tubed and protruding beyond the sepals. In observing this plant in the field the corollas do not exceed the calyx, or if they do, it is by less than 1 mm.

C. barnebyi is a very distinctive species, and is probably most closely related to C. confertiflora or C. johnstonii, but may be distinguished from both of them by the thick stout stems, campanulate corolla, harsher hispid pubescence, and the more woody caudex.

12. Cryptantha leucophaea (Dougl.) Payson

Cryptantha leucophaea (Dougl.) Payson, Ann. Mo. Bot. Gard. 14:262. 1927.

Myosotis leucophaea Dougl. in Lehm. Pug. 2:22. 1830.

Eritrichium leucophaeum (Dougl.) A. DC. Prod. 10:129. 1846.

Krynitzkia leucophaea (Dougl.) Gray, Proc. Am. Acad. 20:280. 1885.

Oreocarya leucophaea (Dougl.) Greene, Pitt. 1:58. 1887.

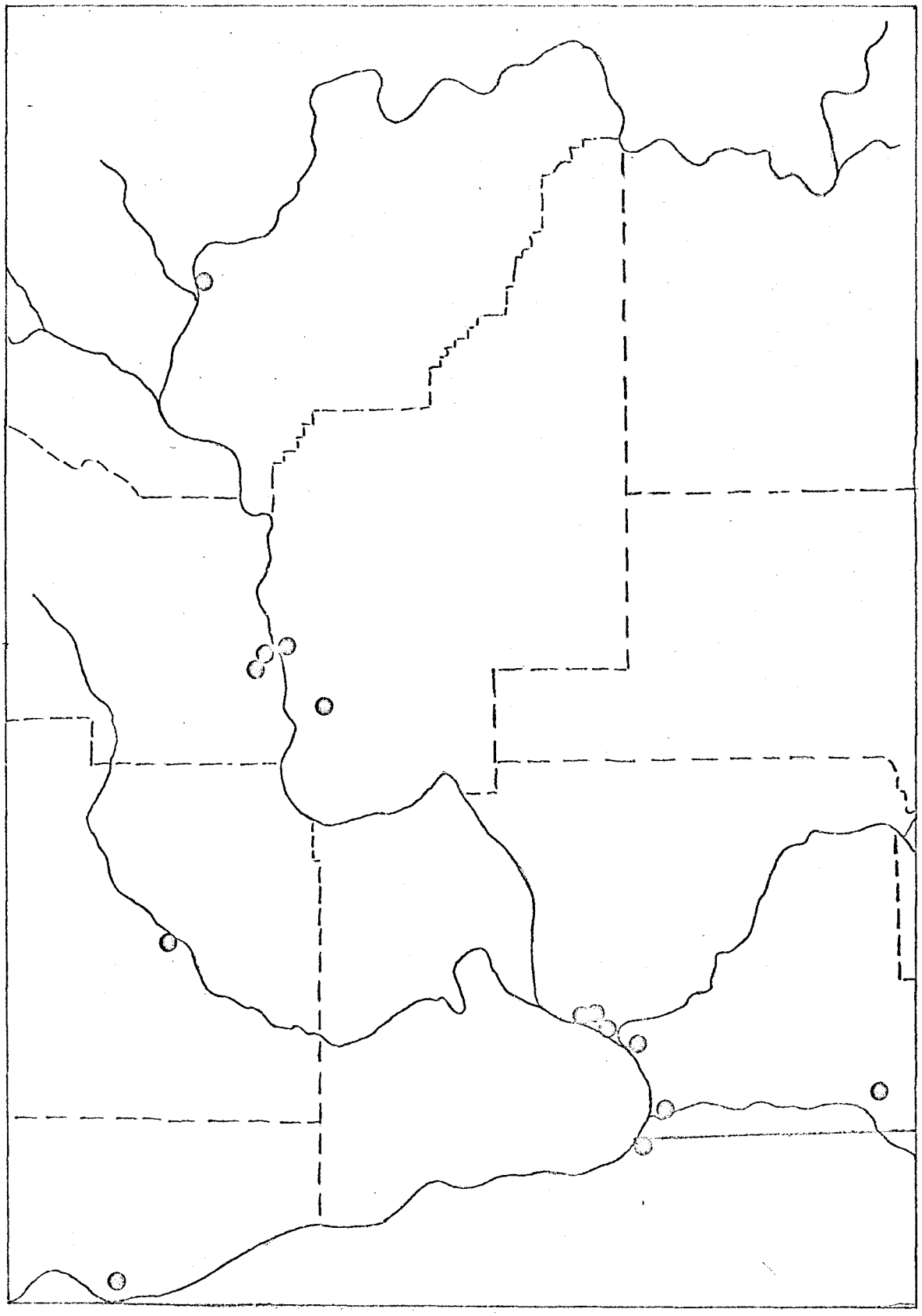
Long-lived perennials, 1.5-3.7 dm tall; stems slender, 1-several from a multiple caudex, 1.2-2.3 dm long, strigose, and appressed setose, leaves linear to narrowly oblanceolate, acute, 3-9 cm long, 0.4-0.7 cm wide, dorsal surface densely strigose, and with appressed setose hairs, pustulate, ventral surface unifromly strigose and with few or no pustulate hairs, petioles white-ciliate; inflorescence narrow, 0.8-1.7 dm long, conspicuously white setose, foliar bracts evident but not conspicuous; calyx segments linear, in anthesis 6-8 mm long, in fruit becoming 10-15 mm long, setose; corolla white, the tube 8-10 mm long, crests at base of tube evident, fornices yellow, emarginate, 0.5-1 mm long, limb 8-10 mm wide; style exceeding mature fruit 2-8 mm (heterostyled); nutlets ovate, 3.5-4.5 mm long, 2.5-3 mm wide, usually less than 4 maturing, margins acute, in contact, both surfaces smooth and glossy, scar straight, closed, elevated margin lacking. Collections: 16 (0); representative: J. H. Sandberg & J. B. Leiberg 373 (RM, US); J. W. Thompson 11453 (US, WTU); T. S. Brandegee 997 (US); L. Hitchcock 20952 (RM); A. Elmer 1056 (US); J. S. Cotton 1027 (US).

Type: Douglas s.n., collected in Washington State, on arid barrens of the Columbia River. Not seem.

Distribution: Upper Sonoran Zone in south-central Washington along the Columbia River and its northern and southern tributaries. Growing in sandy soil. Map No. 12. Late April to early July.

This species of south-central Washington is most closely related to C. confertiflora, but differs from this species by the white corolla, the open and more elongated inflorescence, and the evident crests at the base of the corolla tube.

Map No. 12. Central and southern Washington. Range of C. leucophaea (Dougl.) Payson.



Cryptantha leucophaea (Dougl.) Payson

13. Cryptantha salmonensis (Nels. & Macbr.) Payson

Cryptantha salmonensis (Nels. & Macbr.) Payson, Ann. Mo. Bot. Gard. 14: 263. 1927.

Oreocarya salmonensis Nels. & Macbr. Bot. Gaz. 61:43. 1916.

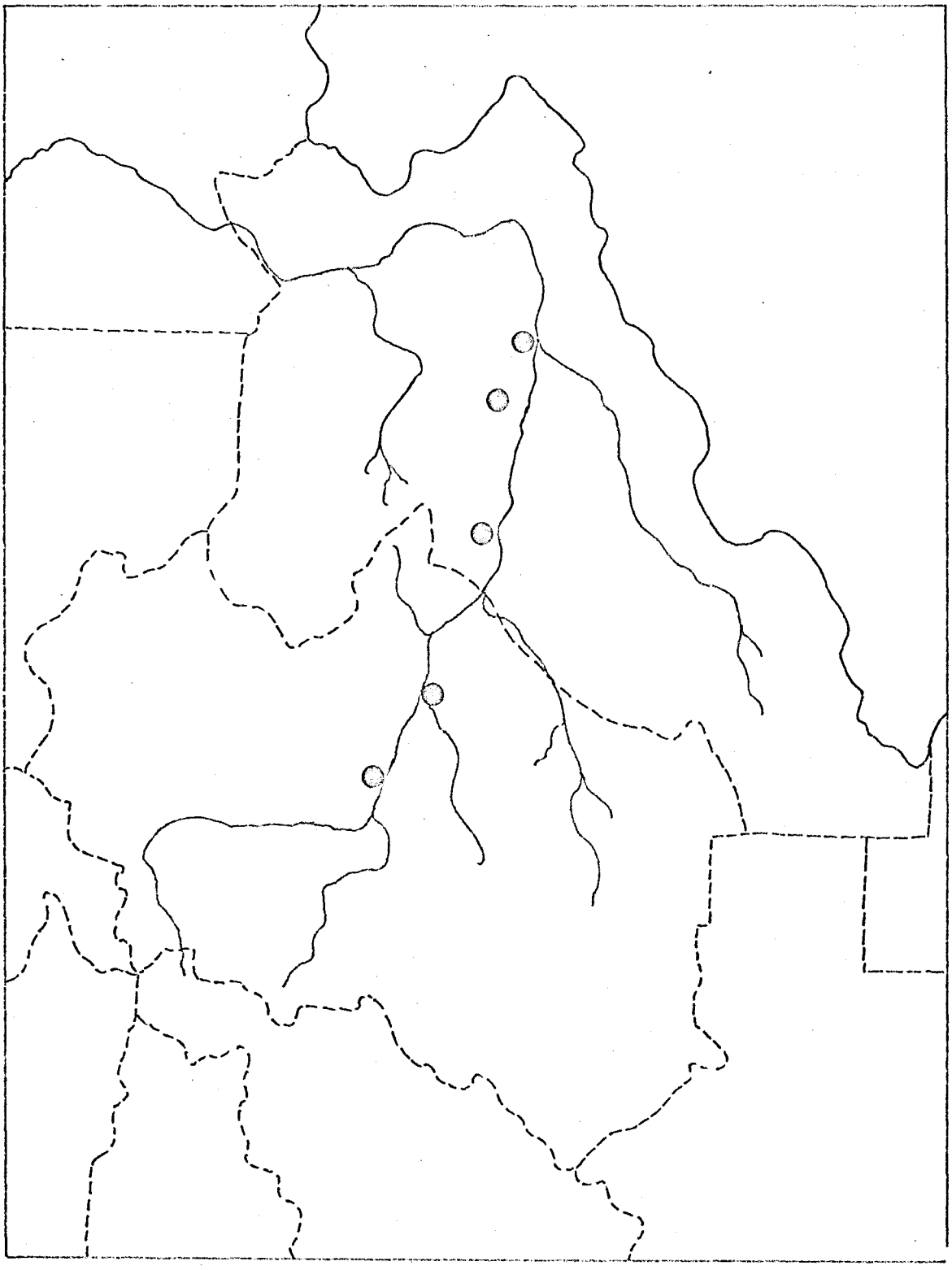
Moderately caespitose perennials, 1.5-3.5 dm tall; stems erect, 0.7-1.5 dm long, strigose, and with some white spreading setose hairs; leaves oblanceolate to spatulate, 2-9 cm long, 0.5-1.5 cm wide, strigose and spreading setose, also somewhat tomentose, pustulate on both of the surfaces; inflorescence narrow, 1-1.8 dm long, foliar bracts evident but not conspicuous; calyx segments lanceolate, 3-4 mm long in anthesis, in fruit becoming 6-8 mm long, setose; corolla white, the tube 3-4 mm long, fornices yellow, rounded, papillose, crests at base of tube well developed, limb 7-10 mm wide; nutlets lanceolate, 3-4 mm long, 1.5-2 mm wide, all 4 usually maturing, acute or narrowly winged-margined, the margins in contact, smooth and glossy on both surfaces, scar straight, closed, and without an elevated margin. Collections: 10 (iv); representative: Macbride & Payson 3348 (RM); Hitchcock & Muhlick 8950 (UTC); A. Cronquist 3812 (UTC); E. B. Payson 1880 (RM); L. C. Higgins 1710, 1711, 1713, 1714, 1715 (BRY).

Holotype: Kirtley s.n., collected in Lehmi County, Idaho, at Salmon, June, 1896, RM. Photograph at BRY.

Distribution: Along the Salmon River in Lehmi and Custer Counties, Idaho. Growing on loose talus slopes of volcanic origin, 4,500 to 7,500 feet. Map No. 13. June to August.

Cryptantha salmonensis is apparently confined to the Salmon River drainage of south-central Idaho. It is perhaps most closely related to C. leucophaea, but differs from that taxon by the short corollas, more

Map No. 13. Central Idaho. Range of C. salmonensis (Nels. & Macbr.) Payson.



Cryptantha salmonensis (Nels. & Macbr.) Payson

lanceolate nutlets, shorter style, and shorter inflorescence.

14. Cryptantha stricta (Osterh.) Payson

Cryptantha stricta (Osterh.) Payson, Ann. Mo. Bot. Gard. 14:264. 1927.

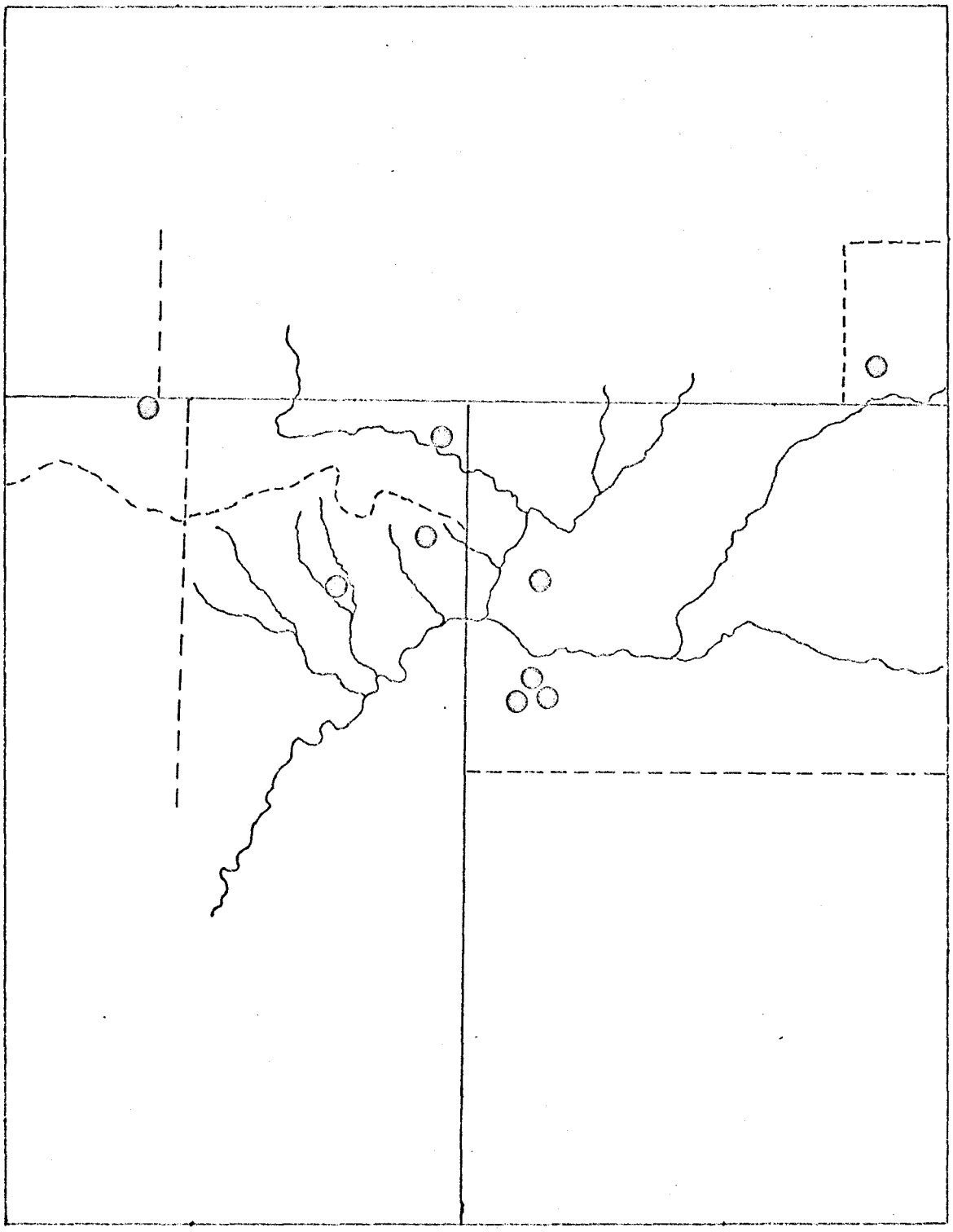
Oreocarya stricta Osterh. Bull. Torrey Bot. Club 50:217. 1923.

Strict perennial, 1-3.7 dm tall; stems 1-several, 0.4-2 dm long, strigose and conspicuously setose-hirsute; leaves mostly basal, oblanceolate to spatulate, acute, 2-7 cm long, 0.4-0.9 cm wide, retrorsely strigose and spreading setose-hirsute, pustulate; inflorescence narrow, interrupted below the terminal cluster, 0.5-2 dm long, setose-hirsute, floral bracts inconspicuous; calyx segments lanceolate, 4-6 mm long in anthesis, in fruit becoming 7-9 mm long, setose-hirsute; corolla white, the tube 3-4 mm long, crests at base of tube conspicuous, fornices yellow, rounded, papillose, limb 7-10 mm wide; style exceeding mature fruit 1-1.5 mm; nutlets lanceolate to elliptic, 3-3.5 mm long, 1.5-2 mm wide, usually all 4 maturing, margins in contact, knife-like, dorsal surface with definite transverse ridges, also somewhat tuberculate, ventral surface smooth or nearly so, scar open, very narrowly linear, elevated margin lacking. Collections: 12 (0); representative: E. H. Graham 8163 (GH); L. Williams 489 (GH); R. C. Barneby 9145 (GH); Welsh & Moore 6714 (BRY); W. J. MacLeod 10a (COLO, CS); G. E. Osterhout 6391 (RM).

Holotype: G. E. Osterhout 6195, collected in Moffat County, Colorado, some distance south of the Yampa or Bear River along the Victory hwy., 21 June, 1922, GH. Photograph at BRY. Isotype at RM.

Distribution: Southwestern Wyoming in Carbon County, south into Moffat County, Colorado, and west to Utah in Uintah, Daggett, and Summit Counties. Growing on clay soils, 5,000 to 8,500 feet. Map No.

Map No. 14. Northeastern Utah and adjoining Colorado and Wyoming. Range of C. stricta (Osterhout) Payson.



Cryptantha stricta (Osterhout) Payson

14. June to September.

Cryptantha stricta is an endemic species, confined to the three corners area of Colorado, Wyoming, and Utah. In general appearance it somewhat resembles C. celosioides, but is probably not very closely related to that plant. It may be distinguished from other species in the Uintah Basin by the strict stems with harsh setose hairs, the nutlets which are smooth on the ventral surface, and the conspicuous transverse ridges on the dorsal surface.

15. Cryptantha nubigena (Greene) Payson

Cryptantha nubigena (Greene) Payson, Ann. Mo. Bot. Gard. 14:265. 1927.

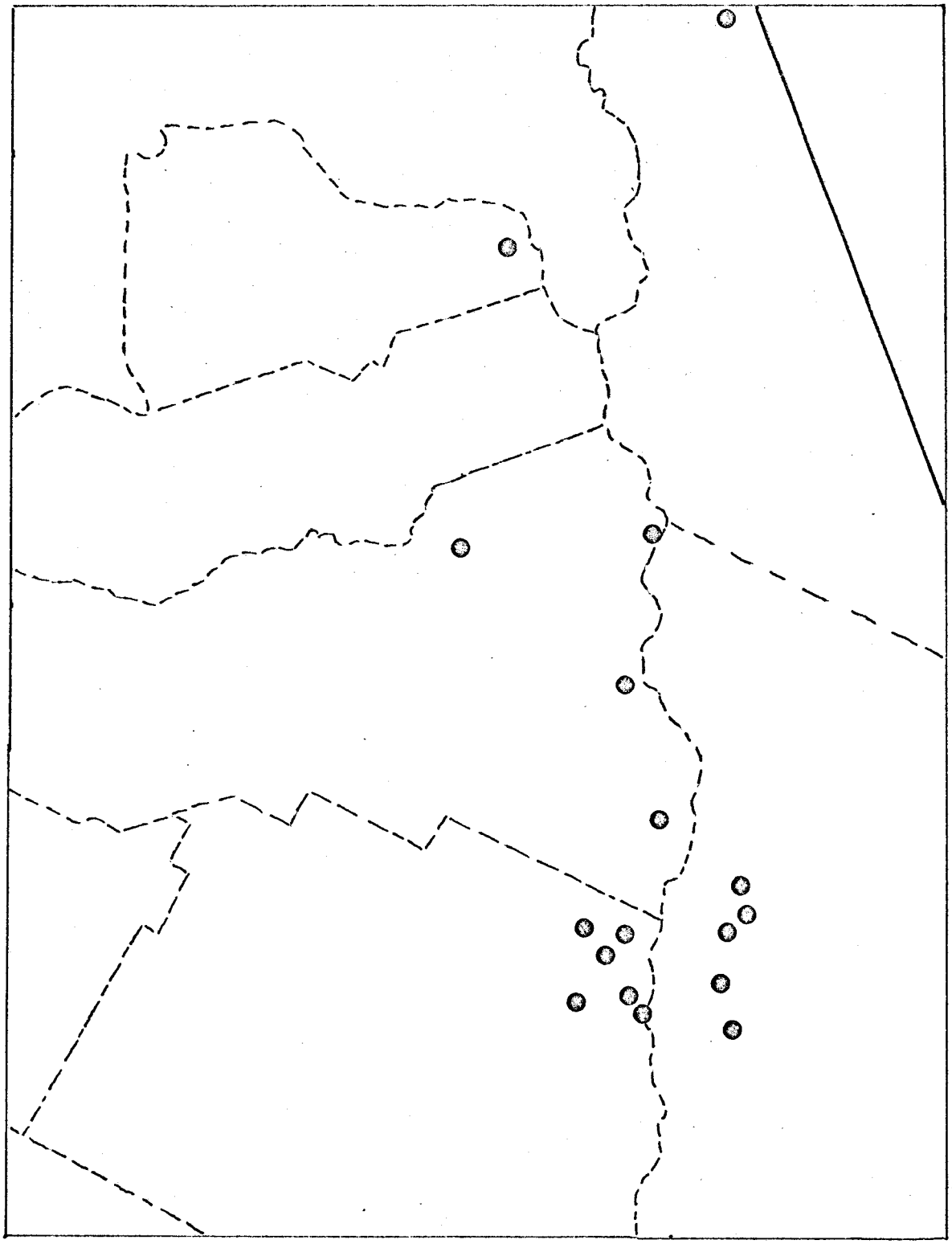
Oreocarya nubigena Greene, Pitt. 3:112. 1896.

Cryptantha clemensae Payson, Ann. Mo. Bot. Gard. 14:267. 1927.

(Type: Glenn's Pass, California, Mrs. Joseph Clemens, 22 July, 1910, RM.)

Short-lived perennials, 0.8-2.5 dm tall; stems several from a slender taproot, 0.4-1 dm long, setose; leaves narrowly oblanceolate, flaccid, obtuse to acute, 2-5 cm long, 0.3-0.7 cm wide, strigose and spreading setose, dorsal surface pustulate, ventral surface with few or no pustules; inflorescence narrow, cylindrical or nearly capitate, 0.4-2 dm long, foliar bracts inconspicuous; calyx segments linear-lanceolate, in anthesis 2.5-3 mm long, in fruit becoming 4-6 mm long, setose; corolla white, the tube 2-2.5 mm long, crests at base of tube evident, fornices light-yellow to nearly white, rounded, about 0.5 mm long, slightly papillose, limb 3.5-5 mm wide; style exceeding mature fruit 0.5-1 mm; Nutlets narrowly lanceolate, papery, 2.8-3.2 mm long, 1.3-1.5 mm wide, margin narrowly winged, in contact, dorsal surface weakly tuberculate to nearly smooth, ventral surface smooth, scar open, narrowly linear,

Map No. 15. Parts of southern California. Range of *C. nubigena* (Greene) Payson.



Cryptantha nubigena (Greene) Payson

margin of scar not elevated. Collections: 32 (O); representative: Chestnut & Drew s.n. (ND-G); G. T. Robbins 3399 (RM, WTU); P. A. Munz 12547 (POM, WTU); J. T. Howell 25933 (POM, UTC); F. W. Pierson 14030 (POM); Alexander & Kellogg 4552 (UTC).

Lectotype: Chestnut & Drew s.n., collected in Mariposa County, California, on Clouds Rest, Yosemite Natl. Park, 10 July, 1889, ND-G. Photograph at BRY. Isotype at CALIF.

Distribution: East-central California in Inyo, Tulare, Frenso, Mono, and Mariposa Counties. Growing in gravelly soil or talus slopes of volcanic origin, 9,000 to 13,000 feet. Map No. 15. July to September.

This species is endemic to the high Sierras, chiefly between 9,000 and 12,500 feet. The specimens of this species available to past monographers has been very poor and scanty. Payson saw a poor isotype of the species and mistakenly identified it with some plants of Oregon and Idaho. The reasonably good specimens of this plant from the southern Sierras Payson described as a new species C. clemensae. This latter name however falls in synonymy of C. nubigena and the plants of Oregon and Idaho mistakenly called nubigena were described as new by Johnston. The oregon plant is now known as C. subretusa, and the Idaho plant as C. hypsophila. C. nubigena may be separated from the latter two by being a weaker, more slender, more bristly plant with less firm, green, basal leaves, much smaller, smoother nutlets, and a more interrupted inflorescence with a capitate terminal cluster, and scattered smaller lateral ones below.

16. Cryptantha subretusa Johnst.

Cryptantha subretusa Johnst. Journ. Arn. Arb. 20:393. 1939.

Cryptantha andina Johnst. ex M. E. Peck, Man. Pl. Ore. 601. 1941.

(Without latin diagnosis or type.)

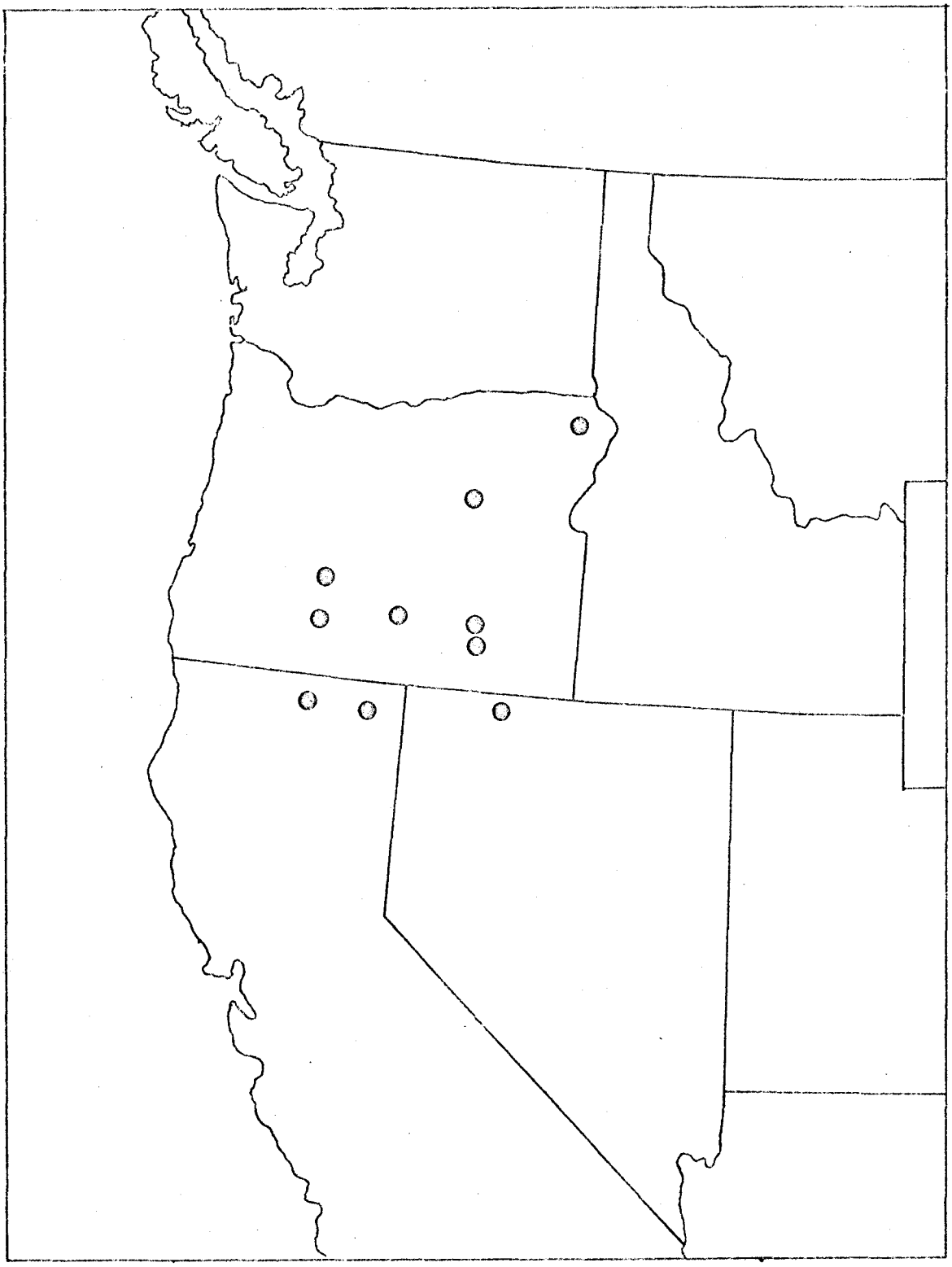
Oreocarya subretusa (Johnst.) Abrams, Ill. Fl. Pac. St. 3:599. 1951.

Caespitose perennial, 1-2 dm tall; stems several, 0.5-1.5 dm long, setose; leaves spatulate, subretuse or obtuse at apex, congested at the base, reduced upward, 1-4 cm long, 0.4-1 cm wide, tomentose and weakly setose, pustules conspicuous on the dorsal surface, fewer and less evident on the ventral surface; inflorescence compact, cylindric, 0.2-1 dm long, spreading setose, floral bracts inconspicuous; calyx segments lanceolate, 3-4 mm long in anthesis, in fruit becoming 6-9 mm long, setose and subtomentose; corolla white, the tube 3-4 mm long, crests at base of tube conspicuous, fornices yellow, rounded, papillose, about 0.5 mm long, limb 4-6 mm wide; style exceeding mature fruit 0.5-1 mm; nutlets lanceolate, 3-4 mm long, 2-2.5 mm wide, 2-4 maturing, the margins in contact, knife-like or narrowly winged, dorsal surface inconspicuously tuberculate, and with low short ridges, ventral surface similar, but the markings much less evident, or smooth, scar open, subulate or narrowly linear, and without an elevated margin. Collections: 25 (O); representative: J. W. Thompson 12206 (GH, POM, WTU); R. L. Rogers 87 (ORE); W. H. Baker 6282 (WTU); W. C. Cusick 2028 (ND-G, RM); C. G. Hansen 534 (GH, ORE); G. Mason 7502 (ORE); M. E. Peck 19480 (GH).

Holotype: J. W. Thompson 12206, collected in Klamath County, Oregon, on pumice rim of Crater Lake, 7,000 feet, 20 July, 1935, GH. Photograph at BRY. Isotypes at POM, WTU.

Distribution: Northeastern Oregon in Wallowa County, south to Harney County, and to Humbolt County, Nevada. West to northern California, and north into Klamath County, Oregon. Growing on pumice or talus slopes slopes of volcanic origin, 6,500 to 10,000 feet.

Map No. 16. Western United States. Range of C. subretusa Johnston.



Cryptantha subretusa Johnston

Map. No. 16. June to August.

Generally C. subretusa may be distinguished from the other plants of Oregon by its elongate nutlets, tomentulose thickish obtuse, truncate or subretuse basal leaves, and the small corollas.

The account of C. rubigena in Payson's monograph applies almost entirely to this species. His discription, as well as the nutlets belong to C. subretusa.

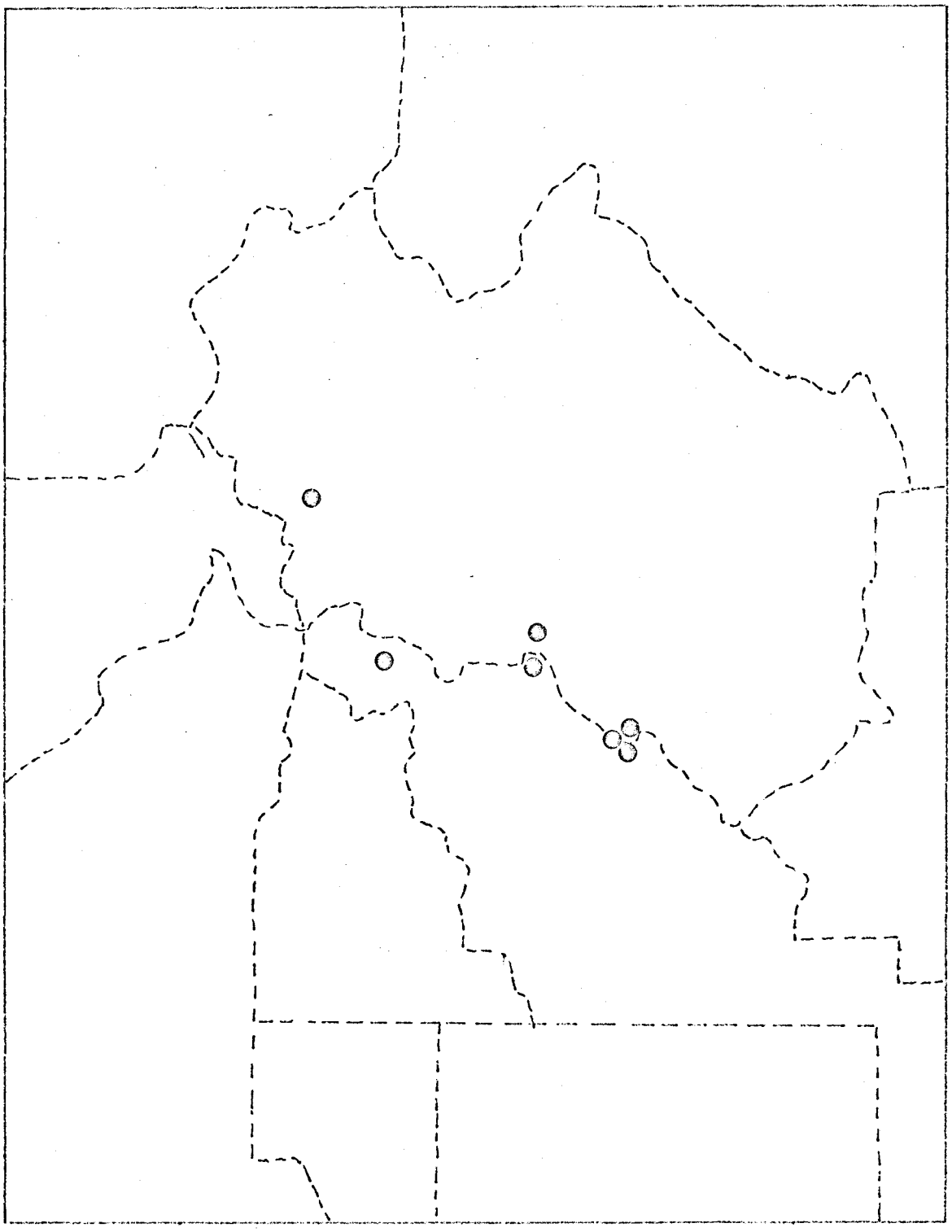
17. Cryptantha hypsophila Johnst.

Cryptantha hypsophila Johnst. Journ. Arn. Arb. 20:395. 1939.

Caespitose perennials, 1-2 dm tall; stems several, 0.5-1.4 dm long, setose-hispid; leaves oblanceolate-spatulate, obtuse, 2-6 cm long, 0.3-0.7 cm wide, strigose and spreading setose, dorsal surface evidently pustulate, ventral surface with fewer pustulae; inflorescence narrow, 0.2-0.7 dm long, foliar bracts inconspicuous; calyx segments lanceolate, 3-4 mm long in anthesis, in fruit becoming 5-7 mm long, setose-hirsute, corolla white, the tube 3-4 mm long, crests at base of tube well developed, fornices yellow, rounded, limb 4-5 mm wide; style exceeding mature fruit 1.2-1.5 mm; nutlets oblong-lanceolate, 3-3.7 mm long, 1.5-1.8 mm wide, margins acute, in contact, dorsal surface tuberculate or some of these connected to form short low ridges, ventral surface smooth or nearly so, scar narrowly linear, the margin not elevated. Collections: 11 (O); representative: J. W. Thompson 14129 (GH, WTU); A. Cronquist 2894 (GH, IDS); C. L. Hitchcock & C. V. Muhlick 10676 (WTU); Macbride & Payson 3771 (POM).

Holotype: J. W. Thompson 14129, collected in Blaine County, Idaho, on crest of high barren ridge at head of Boulder Creek, Sawtooth Mountains, 11,000 feet, 6 August, 1937, GH. Photograph at BRY. Isotype

Map No. 17. Central Idaho. Range of C. hypsophila Johnston.



Cryptantha hypsophila Johnston

at WTU.

Distribution: Endemic to central Idaho in Blaine and Custer Counties. Growing on talus slopes and soils of volcanic origin, 8,000 to 11,500 feet. Map No. 17. July and August.

Payson identified this plant as part of C. nubigena. Its affinities, however, are not with that plant but with C. subretusa of Oregon. The Idaho plant can be distinguished by its spreading bristly hairs, narrower nutlets, and narrower less firm leaves that are obtuse or acute at the apex.

This species may also be confused with C. spiculifera, but differs in being a smaller and more caespitose plant, with more elongate nutlets, and shorter basal leaves. It is also separated from this plant in elevation and flowering time.

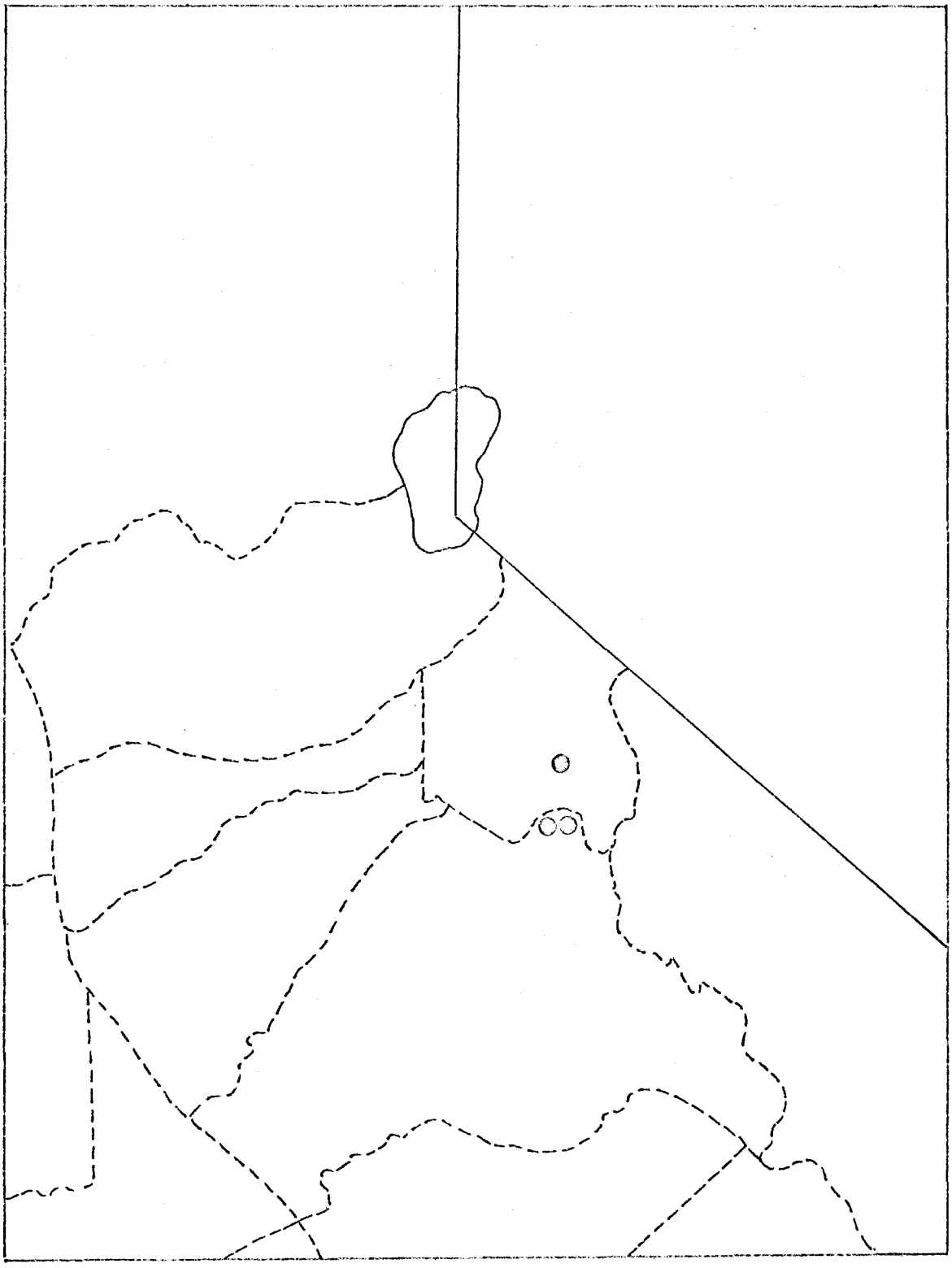
18. Cryptantha crymophila Johnst.

Cryptantha crymophila Johnst. Journ. Arn. Arb. 21:65. 1940.

Oreocarya crymophila (Johnst.) Jeps. & Hoover, in Jepson Fl. Calif. 3:328. 1943.

Perennial, 1.5-3 dm tall; stems 1-several, 0.9-1.3 dm long, erect, hirsute; leaves oblanceolate, 4-10 cm long, 0.5-1.3 cm wide, finely setose and appressed hirsute, the dorsal setae pustulate at base, the ventral with fewer pustules; inflorescence narrow, 1.9-2.3 dm long, setose; calyx segments lanceolate, 4-5 mm long in anthesis, in fruit becoming 10-14 mm long, hirsute; corolla white, the tube 3-5 mm long, crests at base of tube evident, fornices yellow, rounded, papillose, 0.5 mm long, limb 4-7 mm wide; style exceeding mature fruit 1-2 mm; nutlets ovoid, usually 4 maturing, 5-6 mm long, 3-3.5 mm wide, the margins in contact, winged, dorsal surface with low ridges, also inconspicuously muricate, to nearly smooth, ventral surface smooth, scar open, linear,

Map No. 18. Eastcentral California and adjoining Nevada. Range of C. crymophila Johnston.



Cryptantha crymophila Johnston

and without an elevated margin. Collections: 4 (ii); representative: R. F. Hoover 4193 (GH); C. B. Hardham 6510 (POM); L. C. Higgins 1766, 1767 (BRY).

Holotype: R. F. Hoover 4193, collected in Alpine County, California, on Red Peak, 28 July, 1939, GH. Photograph at BRY.

Distribution: Alpine ridges between the Clark Fork and the Middle Fork of the Stanislaus River in Alpine and Tuolumne Counties, California. Growing in loose rocks of volcanic origin, 9,000 to 10,000 feet. Map No. 18. Late June to September.

This species is probably closely related to C. nubigena of the southern Sierras. It differs from this plant by the taller habit, more elongate leaves, much larger fruiting calyces, and the larger more rugose nutlets which are definitely winged-margined.

19. Cryptantha setosissima (Gray) Payson

Cryptantha setosissima (Gray) Payson, Ann. Mo. Bot. Gard. 14:268. 1927.

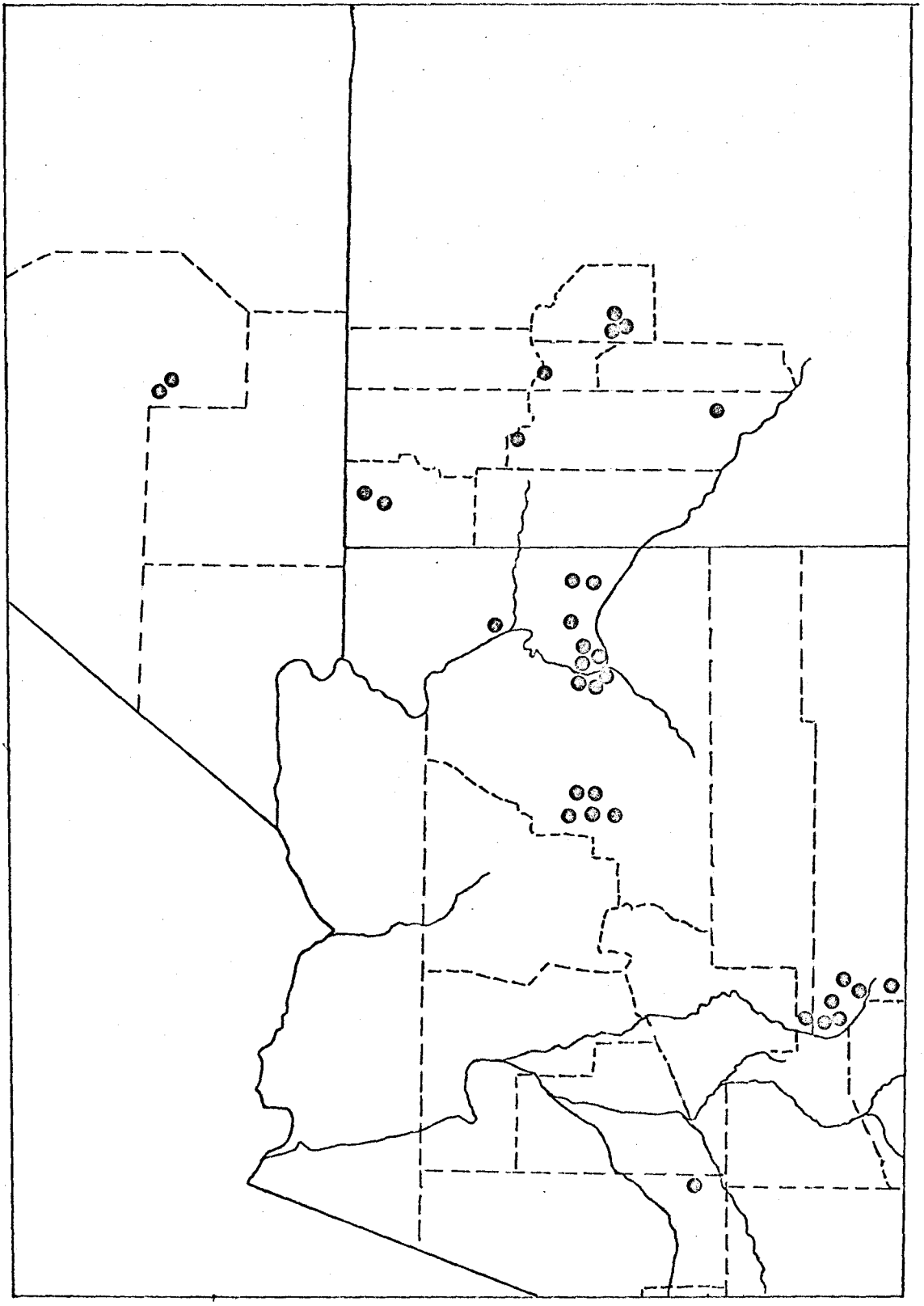
Eritrichium setosissima Gray, Proc. Am. Acad. 12:80. 1877.

Krynitzkia setosissima (Gray) Gray, Proc. Am. Acad. 20:276. 1885.

Oreocarya setosissima (Gray) Greene, Pitt. 1:58. 1887.

Biennial or short-lived perennials, 3-10 dm tall, stems usually 1-3, erect, 1.5-5 dm long, hirsute; leaves clustered at the base, reduced upward, oblanceolate, the apices obtuse to acute, 3-13 cm long, 0.5-1.5 cm wide, setose, with some finer twisted pubescence beneath, pustulate hairs numerous on both surfaces; inflorescence broad-topped due to the elongation of the scorpioid racemes, 1-5 dm long; calyx segments broadly lanceolate, 4-6 mm long in anthesis, in fruit becoming 9-11 long, setose, and strigose; corolla white, the tube 3-5 mm long, constricted above the ovary by the conspicuous ring of crests, fornices yellow, emarginate,

Map No. 19. Utah, Arizona and southeastern Nevada. Range of *C. setosissima* (Gray) Payson.



Cryptantha setosissima (Gray) Payson

0.5 mm long, limb 7-9 mm wide; style exceeding mature fruit 1-2 mm; nutlets ovate, 5-6 mm long, 3.5-4.5 mm wide, papery, with a broad winged margin, dorsal surface muricate, and inconspicuously rugose or tuberculate, ventral surface smooth or nearly so, scar straight, narrow, slightly open, elevated margin lacking. Collections: 58 (viii); representative: Maguire & Holmgren 25583 (BRY, ORE, RM, UTC); L. F. Ward 646 (UC); R. H. Peebles 12566 (ARIZ); D. T. MacDougal 165 (ARIZ, RM); C. F. Deaver 6306 (ASC); W. D. Stanton 516 (UT); E. Palmer 591 (US); L. C. Higgins 1125, 1117, 1440, 1775, 1795 (BRY).

Holotype: L. F. Ward 646, collected in Sevier County, Utah, at Fish Lake, 25 August, 1875, GH. Photograph at BRY. Isotypes at UC, MO, PH, US.

Distribution: Central Utah, south through most of Arizona in the mountainous areas, west to Nye County, Nevada. Growing in gravelly to sandy soils, 7,000 to 10,000 feet. Map No. 19. June to September.

This is one of the most distinctive species in the entire genus. It may be separated from all other species by the stout, strict, solitary stems, and the broadly winged ovate nutlets.

20. Cryptantha virgata (Porter) Payson

Cryptantha virgata (Porter) Payson, Ann. Mo. Bot. Gard. 14:270. 1927.

Eritrichium virgatum Porter, Hayden Rept. 479. 1870.

Eritrichium glomeratum var. virgatum Porter, in Porter & Coulter, Syn. Fl. Colo. 102. 1874.

Krynitzkia virgata (Porter) Gray, Proc. Am. Acad. 20:279. 1885.

Oreocarya virgata (Porter) Greene, Pitt. 1:58. 1887.

Oreocarya spicata Rydb. Bull. Torrey Bot. Club 36:678. 1909.

(Type: Artists Glen, Pikes Peak, Colorado, 1 August, 1901,

Clements 102.)

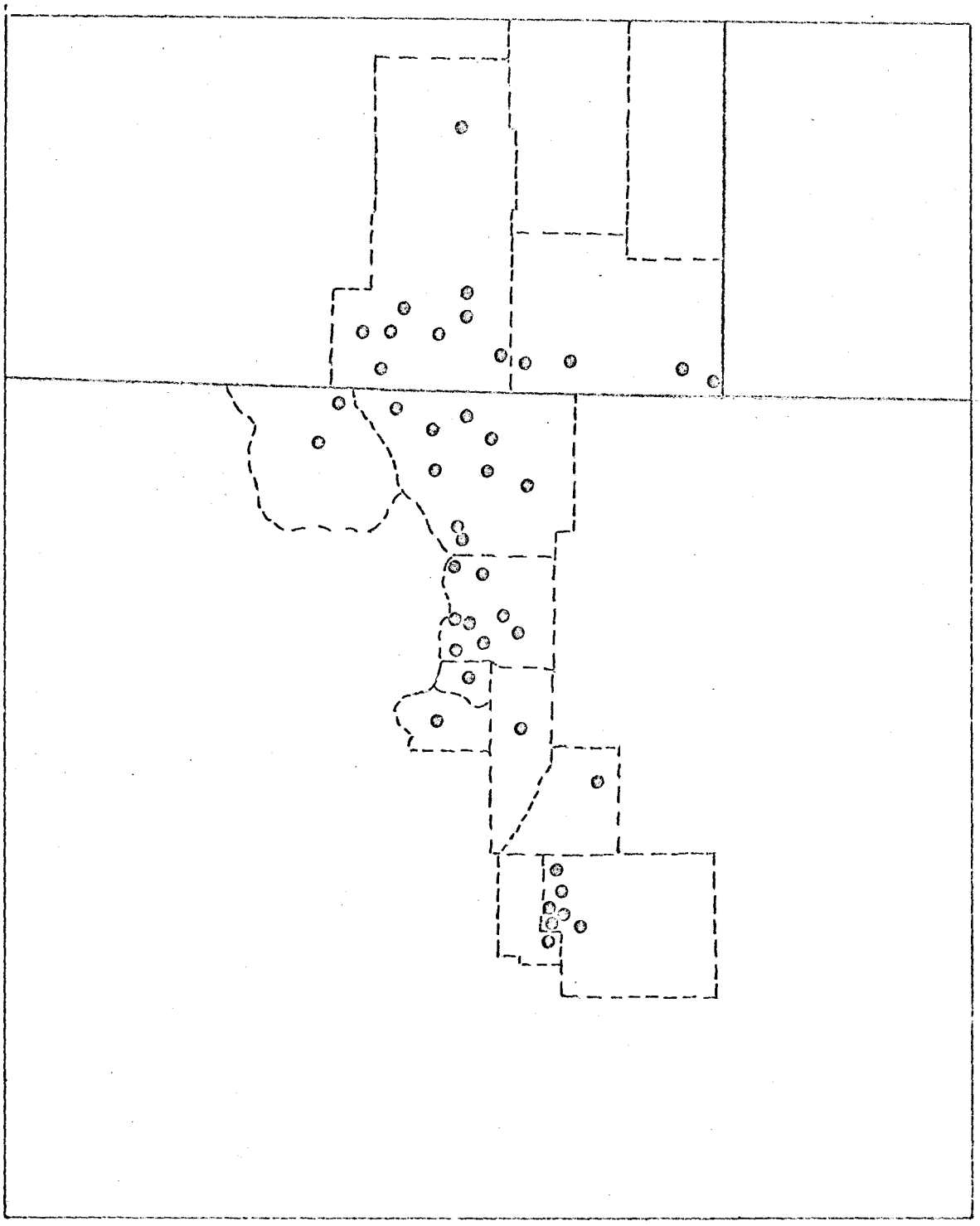
Oreocarya virgata forma spicata (Rydb.) Macbr. Proc. Am. Acad. 51:546. 1916.

Strict biennial, arising from a stout taproot, 2.5-8 (10) dm tall; stems usually solitary, but sometimes several from the base, stout, 0.5-2 dm long, setose or hirsute-hispid; leaves narrowly oblanceolate, obtuse, 3-20 cm long, 0.4-1.5 cm wide, setose-hirsute, with pustulate hairs on both surfaces; inflorescence cylindrical, 1.5-7 (9) dm long, with conspicuous, linear-oblanceolate foliar bracts that much exceed the the cymules; calyx segments lanceolate, in anthesis 3.5-4 mm long, in fruit becoming 10-12 mm long, hirsute; corolla white, the tube 3.5-4 mm long, crests at base of tube very conspicuous, fornices yellow, emarginate, papillose, about 0.5 mm long, limb 8-11 mm wide; style surpassing the mature fruit 1.6-2 mm; nutlets ovate, 2.7-3.5 mm long, 2.4-3 mm wide, usually all 4 maturing, the margins in contact, acute, dorsal surface usually with conspicuous low ridges, and a few tubercles, or sometimes nearly smooth, ventral surface smooth or with a few indistinct tubercles, scar narrowly open, linear, and without an elevated margin. Collections: 62 (vi); representative: B. Maguire 16292 (UTC); A. Nelson 1937 (ND-G, RM); G. T. Robbins 3358 (ARIZ); E. B. Payson 4253 (RM); J. Ewan 14947 (COLO); A. Nelson 1267 (UC, RM); L. C. Higgins 1491, 1501, 1543 (BRY).

Type: B. H. Smith s.n., collected near Denver, Colorado, Colorado Territory, 1869. Not seen.

Distribution: Southeastern Wyoming, south through central Colorado, on foothills on the eastern side of the Rocky Mountains. Growing on gravelly soils, 5,000 to 9,500 feet. Map No. 20. Early May to September.

Map No. 20. Southeastern Wyoming and central Colorado. Range of C. virgata (Porter) Payson.



Cryptantha virgata (Porter) Payson

C. virgata is one of the most conspicuous herbaceous plants on the eastern foothills of the Rocky Mountains. The stems of this plant are usually solitary, with long leafy foliar bracts that greatly exceed the individual cymules. For a few years this plant was treated as a variety of C. celosioides, but there is no reason to believe that it is even remotely related to that species.

Rydberg described Oreocarya spicata as a new species on the basis of the smooth nutlets. Later it was transferred as a form of O. virgata. Macbride contended that O. spicata was not deserving, even of varietal rank. In observing specimens from the type locality about Pikes Peak, it is even more evident that spicata is only a form of virgata.

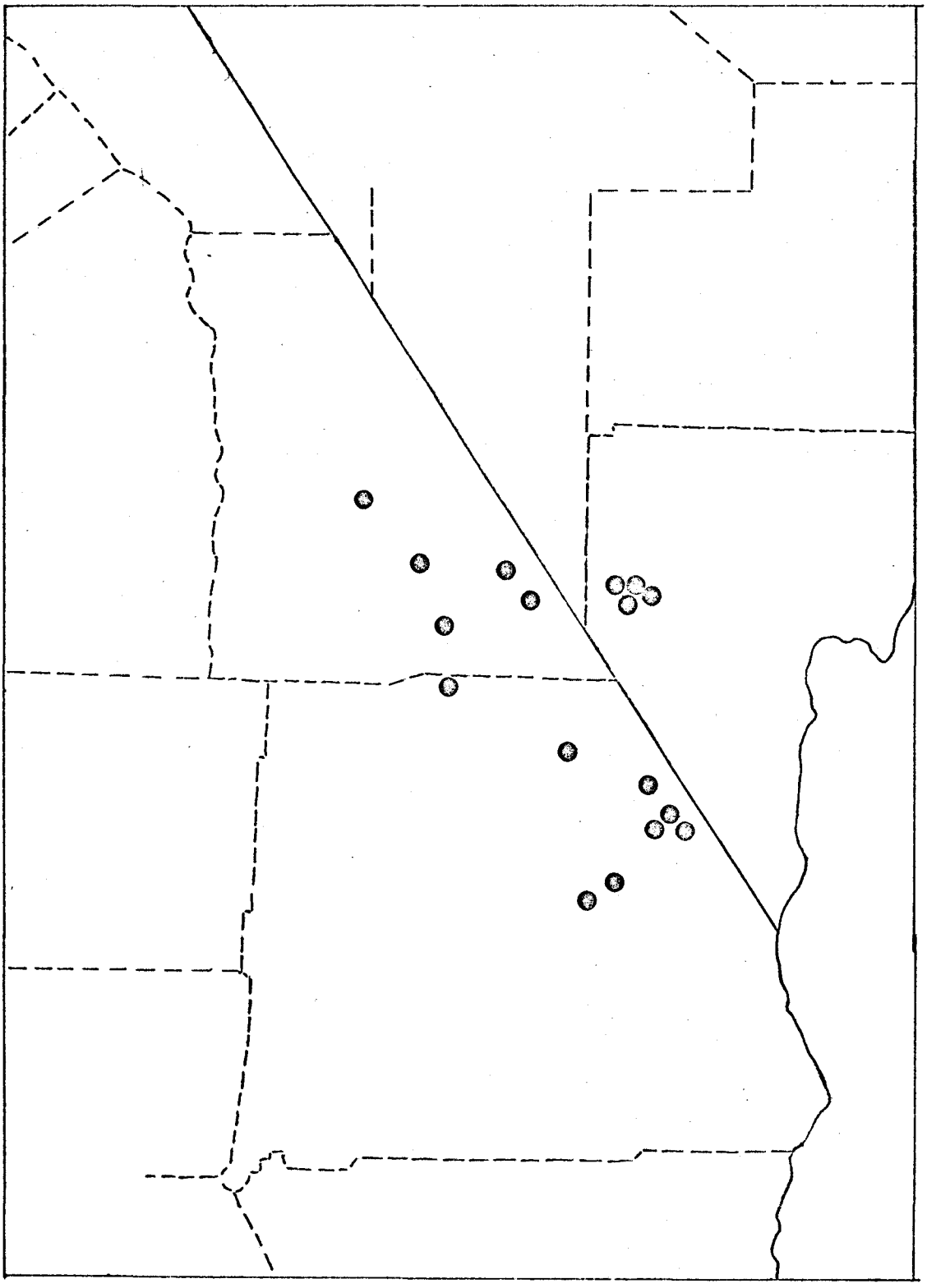
21. Cryptantha tumulosa (Payson) Payson

Cryptantha tumulosa (Payson) Payson, Ann. Mo. Bot. Gard. 14:276. 1927.

Oreocarya tumulosa Payson, Univ. Wyo. Publ. Bot. 1:164. 1926.

Long-lived perennials, 0.8-2.9 dm tall; stems 1-several from a woody taproot, 0.4-1.4 dm long, spreading setose; leaves oblanceolate, obtuse, 3-6 cm long, 0.4-0.9 cm wide, strigose, setose and tomentose, pustulate on both surfaces, but more conspicuous on the dorsal side; inflorescence narrow, cylindric, uninterrupted, 0.4-2 dm long, floral bracts not evident; calyx segments linear-lanceolate, 4-5 mm long in anthesis, in fruit becoming 7-10 mm long, yellowish setose; corolla white, the tube 3.5-4.5 mm long, crests at base of tube evident, fornices yellow, acute, papillose, 0.5-1 mm long, limb 6-8 mm wide; style exceeding mature fruit 0.5-1 mm; nutlets ovate, 3-4 mm long, 2.5-3 mm wide, 1-3 usually maturing, the margins in contact when more than 1 matures, acute, dorsal surface with a low inconspicuous crest, tuberculate, and with some low ridges, ventral surface similar, scar open, triangular,

Map No. 21. Southern Nevada and adjoining California. Range of C. tumulosa (Payson) Payson.



Cryptantha tumulosa (Payson) Payson

margin of scar slightly elevated. Collections: 40 (O); representative: I. W. Clokey 7667 (ARIZ, UC, LL, ORE, RM, UTC); T. S. Brandegee s.n. (UC); P. A. Munz 14787 (BRY, GH); R. S. Ferris 11265 (RM); E. K. Ball 19346 (POM); Alexander & Kellogg 1463 (UC).

Holotype: T. S. Brandegee s.n., collected in San Bernardino County, California, on the Providence Mountains, May, 1902, UC. Photograph at BRY.

Distribution: Clark County, Nevada, in the Charleston Mountains, southwest to the Providence Mountains, California, north to Inyo County. Growing on gravelly to clayey soils, 5,000 to 10,200 feet. Map No. 21. March to July.

This species has been confused in the past with C. humilis and C. nubigena. The nutlets are quite different from either of those species. Its nearest relatives are probably C. virginensis, C. insolita and C. abata. From C. abata it differs in the lack of a conspicuous elevated margin around the scar and by the indefinite roughenings on the dorsal surface. It differs from C. virginensis and C. insolita in its definite perennial habit, narrow congested infloresence, more tomentose indument, and the smoother nutlets with only a slightly elevated margin around the scar.

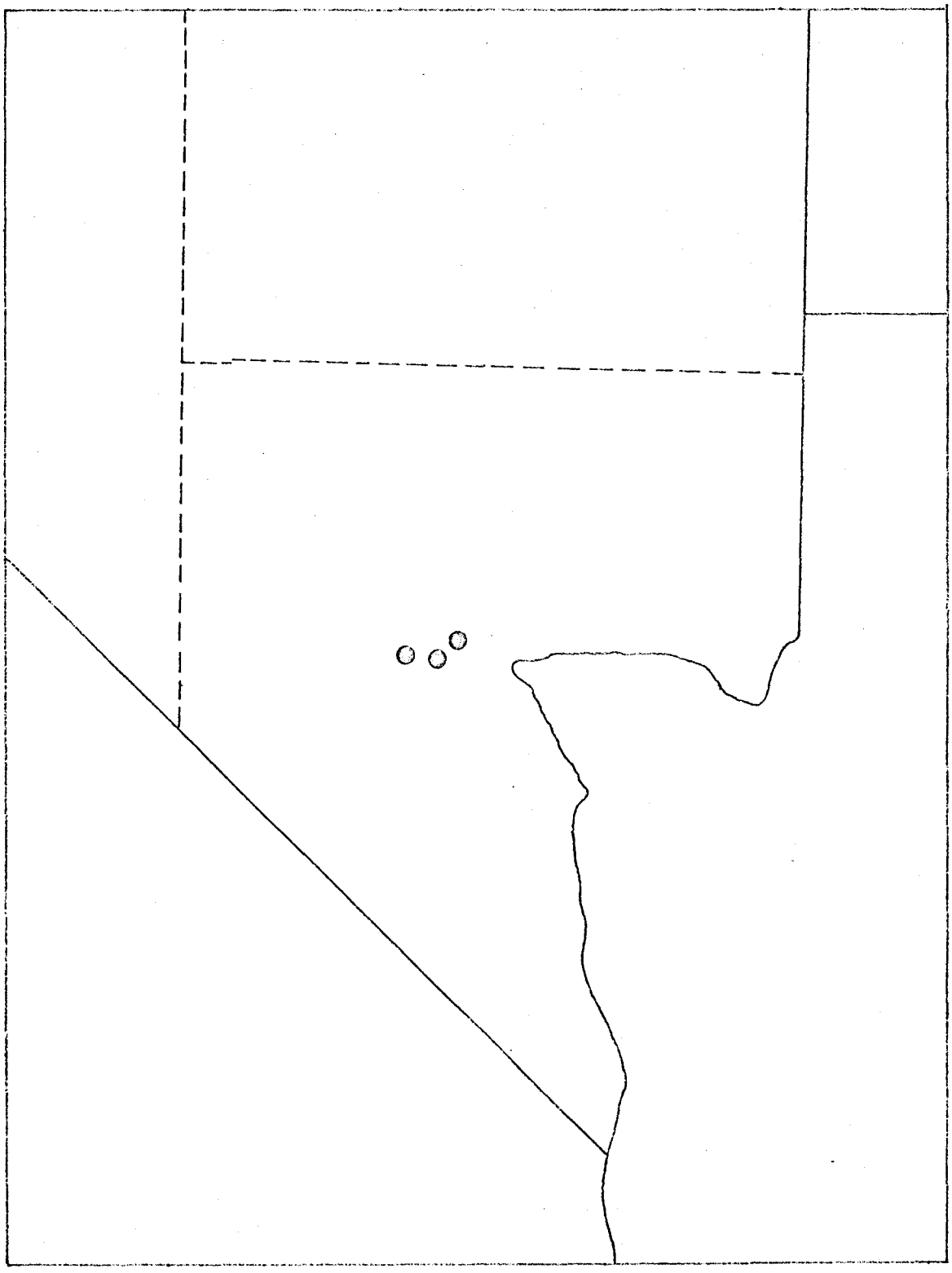
22. Cryptantha insolita (Macbr.) Payson

Cryptantha insolita (Macbr.) Payson, Ann. Mo. Bot. Gard. 14:273. 1927.

Oreocarya insolita Macbr. Contr. Gray Herb. 48:28. 1916.

Biennial or short-lived perennial from a slender taproot, 3-4 dm tall; stems 1-several, 1-3 dm long, strigose and conspicuously setose; leaves spatulate, mostly basal, obtuse, 3-5 cm long, 0.5-1.4 cm wide, dorsal surface subtomentose and sparsely appressed setose pustulate,

Map No. 22. Southern Nevada. Range of C. insolita (Macbr.) Payson.



Cryptantha incolita (Macbr.) Payson

ventral surface similar but the setae smaller and fewer, pustules few and small, petioles long-hairy at the base; inflorescence open, cymes few, much elongating, 0.7-1.4 dm long, weakly setose, foliar bracts inconspicuous; calyx segments linear-lanceolate, in anthesis 3.5-4.5 mm long, in fruit becoming 7-9 mm long, densely hirsute; corolla white, the tube 3-4 mm long, crests at base of tube well developed, fornices yellow, slightly emarginate, papillose, 0.5-1 mm long, limb 6-8 mm wide; style exceeding mature fruit 1-1.5 mm; nutlets ovate to lanceolate, 3.7-4 mm long, 1-4 maturing, the margins acute, in contact or nearly so, dorsal surface carinate, tuberculate, granulo-muricate and sometimes slightly rugulose, ventral surface tuberculate and somewhat rugulose, scar narrow but open, the margin showing some tendency to become elevated. Collections: 2 (0); representative: L. N. Goodding 2286 (GH, RM).

Holotype: L. N. Goodding 2286, collected in Clark County, Nevada, at Las Vegas, 4 May, 1905, GH. Photograph at BRY. Isotype at RM.

Distribution: Known only from the region about Las Vegas. Growing in white alkaline soil, 1,900 to 2,500 feet. Map No. 22. April to June.

This species somewhat resembles C. elata of eastern Utah and western Colorado, but it is doubtful if the two are even remotely related. However, this plant is probably very closely related to C. virginensis, but differs in the length of the floral bracts, number of cymules, and the shape of the nutlets.

23. Cryptantha virginensis (Jones) Payson

Cryptantha virginensis (Jones) Payson, Ann. Mo. Bot. Gard. 14:274. 1927.

Krynitzkia glomerata var. virginensis Jones, Contr. West. Bot.

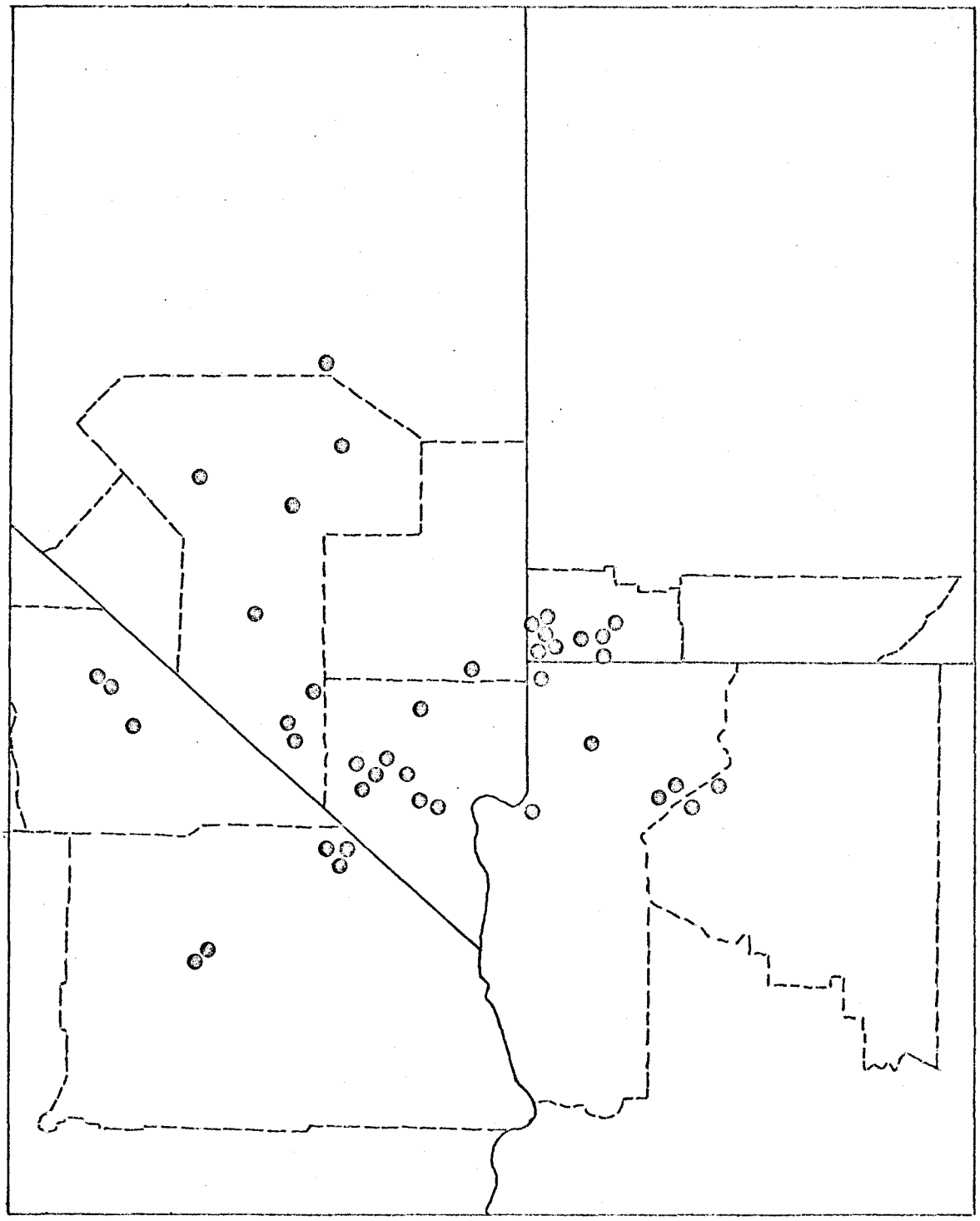
13:5. 1910.

Oreocarya virginensis (Jones) Macbr. Proc. Am. Acad. 51:547. 1916.

Biennial, 1.5-3.5 (4) dm tall; stems 1-several, arising from a stout taproot, 0.3-0.6 dm long, setose-hirsute; leaves oblanceolate to spatulate, obtuse, 3-10 (12) cm long, 0.5-1.5 cm wide, dorsal surface sparsely setose, pustulate, also with some fine tangled hair beneath, ventral surface subtomentose and weakly appressed setose, with only a few pustulate hairs; inflorescence a broad thyrsus with the individual cymes much elongating, 0.5-3 dm long, foliar bracts conspicuous; calyx segments linear-lanceolate, in anthesis 3-4 mm long, in fruit becoming 7-11 mm long, hirsute; corolla white, the tube 3-4 mm long, crests at base of tube conspicuous, fornices yellow, emarginate, papillose, about 1 mm long, limb 7-9 mm broad; style exceeding mature fruit 1-1.5 mm; nutlets ovate, 3.3-4.5 mm long, 2.4-2.6 mm wide, usually only 1-2 nutlets maturing, margins in contact, acute, dorsal surface with a distinct ridge, the surface tuberculate and usually rugulose, ventral surface very uneven with indeterminate rugae and tubercles, scar open, and triangular, with an elevated margin. Collections: 64 (ii); representative: I. W. Clokey 5820 (ARIZ, BRY, ORE, RM, UTC); B. Maguire 4470 (RM, UTC); F. W. Gould 1580 (ARIZ, BRY, DIX, RM); Maguire & Holmgren 25404 (ARIZ, BRY, UTC); Alexander & Kellogg 3019 (RM, UTC); J. Beatley 4275 (BRY, LA); L. C. Higgins 1243 (BRY).

Holotype: M. E. Jones 5195a, collected in Washington County, Utah, at Laverkin, 8 May, 1894, POM. Isotypes at UC, RM, MO, US.

Distribution: Southwestern Utah, southern Nevada, northwestern Arizona, and southeastern California. Growing on gravelly to clay



Cryptantha virginensis (M. E. Jones) Payson

soils, 2,000 to 8,000 feet. Map No. 23. March to July.

Cryptantha virginensis has its closest relatives with C. tumulosa and C. hoffmannii. From the former it differs in the biennial habit, more open inflorescence, more setose indument, and the nutlets which are more conspicuously roughened.

There can be no doubt that C. virginensis and C. hoffmannii are very closely related, and because of the variation encountered in each it is difficult to find characters of a high order which are consistently differential. Variation as now known in C. virginensis is rather great, especially marked in size of nutlets, length of the calyx, and the markings on the nutlets. However, where they approach each other in range, they occupy different life zones, and C. virginensis comes into flower a month or more earlier. The former also has fragrant flowers while C. hoffmannii does not. Additional collections of this complex are badly needed from western Nevada and eastern California.

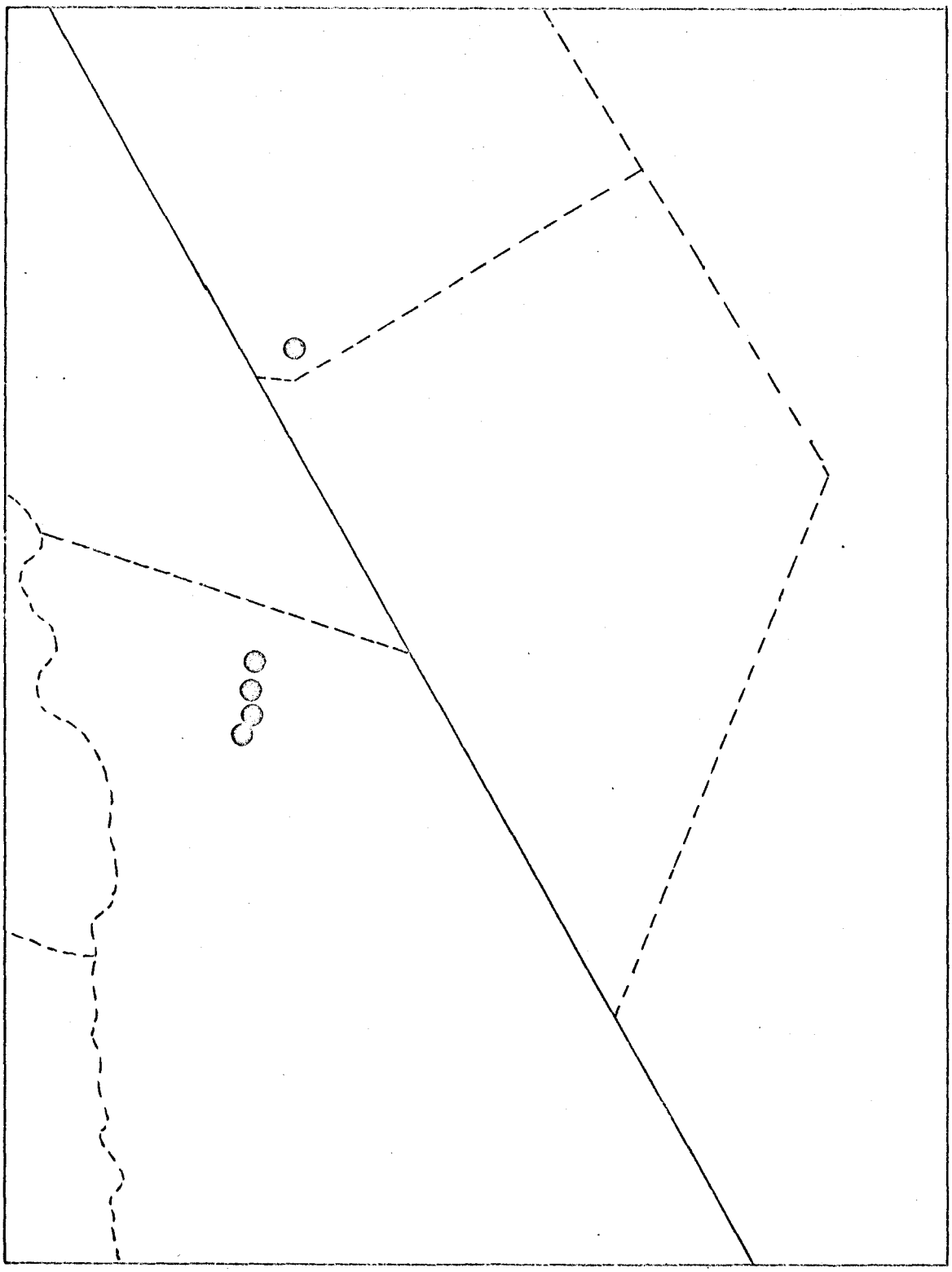
24. Cryptantha hoffmannii Johnst.

Cryptantha hoffmannii Johnst. Contr. Arn. Arb. 3:90. 1932.

Oreocarya hoffmannii (Johnst.) Abrams, Abrams, Ill. Fl. Pac. St. 3:600. 1951.

Plants biennial, 1.7-3.4 dm tall; stems 1-several, 0.2-1.6 dm long, conspicuously hirsute; leaves spatulate, crowded at the base, reduced upward, 2-5 cm long, 0.5-1.2 cm wide, spreading setose-hirsute, pustulate on both leaf surfaces, but more conspicuous dorsally; inflorescence broad-topped, interrupted, 1-2.8 dm long, floral bracts evident but not conspicuous; calyx segments lanceolate, in anthesis 3-5 mm long, in fruit becoming 5-8 mm long, hirsute-hispid; corolla white, the tube 3-4 mm long, crests at base of tube evident, fornices

Map No. 24. Inyo County, California and adjoining Nevada. Range of C. hoffmannii Johnston.



Cryptantha hoffmannii Johnston

yellow, rounded, 0.5 mm long, papillose, limb 5-7 mm wide; style exceeding mature fruit 0.2-0.8 mm; nutlets ovate, 3-3.5 mm long, 2-2.5 mm wide, 2-4 nutlets maturing, the margins in contact, acute, both surfaces irregularly low rugose and minutely tuberculate, the dorsal with a low inconspicuous crest, scar open, triangular, without an elevated margin. Collections: 10 (i); representative: R. Hoffmann 78 (GH); Alexander & Kellogg 2503 (ARIZ, POM, RM); F. W. Pierson 7544 (GH, POM); P. Train 3977 (UTC); J. Roos 5849 (POM).

Holotype: R. Hoffmann 78, collected in Inyo County, California, on rocky open slopes of Westgard Pass, 7,300 feet, 11 July, 1930, GH. Photograph at BRY.

Distribution: Western Nevada and southeastern California. Growing on gravelly soil in the Pinyon-Juniper community, 7,000 to 9,000 feet. Map No. 24. June and July.

Johnston, in the original description, said that this species was most closely related to C. insolita, however, I believe that its closest relative is C. virginensis, as discussed under that taxon.

25. Cryptantha abata Johnst.

Cryptantha abata Johnst. Journ. Arn. Arb. 24:240. 1948.

Krynitzkia depressa Jones, Contr. West. Bot. 13:5. 1910, not

C. depressa A. Nels. Bot. Gaz. 34:29. 1902.

Oreocarya depressa (Jones) Macbr. Contr. Gray Herb. 48:32. 1916.

Cryptantha modesta Payson, Ann. Mo. Bot. Gard. 14:278. 1927, not

C. modesta Brand, Fedde, Rep. Spec. Nov. 24:48. 1924.

Plants perennial, arising from a strong woody taproot, 0.5-1.8 dm tall; stems many, 0.2-1.5 dm long, strigose and weakly setose, leaves oblanceolate to spatulate, obtuse, strigose, setose, and subtomentose,

the petioles ciliate margined; inflorescence narrow, 0.2-0.8 dm long; calyx segments lanceolate to ovate, 2.5-4 mm long in anthesis, in fruit becoming 5-8 mm long, setose; corolla white, the tube 3-4 mm long, crests at base of tube conspicuous, fornices yellow, rounded, papillose, about 0.5 mm long, limb 7-8 mm wide; style exceeding mature fruit 0.5-1 mm; nutlets ovate, 3-3.5 mm long, 2-2.5 mm wide, usually all 4 maturing, margins in contact, obtuse to acute, dorsal surface carinate, tuberculate, muricate, and sometimes with low inconspicuous ridges, ventral surface deeply and irregularly rugose, scar open, triangular, surrounded by a slightly elevated margin. Collections: 26 (iii); representative: M. E. Jones 6692 (POM, UTC); B. F. Harrison 9009 (BRY); W. S. Boyle 1117 (BRY, UTC); L. N. Goodding 996 (POM, RM); Eastwood & Howell 651 (CAS); L. C. Higgins 1015, 1016 (BRY).

Lectotype: M. E. Jones 6692, collected at Aurum, Nevada, 7,300 feet, 20 June, 1893, POM. Photograph at BRY. Isotype at US.

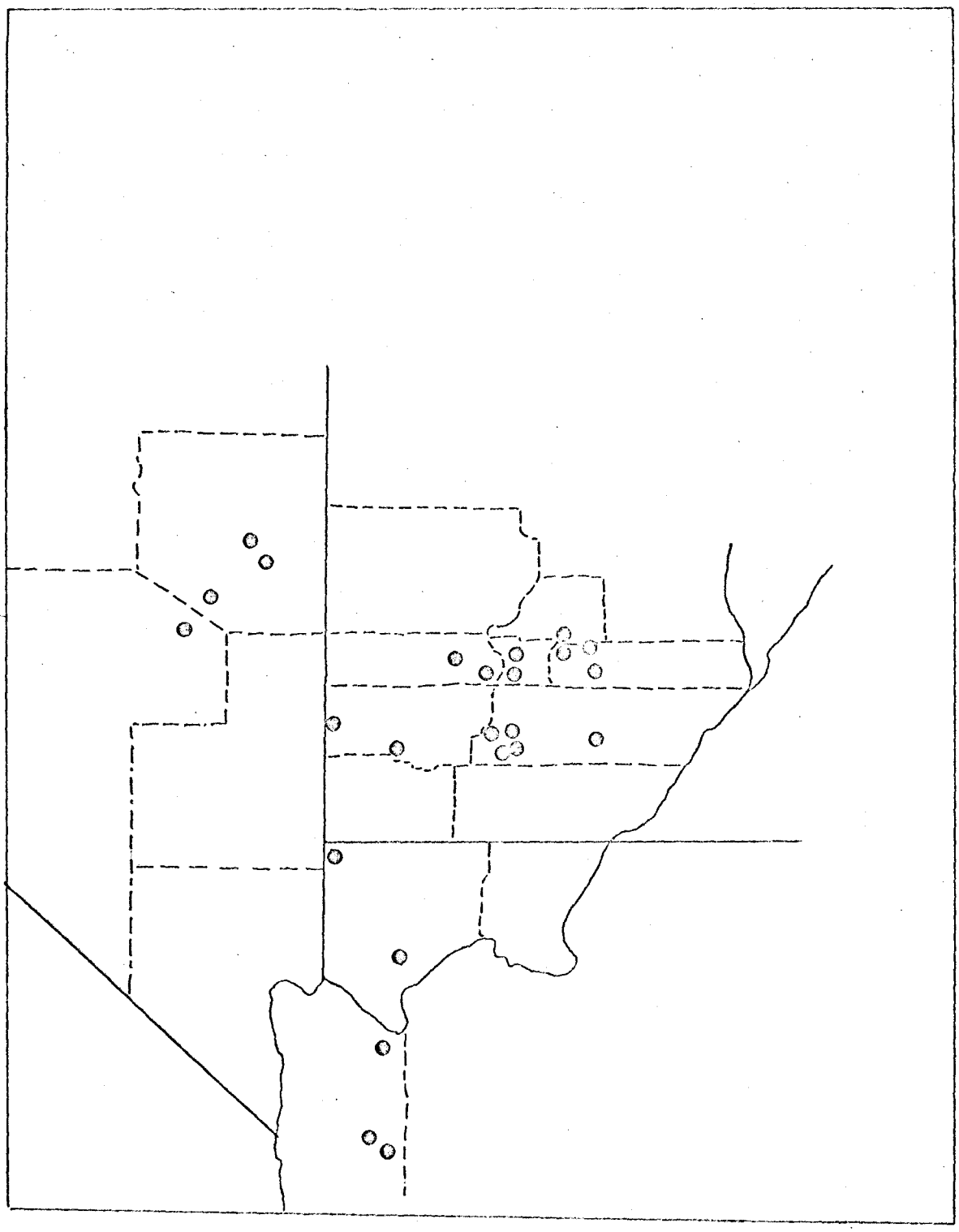
Distribution: South-central Utah, northwestern Arizona, and eastern Nevada. Growing on sandy or gravelly soil, 4,000 to 9,000 feet. Map No. 25. April to early July.

The name Payson applied to this species of southern Utah and eastern Nevada was invalid because of an earlier homonym. Johnston, noting this, named the plant C. abata.

Cryptantha abata is a modest, densely tufted Cryptantha, that is not greatly different in general appearance from some of the varieties of C. humilis or of C. tumulosa. It differs from these species by the short inflorescence, the deeply rugose nutlets on the ventral surface, and the spatulate leaves.

This plant is not often collected because of the early flowering time.

Map No. 25. Southwestern Utah and adjoining states. Range of C. abata Johnston.



Cryptantha abata Johnston

26. Cryptantha caespitosa (A. Nels.) Payson

Cryptantha caespitosa (A. Nels.) Payson, Ann. Mo. Bot. Gard. 14:281. 1927.

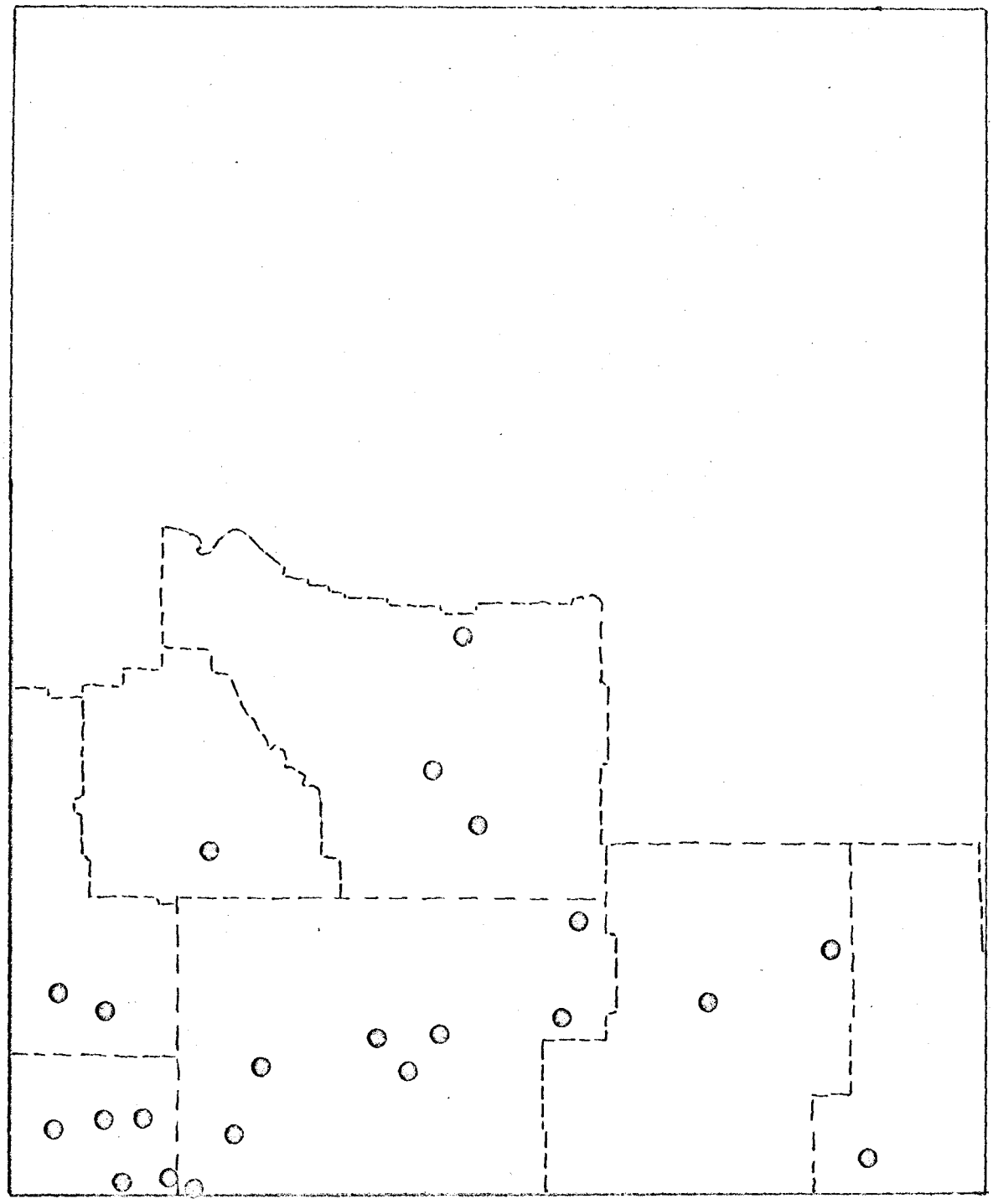
Oreocarya caespitosa A. Nels. Erythea 7:65. 1899.

Densely caespitose perennials, 0.5-1.5 dm tall; stems 1-many, arising from a much-branched woody caudex, 0.2-0.9 dm long, weakly setose, and appressed strigose; leaves oblanceolate to spatulate, 1-3 cm long, 0.3-0.7 cm wide, pubescence of two kinds, strigose and appresse setose, becoming tomentulose toward the petiole; inflorescence narrow, 0.3-1 dm long, foliar bracts inconspicuous; calyx segments lanceolate, in anthesis 3-4 mm long, in fruit becoming 5-8 mm long, strigose and weakly setose, also somewhat tomentulose; corolla white, the tube 3-4 mm long, crests at base of tube conspicuous, fornices yellow, rounded, about 0.5 mm long, limb 4-7 mm wide; style equalling or 0.5 mm longer than mature fruit; nutlets lanceolate, 3-3.5 mm long, 2-2.5 mm wide, the margins acute, in contact, dorsal surface with low rounded rugae, also tuberculate, and with numerous muricationsbetween the ridges, ventral surface muricate, scar open, narrowly triangular, margin of scar not elevated. Collections: 37 (vi); representative: A. Nelson 4671 (CS, RM); E. Nelson 4497 (RM); G. E. Osterhout 6248 (RM); E. B. Payson 4249 (RM); R. C. Rollins 1685 (RM, UTC); D. Atwood 1568 (BRY); L. C. Higgins 1557, 1562, 1563, 1566, 1586, 1570 (BRY).

Lectotype: A. Nelson 4749, collected in Sweetwater County, Wyoming, at Point of Rocks, 15 June, 1898, RM. Photograph at BRY. Isotype at US.

Distribution: Southern Wyoming, but to be expected in northern Colorado and Utah, and perhaps eastern Idaho. Growing on heavy clay

Map No. 26. Southern Wyoming. Range of C. caespitosa (A. Nels.) Payson.



Cryptantha caespitosa (A. Nels.) Payson

soils, 5,000 to 7,500 feet. Map No. 26. Early May to late July.

From the original description it is evident that Nelson also included in this species the plants that he later described as C. cana. In C. cana the leaves are silky-strigose, the inflorescence more capitate, and the nutlets are sharply muricate.

27. Cryptantha ochroleuca Higgins

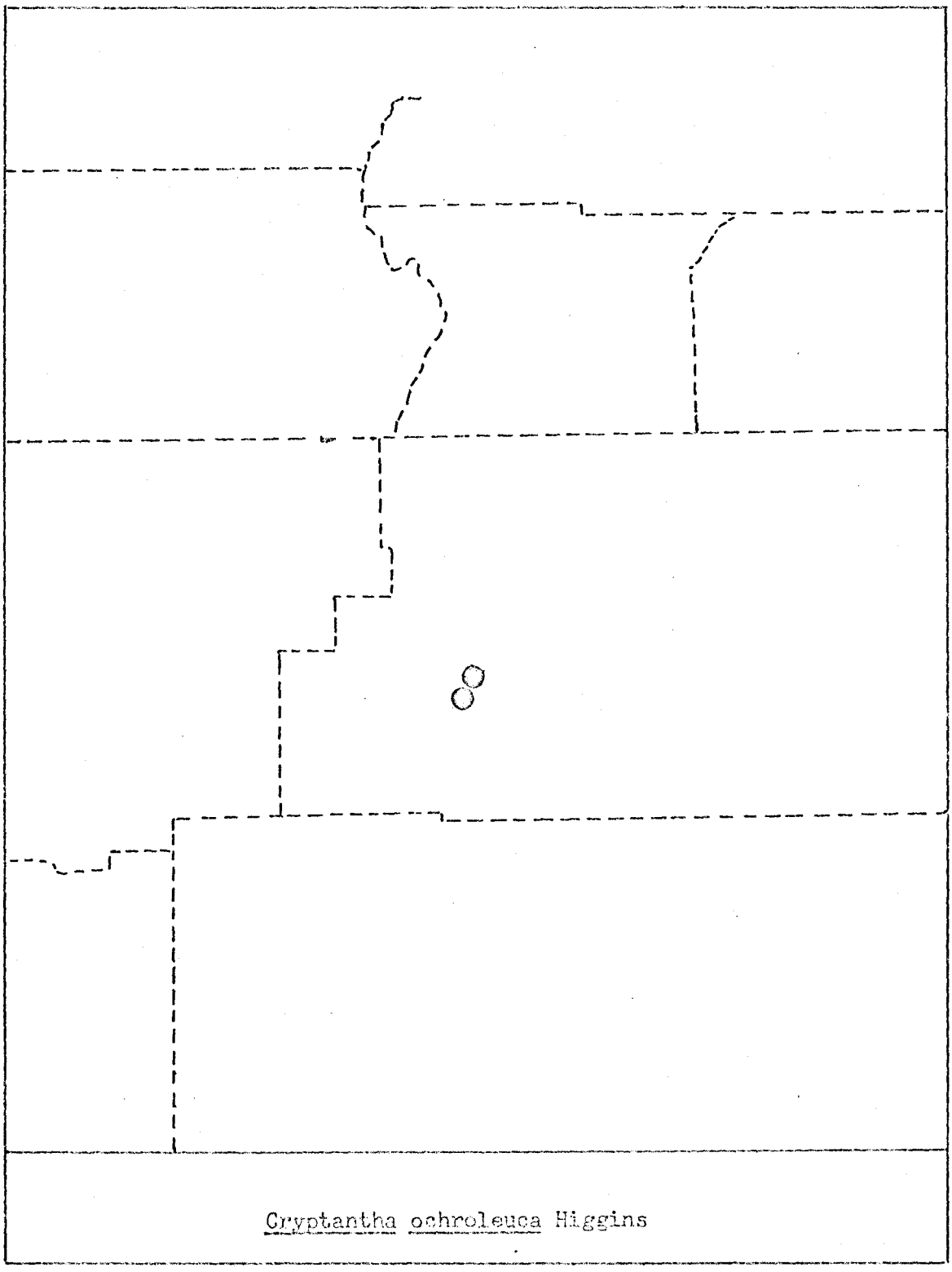
Cryptantha ochroleuca Higgins, Great Basin Naturalist 28:197. 1968.

Low caespitose perennial, 0.2-1.3 dm tall; stems several, 0.1-0.4 dm long, strigose and weakly setose; leaves linear-oblanceolate to oblanceolate, the apices acute or sometimes obtuse, 1-2.5 cm long, 0.1-0.3 cm wide, basal leaves uniformly and densely strigose, sparsely setose, the petiole white-hairy, cauline leaves strigose and with some setose-pustulate bristles; inflorescence narrow, 0.2-0.7 dm long, weakly setose; calyx segments linear-lanceolate, 2-2.5 (3) mm long in anthesis, in fruit 4-6 mm long, setose; corolla pale-yellow, the tube 2-2.5 mm long, crests at base of tube conspicuous, fornices yellow, rounded, about 0.3 mm long, limb 4-5 mm wide; style scarcely surpassing mature fruit; nutlets lanceolate, 2.5-3 mm long, 1.4-1.6 mm wide, usually only one maturing, margine acute, dorsal surface irregularly rugose with low rounded ridges, ventral surface only slightly uneven, scar open, narrowly-triangular, extending 3/4 the length of nutlet, no elevated margin. Collections: 2 (i); representative: L. C. Higgins 1788 (BRY); Reveal & Reveal 1031 (BRY).

Holotype: L. C. Higgins 1788, collected in Garfield County, Utah, on outcrop 100 m south of Red Canyon Campground along hwy. 12, 6,500 feet, 21 July, 1968, BRY. Isotypes at GH, NY, US.

Distribution: Limited to the red Wasatch Formation near Red

Map No. 27. Garfield County, Utah. Range of C. ochroleuca Higgins.



Cryptantha ochroleuca Higgins

Canyon Campground in southwestern Garfield County, Utah, 6,500 to 7,000 feet. Map No. 27. May to August.

Cryptantha ochroleuca is apparently most closely related to C. caespitosa of southwestern Wyoming, but also has some affinities with C. humilis. It differs from C. caespitosa by its less caespitose habit, the slender, less woody taproot, shorter calyx, shorter, pale yellow instead of white corolla, and the smaller nutlets which are more rugose. From C. humilis, C. ochroleuca differs in the shorter calyx, pale yellow corolla, and the rugose nutlets.

This local species is apparently confined to the red Wasatch Formation in southwestern Garfield County, Utah.

28. Cryptantha humilis (A. Gray) Payson

Perennials, more or less densely caespitose, 0.5-3 dm tall; stems many, arising from the ends of the branched caudex, 0.2-1.5 dm long, strigose to spreading setose; leaves oblanceolate to spatulate, 1-6 cm long, 0.2-1.2 cm wide, strigose, setose or subtomentose, pustulate on both surfaces; inflorescence narrowly cylindrical to open and lax, 0.2-1.8 dm long, tomentose to conspicuously setose; calyx segments linear-lanceolate, in anthesis 2.5-4.5 mm long, in fruit becoming 6-13 mm long, setose or tomentose; corolla white, the tube 2.5-4.5 mm long, crests at base of tube conspicuous to nearly obsolete, fornices yellow, more or less papillose, rounded, about 0.5 mm long, limb 7-10 mm wide; the style shorter than to exceeding the mature fruit by 2.5 mm; nutlets lanceolate to ovate-lanceolate, 3-4.5 mm long, 1.8-3.2 mm wide, 1-4 of them maturing, margins in contact, acute to obtuse, dorsal surface muricate, tuberculate, or somewhat rugulose, ventral surface indistinctly muricate or tuberculate, scar open, triangular, margin not elevated.

Key to the varieties of C. humilis

1. Leaves strigose and setose but not conspicuously tomentose; calyx conspicuously setose (2).

1. Leaves densely strigose as well as tomentose; calyx setose and subtomentose (4).

2. Nutlets rugulose as well as muricate; style 1.5-2.5 mm longer than mature fruit. . . . . 28a. var. humilis

2. Nutlets muricate or tuberculate; style not exceeding the fruit by more than 1.5 mm (3).

3. Style exceeding the mature nutlets 1-1.5 mm; the inflorescence open and broad; plants loosely tufted. . . . . 28b. var. commixta

3. Style not or only slightly surpassing the nutlets; inflorescence congested, even in fruit; plants densely caespitose. 28e. var. nana

4. Style scarcely exceeding the mature nutlets; inflorescence somewhat open at maturity; north-central Utah and southeastern Idaho. . . . . 28c. var. shantzii

4. Style exceeding the mature nutlets 0.5-1.5 mm; inflorescence cylindrical and congested in fruit; southwestern Utah to southeastern California. . . . . 28d. var. ovina

28a. var. humilis

Cryptantha humilis (A. Gray) Payson var. humilis

Eritrichium glomeratum var. humile A. Gray, Proc. Am. Acad. 10: 61. 1875.

Oreocarya humilis Greene, Pitt. 3:112. 1896.

Oreocarya hispida Nels. & Kennedy, Proc. Biol. Soc. Wash. 19:156.

1906. (Type: Ormsby County, Nevada, in Carson Valley, 24 April, 1904, G. H. True 865.)

Oreocarya echinoides Macbride, Contr. Gray Herb. 48:31. 1916, not Krynitzkia echinoides M. E. Jones.

Oreocarya macbridii Brand, Fedde, Rep. Spec. Nov. 19:73. 1923. (Type: Mt. Jarbidge, Nevada, 6 July, 1912, Nelson and Macbride 1960.)

Cryptantha humilis (Greene) Payson, Ann. Mo. Bot. Gard. 14:278. 1927.

Caespitose perennial, 0.5-3 dm tall; stems 1-many, 0.4-1.5 dm long, erect, strigose and sparsely setose; leaves spatulate to oblanceolate, 1.5-7 cm long, 0.2-1 cm wide, weakly setose, strigose, and subtomentose, the petioles ciliate-margined, both surfaces pustulate; inflorescence narrow to somewhat open, 0.8-1.7 dm long, the floral bracts inconspicuous; calyx segments linear-lanceolate, in anthesis 4-5 mm long, in fruit becoming 7-13 mm long, setose; corolla white, the tube 3.4-5 mm long, crests at base of tube evident to nearly obsolete, fornices yellow, rounded, papillose, about 0.5 mm long, limb 8-10 mm wide; style exceeding mature fruit 1.5-2.5 mm; nutlets ovate-lanceolate, 3-4.5 mm long, 1.8-2 mm wide, dorsal surface muricate, tuberculate, and usually rugulose, scar open at the base or nearly closed. Collections: 62 (vii); representative: Alexander & Kellogg 4443 (UC, US, UTC); Maguire & Holmgren 25938 (ARIZ, UC, ORE, UTC); A. Cronquist 8312 (ORE, UTC, WTU); P. A. Munz 21036 (CAS); M. E. Jones 5163 (US); Eastwood & Howell 8451 (POM); L. C. Higgins 1745, 1747, 1757, 1761 (BRY).

Lectotype: Bolander s.n., collected at Summit Station (Donner Pass), Nevada County, California, 1871. Not seen.

Distribution: Southeastern Oregon and southwestern Idaho, south throughout Nevada and into eastern California, mainly in mountaineous regions. Usually growing on gravelly slopes and ridges, 4,500 to 12,000 feet. Map No. 28. April to August.

In eastern Nevada the boundary between this variety and variety commixta is rather weak. The rugae tend to be reduced to scarcely continuous tubercles or indistinct wrinkles. It was one of these forms that Macbride classified as C. nana var. commixta. Brand, examining it more critically, noticed the rugae and thinking that it could not be placed in commixta, proposed a new species for it, O. macbridii. An examination of a nutlet from Greene's plant from Holborn, Nevada, makes it evident that the elevations are two sizes, murications and tubercles. In neither are the rugae entirely absent. The specific limits between C. humilis of A. Gray, and that of C. nana were uncertain, and too many intermediates were present to hold them apart. The two species have thus been combined under humilis.

28b. var. commixta (Macbr.) Higgins

Cryptantha humilis (A. Gray) Payson var. commixta (Macbr.) Higgins

Oreocarya commixta Macbr. Contr. Gray Herb. 48:33. 1916.

Cryptantha nana (Eastw.) Payson var. commixta (Macbr.) Payson, Ann. Mo. Bot. Gard. 14:312. 1927.

Caespitose perennials, 1-2.7 dm tall; stems 1-several, arising from the ends of the branched caudex, 0.3-1 dm long, weakly strigose and spreading setose; leaves spatulate to broadly oblanceolate, 2.5-6 cm long, 0.5-1.2 cm wide, strigose and spreading setose; inflorescence open, 0.8-1.8 dm long, foliar bracts evident on lower part of the inflorescence; calyx segments linear-lanceolate, in anthesis 3.5-4.5 mm

long, in fruit becoming 7-10 mm long, setose; style exceeding mature fruit 0.7-1.6 mm; nutlets lance-ovate, 3.5-4 mm long, muricate, tuberculate, or sometimes with the murications joined to form short irregular ridges, scar subulate or nearly closed. Collections: 18 (iv); representative: L. N. Goodding 1074 (GH, RM); M. E. Jones 5388L (US); B. F. Harrison 10148 (BRY); R. C. Holmgren 266 (BRY); L. C. Higgins 1468, 1617 (BRY).

Holotype: L. N. Goodding 1074, collected in Juab County, Utah, on sandy slides at Juab, 9 June, 1902, GH. Photograph at BRY. Isotype at RM.

Distribution: Central Utah to eastern Nevada. Growing on gravelly soil or talus slopes, 4,500 to 7,500 feet. Map No. 28. May to July.

This variety may be distinguished by its open inflorescence, setose or coarsely strigose leaves, and the length of the style.

The variation within this variety is also noticeable, and a population along the Sevier River in Sevier and Piute Counties may prove to be another variety. The nutlets of this population are more tuberculate than muricate, the scar is closed or nearly so, and the leaves are greener than in typical commixta.

28c. var. shantzii (Tidestr.) Higgins

Cryptantha humilis (A. Gray) Payson var. shantzii (Tidestr.) Higgins.

Oreocarya shantzii Tidestr. Proc. Biol. Soc. Wash. 26:122. 1913.

Oreocarya dolosa Macbr. Contr. Gray Herb. 48:32. 1916. (Type: College Bench, Logan, Utah, 4 June, 1909, Smith 1605.)

Cryptantha nana (Eastw.) Payson var. shantzii (Tidestr.) Payson, Ann. Mo. Bot. Gard. 14:313. 1927.

Caespitose perennial, 1-2 dm tall; stems 1-many from the ends of the much branched caudex, 0.3-1 dm long, weakly setose and strigose; leaves spatulate to oblanceolate, obtuse, 2-5 cm long, 0.3-0.7 cm wide, tomentose and appressed setose, with slender more or less appressed bristles; inflorescence usually narrow, but the cymules slightly elongating, lower foliar bracts rather conspicuous in the young inflorescence; calyx segments densely setose and subtomentose; style scarcely exceeding the mature nutlets; nutlets muricate. Collections: 34 (i); representative: B. Maguire 12952 (RM); C. P. Smith 1573 (RM); C. P. Smith 1605 (RM); Kearney & Shantz 3098 (US); R. Gourley 8068 (UT); R. J. Davis 988 (IDS); A. A. Beetle 5792 (ND); E. Palmer 42 (RM); L. C. Higgins 1087 (BRY).

Holotype: Kearney & Shantz 3098, collected in dry saline soil at Grants Station south of the Great Salt Lake, Utah, 6 August, 1912, GH.

Distribution: Southwestern Montana, eastern Idaho, and northern Utah. Growing on a wide variety of soils, 4,500 to 8,000 feet. Map No. 28. April to July.

This variety may be distinguished by the short style, evident foliar bracts, and the basal leaves, which are silvery strigose and setose.

Payson designated the specimen collected by C. P. Smith 1605, as the type of var. shantzii. However, the plant collected by Kearney & Shantz 3098, should have been used instead.

28d. var. ovina (Payson) Higgins

Cryptantha humilis (A. Gray) Payson var. ovina (Payson) Higgins.

Cryptantha nana (Eastw.) Payson var. ovina Payson, Ann. Mo. Bot. Gard. 14:314. 1927.

Densely caespitose long-lived perennials, 0.5-1.5 dm tall; stems several, 0.2-0.7 dm long; leaves spatulate to oblanceolate, obtuse, 2-4 cm long, tomentose and appressed setose with rather weak bristles; inflorescence narrow, cylindrical, lower foliar bracts inconspicuous; calyx segments linear-lanceolate, densely setose and tomentose; style exceeding the mature fruit 0.5-1 mm; nutlets muricate or tuberculate. Collections: 21 (v); representative: P. A. Munz 21036 (UT); Eastwood & Howell 9377 (CAS); Ripley & Barneby 3485 (CAS); G. H. Bentley s.n. (RM); J. L. Reveal 1414 (BRY, LA); S. L. Welsh 5226 (BRY); L. C. Higgins 1234, 1409, 1449, 1455 (BRY).

Holotype: Georgia H. Bentley s.n., collected in Nye County, Nevada, in the vicinity of Currant, June, 1916, RM.

Distribution: Southwestern Utah, southern Nevada, and southeastern California. Growing on gravelly loam or clayey soils, mainly in the Pinyon-Juniper belt, 3,500 to 7,000 feet. Map No. 28. April to July.

Variety ovina has its closest relative in var. shantzii. It may be separated from that variety only tentatively by the more tomentose leaves and calyces, and the longer style. The foliar bracts are also less evident in this variety.

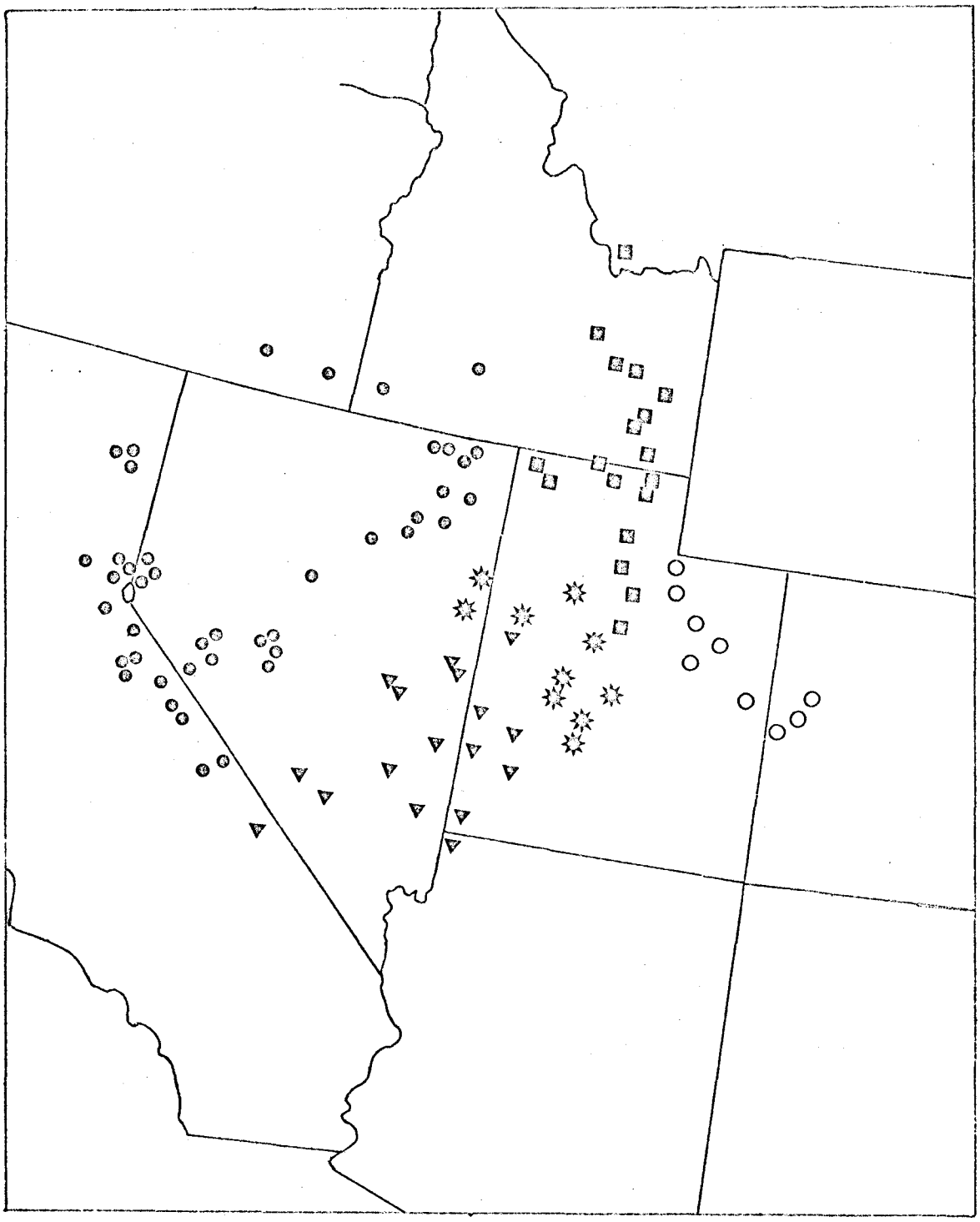
28e. var. nana (Eastw.) Higgins

Cryptantha humilis (A. Gray) Payson var. nana (Eastw.) Higgins.

Oreocarya nana Eastw. Bull. Torrey Bot. Club 30:243. 1903.

Cryptantha nana (Eastw.) Payson var typica, Ann. Mo. Bot. Gard. 14:315. 1927.

Caespitose perennial, 0.5-1.5 dm tall; stems several, 0.2-0.7 dm long, setose; leaves oblanceolate to spatulate, 0.5-4 cm long, 0.2-0.6 cm wide, strigose to subtomentose, spreading setose; inflorescence



Cryptantha humilis (A. Gray) Payson

narrow, cylindrical, 0.2-1 dm long, setose; calyx segments linear-lanceolate, in anthesis 2.5-3.5 mm long, in fruit becoming 6-8 mm long, setose; corolla white, the tube 2.5-3.5 mm long, crests at base of tube evident; style shorter to slightly longer than mature fruit; nutlets muricate or sometimes tuberculate or rugulose. Collections: 18 (v); representative: Ripley & Barneby 4675 (CAS); W. A. Weber 11258 (COLO); A. Eastwood s.n. (CAS); G. E. Osterhout 4484 (RM). D. Wiens 3066 (COLO); L. C. Higgins 1066, 1598 (BRY).

Holotype: A. Eastwood s.n., collected in Mesa County, Colorado, near Grand Junction on the mesa above the Gunnison River, 17 May, 1892, CAS. Photograph at BRY. Isotypes at RM, UC, GH.

Distribution: Western Colorado and eastern Utah. Growing on sandy or clay soils, 4,500 to 7,000 feet. Map No. 28. April to July.

Variety nana can usually be separated from the other varieties of this complex by the setose leaves which are only rarely tomentose, the very short style which usually does not exceed the fruit, and the compact inflorescence.

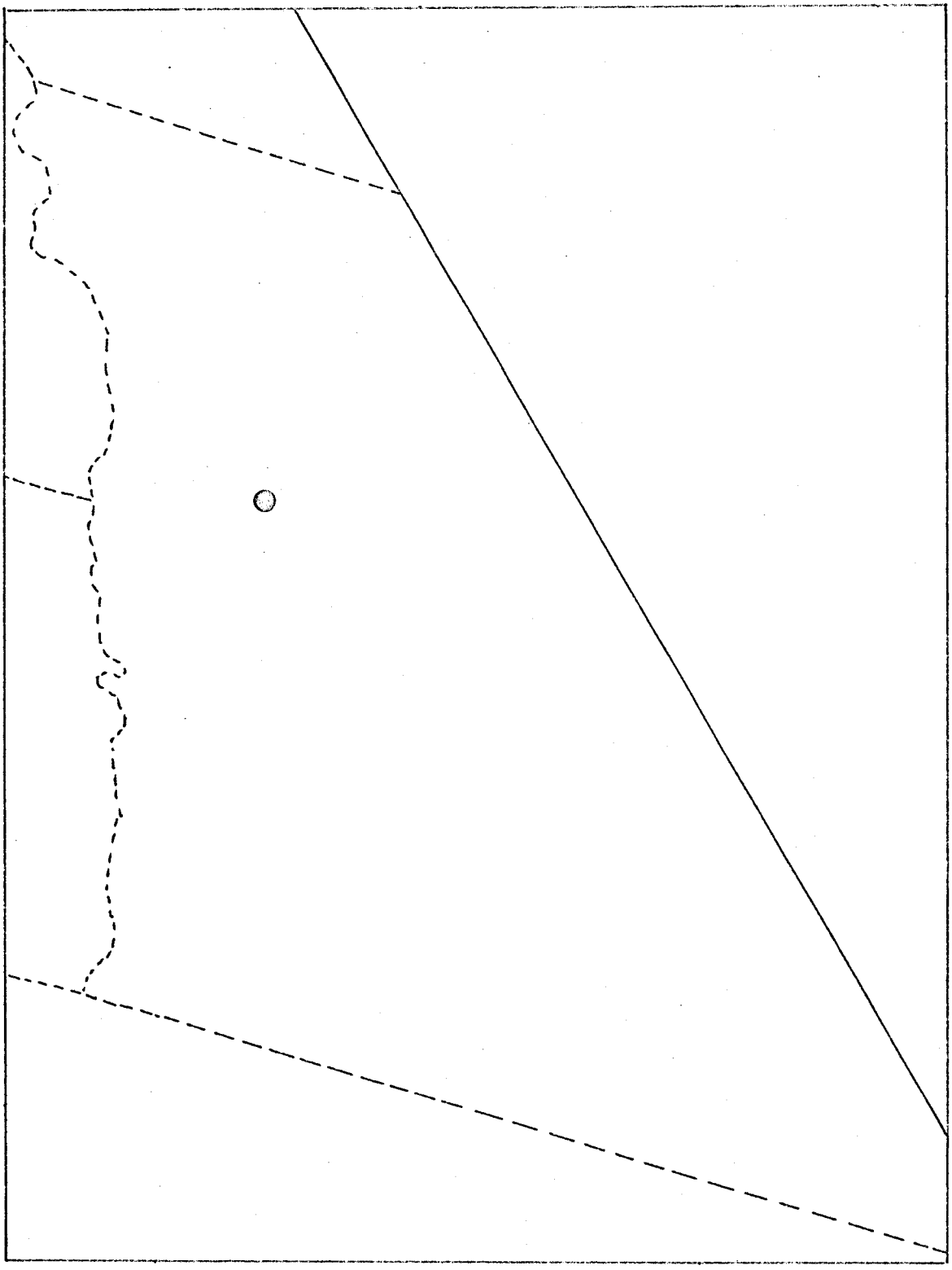
The whole aggregate treated here as C. humilis is distinguished mainly by the short corollas and the muricate nutlets. These are characters which are also possessed by C. cana and C. breviflora, but these species have an indument which is silky-strigose, and with few or no pustulate hairs.

29. Cryptantha roosiorum Munz

Cryptantha roosiorum Munz, El Aliso 3:124. 1955.

Densely caespitose, long-lived perennial, 0.1-0.3 dm tall; stems many from the end of the branched caudex, rather slender, 0.1-0.2 dm long; leaves spatulate to oblanceolate, acute, 0.5-1.2 cm long, densely

Map No. 29. Inyo County, California. Range of C. roosiorum Munz.



Cryptantha roosiorum Munz

strigose and appressed setose, appearing almost tomentose, scarcely pustulate; inflorescence compact, about 1 cm long, foliar bracts inconspicuous; calyx segments linear, in anthesis 2.8-3.1 mm long, in fruit becoming 3.8-4.3 mm long, strigose, and more or less setose; corolla white, the tube 2.5-3 mm long, crests at base of tube well developed, fornices low, rounded, yellow, about 0.5 mm long, limb 4.5-5.5 mm wide; style slightly surpassing the nutlets; nutlets 2.3-2.5 mm long, lance-ovate, acutish, dorsal surface rugulose, with low, rounded, irregular ridges, also somewhat muricate, ventral surface similar but the markings less evident, scar narrowly triangular, and lacking an elevated margin. Collections: 1 (0); representative: J. C. & A. R. Roos 6015 (RSA).

Holotype: J. C. & A. R. Roos 6015, collected in Inyo County, California, along crest of Inyo Mountains three miles east of Badger Flat, at 10,600 feet, 13 August, 1953, RSA. Photograph at BRY. Isotypes at CAS, GH.

Distribution: Apparently endemic to the type locality, Inyo County, California. Growing on open rocky slopes, 10,600 feet. Map No. 29. July and August.

Cryptantha roosiorum is not very well known, and many more collections of this species are badly needed. It is perhaps most closely related to C. humilis, but differs in the more caespitose habit, smaller leaves, calyx, and corolla. The inflorescence is also more compact, and the whole plant is much smaller.

30. Cryptantha compacta Higgins

Cryptantha compacta Higgins, Great Basin Naturalist 28:196. 1968.

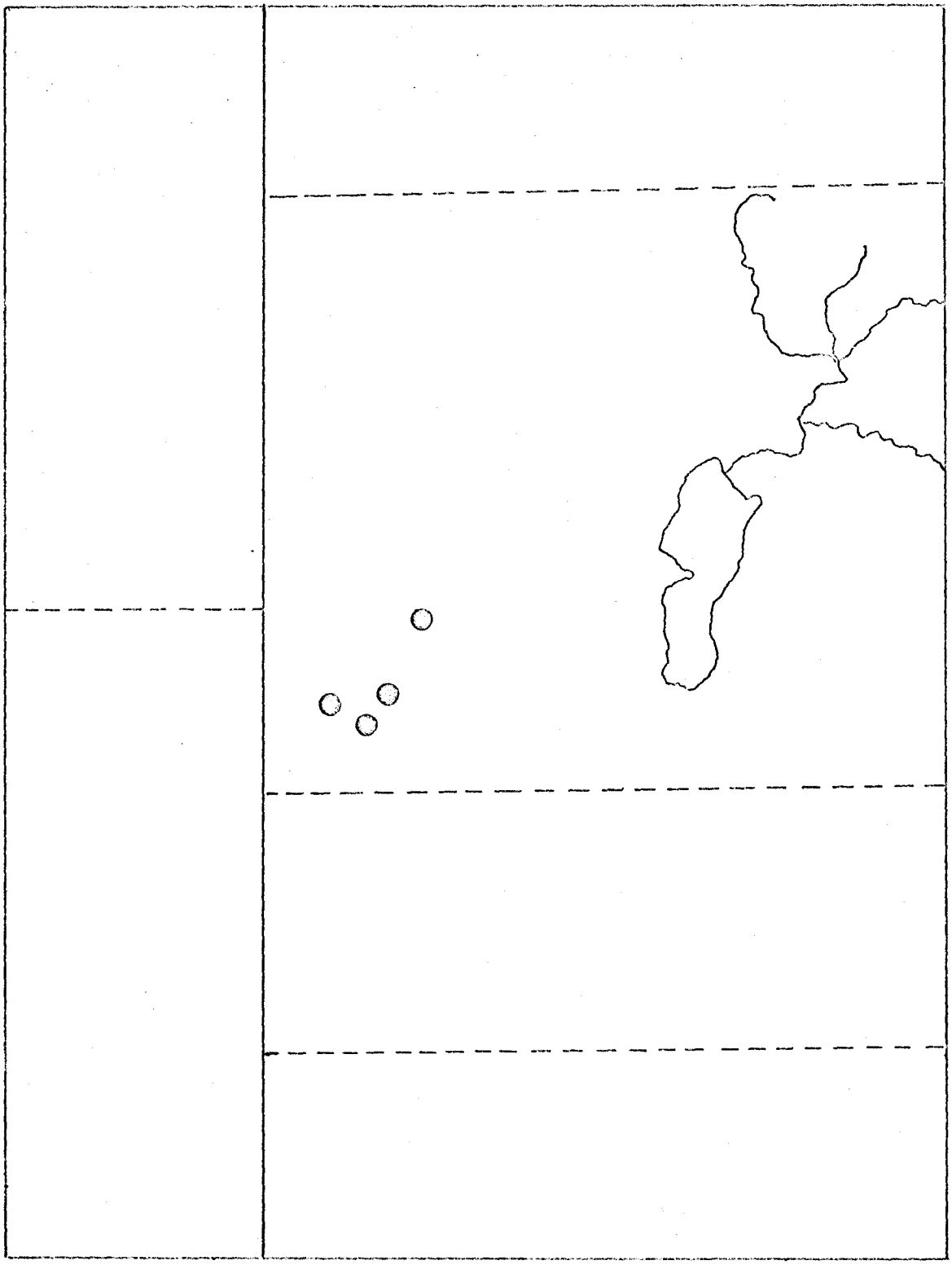
Densely caespitose perennial, 0.3-1 dm tall; stems numerous,

arising from a woody root, 0.1-0.4 dm long, tomentose below, weakly strigose above; leaves oblanceolate to spatulate, obtuse, 0.5-1.5 (2) cm long, 0.2-0.4 cm wide, dorsal surface with appressed setose-pustulate bristles, also densely strigose or subtomentose, ventral surface similar but with fewer pustulate hairs, the petioles tomentose; inflorescence narrow, nearly capitate, 1-5 cm long; foliar bracts evident but not conspicuous; calyx segments lanceolate, 2-2.5 mm long in anthesis, in fruit becoming 3.5-4.5 (5) mm long, densely white setose and tomentose; corolla white, the tube 1.8-2.2 mm long, crests at base of tube evident, fornices yellow, rounded, papillose, about 0.5 mm long, limb 4.5-5.5 mm wide; style equalling or shorter than mature fruit; nutlets lance-ovate, acute, 2.5-3 mm long, 1.5-1.8 mm wide, only 1-2 maturing, dorsal surface muricate or weakly tuberculate-rugulose, ventral surface muricate, scar Open, subulate to narrowly triangular, elevated margin lacking. Collections: 6 (ii); representative: R. C. Holmgren 521 (BRY); B. F. Harrison 6371 (BRY); L. C. Higgins 1462 (BRY).

Holotype: L. C. Higgins 1613, collected in Millard County, Utah, about 8 miles west of Desert Range Experiment Station Headquarters along hwy. 21, 100 m west of pass at the north end of Needle Range, 18 June, 1968, BRY. Isotypes at CAS, GH, NY, POM, US, UTC.

Distribution: Known only from southwestern Millard County, Utah, but to be expected from northern Beaver County, Utah, and perhaps in eastern Nevada. Growing on gravelly loam soil, 4,500 to 6,000 feet. Map No. 30. May to July.

Cryptantha compacta is most closely related to C. humilis but differs in its more compact and caespitose habit, smaller leaves, shorter calyx segments, and smaller corolla. This plant has been known for over



Cryptantha compacta Higgins

thirty years, but has been placed with C. humilis, probably due to the immaturity of the specimens. In observing this species in the field it becomes even more apparent of its right to specific distinction, due to its dense caespitose habit that more resembles C. caespitosa than C. humilis. At the type locality it is the most common plant, growing on shallow stony loam.

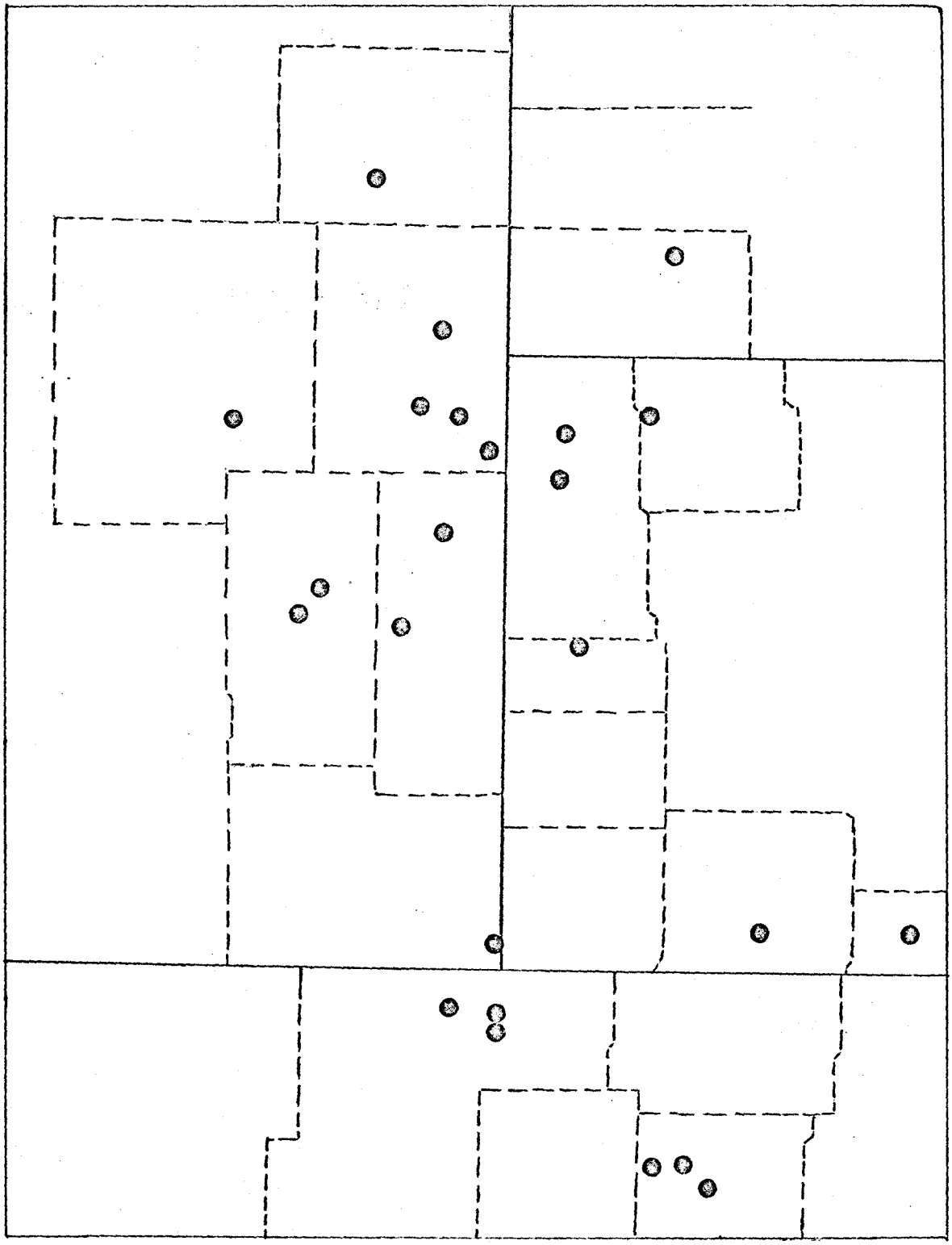
31. Cryptantha cana (A. Nels.) Payson

Cryptantha cana (A. Nels.) Payson, Ann. Mo. Bot. Gard. 14:316. 1927.

Oreocarya cana A. Nels. Bot. Gaz. 34:30. 1902.

Caespitose perennials, 0.5-2 dm tall; stems many, arising from a multiple caudex, 0.2-0.5 dm long, weakly setose; leaves narrowly oblanceolate, acute, very dense at the ends of the caudices, 2-6 cm long, 0.3-1 cm wide, uniformly silky-strigose, also with small inconspicuous pustulate hairs on both leaf surfaces; inflorescence narrow, setose, foliar bracts inconspicuous; calyx segments linear-lanceolate, 3-4 mm long in anthesis, in fruit becoming 6-7 mm long, weakly setose; corolla white, the tube 3-4 mm long, crests at base of tube evident, fornices yellow, rounded, papillose, about 0.5 mm long, limb 6-9 mm wide; nutlets lance-ovoid, 2.5-3 mm long, 1.4-1.8 mm wide, usually only 1 maturing, margins acute, dorsal surface muricate with elongated papillae, or sometimes tuberculate, ventral surface similar but less roughened, scar narrowly triangular, and without an elevated margin; style shorter than the mature fruit. Collections: 29 (iv); representative: E. J. Palmer 37423 (GH); C. L. Porter 5723 (GH, RM); Ripley & Barneby 10547 (GH); A. Nelson 2876 (ND-G); J. Ewan 12770 (GH); L. C. Higgins 1534, 1542, 1537 (BRY).

Holotype: A. Nelson 8309, collected in Goshen County, Wyoming,



Cryptantha cana (A. Nels.) Payson

at Fort Laramie, on gravelly hilltop, 29 June, 1901, RM. Photograph at BRY. Isotype at GH.

Distribution: Western Nebraska, northeastern Colorado, and southeastern Wyoming. Growing on gravelly loam soils, 4,000 to 6,000 feet. Map No. 31. May to early September.

Cryptantha cana is similar to C. caespitosa in habit, but can be from it by the silky-strigose pubescence, sharply muricate nutlets, and the different range.

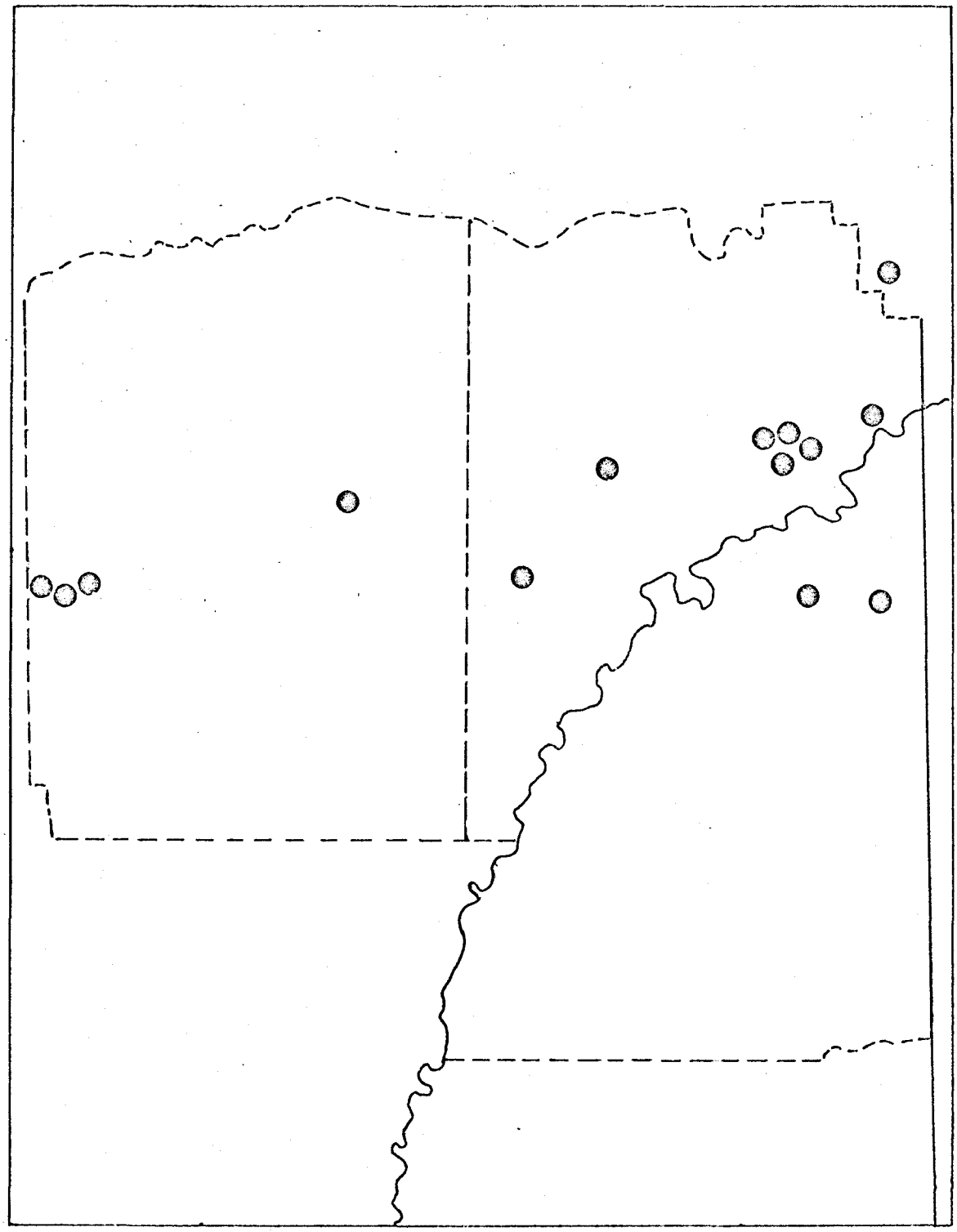
32. Cryptantha breviflora (Osterh.) Payson

Cryptantha breviflora (Osterh.) Payson, Ann. Mo. Bot. Gard. 14:318. 1927.

Oreocarya breviflora Osterh. Univ. Wyo. Publ. Bot. 1:169. 1926.

Long-lived perennials, 1.6-3 dm tall; stems several, slender, 0.7-1.7 dm long, densely white setose at the base, strigose above; leaves oblanceolate to spatulate, 2.5-9 cm long, 0.4-1.4 cm wide, clustered at the ends of the branched caudices, the apices obtuse, dorsal surface densely and uniformly silky-strigose, with many small pustulae, ventral surface similar but with fewer pustules; inflorescence narrow in flower, but becoming broad and open at maturity, 0.6-2.7 dm long, setose; calyx segments linear-lanceolate, 4.5-6 mm long in anthesis, in fruit becoming 7-9 mm long, setose; corolla white, 3.5-4.5 mm long, crests at base of tube evident, fornices yellow, rounded, about 0.5 mm long, limb 8-12 mm wide; style exceeding mature fruit by 2 mm or less; nutlets lanceolate, 3.4-4 mm long, 2-2.5 mm wide, less than 4 nutlets maturing, margins in contact, knife-like, dorsal surface uniformly muricate or tuberculate, ventral surface similar, scar open, narrowly triangular, margin not elevated. Collections: 20 (vi); representative: R. C. Rollins 1736

Map No. 32. Northeastern Utah. Range of C. breviflora (Osterh.) Payson.



Cryptantha breviflora (Osterh.) Payson

(UTC); S. L. Welsh 466 (COLO); J. Brotherson 806 (BRY); W. A. Weber 5310 (COLO); Higgins & Welsh 1018 (BRY) L. C. Higgins 1084 (BRY).

Holotype: G. E. Osterhout 6414, collected in Uintah County, Utah, 6 1/2 miles north of Jensen, 19 June, 1925, RM. Photograph at BRY.

Distribution: Northeastern Utah in Duchesne and Uintah Counties. Growing on heavy clay soils, 4,500 to 7,000 feet. Map No. 32. May to July.

Cryptantha breviflora is apparently endemic to the Uintah Basin. It differs from its closest relative, C. fulvocanescens, by the short corolla, low fornices, different pubescence, and shorter style. The range of the two is also consistently different, C. fulvocanescens being more southerly, and never in the Uintah Basin.

33. Cryptantha propria (Nels. & Macbr.) Payson

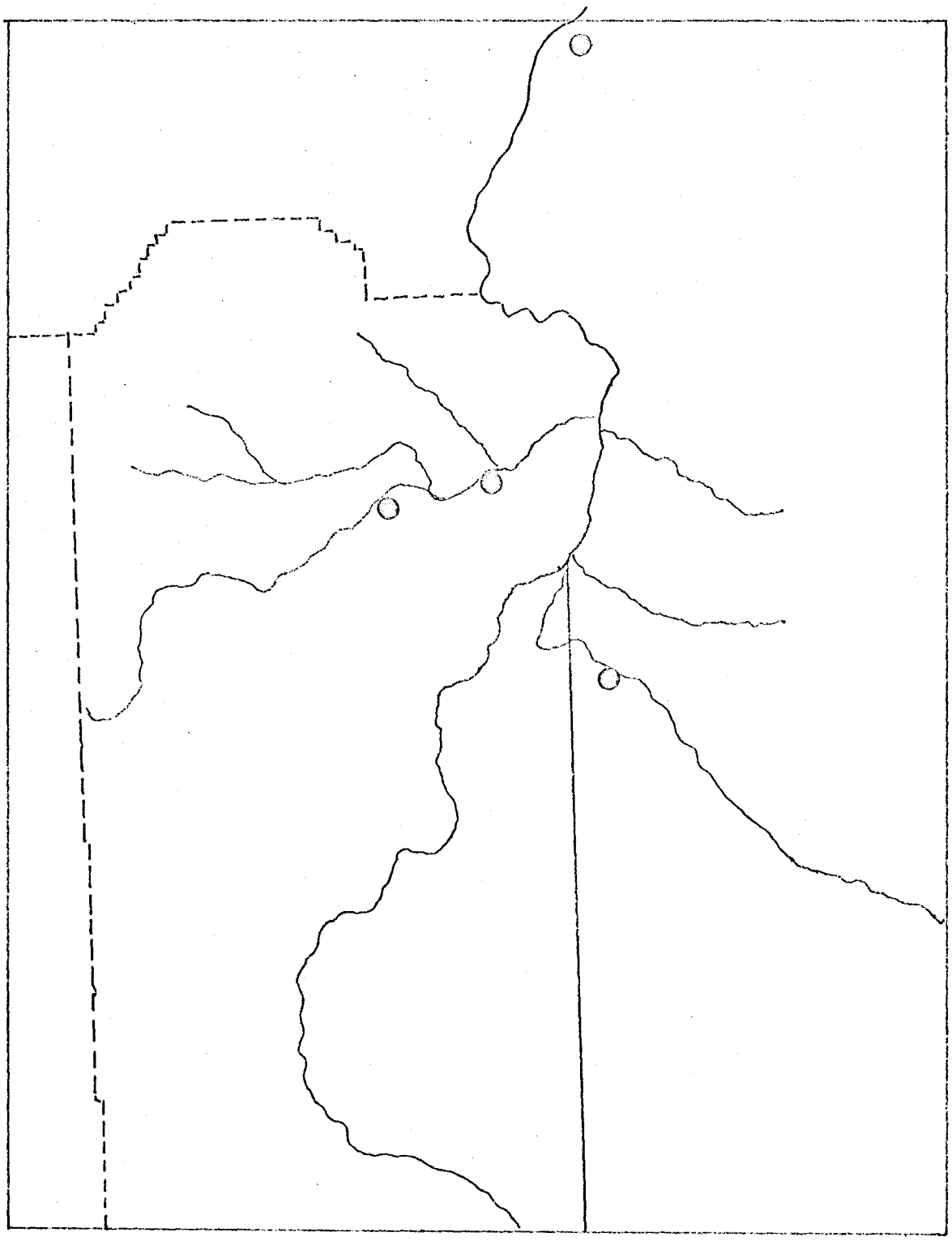
Cryptantha propria (Nels. & Macbr.) Payson, Ann. Mo. Bot. Gard. 14:317. 1927.

Krynitzkia fulvocanescens var. idahoensis Jones, Contr. West. Bot. 13:6. 1910. (Type: Jones 6474, near Weiser, Idaho, 28 April, 1910.)

Oreocarya propria Nels. & Macbr. Bot. Gaz. 62:145. 1916.

Caespitose perennials from a strongly lignified taproot, 1-2.3 dm tall; stems several, 0.7-1.2 dm long, finely strigose and setose; leaves oblanceolate to spatulate, obtuse, 3-9 cm long, 0.4-1.2 cm wide, dorsal surface finely strigose and scattered appressed setose, ventral surface finely and uniformly strigose, without pustules; inflorescence narrow, 0.5-1.2 dm long, foliar bracts inconspicuous; calyx segments linear-lanceolate, in anthesis 4-6 mm long, in fruit becoming 7-13 mm long, densely setose-hirsute; corolla white, the tube 3.5-4.5 mm long, crests

Map No. 33. Parts of western Idaho and eastern Oregon. Range of *C. propria* (Nels. & Macbr.) Payson.



Cryptantha propria (Nels. & Macbr.) Payson

at base of tube conspicuous, fornices yellow, rounded, papillose, about 0.5-1 mm long, limb 6-8 mm wide; style exceeding mature fruit 1.5-2 mm; nutlets ovate-lanceolate, 3-4 mm long, 2.5-3 mm wide, margins in contact, acute, dorsal surface densely and irregularly rugulose, with narrow high ridges, muricate between the ridges, ventral surface tuberculate, or with some of the tuberculations joined to form short ridges, scar open, linear, and without an elevated margin. Collections: 6 (0); representative: J. B. Leiberg 2049 (UC, GH, POM, US); J. B. Leiberg 2223 (UC, GH, US); R. J. Davis 4496 (GH); H. M. Tucker 1022 (GH, IDS); M. E. Jones 4674 (POM).

Holotype: J. B. Leiberg 2049, collected in Malheur County, Oregon, at Vale, 14 May, 1896, GH. Photograph at BRY. Isotypes at UC, GH, POM, US.

Distribution: Southwestern and western Idaho, and eastern Oregon in Malheur County. Growing in clay soils, 2,000 to 4,000 feet. Map No. 33. April to June.

It is difficult to say to what species this plant is most nearly related. It would perhaps be most easily confused with C. cana or C. breviflora but those are plants far removed from it geographically, and C. propria may not be very closely related to either. It is probably most closely related to C. humilis. It is very distinct, however, in its racemose inflorescence, and different pubescence.

34. Cryptantha fulvocanescens (Wats.) Payson

Densely caespitose perennials from a strongly lignified taproot, 0.8-3 dm tall; stems many from the multiple caudex, 0.5-1.3 dm long, white hairy at the base, setose-hirsute upward; leaves spatulate or oblanceolate, acute to obtuse, 1.5-7 cm long, 0.4-1.2 cm wide, uniformly

strigose, pustules mainly confined to the dorsal surface; inflorescence narrow or somewhat open at maturity, 0.3-1.9 dm long, white or yellowish setose, foliar bracts inconspicuous; calyx segments linear, 4-6 mm long in anthesis, in fruit becoming 9-13 mm long, densely white or yellowish setose, pedicels 2-10 mm long; corolla white, the tube 7-11 mm long, crests at base of tube evident or lacking, fornices yellow, emarginate or rounded, 0.7-1.3 mm long, limb 7-9 mm broad; style exceeding mature fruit 3-7 mm; nutlets lance-ovate, 3.5-4.5 mm long, 2-3 mm wide, 1-2 usually maturing, margins acute to obtuse, in contact when more than 1 nutlet matures, both surfaces densely and uniformly muricate, scar open or nearly closed, elevated margin lacking.

Key to the varieties of C. fulvocanescens

1. Muricications on the nutlet rounded; corolla 9-13 mm long; inflorescence narrow, white setose at maturity. 34a. var. fulvocanescens
1. Muricications on the nutlet with 1 or 2 setose projections; corolla 7-9 mm long; inflorescence broader and usually yellowish setose at maturity. . . . . 34b. var. echinoides

34a. var. fulvocanescens

Cryptantha fulvocanescens (Wats.) Payson var. fulvocanescens

Eritrichium glomeratum var. ? fulvocanescens S. Wats. Bot. King Exp. 243. 1871.

Eritrichium fulvocanescens Gray, Proc. Am. Acad. 10:61. 1875.

Krynitzkia fulvocanescens Gray, Proc. Am. Acad. 20:280. 1885.

Oreocarya fulvocanescens (Wats.) Greene, Pitt. 1:58. 1887.

Oreocarya nitida Greene, Pl. Baker. 3:21. 1901. (Type: Deer Run, Colorado, 11 June, 1901, C. F. Baker 95.)

Cryptantha fulvocanescens (Wats.) Payson, Ann. Mo. Bot. Gard. 14: 319. 1927.

Densely caespitose perennial, 1-3 dm tall; inflorescence narrow, white setose; pedicels 2-3 mm long; corolla white, the tube 9-11 mm long, crests at base of tube evident or lacking, fornices yellow, rounded to acute; nutlets lanceolate, 3.5-4 mm long, 2-2.5 mm wide, the dorsal surface with rounded murications, scar straight, closed or slightly open. Collections: 58 (viii); representative: A. Cronquist 9096 (POM, UTC); A. H. Holmgren 3225 (US); G. Heller 3517 (ND-G, US); Fendler 632 (GH); C. F. Baker 561 (ND-G, US); C. F. Baker 95 (UC, POM, GH, RM, US); L. C. Higgins 999, 1012, 1307 (BRY).

Holotype: Fendler 632, collected in Santa Fe County, New Mexico, near Santa Fe, 1847, GH. Photograph at BRY. Isotypes at PH, US.

Distribution: Western Colorado, northwestern New Mexico, northeastern Arizona, and eastern Utah. Growing on sandy soil, 4,000 to 7,500 feet. Map No. 34. April to August.

Cryptantha fulvocanescens var. fulvocanescens is most likely to be confused with C. breviflora, but differs in the longer corolla tube, narrower inflorescence, longer style, and different pubescence.

34b. var. echinoides (Jones) Higgins

Cryptantha fulvocanescens (Gray) Payson var. echinoides (Jones) Higgins.

Krynitzkia echinoides Jones, Proc. Calif. Acad. Sci. II. 5:709. 1895.

Oreocarya echinoides (Jones) Macbr. Contr. Gray Herb. 48:31. 1916, as to synonymy, not as to specimens cited.

Cryptantha echinoides (Jones) Payson, Ann. Mo. Bot. Gard. 14:321. 1927.

Caespitose perennials, 0.8-3.6 dm tall; inflorescence narrow to somewhat open at maturity, yellowish setose; pedicels 3-10 mm long;

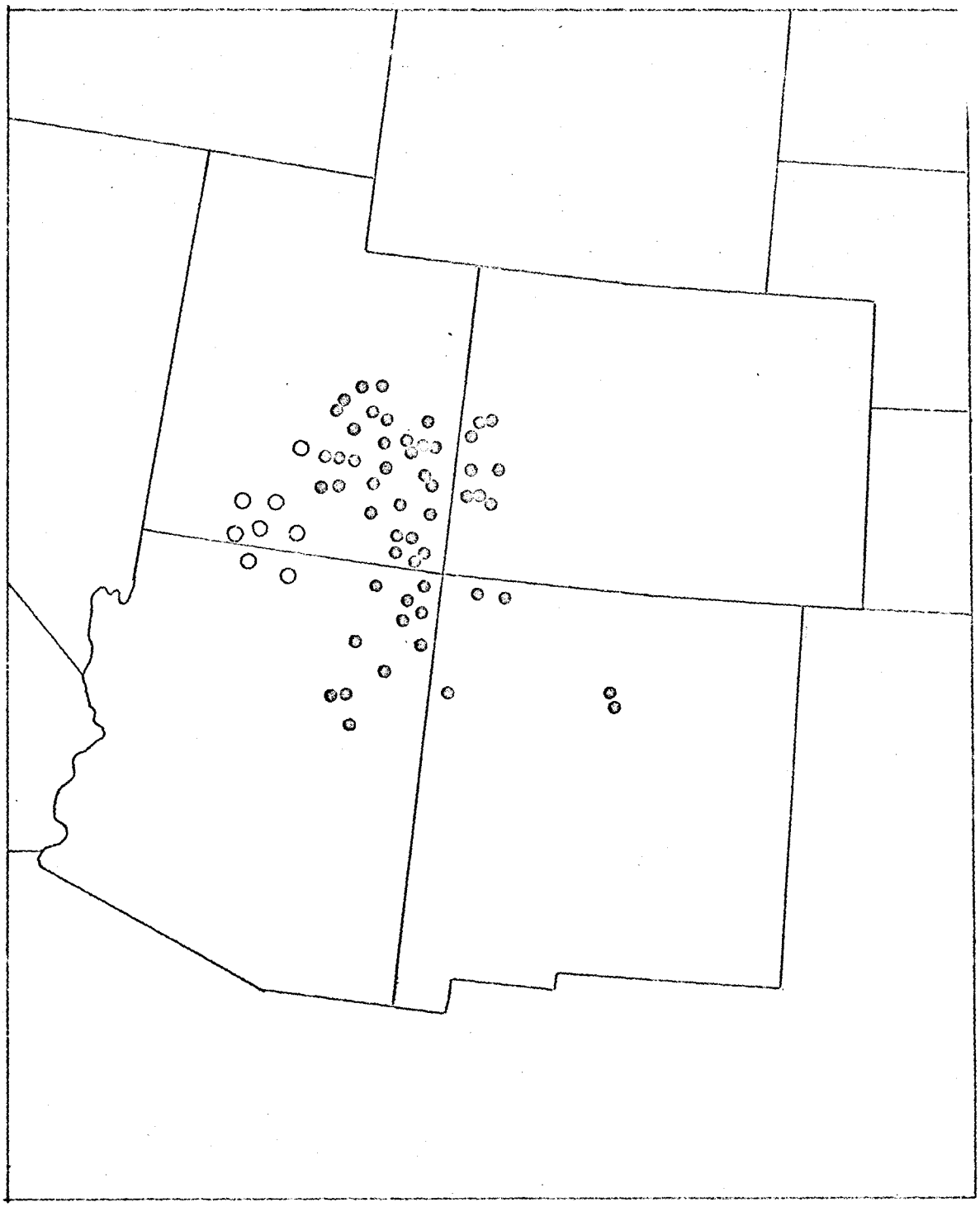
corolla white, the tube 7-9 mm long, crests at base of tube lacking, or sometimes evident, fornices yellow, emarginate; nutlets lance-ovoid, 4-4.7 mm long, 2.5-3 mm wide, the dorsal surface with 1-2 setose projections terminating each murication, scar asymmetrical, and without an elevated margin. Collections: 19 (vi); representative: M. E. Jones 5297p (POM); M. E. Jones 5312ac (POM); Eastwood & Howell 9265 (UTC); R. H. Peebles 14688 (ARIZ, US); Reveal, Gentry & Davidsee 781 (BRY); A. Cronquist 10212 (BRY, NY); L. C. Higgins 1008, 1344 (BRY).

Lectotype: M. E. Jones 5297p, collected in Kane County, Utah, in Pahria Canyon, 26 May, 1894, POM. Photograph at BRY.

Distribution: South-central Utah and north-central Arizona. Usually growing on heavy saline clay soils, 4,000 to 7,500 feet. Map No. 34. April to July.

Payson cites Eritrichium glomeratum var. (?) fulvocanescens, Wats. Bot. King Exped. 243 (1871), as a synonym of C. humilis. This I believe is incorrect. Watson took a herbarium name of Gray's and described under it an aggregate species. When Gray finally published his name E. fulvocanescens he cited Watsons trinomial as a synonym and appears to have accepted the limits given it by Watson. Watson, however, found Gray's name on a specimen from New Mexico collected by Fendler (no. 632). He accepted that specimen as belonging to his variety and indicated it as the source of his botanical name. He erred in taxonomic judgment, though, in placing with it certain material from Nevada and possibly Utah, that belongs at least in part to C. humilis. Payson placed particular emphasis on these latter specimens. However, since Watson included the Fendlerian New Mexican plant in his concept and indicated it as the source of his name that it should be taken as the type of fulvocanescens, both as variety and species. Consequently the name

Map No. 34. Parts of western United States. Range of C. fulvocanescens: ● var. fulvocanescens (Gray) Payson; O var. echinoides (Jones) Higgins.



Cryptantha fulvocanescens (Gray) Payson

applies to a very different plant from that described as Oreocarya humilis by Greene.

The variety echinoides was entirely misunderstood by Macbride (1916). From the specimens he cited from western Nevada and adjacent California it is evident that he never saw a specimen of true echinoides. It differs from the typical plant in that the murications are setose, and the nutlets are usually larger.

35. Cryptantha jonesiana (Payson) Payson

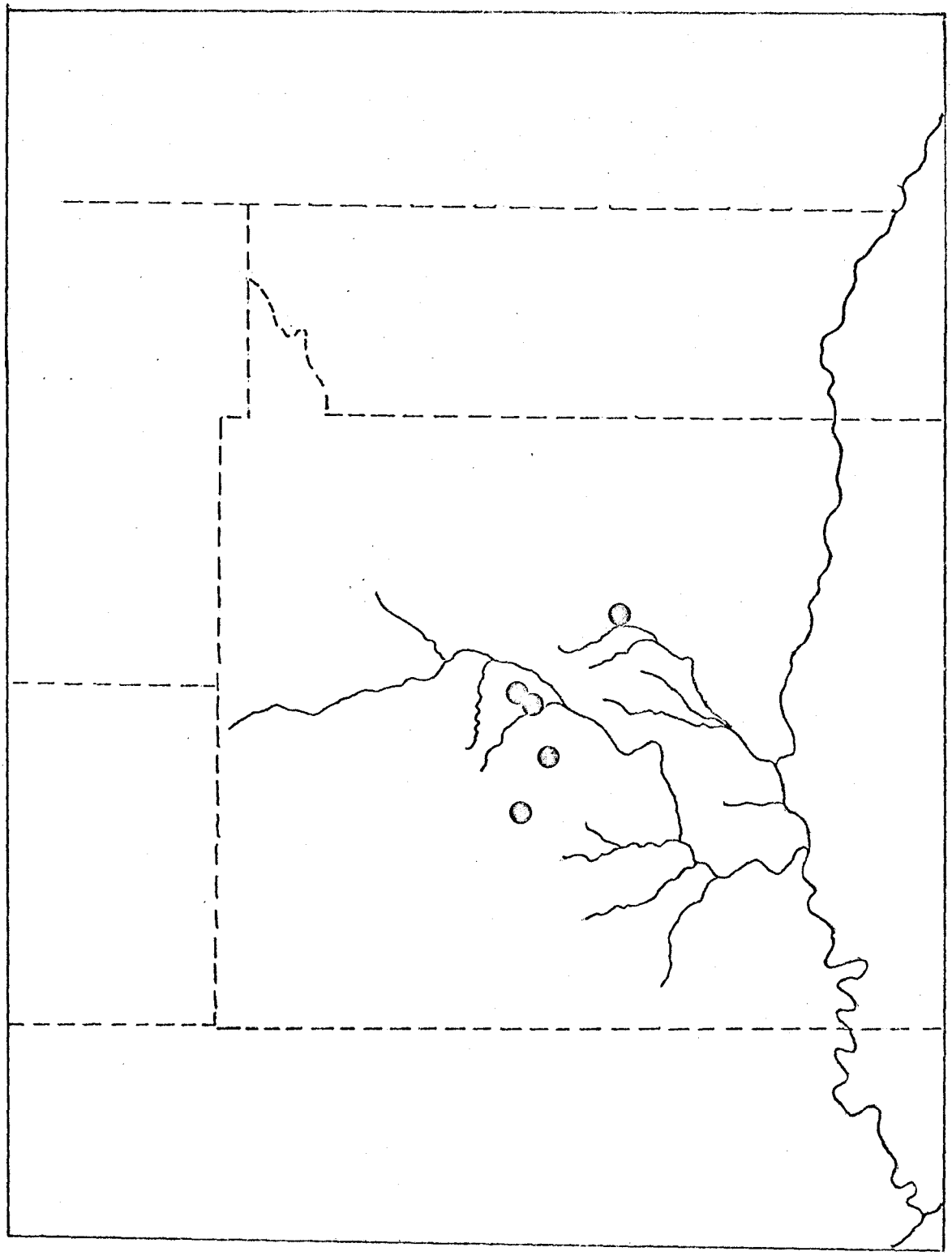
Cryptantha jonesiana (Payson) Payson, Ann. Mo. Bot. Gard. 14:323. 1927.

Oreocarya jonesiana Payson, Univ. Wyo. Publ. Bot. 1:168. 1926.

Coarse perennials, 0.5-1.5 dm tall; stems many, arising from a thick multiple caudex, 0.2-0.7 dm long, setose; leaves spatulate, 1-4 cm long, 0.4-1.3 cm wide, coarsely appressed setose-pustulate, leaf bases also setose with dense white hairs; inflorescence narrow, somewhat capitate, with 1-3 flowers in the axis of the bracts below the terminal cluster; calyx segments lanceolate to nearly linear, in anthesis 5-7 mm long, in fruit becoming 7-10 mm long, densely setose, with ascending, yellowish bristles; corolla white, the tube 10-15 mm long, campanulate in the throat, fornices low and broad, pappilose, crests at base of tube lacking, limb 9-13 mm wide; nutlets lanceolate, 3.5-4.5 mm long, densely and uniformly muricate, or with a few short, low ridges, scar narrow, open, and without an elevated margin. Collections: 11 (v); representative: W. P. Cottam 5247 (UT); M. E. Jones s.n. (POM); D. Atwood 1301 (BRY); Higgins & Reveal 1265, 1275, 1299 (BRY); L. C. Higgins 1322, 1308 (BRY).

Holotype: M. E. Jones s.n., collected in Emery County, Utah, on the San Rafael Swell, 15 May, 1914, POM. Photograph at BRY.

Map No. 35. Emery County, Utah. Range of C. jonesiana (Payson) Payson.



Cryptantha jonesiana (Payson) Payson

Distribution: Endemic to the San Rafael Swell in Emery County, Utah. Usually growing on barren clay hills, 4,000 to 7,000 feet. Map No. 35. April to June.

Cryptantha jonesiana is probably most closely related to C. fulvocanescens but resembles it not at all. This handsome plant can be distinguished by its very large corolla, low broad fornices, spatulate leaves, and harsh pubescence.

36. Cryptantha thyrsiflora (Greene) Payson

Cryptantha thyrsiflora (Greene) Payson, Ann. Mo. Bot. Gard. 14:283. 1927.

Eritrichium glomeratum var. hispidissimum Torr. Bot. Mex. Bound. Surv. 140. 1859, at least in part.

Oreocarya thyrsiflora Greene, Pitt. 3:111. 1896.

Oreocarya hispidissima (Torr.) Rydb. Bull. Torrey Bot Club 33:150. 1906.

Oreocarya urticacea Wooton & Standl. Contr. U. S. Natl. Herb. 16: 166. 1913. (Type: Canyoncito, Santa Fe County, New Mexico, 18 June, 1897, A. A. & E. G. Heller 3731.)

Oreocarya dura Nels. & Macbr. Bot. Gaz. 62:144. 1916. (Type: E. L. Johnston 418, 1907, central Colorado.)

Oreocarya monosperma Osterh. Bull. Torrey Bot. Club 46:55. 1919. (Type: Trinidad, Las Animas Co., Colorado, 20 July, 1918, Osterhout 5754.)

Short-lived perennials or sometimes biennial, 1.7-4 dm tall; stems stout, 1-several, arising from the base, 0.5-1.8 dm long, conspicuously spreading setose; leaves oblanceolate, obtuse, 5-12 cm long, 0.5-1.4 cm wide, conspicuously spreading setose, pustulate on both surfaces, with

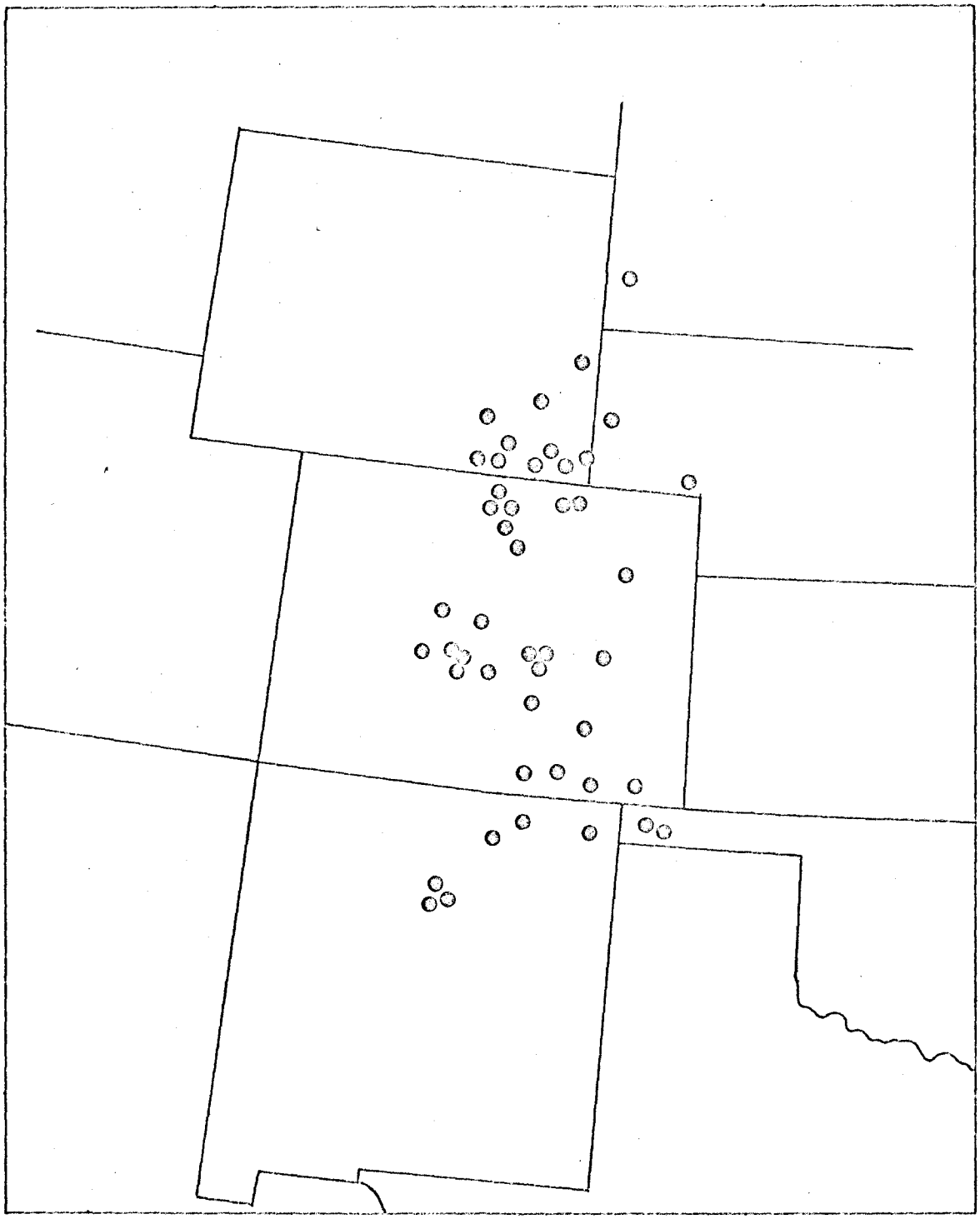
some finer strigose hairs beneath, the petioles ciliate-hirsute; inflorescence very broad and open, cymules much elongating, 1-2 dm long, 0.6-2.5 dm wide, setose, foliar bracts 2-3 cm long, but not very conspicuous due to the width of the inflorescence; calyx segments linear, in anthesis 3-4 mm long, in fruit becoming 6-9 mm long, setose; corolla white, the tube 3-4 mm long, crests at base of tube conspicuous, fornices yellow, emarginate, papillose, about 0.5 mm long, limb 5-8 mm wide; style exceeding mature fruit 1-1.5 mm; nutlets ovate to ovate-lanceolate, 2.5-3.5 mm long, 1.5-2 mm wide, usually 2-4 maturing, acute, margins in contact, dorsal surface low rugulose and tuberculate, sometimes with murications between the rugae, ventral surface similar but with fewer ridges, or sometimes almost smooth, scar subulate, the margin not elevated. Collections: 97 (v); representative: A. Nelson 7306 (RM, COLO, US); M. E. Jones 972 (RM, US, UTC); C. F. Baker, F. S. Earle & Tracy 13 (ND-G, RM, US); W. A. Weber 4389 (ARIZ, COLO); R. C. Rollins 1865 (ND, RM); U. T. Waterfall (COLO, UTC); M. Ownbey 1311 (COLO, RM, UTC); L. C. Higgins

Lectotype: E. L. Greene s.n., collected in southeastern Wyoming, at Cheyenne, 6 July, 1892, ND-G. Photograph at BRY.

Distribution: Western Nebraska and southeastern Wyoming, south throughout eastern Colorado, New Mexico, and into Oklahoma. Growing in gravelly loam soil, 4,500 to 9,600 feet. Map No. 36. Late May to September.

Early collections of this species were often referred to C. celosioides, but it is probably not very closely related to that plant. The broad inflorescence is the outstanding distinction of the species, but in addition the flowers of thyrsiflora are much smaller and the

Map No. 36. Parts of western United States. Range of C. thyrsiflora (Greene) Payson.



Cryptantha thyrsiflora (Greene) Payson

blooming season later than in C. celosioides. In observing the types of O. urticacea, dura, and monosperma it is apparent that they are exact synonyms of thyrsiflora.

37. Cryptantha elata (Eastw.) Payson

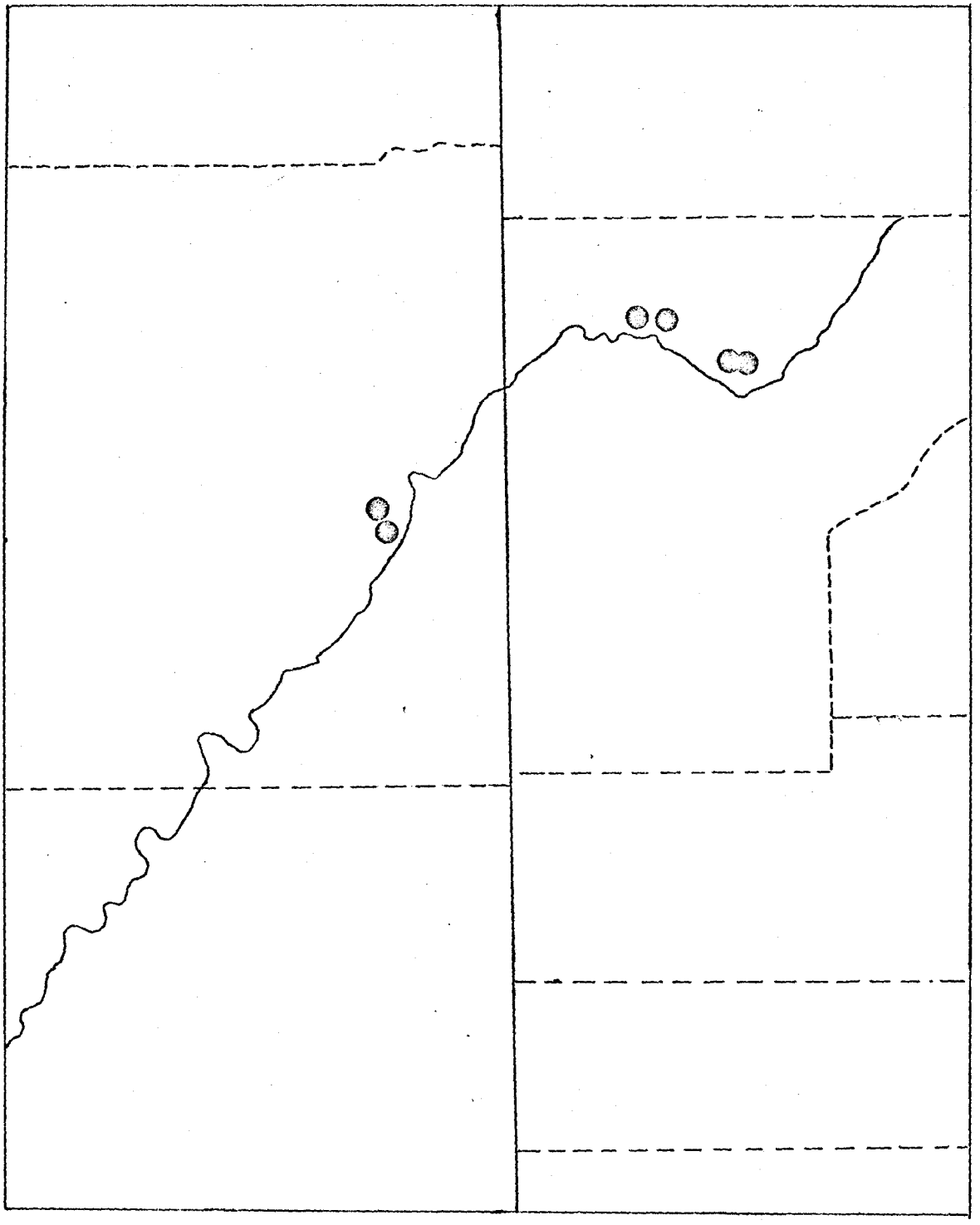
Cryptantha elata (Eastw.) Payson, Ann. Mo. Bot. Gard. 14:285. 1927.

Oreocarya elata Eastw. Bull. Torrey Bot. Club 30:241. 1903.

short-lived perennials, 3-5 dm tall; stems 1-6, erect, stout, weakly setose with spreading white hairs, 0.9-1.5 dm long; leaves oblanceolate to spatulate, 2-5 cm long, 0.4-1.3 cm wide, apices acute to obtuse, the blade tapering abruptly to the narrow petiole, dorsal surface strigose and appressed setose, ventral surface strigose, both surfaces pustulate; inflorescence spreading in age, 1.5-3.5 dm long, setose, foliar bracts inconspicuous; calyx segments lanceolate, in anthesis 3-4.5 mm long, in fruit becoming 7-8 mm long, hirsute; corolla white, the tube 3.5-5 mm long, fornices yellow, rounded, papillose, about 1 mm long, crests at base of tube well developed, limb 6-8 mm wide; style exceeding mature fruit 0.5-2 mm; nutlets lanceolate-ovate, 4-4.5 mm long, 2-2.5 mm wide, usually all 4 maturing, margins in contact, dorsal surface densely tuberculate and somewhat rugulose, the surface also covered with dense, minute papillae, ventral surface similar but the roughenings less prominent, scar closed, or narrowly open at the base, and without an elevated margin. Collections: 10 (ii); representative: A. Eastwood s.n. (CAS, GH); S. L. Welsh 6952 (BRY); G. E. Osterhout 5996 (RM); W. A. Weber 11294 (BRY, COLO); L. C. Higgins 1479 (BRY).

Lectotype: A. Eastwood s.n., collected in Mesa County, Colorado, near Grand Junction on the road to the coal mines, growing on bare clay

Map No. 37. Colorado and adjoining Utah. Range of *C. elata* (Eastw.) Payson.



Cryptantha elata (Eastw.) Payson

hills characteristic of the region, 25 May, 1892, CAS. Photograph at BRY. Isotypes at GH, NY, US.

Distribution: West central Colorado in Mesa County, and east-central Utah in Grand County. Growing on heavy clay soil, 4,500 to 5,500 feet. Map No. 37. May to June.

This species resembles C. insolita from southern Nevada, but is probably not very closely related to that taxon. It differs in the shorter spatulate leaves, differently marked nutlets which have the scar closed, and the larger nutlets. In practice this plant is so distinct that it is not to be confused with any other species in this subgenus. Additional collections of this very narrow endemic are badly needed in order to determine the exact limits of this very handsome species.

38. Cryptantha sericea (Gray) Payson

Cryptantha sericea (Gray) Payson, Ann. Mo. Bot. Gard. 14:286. 1927.

Krynitzkia sericea Gray, Proc. Am. Acad. 20:279. 1885.

Oreocarya sericea Greene, Pitt. 1:58. 1887.

Oreocarya affinis perennis A. Nels. Erythea 7:67. 1899. (Type: Green River, Wyoming, 31 May, 1897, A. Nelson 3035.)

Oreocarya argentea Rydb. Bull. Torrey Bot. Club 31:637. 1904. (Type: Rifle, Garfield County, Colorado, 1900, Osterhout 2122.)

Oreocarya perennis Rydb. Bull. Torrey Bot. Club 33:150. 1906.

Oreocarya procera Osterh. Bull. Torrey Bot. Club 47:211. 1920. (Type: Glenwood Springs, Garfield County, Colorado, 18 June, 1899, Osterhout 1867.)

Cryptantha sericea var. perennis (Nels.) Payson, Ann. Mo. Bot.

Gard. 14:288. 1927.

Perennials, 1.5-4.3 dm tall; stems 1-several, branched from the base, 0.5-1.2 dm long, setose with spreading hairs; leaves oblanceolate to spatulate, obtuse, 2.5-10 (15) cm long, 0.5-2 cm wide, dorsal surface strigose and slightly appressed to spreading setose, pustulate, ventral surface silky-strigose, pustules lacking or very inconspicuous; inflorescence narrow to somewhat open, 0.5-3.2 dm long, setose-hispid, foliar bracts 2-5 cm long; calyx segments lanceolate, 2.5-4 mm long in anthesis, in fruit becoming 6-8 mm long; pedicels 0.5-1 mm long; corolla white, the tube 2.5-3.5 mm long, crests at base of tube conspicuous, fornices yellow, depressed, broad, 0.5-0.6 mm long, limb 7-9 mm wide; style exceeding the mature fruit 0.5-1.3 mm; nutlets lanceolate, 2.5-3.5 mm long, 1.5-2 mm wide, usually all 4 maturing, margins acute or narrowly winged, in contact, dorsal surface with low rounded tuberculations, also somewhat rugulose and muricate, ventral surface similar but the markings less evident, scar straight, closed, and without an elevated margin. Collections: 70 (viii); representative: C. L. Porter 4583 (MONT, RM, WTU); R. C. Rollins 1772 (ND, UTC); B. Maguire 12378 (UTC); L. Williams 464 (RM); S. L. Welsh & E. M. Christensen 6572 (BRY); W. A. Weber 6111 (ARIZ, COLO, RM, UTC, CS); G. E. Osterhout 5119 (RM); L. C. Higgins 1048, 1055 (BRY).

Lectotype: H. Engelmann s.n., collected in Wyoming at Bridger Pass, 1856, GH. vide Payson.

Distribution: Southwestern Wyoming, northwestern Colorado, and northeastern Utah. Growing on heavy clay soils, 4,200 to 7,000 feet. Map No. 38. Late May to August.

The name sericea has always been a stumbling block in the way of

any satisfactory treatment of this group of plants. Payson was faced with the problem of selecting a type from the collections available to Dr. Gray at the time he described sericea. The specimens that were considered to compete for the type of sericea were;

Sheet 1 contains 4 specimens:

a. Bridger's Pass, 1856, H. Engelmann — equals O. argentea Rydb.

b. Wasatch Mts., 1844, Fremont — equals O. humilis Greene

c. Clover Mts., Nevada, 1868, Watson — equals O. humilis Greene

d. Mountain Hot Springs, Yellowstone Park, 1885, Tweedy 816 — equals C. celosioides

Sheet 2 contains 3 specimens:

a. Montana Terr. 1867 — equals C. celosioides

b. Summit, California, 1871, Bolander — equals C. nubigena Greene

c. Grass Valley, Utah, 1875, Ward 49 — equals C. abata Johnst.

Sheet 3 contains 2 specimens at the present time and probably 5 (including fragments) in Gray's time:

a. Southern Montana, 1880, Watson 287 — equals C. celosioides

b. A specimen of celosioides without data — equals C. celosioides

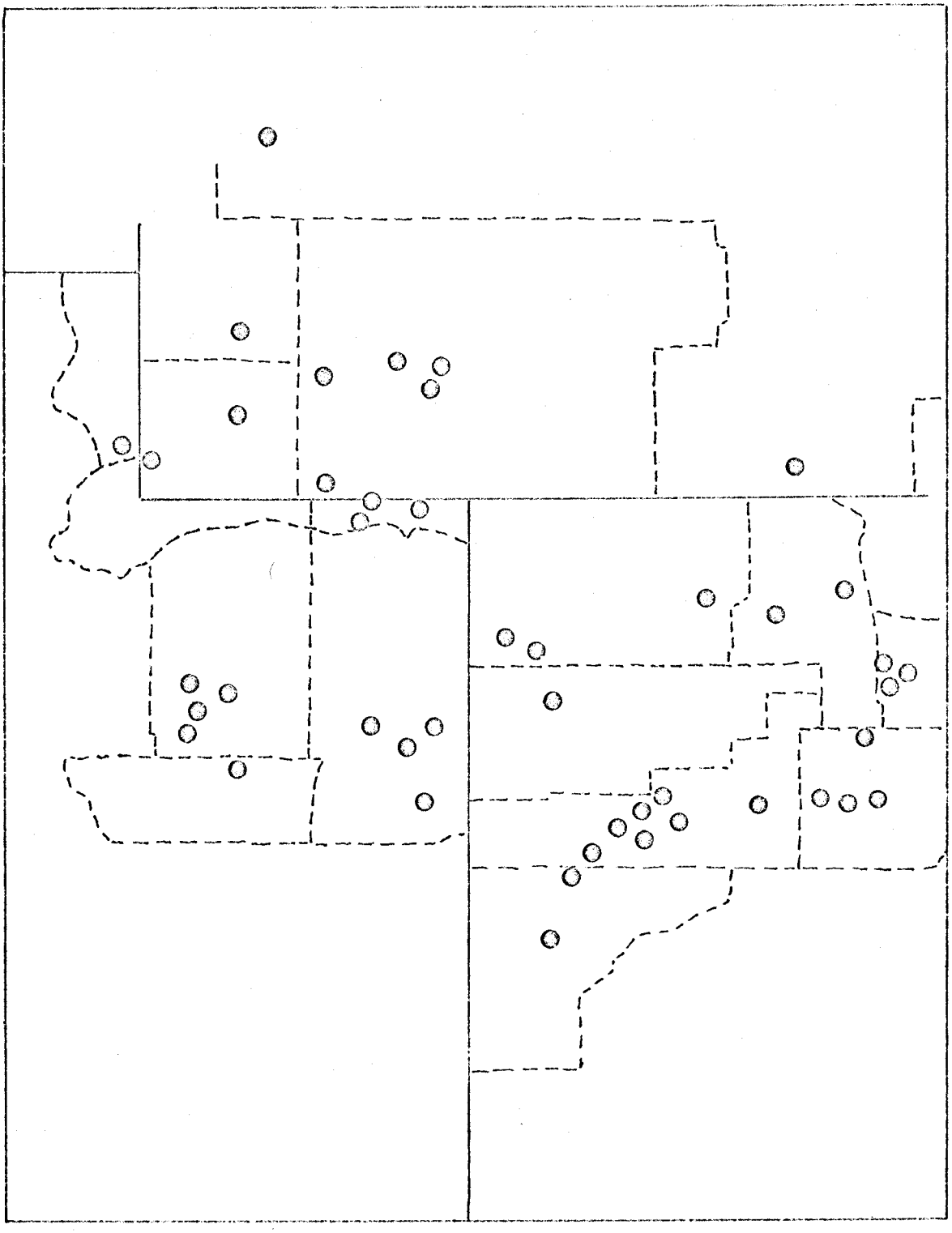
c. Fragment, Baker County, Oregon, 1879, Cusick. — equals C. subretusa Johnst.

d. Fragment from southern Wyoming — equals C. caespitosa

e. Fragment from Scotts Bluff, 1858 — equals C. cana

The specimens that were considered to compete for the type of sericea were then C. argentea, humilis, C. celosioides, abata, nubigena, subretusa, caespitosa and cana. By a process of elimination a type for sericea was selected. That from Bridger's Pass, collected by Engelmann,

Map No. 38. Southwestern Wyoming, northeastern Utah and adjoining Colorado. Range of C. sericea (Gray) Payson.



Cryptantha sericea (Gray) Payson

as this was the only specimen that fit the published description, the maturity of the plant Dr. Gray had in mind, and the geographical range.

Cryptantha sericea is similar in appearance to C. celosioides but can be recognized at once by the silky-strigose ventral surface of the leaves, which lack pustulate hairs, and the differently marked nutlets.

39. Cryptantha aperta (Eastw.) Payson

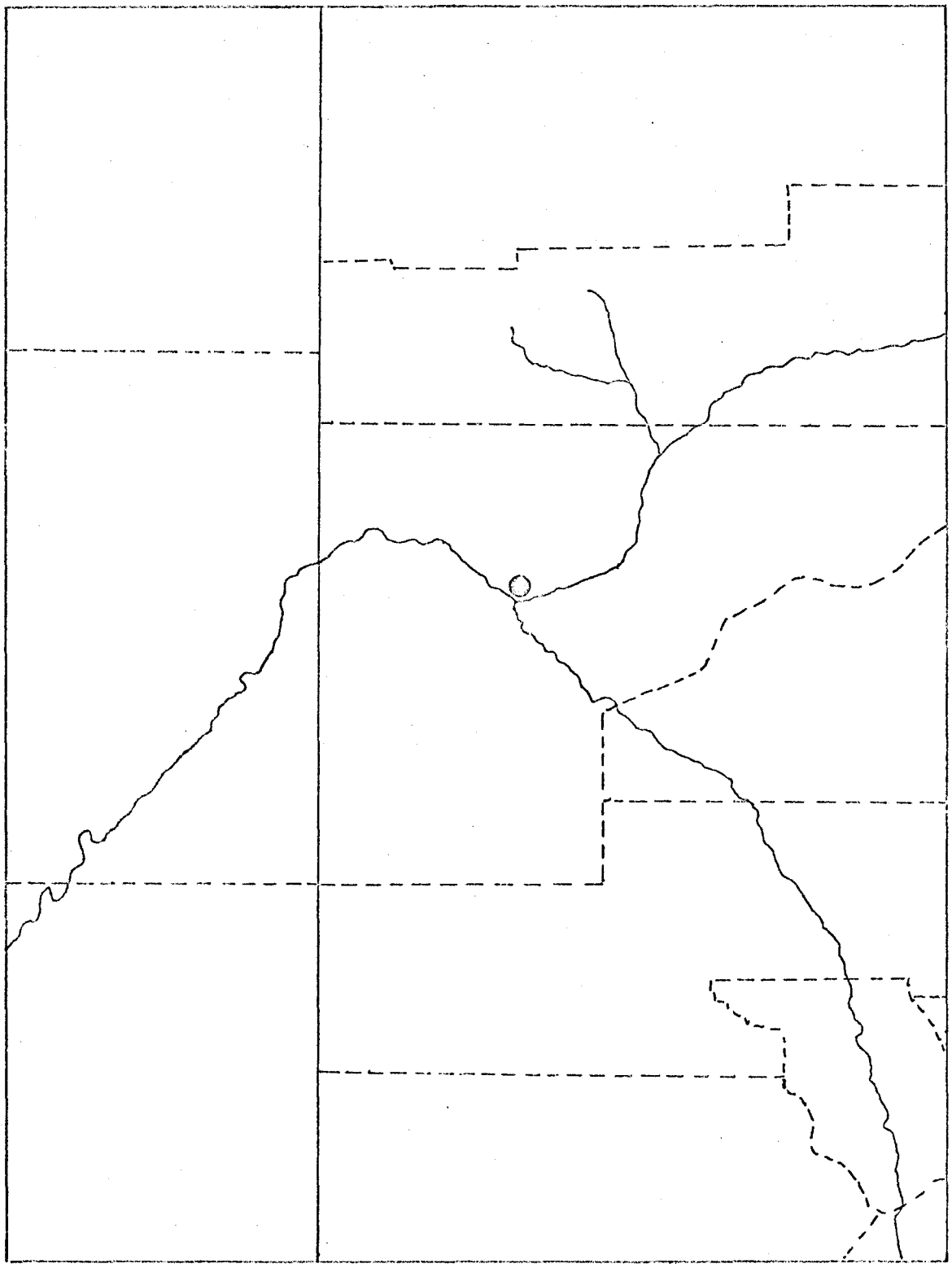
Cryptantha aperta (Eastw.) Payson, Ann. Mo. Bot. Gard. 14:295. 1927.

Oreocarya aperta Eastw. Bull Torrey Bot. Club 30:241. 1903.

Caespitose perennial, 1.2-2 dm tall; stems several, slender, arising from a woody root, 0.3-0.5 dm long, strigose and conspicuously white setose-hispid; leaves spatulate to oblanceolate, somewhat folded, and with the midrib strongly developed, obtuse, 2-3.5 cm long, 0.3-0.6 cm wide, both surfaces setose-hispid and pustulate, with fine appressed hairs beneath the bristles; inflorescence open, branched from near the base, with simple or 2-forked spikes, 1-1.3 dm long, the individual spikes becoming 4-7 cm long, foliar bracts inconspicuous; calyx segments linear-lanceolate, in anthesis 2.8-3 mm long, in fruit becoming 7-9 mm long, densely setose; corolla white, the tube 2.6-3 mm long, crests at base of tube conspicuous, fornices yellow, truncate, distinctly papillose, about 0.5 mm long, limb 4-6 mm wide; style exceeding mature fruit 1.5-2 mm; nutlets ovate-lanceolate, 2-2.6 mm long, 1.4-1.6 mm wide, usually all 4 maturing, margins acute, in contact, dorsal surface indistinctly carinate, tuberculate, somewhat rugulose, and indistinctly muricate, ventral surface indistinctly roughened, scar closed, and without an elevated margin. Collections: 1 (O); representative: A. Eastwood s.n. (CAS).

Holotype: A. Eastwood s.n., collected in Mesa County, Colorado,

Map No. 39. Mesa County, Colorado. Range of *C. aperta* (Eastw.) Payson.



Cryptantha aperta (Eastw.) Payson

at Grand Junction, 27 June, 1892, CAS. Photograph at BRY.

Distribution: Known only from the type locality, Mesa County, Colorado. Probably growing on clay soil characteristic of the region, 4,000 to 5,500 feet. Map No. 39. May to July.

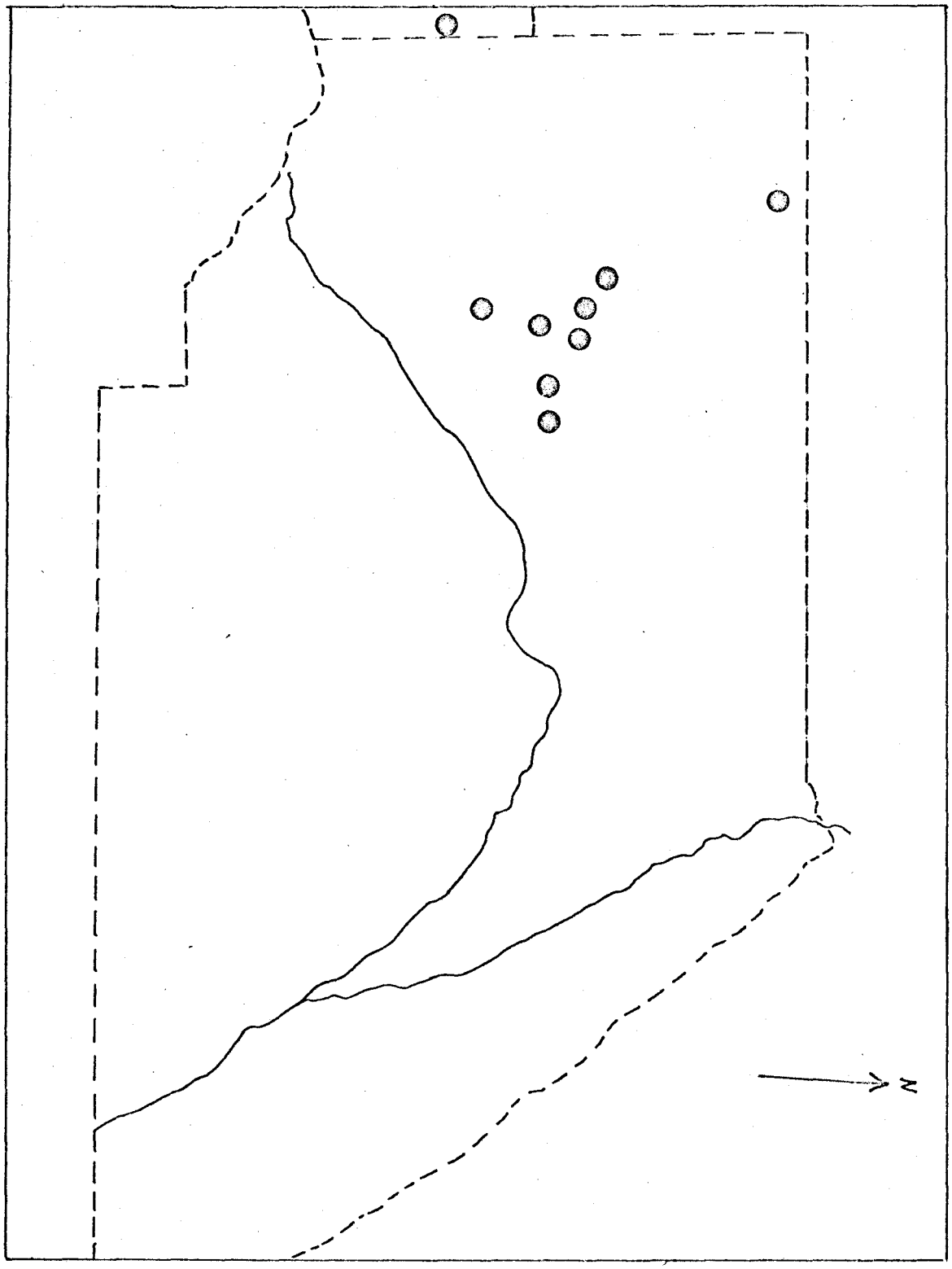
This species still remains obscure because of the lack of herbarium material. In observing the type specimen it appears that the plant is quite distinct, with its broad inflorescence and the ornamentation on the nutlet. It is perhaps closely related to C. thyrsiflora but is entirely distinct.

40. Cryptantha weberi Johnst.

Cryptantha weberi Johnst. Journ. Arn. Arb. 33:72. 1952.

Caespitose perennials, 1-1.8 dm tall; stems numerous, erect, 0.2-0.5 dm long, strigose, and weakly setose; leaves numerous, narrowly oblanceolate, 3-8 cm long, 0.3-0.7 cm wide, densely hispid villous, with pustules on both surfaces; inflorescence cylindrical, narrow, 0.4-1 dm long, hispid-villous; foliar bracts evident on lower part of inflorescence; calyx segments lanceolate, in anthesis 3-4 mm long, in fruit becoming 5-6 mm long, hispid-villous; corolla white, the tube 3-3.2 mm long, crests at base of tube conspicuous, fornices yellow, emarginate, somewhat papillose, about 0.5 mm long; style exceeding mature fruit 1.5-1.8 mm; nutlets ovate, 2-2.3 mm long, 1.3-1.8 mm wide, all 4 usually maturing, margins acute or narrowly winged, dorsal surface tuberculate, and with short irregular transverse ridges, ventral surface nearly smooth, scar open, triangular or narrowly cuneate, elevated margin lacking. Collections: 11 (O); representative: W. A. Weber 5778 (COLO, GH, LL); J. H. Langenheim 4047 (RM); H. Gentry 2405 (ARIZ); J. Barrell 92-55 (CS); S. A. Spongberg 62-55 (CS); W. A. Weber 9411 (UT).

Map No. 40. Central Colorado in Saguache and adjoining Counties. Range of C. weberi Johnston.



Cryptantha weberi Johnston

Holotype: W. A. Weber 5778, collected in Saguache County, Colorado, along road to Stone Cellar Ranger Station and Saguache Park, near junction of main highway, 4 miles west of Cochetopa Pass, volcanic ash deposit, 9,700 feet, 28 July, 1950, GH. Photograph at BRY. Isotypes at COLO, LL.

Distribution: Saguache and Hinsdale Counties, Colorado. Growing on volcanic ash deposites, 9,000 to 10,500 feet. Map No. 40. July and August.

This delicate little Cryptantha from the high mountains of Colorado is one of the most distinct in the entire subgenus, and is not confused with any other species, because of the narrow inflorescence, pubescence, and the very distinctive nutlets. It keys out in Payson's monograph to C. rugulosa, but is only remotely related to that species.

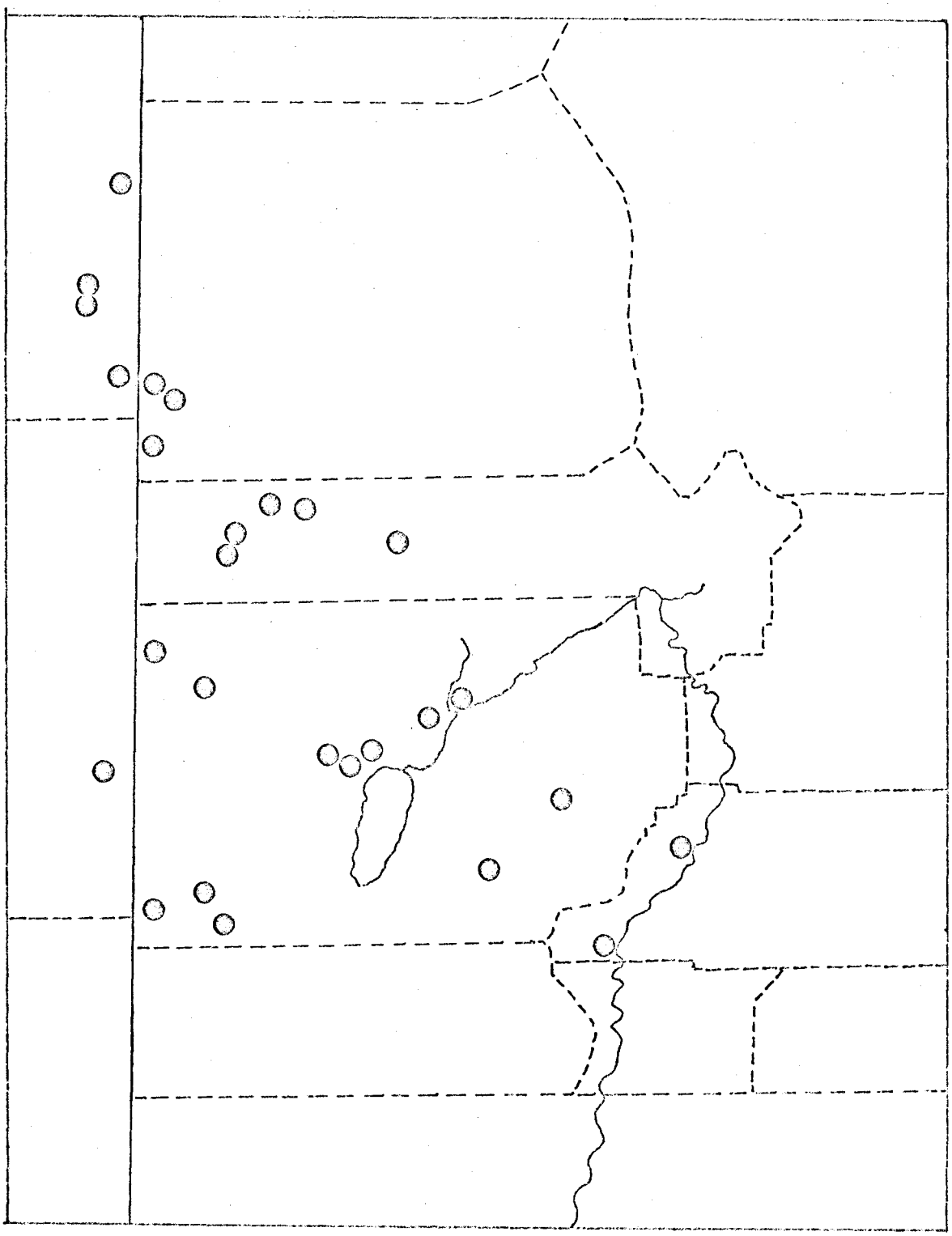
41. Cryptantha rugulosa (Payson) Payson

Cryptantha rugulosa (Payson) Payson, Ann. Mo. Bot. Gard. 14:295. 1927.

Oreocarya rugulosa Payson, Univ. Wyo. Publ. Bot. 1:166. 1926.

Biennial or short-lived perennial, 1.2-3 dm tall; stems slender, 1-several, 0.8-1.6 dm long, spreading setose-hispid; leaves oblanceolate to spatulate, obtuse to acute, strigose and conspicuously setose-hispid, pustulate on both surfaces; inflorescence 0.2-2 dm long, hispid; foliar bracts inconspicuous; calyx segments linear-lanceolate, in anthesis 4-5 mm long, in fruit becoming 7-9 mm long, strigose and spreading hirsute; corolla white, the tube 3-4 mm long, crests at base of tube conspicuous, fornices rounded, distinctly papillose, about 0.5 mm long, limb 5-7 mm wide; style exceeding mature fruit 1-1.5 mm; nutlets lanceolate, 2.8-3.2 mm long, 1.3-1.7 mm wide, all 4 usually maturing, margins in contact, acute, dorsal surface with short low ridges, also somewhat tuberculate,

Map No. 41. Western Utah and adjoining Nevada. Range of C. rugulosa (Payson) Payson.



Cryptantha rugulosa (Payson) Payson

ventral surface smooth or nearly so, scar open, subulate, without an elevated margin. Collections: 30 (vii); representative: B. Maguire 22021 (ARIZ, UTC); Maguire & Becraft 2729 (RM, UTC); W. P. Cottom 9569 (UT); B. F. Harrison 11658 (BRY); M. E. Jones s.n. (POM, RM); L. C. Higgins 1463, 1474, 1614, 1621, 1720 (BRY).

Holotype: M. E. Jones s.n., collected in Juab County, Utah, at Fish Springs, 4 June, 1891, RM. Photograph at BRY. Isotypes at UC, POM.

Distribution: Central Utah to northeastern Nevada. Growing in clay or gravelly loam soils, 4,500 to 6,500 feet. Map No. 41. May to July.

Cryptantha rugulosa is closely related to C. spiculifera and C. interrupta, but differs in the very setose-hispid indument, differently marked nutlets which are smooth on the ventral surface, and different geographical range.

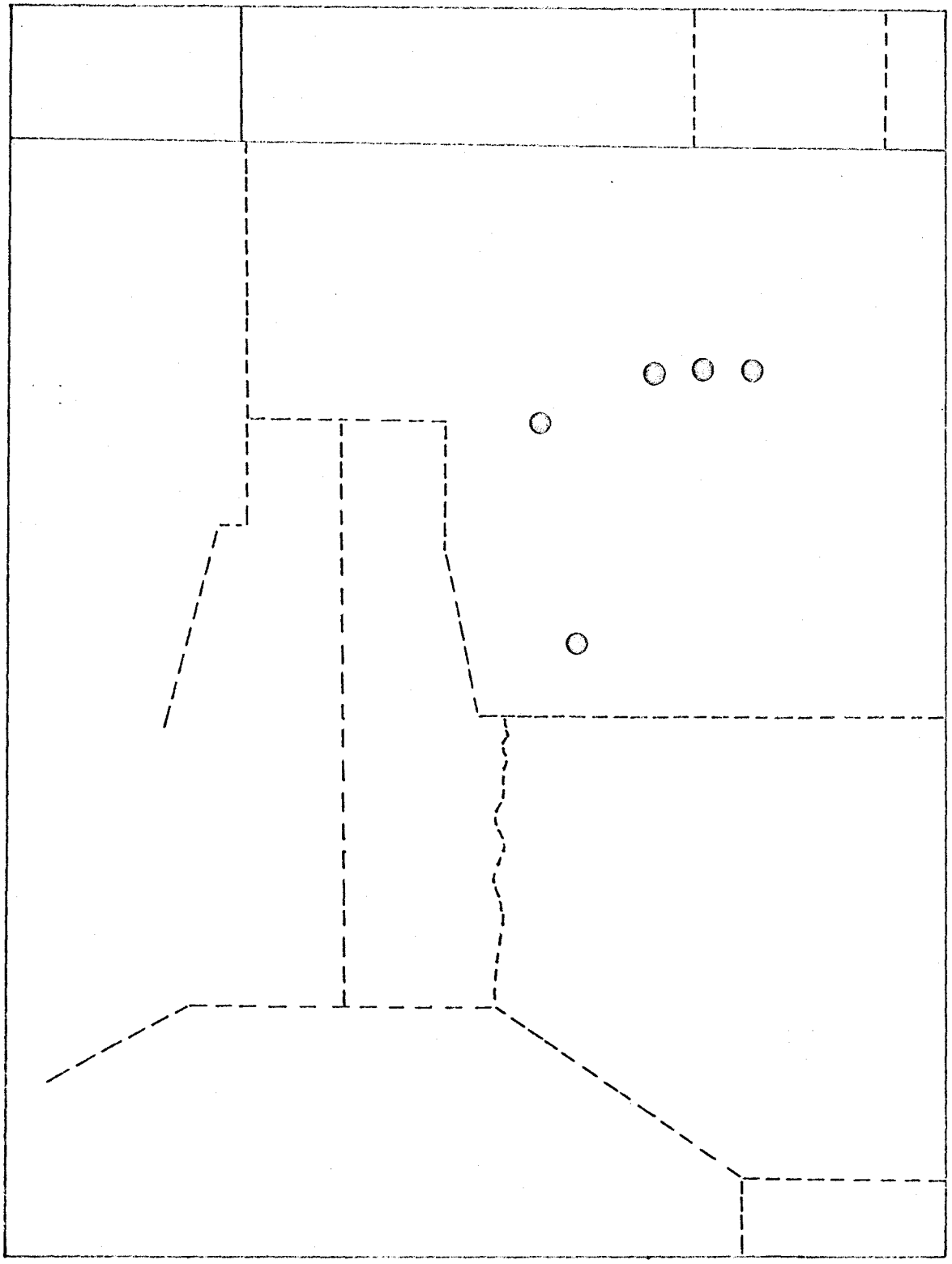
42. Cryptantha interrupta (Greene) Payson

Cryptantha interrupta (Greene) Payson, Ann. Mo. Bot. Gard. 14:296. 1927.

Oreocarya interrupta Greene, Pitt. 3:111. 1896.

Long-lived perennial, 1.7-6 dm tall; stems few to several, slender, 1-3.5 dm long, strigose and weakly setose with slender white hairs; leaves oblanceolate to spatulate, obtuse, 1.5-7 cm long, 0.4-1.2 cm wide, dorsal surface densely strigose, and appressed setose pustulate, upper surface more finely strigose, setose hairs less conspicuous, pustules fewer; inflorescence narrow, interrupted, 1-2.5 dm long, densely setose, cymes somewhat elongating at the top, foliar bracts evident on lower part of stem; calyx segments lanceolate, 2-3 mm long in anthesis, in fruit becoming 5-8 mm long, setose; corolla white, the tube 2-2.5 mm long, crests at base of tube very conspicuous, fornices

Map No. 42. Northeastern Nevada. Range of C. interrupta (Greene) Payson.



Cryptantha interrupta (Greene) Payson

light-yellow, slightly emarginate, about 0.5 mm long, limb 5-6 mm wide; style exceeding mature fruit by less than 1 mm; nutlets lanceolate, 3.3-3.6 mm long, 1.7-2 mm wide, all 4 usually maturing, margins in contact, acute, both surfaces tuberculate with scattered, rounded tubercles, or sometimes nearly smooth, scar slightly open, linear, margin not elevated. Collections: 10 (iv); representative: A. A. Heller 9185 (NY, PH, RM, US); Hitchcock 1005, 929 (US); R. C. Rollins 2542 (UTC); Gentry & Davidse 1824 (BRY, NY); L. C. Higgins 1721, 1724 (BRY).

Neotype: L. C. Higgins 1721, collected about 8 miles east of Wells, Elko County, Nevada, 13 July, 1968, BRY.

Distribution: Apparently endemic to Elko County, Nevada. Growing on clay soil, in the Pinyon-Juniper community, 5,000 to 7,500 feet. Map No. 42. June to August.

Dr. Greene stated that he had not seen this plant in any herbarium, but was collected by him in the mountains of eastern Nevada. He also said, "it abounds in open woods some miles east of Wells". In an attempt to locate this collection of Greene's from east of Wells no specimen could be found which fit his description. Payson also stated that he was unable to locate the specimen. This type specimen is apparently lost or has been destroyed, as a result a neotype has been selected, Higgins 1721.

This distinctive plant is most closely related to C. spiculifera but differs in the shorter style, tuberculate nutlets, and the longer stems. In a collection by Gentry & Davidse 1824, from Harrison Pass the nutlets were almost smooth, otherwise the plant was quite the same.

43. Cryptantha spiculifera (Piper) Payson

Cryptantha spiculifera (Piper) Payson, Ann. Mo. Bot. Gard. 14:298. 1927.

Oreocarya spiculifera Piper, Contr. U. S. Natl. Herb. 11:481. 1906.

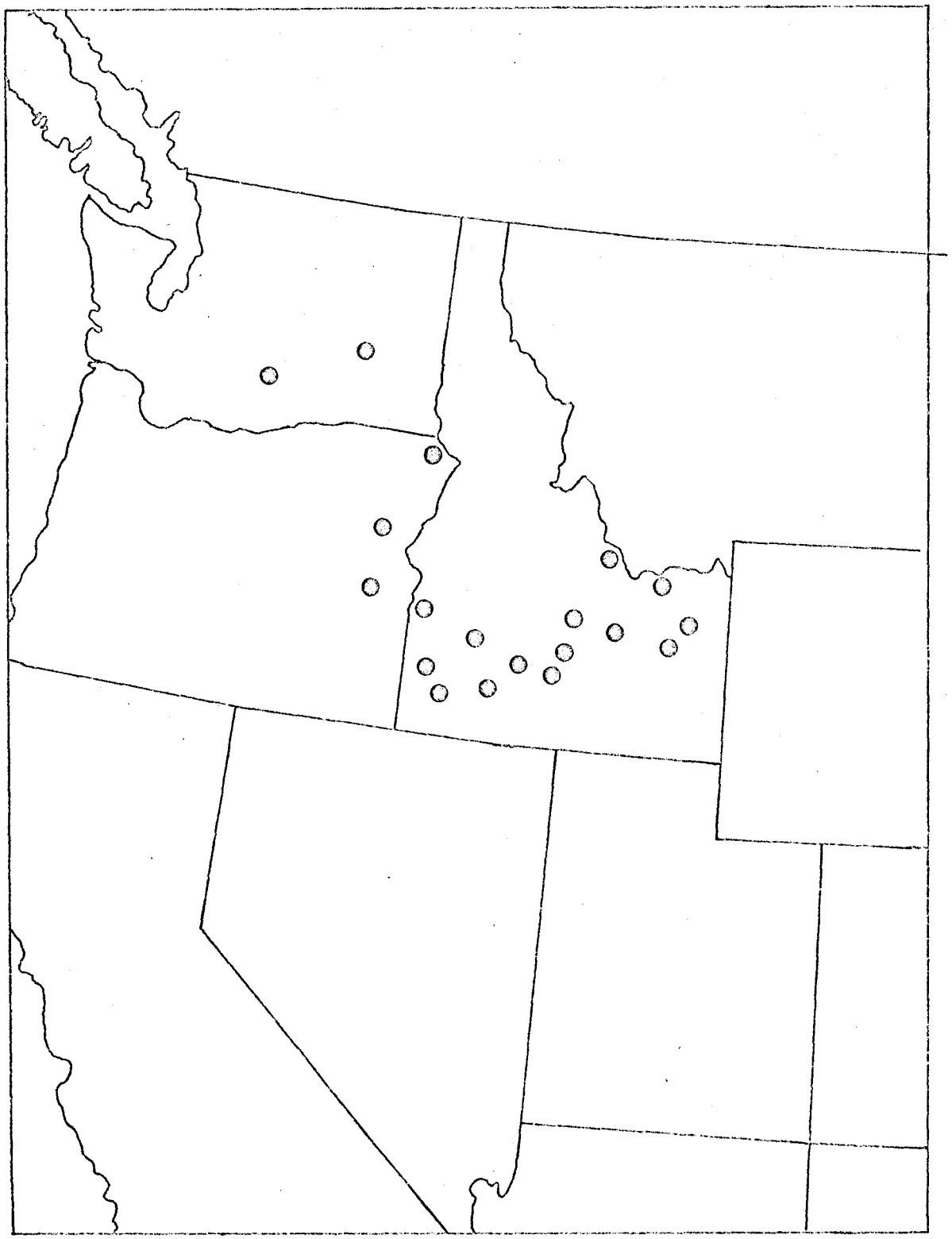
Oreocarya cilio-hirsuta Nels. & Macbr. Bot. Gaz. 55:378. 1913. (Type: Nelson & Macbride 1799, Minidoka, Idaho, 23 June, 1912.)

Perennial, 1.5-3 dm tall; stems 1-several, 1.2-2 dm long, strigose, and spreading setose; leaves oblanceolate, acute to obtuse, 2-7 cm long, 0.3-0.6 cm wide, dorsal surface densely strigose and spreading setose, pustulate, ventral surface similar, petioles conspicuously setose ciliate-margined; inflorescence narrow, 0.4-1.5 dm long, foliar bracts inconspicuous; calyx segments linear-lanceolate, in anthesis 4-5 mm long, in fruit becoming 6-10 mm long, strigose and spreading setose; corolla white, the tube 3-4 mm long, crests at base of tube conspicuous, fornices yellow, rounded, nearly glabrous, about 0.5 mm long, limb 5-9 mm wide; style exceeding mature fruit 1.5-2 mm; nutlets lanceolate to ovate-lanceolate, 2.8-4 mm long, 1.5-2.2 mm wide, 1-4 nutlets maturing, margins acute, in contact, dorsal surface rugulose, or tuberculate, and with some inconspicuous murications, scar subulate, the margin not elevated. Collections: 65 (ii); representative: A. Cronquist 2396 (GH, IDS, UTC); J. S. Cotton 359 (WTU); R. J. Davis 3803 (GH, IDS); J. F. Macbride 875 (GH, RM, UTC); M. E. Peck 19918 (GH, ORE); Sandberg & Leiberg 164 (GH); Maguire & Holmgren 26223 (GH, UTC, WTU); L. C. Higgins 1635, 1636 (BRY).

Holotype: J. H. Sandberg & J. B. Leiberg 164, collected in Adams County, Washington, at Ritzville, 6 June, 1893, US. Photograph at BRY. Isotypes at UC, GH, WTU.

Distribution: Southeastern Washington to southern Idaho and

Map No. 43. Parts of northwestern United States. Range of C. spiculifera (Piper) Payson.



Cryptantha spiculifera (Piper) Payson

and eastern Oregon. Growing on sandy or clay soils, 1,500 to 7,000 feet. Map No. 43. May to July.

Cryptantha spiculifera is a fairly well defined species characterized by narrow radial leaves with their ciliate-margined petioles. In various parts of its range it may be confused with C. interrupta, C. humilis, or C. celosioides. It differs from C. interrupta by the narrower leaves, rugulose nutlets, and the longer style. It can be distinguished from C. humilis by its taller habit, rugose nutlets which are not at all muricate, and the different pubescence. From C. celosioide it differs in the narrower leaves, a stronger tendency to a multiple caudex, somewhat different nutlets, and a more southerly range.

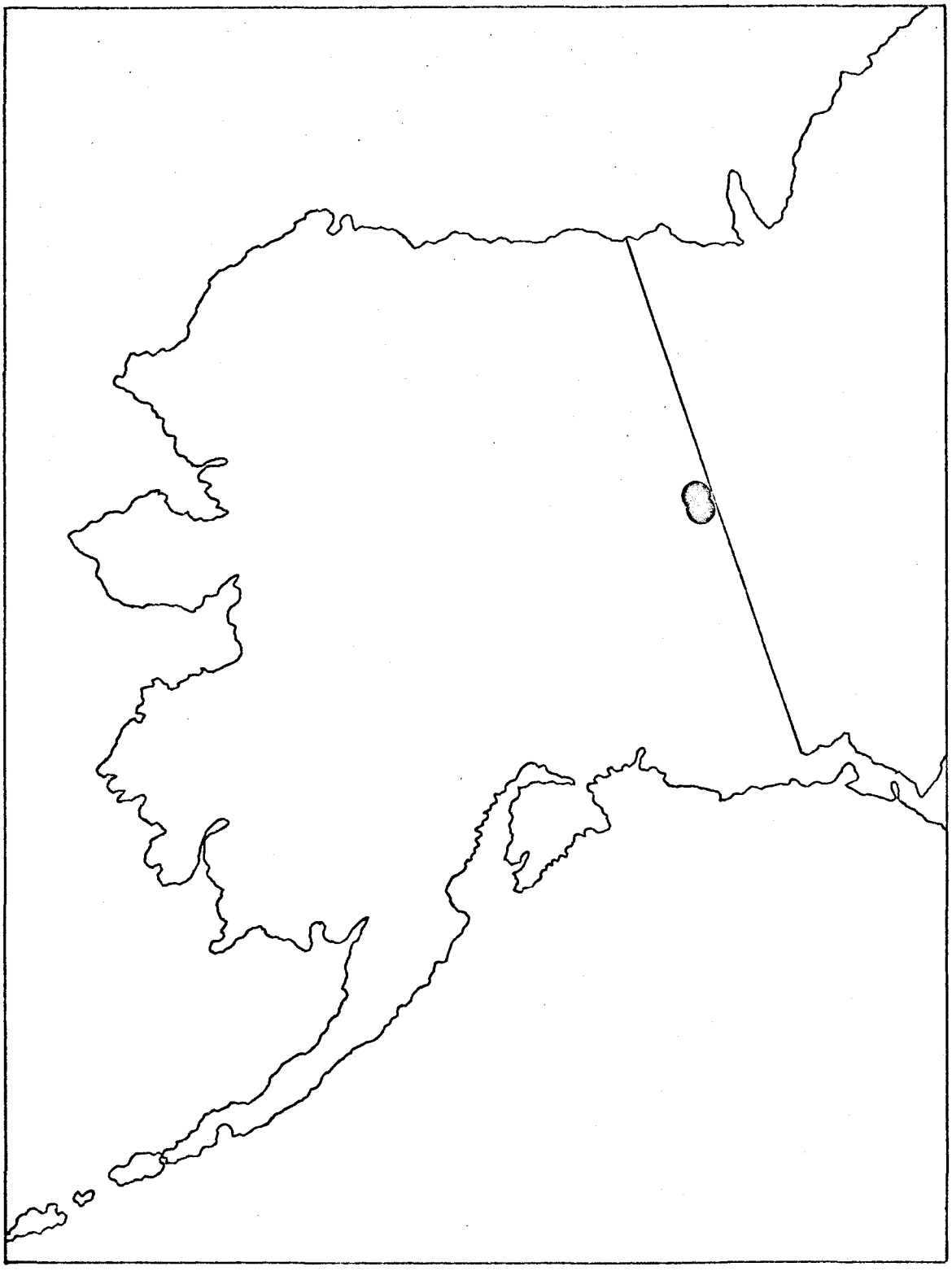
The plant described as cilio-hirsuta by Nelson and Macbride is almost identical to the type of spiculifera, and so is placed in synonymy under that species.

44. Cryptantha shackletteana Higgins

Cryptantha shackletteana Higgins, Great Basin Naturalist.

Caespitose perennial herb, 1-3 dm tall; stems slender, weak, 1-several, 0.7-1.8 dm long, strigose and spreading setose with slender weak hairs; leaves linear, 2-13 cm long, 0.1-0.5 cm wide, strigose on both surfaces, and with a few inconspicuous pustulate hairs on the dorsal surface; inflorescence narrow, nearly capitate, 0.2-0.8 dm long; calyx segments linear or narrowly lanceolate, in anthesis 3-5 mm long, in fruit becoming 7-10 mm long, setose, with yellowish spreading hairs; corolla white, the tube 3-3.3 mm long, crests at base of tube evident, fornices yellow, emarginate, 0.5 mm long, limb 5-6 mm wide; style exceeding mature fruit 1.3-1.6 mm; nutlets lanceolate, 3.3-3.6 mm long, 1.6-2 mm wide, usually all 4 maturing, the margins acute, in contact,

Map No. 44. Central Alaska. Range of C. shackletteana Higgins



Cryptantha shackletteana Higgins

dorsal surface muricate and rugulose with low inconspicuous ridges, the ventral surface similar but the markings much less evident, scar open, subulate, and without an elevated margin. Collections: 2 (0); representative: H. T. Shacklette 6183 (US); Welsh & Moore 8629 (BRY).

Holotype: S. L. Welsh & G. Moore 8629, collected in Alaska, on steep southfacing slope of Eagle Bluff, about 1 mile northwest of Eagle. Growing with Artemisia frigida and Agropyron smithii, 26 July, 1968, BRY.

Cryptantha shackletteana is probably closely related to C. spiculifera but differs in the longer and narrower leaves with only inconspicuous pustulate hairs, the more capitate inflorescence, more elongated nutlets with less evident markings, and weaker stems.

45. Cryptantha celosioides (Eastw.) Payson

Cryptantha celosioides (Eastw.) Payson, Ann. Mo. Bot. Gard. 14:299. 1927.

Cynoglossum glomeratum Nutt. ex Pursh, Fl. Am. Sept. 2:729. 1814, not Cryptantha glomerata Lehm.

Myosotis glomerata Nutt. Gen. Pl. 1:112. 1818.

Rochelia glomerata Torr. Ann. Lyc. N.Y. 2:226. 1827.

Eritrichium glomeratum A. DC. Prod. 10:131. 1846.

Krynitzkia glomerata Gray, Proc. Am. Acad. 20:279. 1885.

Oreocarya glomerata Greene, Pitt. 1:58. 1887.

Oreocarya affinis Greene, Pitt. 3:110. 1896. (Type: Sand hills near Red Buttes, Wyoming, 5 July, 1896, Greene.) not O. affinis (Gray) Greene.

Oreocarya celosioides Eastw. Bull. Torrey Bot. Club 30:240. 1903. (Type: T. J. Howell, collected on the banks of the Columbia River, eastern Washington Territory, July, 1881.)

Krynitzkia pustulata Blankenship, Mont. Agr. Coll. Stud. Bot. 1:96. 1905. (Greene, Red Buttes, Wyoming, 5 July, 1896.) not C. pustulata (Rydb.) Payson.

Oreocarya sericea sensu Piper, Contr. U. S. Natl. Herb. 11:482. 1906, not C. sericea (Gray) Payson.

Oreocarya macounii Eastw. Bull. Torrey Bot. Club 40:480. 1913. (Type: Moose Mt. Creek, Saskatchewan, 6 July, 1880, John Macoun.)

Oreocarya perennis Rydb. Fl. Rocky Mts. 722. 1917, in part, not O. affinis perennis A. Nels.

Oreocarya sheldonii Brand, Fedde, Rep. Spec. Nov. 19:73. 1923. (Type: Deep Creek, Wallowa County, Oregon, 16 June, 1897, Sheldon 8315.)

Cryptantha sheldonii (Brand) Payson, Ann. Mo. Bot. Gard. 14:301. 1927.

Cryptantha macounii (Eastw.) Payson, Ann. Mo. Bot. Gard. 14:303. 1927.

Cryptantha bradburiana Payson, Ann. Mo. Bot. Gard. 14:307. 1927.

Biennial or short-lived perennial, with or without a branched caudex; stems 1-several, 1-6 dm tall, often relatively robust, strigose, setose-hirsute, and subtomentose with pustulate bristles; leaves oblanceolate to spatulate, obtuse to acute, 2.5-9 cm long, 0.4-1.5 cm wide, strigose, setose, and subtomentose, pustulate on both surfaces; inflorescence narrow to open and very broad, 1-3.8 dm long, setose-hirsute; calyx segments lanceolate, 3-6 mm long in anthesis, in fruit becoming 7-12 mm long, setose-hirsute; corolla white, the tube 3-7 mm long, crests at base of tube evident, fornices yellow, rounded or emarginate, about 0.5 mm long, limb 7-12 mm wide; style exceeding mature fruit 1.5-

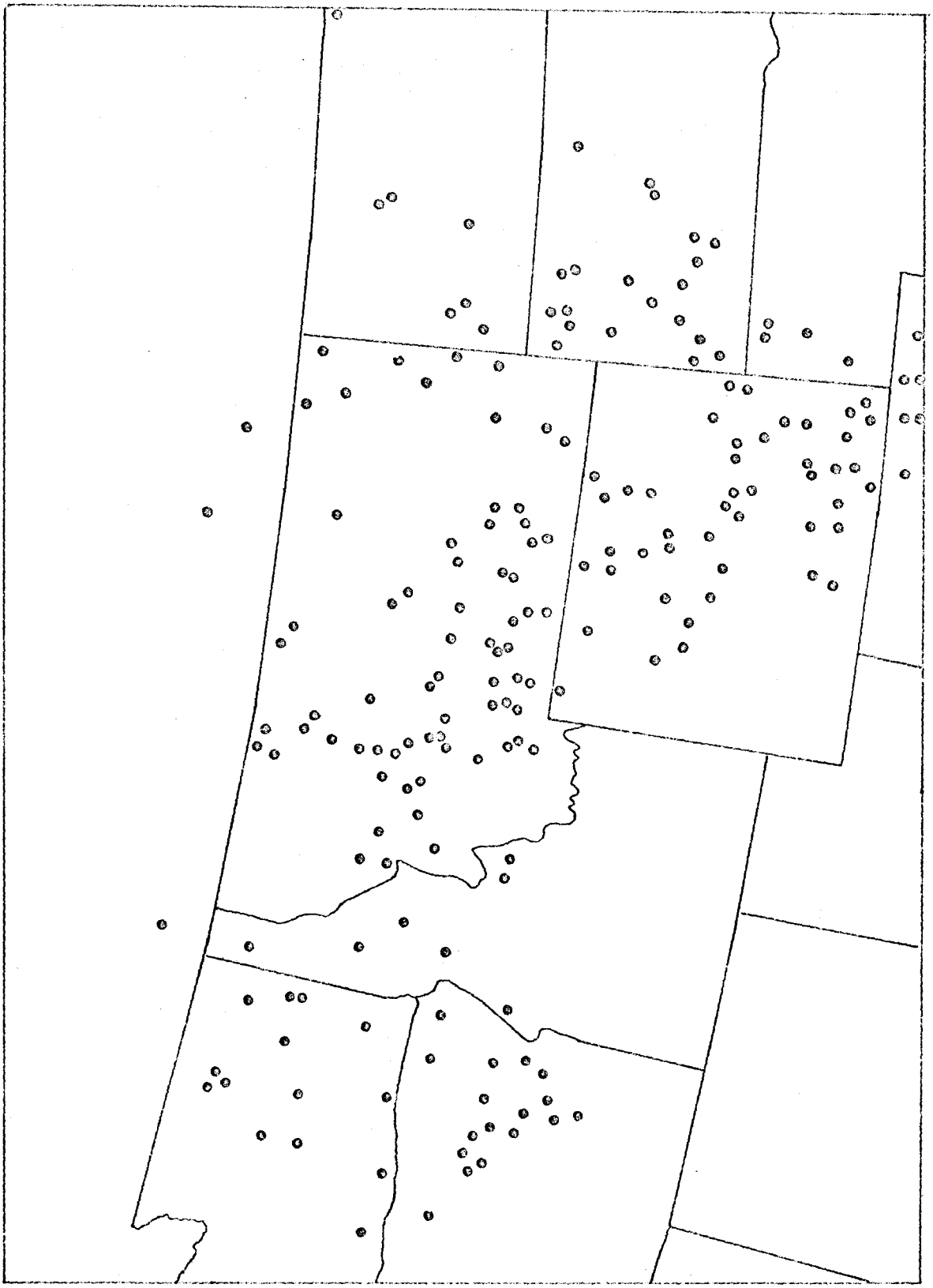
6 mm; nutlets lanceolate to ovate-lanceolate, 2.8-5 mm long, 1.5-2.6 mm wide, 2-4 maturing, margins acute or narrowly winged, in contact, dorsal surface tuberculate to deeply and sharply rugose, sometimes papillose between the markings, ventral surface similar but the markings less evident, scar closed or narrowly open at the base, elevated margin lacking. Collections: 457 (xxiv); representative: A. Nelson 1956 (ND-G, RM); M. Ownbey 1043 (IDS, RM); C. L. Hitchcock 17955 (RM, WTU); W. E. Booth 55110 (MONT, RM); P. A. Rydberg & E. A. Bessey 4883 (MONT, RM); C. L. Porter 7752 (RM, WTU); Hitchcock & Muhlick 12553 (RM, UTC, WTU); Maguire & Holmgren 26615 (UC, CAS, IDS, UTC, WTU); A. R. Kruckeberg 2197 (UC, CAS, ORE, UTC, WTU); T. J. Howell s.n. (UC, CAS); J. W. Thompson 11696 (MONT, US, WTU); H. T. Rogers 613 (UC, CAS, UTC); L. C. Higgins 1535, 1538, 1558, 1689, 1693, 1697, 1701, 1704 (BRY).

Lectotype: Bradbury s.n., collected in Upper Louisiana, supposed to be about the Big Bend of the Missouri in what is now South Dakota, PH. Photograph at BRY.

Distribution: Eastern Oregon from Grant County to northern Washington and southern British Columbia, east through the lower parts of northern Idaho to Montana, thence south and east into North Dakota, Nebraska, and Colorado. Growing on dry open slopes and valleys, plains and foothills, occasionally ascending to moderate elevations in the mountains, 1,500 to 8,500 feet. Map No. 45. May to August.

Cryptantha celosioides is a very widespread and polymorphic species with a great amount of variation throughout its range. The species C. bradburiana, sheldonii, macounii, and celosioides as recognized by Payson in his monograph have here been combined. The basis for this wholesale combining of species is that no differential characters of high enough

Map No. 45. Parts of northwestern United States and adjoining Canada. Range of C. celosioides (Eastw.) Payson.



Cryptantha celosioides (Eastw.) Payson

magnitude exist to separate out species or even varieties with any consistency. The consistent characters used to distinguish species throughout this subgenus seems to entirely break down in the present case, so until more information can be gleened and utilized, this complex is best treated as a single taxon, even though this is not entirely satisfactory.

This species is distinguished by it setose indument, large corolla habit, and characteristic inflorescence.

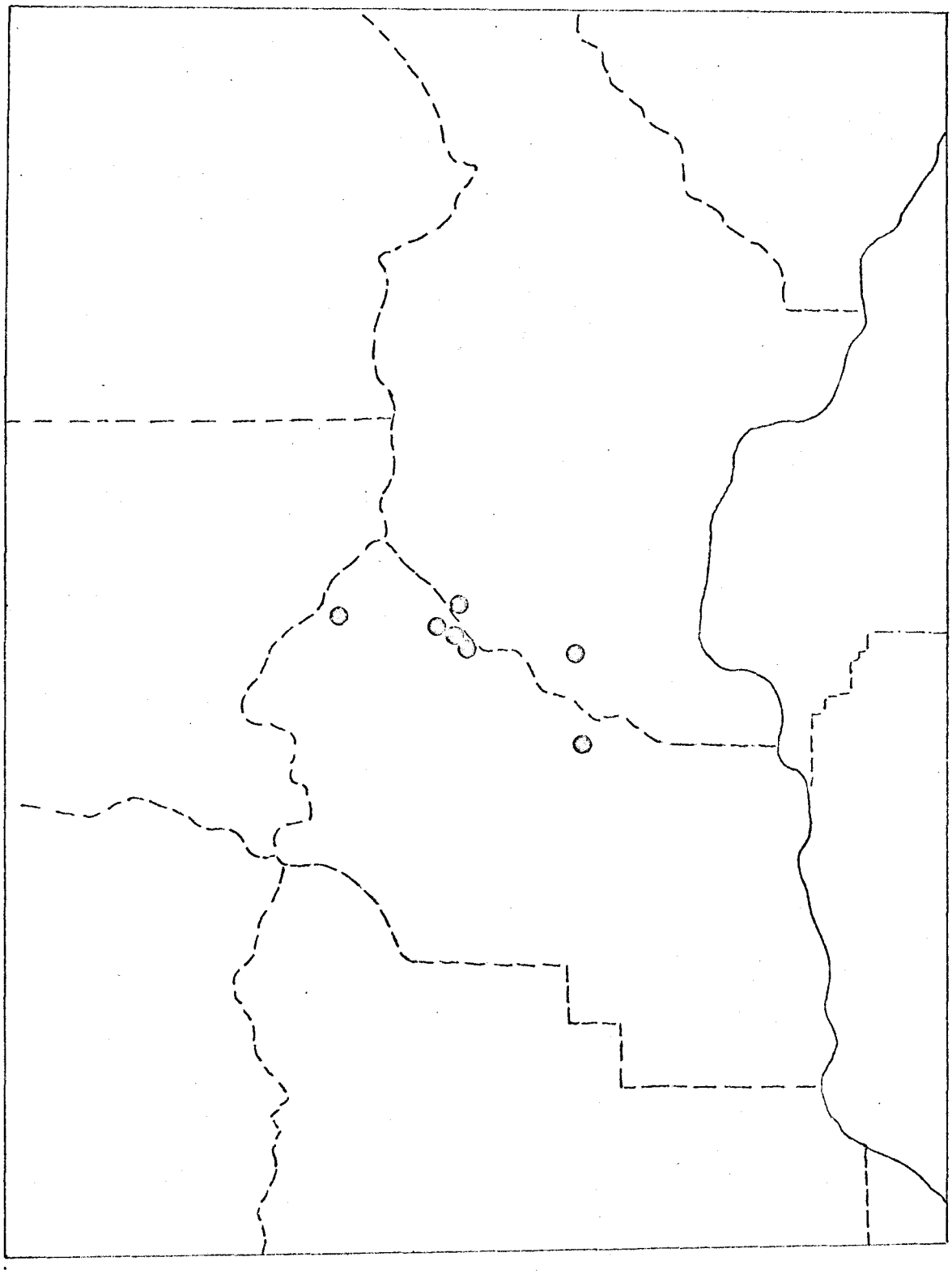
46. Cryptantha thompsonii Johnst.

Cryptantha thompsonii Johnst. Contr. Arn. Arb. 3:88. 1932.

Oreocarya thompsonii (Johnst.) Abrams, Abrams Ill. Fl. Pac. St. 3:600. 1951.

Caespitose perennials, 1.5-3 dm tall; stems several from a woody caudex, 1-1.7 dm long, setose-hirsute; leaves oblanceolate, acute to obtuse, 4-8 cm long, 0.4-0.8 cm wide, yellowish tomentose and with scattered appressed setose bristles on both surfaces; inflorescence usually narrow, 0.2-1.3 dm long, foliar bracts evident to conspicuous; calyx segments lanceolate, in anthesis 3.5-4.5 mm long, in fruit becoming 9-12 mm long, setose; corolla white, the tube 3-4 mm long, crests at base of tube evident, fornices yellow, low, rounded or emarginate, papillose, limb 6-8 mm wide; style exceeding mature fruit 1-2 mm; nutlets lanceolate, 4-5 mm long, 2-3 mm wide, all 4 usually maturing, margins narrowly winged or knife-like, in contact, dorsal surface tuberculate and irregularly rugose, ventral surface smooth or slightly uneven, scar open, cuneate, and without an elevated margin. Collections: 25 (ii); representative: J. W. Thompson 8742 (GH, WTU); A. R. Kruckeberg 2750 (ORE, WTU); W. W. Canby 996 (UC); L. C. Higgins

Map No. 46. Central Washington. Range of C. thompsonii Johnston.



Cryptantha thompsonii Johnston

1661, 1667 (BRY).

Holotype: J. W. Thompson 7663, collected in Kittitas County, Washington, on the crest of Iron Mountain, Mount Stuart Region, 1930, GH.

Distribution: Kittitas and Chelan Counties in the Wenatchee Mountains of central Washington. Growing on steep talus slopes, 3,000 to 7,000 feet. Map No. 46. Late May to August.

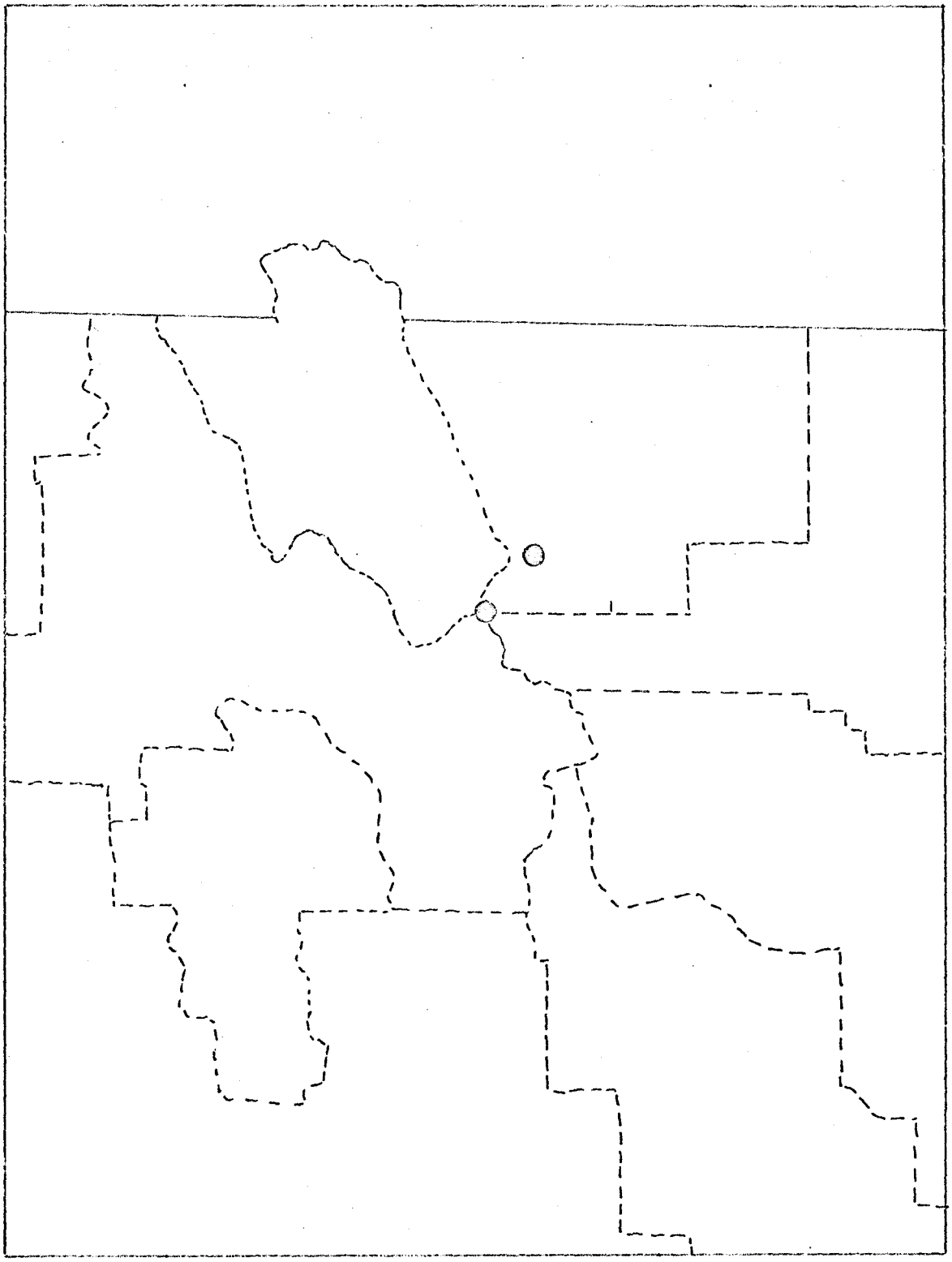
Cryptantha thompsonii is a loosely caespitose species arising from a thick, very woody taproot. It is endemic to the high mountains of east-central Washington. The plant may be distinguished by its thick leaves, nutlets, which are smooth on the ventral surface, and the scar which is evidently open for most of its length. A very distinct species not to be confused with any other in the region where it grows.

47. Cryptantha sobolifera Payson

Cryptantha sobolifera Payson, Ann. Mo. Bot. Gard. 14:305. 1927.

Long-lived perennials, 1-1.8 dm tall; stems 1-several from the branched caudex, some of them sterile and prostrate and terminating in soboles, 0.5-0.7 dm long; leaves spatulate to oblanceolate, obtuse, 1.5-4 cm long, 0.5-0.8 cm wide, strigose, and setose-hirsute, also somewhat tomentose, pustules conspicuous on both surfaces, petioles ciliate-margined; inflorescence cylindric, narrow, 0.3-0.8 dm long, setose, foliar bracts inconspicuous; calyx segments linear-lanceolate, in anthesis 3-5 mm long, in fruit becoming 6-7 mm long, strigose and conspicuously setose; corolla white, the tube 3.5-4 mm long, crests at base of tube well developed, fornices yellow, emarginate, distinctly papillose, about 1 mm long, limb 6-8 mm wide; style exceeding mature fruit 1.8-2.5 mm; nutlets ovate-lanceolate, 2.5-3.5 mm long, 1.4-1.7

Map No. 47. Glacier County, Montana. Range of C. sobolifera Payson.



Cryptantha sobolifera Payson

mm wide, dorsal surface with low inconspicuous tubercles or ridges, or sometimes almost smooth, ventral surface smooth or nearly so, scar straight, closed, the margin not elevated. Collections: 3 (0); representative: M. E. Jones s.n. (POM); Pennell, Cotner & Schaeffer 23928 (US); Hitchcock & Muhlick 13021 (RM).

Holotype: M. E. Jones s.n., collected in Glacier County, Montana, at Upper Marias Pass, 10 September, 1909, POM. Photograph at BRY.

Distribution: Western Montana in the high Rocky Mountains. Growing on sandy soil or serpentine talus slopes, 5,000 to 10,000 feet. Map no. 47. Late June to September.

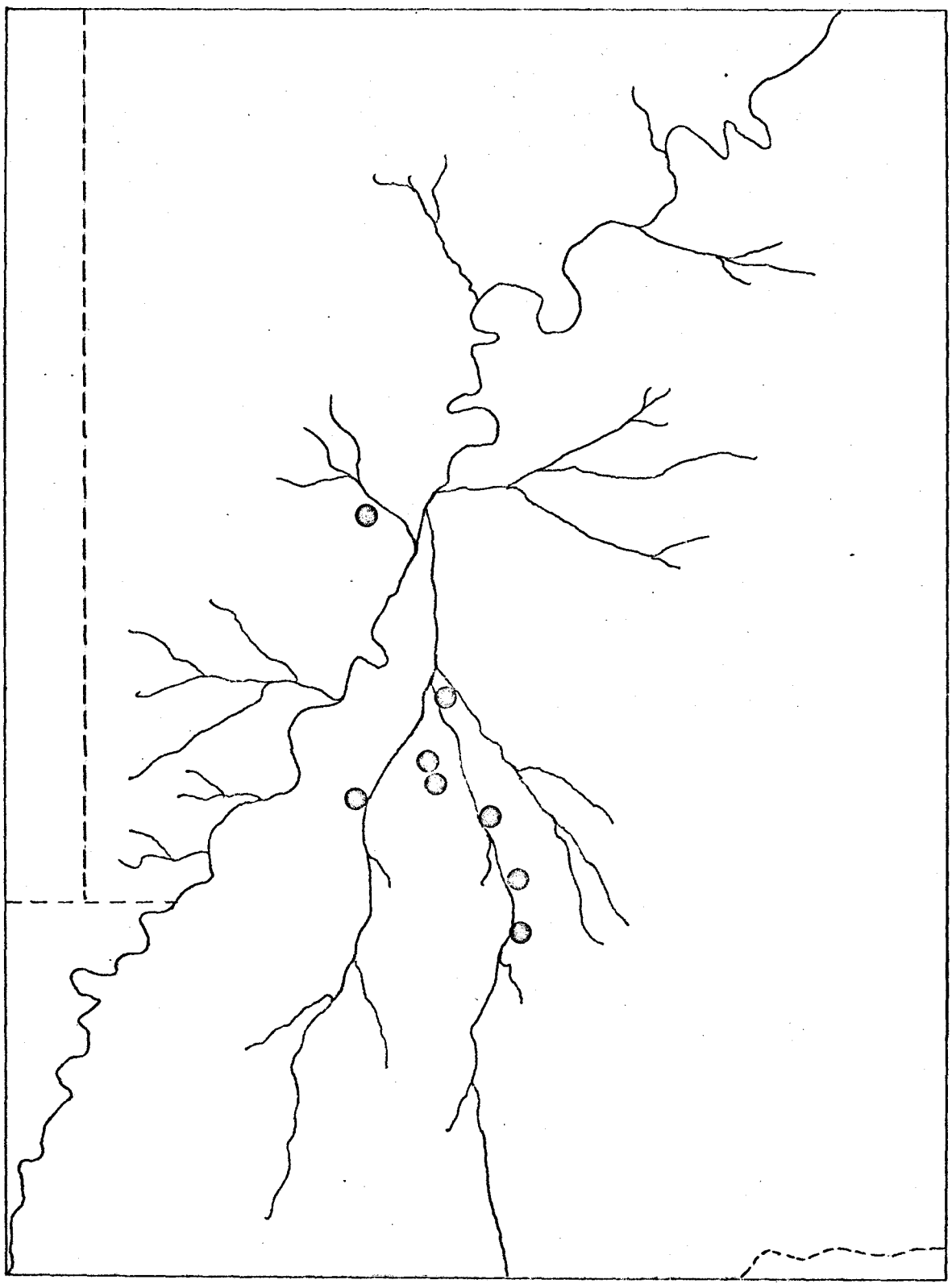
This species is not very well known or represented by herbarium specimens, and more collections of it are badly needed. It is perhaps most closely related to C. celosioides, but differs in the smooth ventral surface of the rutlets, the soboliferous leaves, and different flowering time.

48. Cryptantha grahamii Johnst.

Cryptantha grahamii Johnst. Journ. Arn. Arb. 20:391. 1939.

Long-lived perennial from a thick woody taproot, 1.5-2 dm tall; stems several, 0.4-1.2 dm long, weakly spreading setose; leaves spatulate to oblanceolate, 2-4.5 cm long, 0.4-1 cm wide, conspicuously setose-pustulate on both surfaces, with some finer pubescence beneath; inflorescence narrow, 0.4-1 dm long, setose, foliar bracts evident but not conspicuous; calyx segments lanceolate, in anthesis 5-7 mm long, in fruit becoming 7-9 mm long, abundantly setose; corolla white, the tube 3.5-5 mm long, constricted at the middle, crests at base of tube evident, fornices yellow, emarginate, papillose, 0.5-1 mm long, limb 11-15 mm

Map No. 48. Uintah County, Utah. Range of C. grahamii Johnston.



Cryptantha grahamii Johnston

wide; style coarse, exceeding mature fruit 1.8-2.1 mm; nutlets lanceolate, 3-3.8 mm long, 1.7-2 mm wide, 2-4 maturing, margins in contact, acute, both surfaces of nutlet with inconspicuous small, low rounded tubercles, or some of these confluent into short irregular ridges, scar straight, open, narrowly linear, the margin not elevated. Collections: 12 (v); representative: R. C. Rollins 1707 (GH, RM); E. H. Graham 7924 (GH); Holmgren & Reveal 1879 (BRY, UTC); R. C. Rollins 1716 (GH); E. H. Graham 8962 (GH); L. C. Higgins 1602, 1607, 1610 (BRY).

Holotype: Edward H. Graham 7924, collected in Uintah County, Utah, on bench west of Green River north of mouth of Sand Wash, 4,500 feet, 28 May, 1933, GH. Photograph at BRY.

Distribution: Endemic to the Uintah Basin, Uintah County, Utah, along Willow Creek and the willow Creek drainage basin. Growing on white shale, 4,300 to 6,000 feet. Map No. 48. May to June.

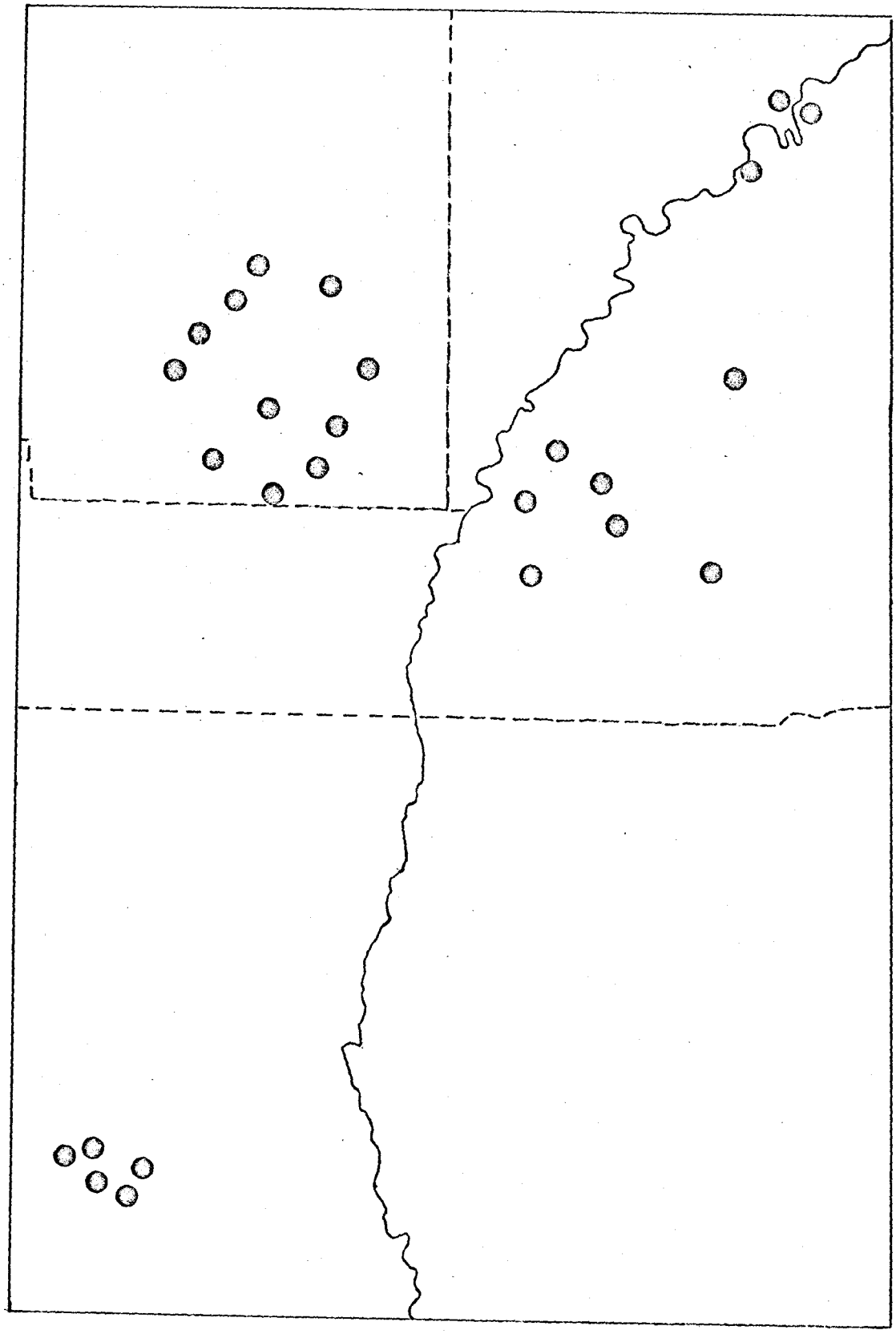
Cryptantha grahamii can be distinguished from other species of the Uintah Basin by its large corolla, tuberculate nutlets, coarse style, and the thick woody caudex.

49. Cryptantha rollinsii Johnst.

Cryptantha rollinsii Johnst. Journ. Arn. Arb. 20:391. 1939.

Biennial herbs, 1-3.5 dm tall; stems 1-several, 0.2-1 dm long, setose; leaves clustered at the base, gradually reduced upward, oblanceolate to spatulate, obtuse to acute, 2-5 cm long, 0.5-1.5 cm wide, setose and hispid, pustulate on both surfaces; inflorescence narrow to somewhat open at maturity, cylindric to obovoid, racemes in dense glomerules, 3-6 flowered, hispid, 0.5-2 dm long; calyx segments linear, in anthesis 7-8 mm long, in fruit becoming 8-10 mm long, hispid; corolla white, campanulate, the tube 7-9 mm long, crests at base of tube evident,

Map No. 49. Eastern and northern Utah. Range of C. rollinsii Johnston.



Cryptantha rollinsii Johnston

fornices yellow, papillose, about 0.5-1 mm long, limb 7-8 mm wide; plants slightly heterostyled; nutlets lanceolate, 3-4 mm long, 1-1.5 mm wide, obscurely rugulose and tuberculate on the dorsal surface, ventral surface smooth, scar closed, and without an elevated margin. Collections: 40 (x); representative: R. C. Rollins 3084 (GH, RM); R. C. Rollins 1715 (GH); Ripley & Barneby 7804 (GH); E. H. Graham 7870 (GH); B. F. Harrison 400H (BRY, GH); J. Brotherson 1049 (BRY); D. Atwood 1617 (BRY); Welsh & Christensen 6622 (BRY); L. C. Higgins 1056, 1068, 1324, 1606 (BRY).

Holotype: Reed C. Rollins 1715, collected in Uintah County, Utah, shale hillside on Thorne's Ranch near Willow Creek, 22 miles south of Ouray, 5,500 feet, 16 June, 1937, GH. Photograph at BRY.

Distribution: Central and northeastern Utah in Emery, Uintah, and Duchesne Counties. Growing on white or red shale, 4,000 to 6,000 feet. Map No. 49. May to July.

Cryptantha rollinsii is very common in the Uintah Basin, and can be found on most shaley hillsides throughout the region. An isolated population also occurs in Emery County on the south end of the San Rafael Swell near Temple Mountain, but is undoubtedly the same species.

This distinctive plant may be recognized by its campanulate corolla, nearly smooth nutlets, non caespitose habit, and single stem.

50. Cryptantha wetherillii (Eastw.) Payson

Cryptantha wetherillii (Eastw.) Payson, Ann. Mo. Bot. Gard. 14:324. 1927.

Krynitzkia glomerata var. acuta Jones, Zoe 2:250. 1891. (Type: Cisco, Utah, 2 May, 1890, Jones.)

Oreocarya wetherillii Eastw. Bull. Torrey Bot. Club 30:242. 1903.

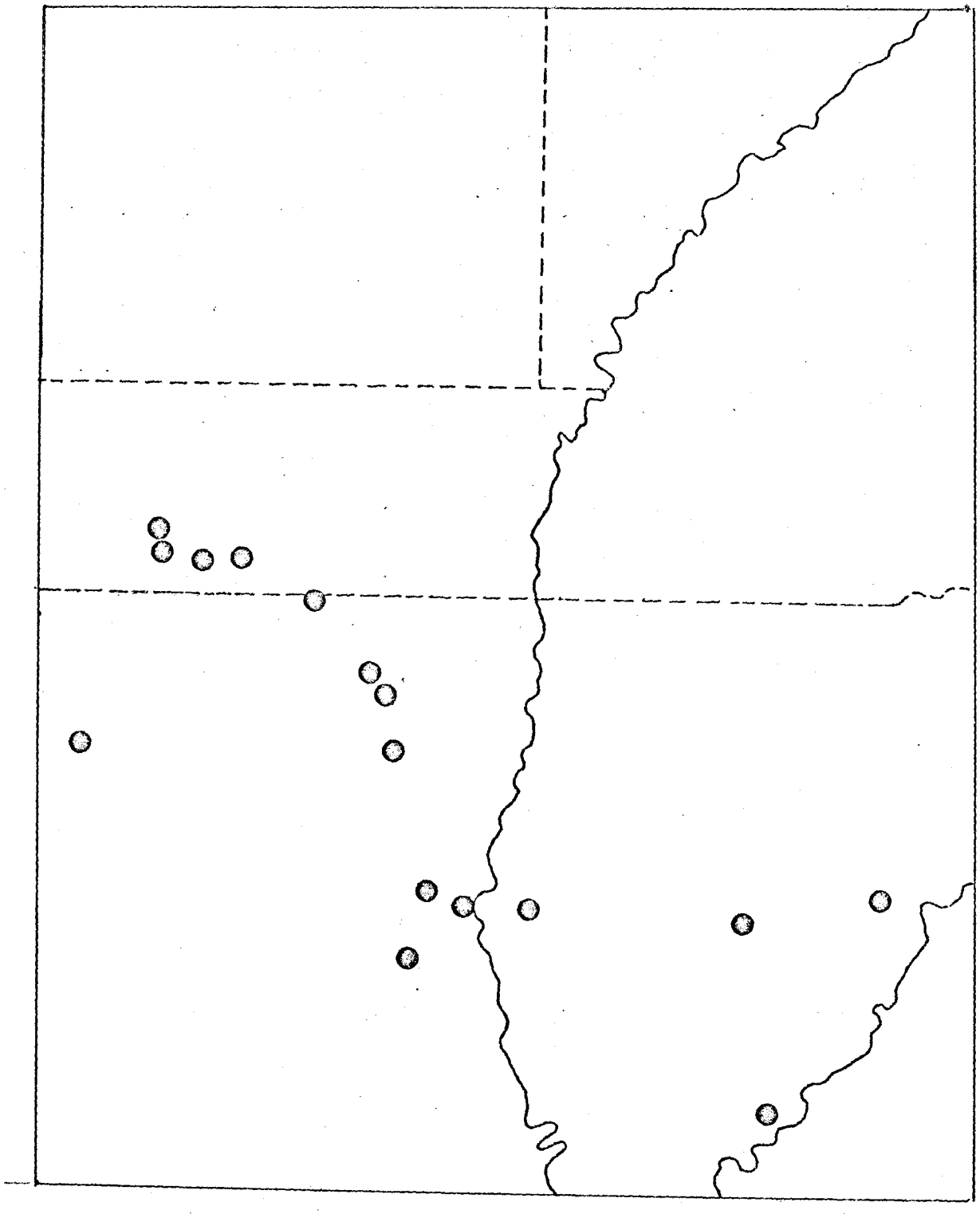
Biennial or short-lived perennials, 1-3.5 dm tall; stems 1-6, 0.5-0.8 dm long, branched from the base with 1 stout stem and usually several low slender stems; leaves clustered at the base, gradually reduced upward, spatulate to broadly oblanceolate, the apices obyuse to rounded, 2.5-5 cm long, 0.7-1.6 cm wide, strigose and appressed setose, dorsal surface conspicuously pustulate, ventral surface with few or no pustules; inflorescence becoming broad in age due to the elongation of the racemes, 0.6-3 dm long; calyx segments lanceolate, in anthesis 5-7 mm long, in fruit becoming 7-13 mm long, white setose; corolla white, the tube 7-10 mm long, crests at base of tube lacking, fornices light-yellow, emarginate, papillose, about 1 mm long, limb 6-13 mm wide; style exceeding mature fruit 3-5 mm; nutlets lanceolate or ovate-lanceolate, 3.5-4 mm long, 2-2.5 mm wide, usually all 4 maturing, margins acute, in contact, dorsal surface distinctly tuberculate and often rugulose as well as with numerous murications between the larger roughenings, ventral surface similar but the markings not as distinct, scar open, linear, surrounded by a slightly elevated margin. Collections: 22 (iii); representative: A. Eastwood s.n. (UC, CAS); M. E. Jones 6734 (UC, GH, RM); B. Maguire 18229 (UC, UTC); W. P. Cottam 2073 (BRY); G. L. Pyrah (BRY, UTC); Welsh & Moore 2786 (BRY); L. C. Higgins 1476 (BRY);

Lectotype: A. Eastwood s.n., collected in Grand County, Utah, near Moab, Court House Wash, 25 May, 1892, CAS. Photograph at BRY. Isotype at UC.

Distribution: East-central Utah in Grand, Carbon, Emery, Wayne and Garfield Counties. Usually growing on heavy clay soils, 4,000 to 6,000 feet. Map No. 50. April to June.

Cryptantha wetherillii is a close relative of C. longiflora, but

Map No. 50. Eastern Utah. Range of C. wetherillii (Eastw.) Payson.



Cryptantha wetherillii (Eastw.) Payson

differs in the shorter corolla tube, tuberculate nutlets, ventral surface of the leaves without or with only a few pustules, and the flowers which are not strongly dimorphic.

51. Cryptantha longiflora (A. Nels.) Payson

Cryptantha longiflora (A. Nels.) Payson, Ann. Mo. Bot. Gard. 14:326. 1927.

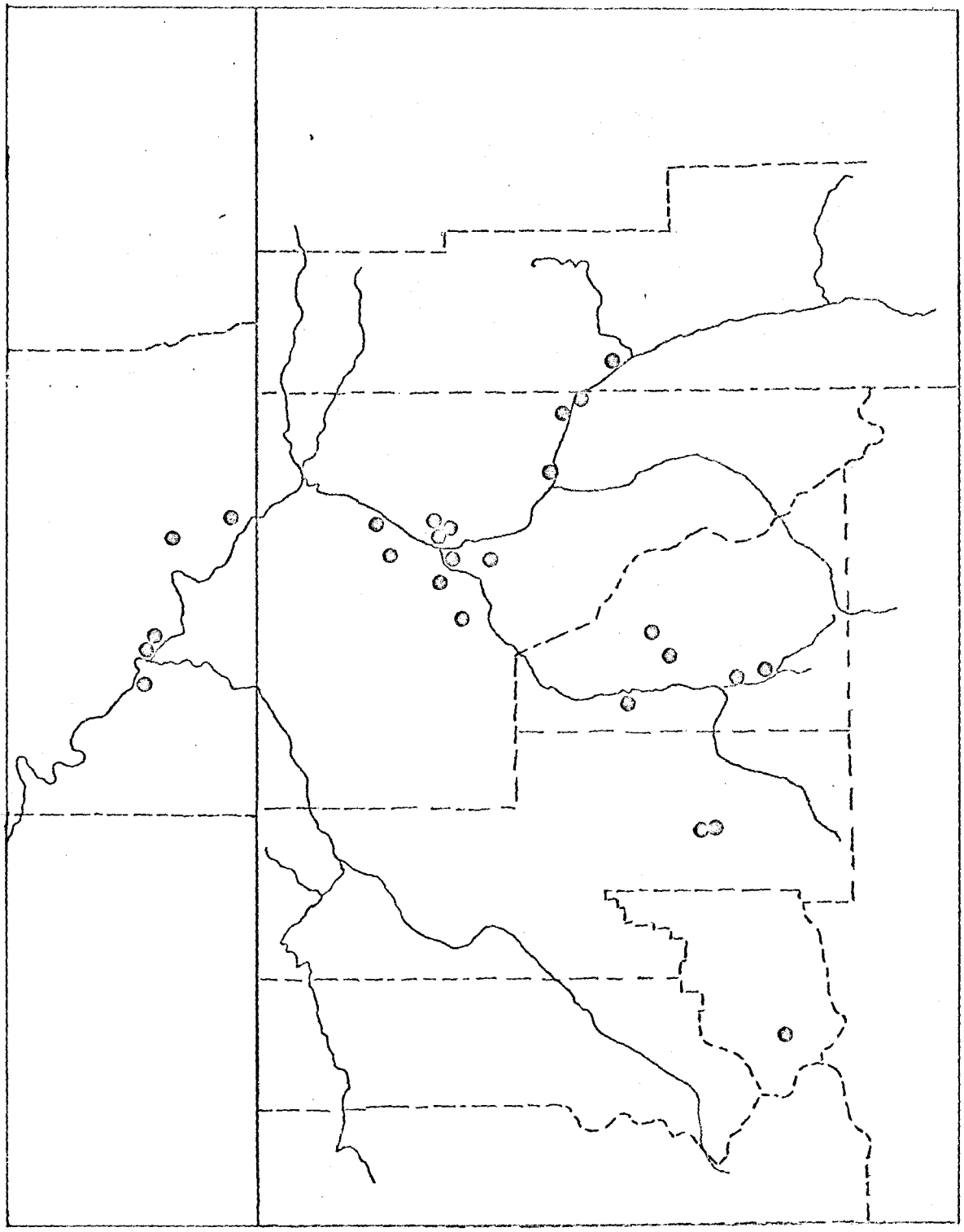
Oreocarya longiflora A. Nels. Erythea 7:67. 1899.

Oreocarya horridula Greene, Pl. Baker. 3:20. 1901. (Type: Deer Run, Colorado, 11 June, on dry bank, C. F. Baker 133.)

Short-lived perennial or possibly biennial, 0.8-3 (5) dm tall; stems 1-several, 0.5-1 dm long, setose and spreading hirsute; leaves spatulate, obovate or oblanceolate, 2-7 cm long, 0.5-1.5 cm wide, both surfaces strigose and strongly hirsute, pustulate; inflorescence broad and open, 0.7-2.5 dm long, setose, foliar bracts inconspicuous; calyx segments linear-lanceolate, in anthesis 7-10 mm long, in fruit becoming 10-16 mm long, setose; corolla white, the tube 12-14 mm long, crests at base of tube lacking, fornices yellow, emarginate, broad, rounded, papillose, 0.5-1 mm long, limb 9-11 mm wide; style exceeding mature fruit 4-9 mm (heterostyled); nutlets lanceolate-ovate, 3-4 mm long, 2.2-2.6 mm wide, 2-4 maturing, both surfaces with tubercles and low rounded ridges, scar straight, closed or very narrowly open, with a slightly elevated margin. Collections: 33 (iii); representative: S. L. Welsh 6989, 6966 (BRY); R. C. Rollins 2181 (RM, UTC); W. A. Weber 3799 (COLO, UTC); D. Wiens 3061 (BRY, COLO); G. E. Osterhout 5995 (RM); A. H. Barnum 799 (DIX); C. F. Baker 133 (ND-G); L. C. Higgins 1478 (BRY)

Holotype: C. S. Crandall s.n., collected in Mesa County, Colorado at Palisades, 14 May, 1898, RM. Photograph at BRY.

Map No. 51. Western Colorado and eastern Utah. Range of C. longiflora (A. Nels.) Payson.



Cryptantha longiflora (A. Nels.) Payson

Distribution: Western Colorado and eastern Utah along the Colorado River drainage. Growing on sandy to clay soils, 3,800 to 6,000 feet. Map No. 51. May and June.

This species is perhaps most closely related to C. wetherillii, but differs in several notable respects as discussed under that species.

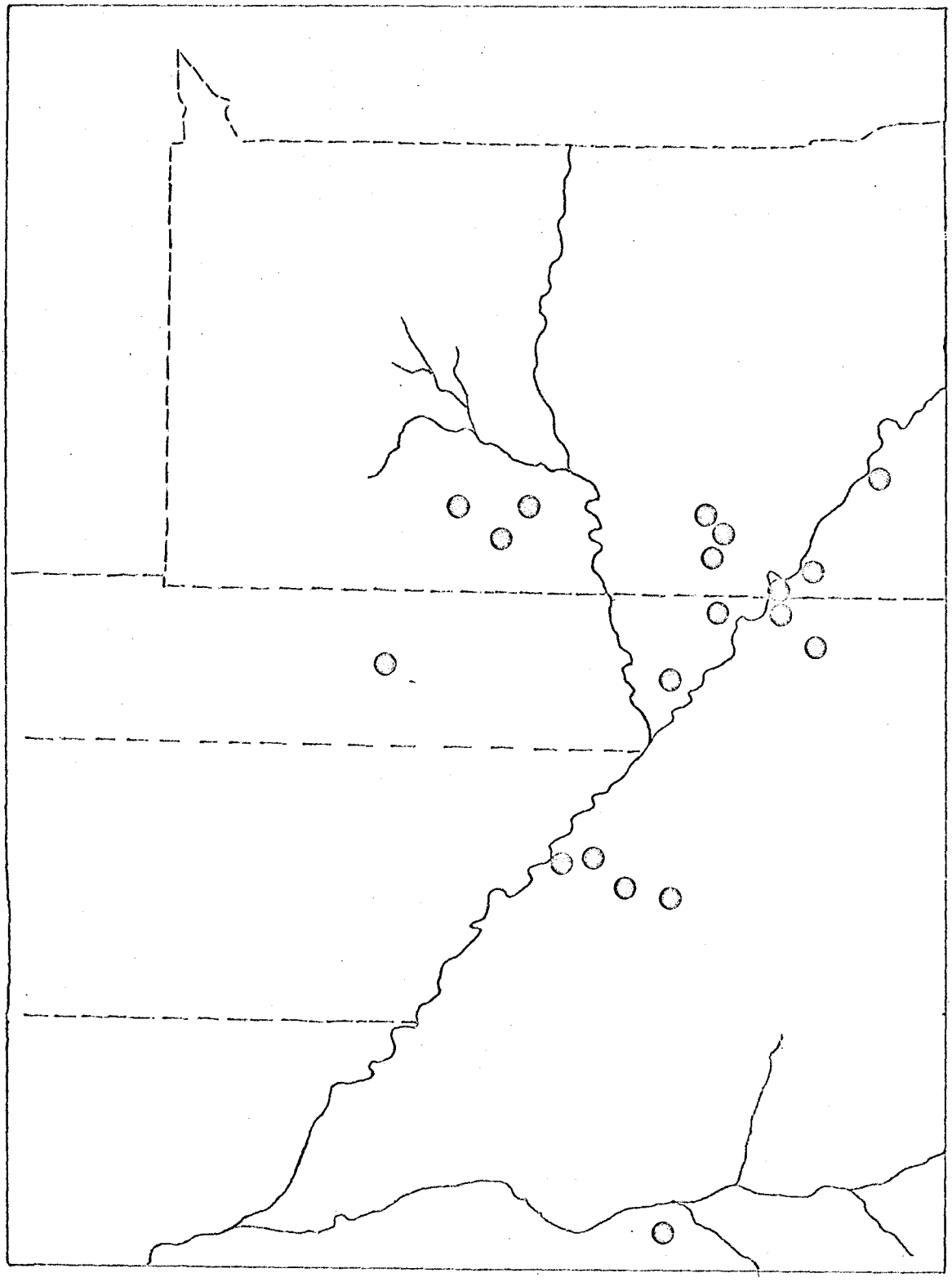
The type of Oreocarya horridula, described by Greene from Deer Run is the same in every respect as this taxon, so is placed in synonymy under it.

52. Cryptantha tenuis (Eastw.) Payson

Cryptantha tenuis (Eastw.) Payson, Ann. Mo. Bot. Gard. 14:327. 1927.

Oreocarya tenuis Eastw. Bull. Torrey Bot. Club 30:244. 1903.

Caespitose perennials, 1.3-2.5 dm tall; stems slender, 1-many, 0.8-1.2 dm long, strigose and weakly spreading setose; leaves linear-spatulate, mostly basal, obtuse, 2-5 cm long, 0.3-0.6 cm wide, dorsal surface strigose and weakly spreading setose, conspicuously pustulate, ventral surface uniformly strigose and without pustules; inflorescence narrow, interrupted, 0.6-1.4 dm long, weakly setose, foliar bracts inconspicuous; calyx segments linear-lanceolate, in anthesis 4.5-6 mm long, in fruit becoming 7-9 mm long, white setose; corolla white, the tube 5.5-7 mm long, crests at base of tube lacking or sometimes evident, fornices yellow, broad, emarginate, papillose, about 0.5 mm long, limb campanulate, 5-8 mm wide; style exceeding mature fruit 3-4 mm; nutlets lanceolate, 3-4 mm long, 1.8-2 mm wide, all 4 usually maturing, margins acute, nearly in contact, dorsal surface carinate, sharply and deeply rugose, ventral surface rugose, scar open, constricted above the base, and with an elevated margin. Collections: 38 (v); representative: A. H. Holmgren 3237 (US); R. C. Barneby 13075 (CAS); A. Eastwood s.n. (UC,



Cryptantha tenuis (Eastw.) Payson

CAS); B. F. Harrison 11576 (BRY, UC); A. Cronquist 8978 (UTC); S. L. Welsh 6999, 7053, 7061, 7066 (BRY); D. Atwood 1541 (BRY); L. C. Higgins 1000, 537, 1281, 1326, 1334 (BRY).

Holotype: Alice Eastwood s.n., collected in Grand County, Utah, near Moab, in Court House Wash, 25 May, 1892, CAS. Photograph at BRY.

Distribution: Southeastern Utah in Emery, Grand, Wayne, and San Juan Counties. Growing on sandy to clay soils, 2,500 to 5,500 feet. Map No. 52. Late April to July.

Cryptantha tenuis is often confused with C. osterhoutii, but differs in its taller habit, longer leaves, longer campanulate corolla, smaller calyx, and the shorter style.

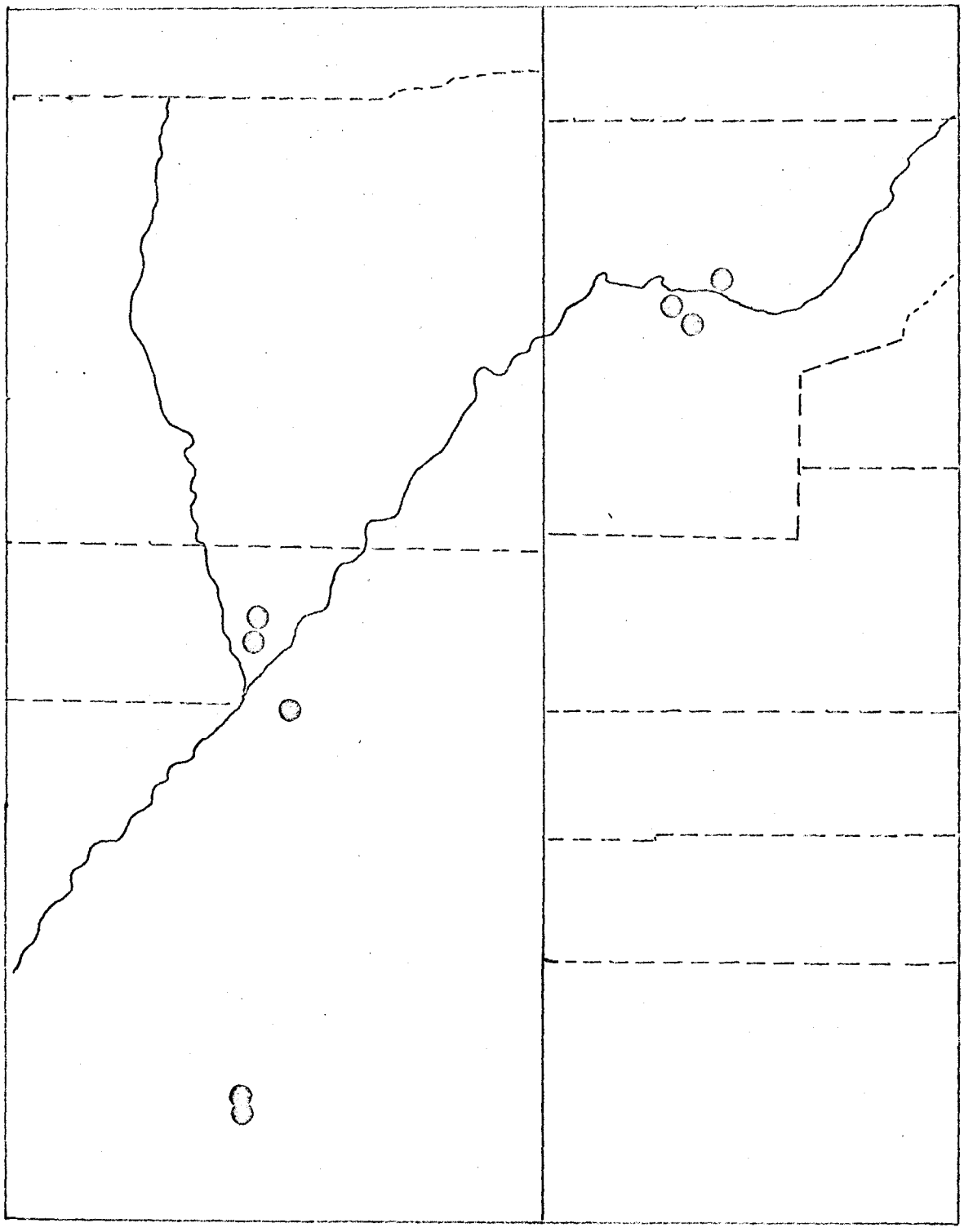
53. Cryptantha osterhoutii (Payson) Payson

Cryptantha osterhoutii (Payson) Payson, Ann. Mo. Bot. Gard. 14:329. 1927.

Oreocarya osterhoutii Payson, Univ. Wyo. Publ. Bot. 1:167. 1926.

Densely caespitose perennials, 0.7-1.2 dm tall; stems slender, many, arising from the densely branched multiple caudex, 0.3-0.6 mm long, strigose and spreading setose; leaves spatulate to oblanceolate, obtuse, 1-3 cm long, 0.3-0.8 cm wide, dorsal surface strigose and appressed setose, pustulate, ventral surface strigose, not pustulate or the pustulae inconspicuous, petioles ciliate margined; inflorescence open, 0.3-0.8 dm long, weakly white setose, foliar bracts inconspicuous; calyx segments lanceolate, in anthesis 2.5-4 mm long, in fruit becoming 5-6.5 mm long, strigose and spreading white setose; corolla white, the tube 2-3 mm long, crests at base of tube usually evident but poorly developed, fornices yellow, broad, emarginate, papillose, about 0.5 mm long, limb 5-7 mm wide; style exceeding mature fruit 0.2-0.7 mm; nutlet

Map No. 53. Western Colorado and southeastern Utah. Range of C. osterhoutii (Payson) Payson.



Cryptantha osterhoutii (Payson) Payson

lanceolate, 2.7-3.2 mm long, 1.8-2.2 mm wide, usually less than 4 maturing, margins obtuse, not in contact, dorsal surface carinate, sharply tuberculate and rugose, ventral surface sharply tuberculate, scar open, constricted above the base, elevated margin evident but not conspicuous. Collections: 14 (0); representative: W. A. Weber 6088 (ARIZ, COLO, CS, RM, UTC); G. E. Osterhout 6138 (COLO, RM); D. Atwood 1538A (BRY); B. F. Harrison 11923 (BRY); Welsh, Moore & Canter 2946 (BRY); G. Moore 399 (BRY); G. Moore 299 (BRY); S. L. Welsh 7070 (BRY).

Holotype: G. E. Osterhout 6138, collected in Monument Park, near Grand Junction, Mesa County, Colorado, 3 June, 1921, RM. Photograph at BRY. Isotype at COLO.

Distribution: Mesa County, Colorado and San Juan County, Utah. Growing in sandy soil, 2,500 to 6,000 feet. Map No. 53. May to June.

This very distinctive species is not often collected, but is one of the most distinct in this group.

54. Cryptantha paradoxa (A. Nels.) Payson

Cryptantha paradoxa (A. Nels.) Payson, Ann. Mo. Bot. Gard. 14:330. 1927.

Oreocarya paradoxa A. Nels. Bot. Gaz. 56:69. 1913.

Oreocarya gypsophila Payson, Bot. Gaz. 60:380. 1915. (Type: On dry gypsum hill in Paradox Valley, Colorado, 18 June, 1914, Payson 458.)

Caespitose perennial, 0.4-1.2 dm tall; stems 1-many, slender, 0.2-0.8 dm long, subtomentose near the base, weakly setose above; leaves oblanceolate to spatulate, usually folded, obtuse, 1.5-4 cm long, 0.2-0.4 cm wide, dorsal surface with appressed setose-pustulate hairs, ventral surface uniformly strigose and without pustulate hairs, the petioles

ciliate-margined; inflorescence subcapitate, 0.1-0.4 dm long, setose, foliar bracts inconspicuous; calyx segments linear-lanceolate, in anthesis 5-6 mm long, in fruit becoming 6-8 mm long, weakly setose; corolla white, usually with a yellow tube 10-12 mm long, crests at base of tube lacking, fornices yellow, broad, slightly emarginate, papillose, about 0.5 mm long, limb 10-12 (15) mm wide; style exceeding mature fruit 4-9 mm; nutlets lanceolate, turgid, 2-3 mm long, 1.3-1.6 mm wide, all 4 usually maturing, margins acute to obtuse, not in contact, dorsal surface densely tuberculate and conspicuously rugose, ventral surface tuberculate, also somewhat rugulose, scar open, constricted below the middle, the margin elevated. Collections: 15 (vi); representative: E. P. Walker 91 (RM); Payson & Payson 4223 (GH, RM); E. B. Payson 458 (GH, RM); W. A. Weber 4722 (COLO, RM, UTC); A. Cronquist 9204 (UTC); B. Maguire 18282 (UTC); B. F. Harrison 9607 (BRY); Higgins & Reveal 1272 (BRY); L. C. Higgins 1314, 1317, 1319 (BRY).

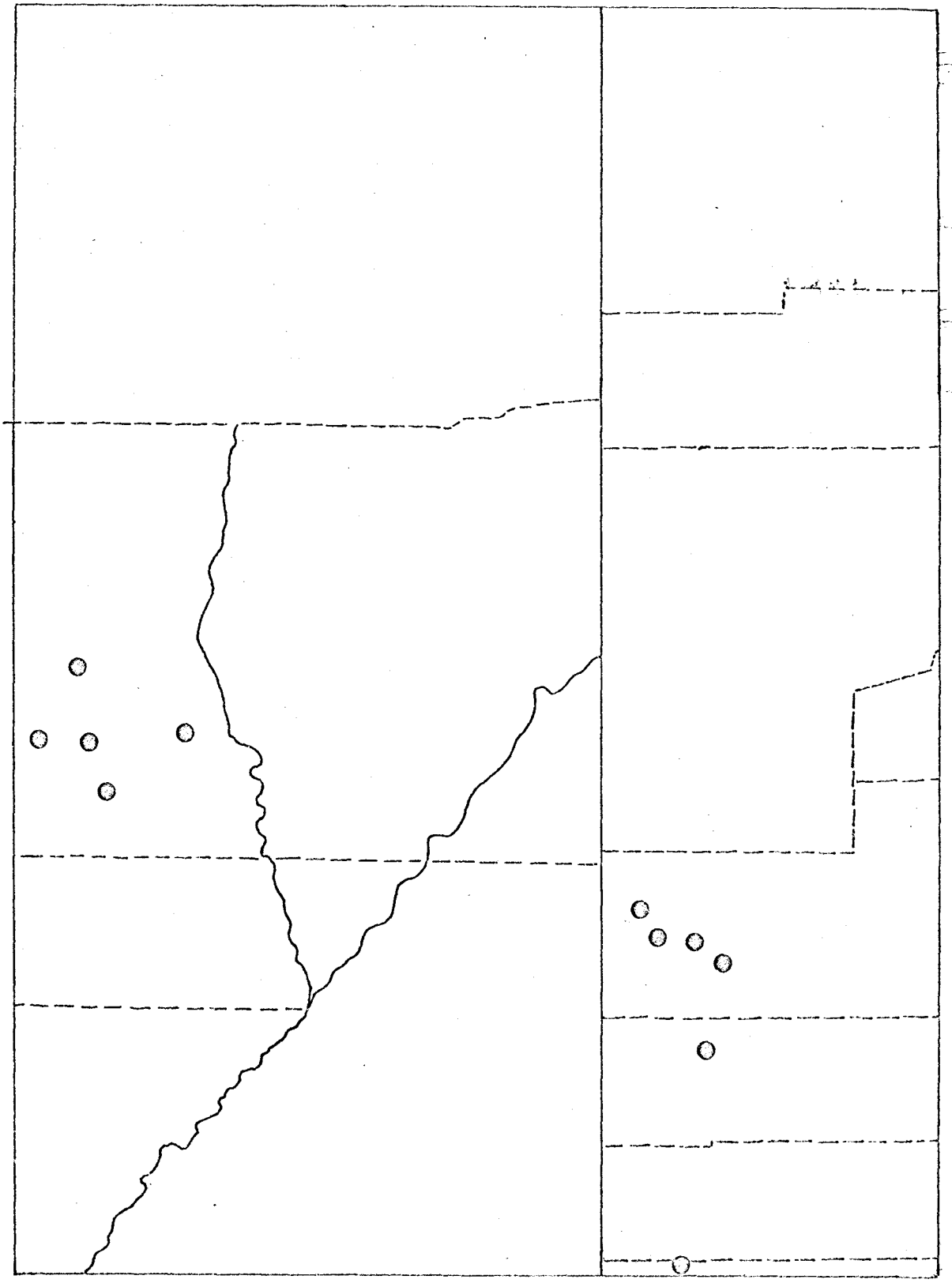
Holotype: E. P. Walker 91, collected in Montrose County, Colorado on dry gypsum hills in Paradox Valley, 17 June, 1912, RM. Photograph at BRY. Isotypes at GH, POM, US.

Distribution: Western and southwestern Colorado and Emery County, Utah. Growing on clay or sandy soil, 4,000 to 7,000 feet. Map No. 54. May and June.

Cryptantha gypsophila is the same plant in every respect as C. paradoxa. Payson noted, "unfortunately the specimens of paradoxa had not been mounted and so were not available when gypsophila was describe However, there is no doubt that the two names are completely synonymous

This delicate little species may be distinguished by its densely caespitose habit, short leaves, and the long dimorphic corollas.

Map No. 54. Western Colorado and eastern Utah. Range of C. paradoxa (A. Nels.) Payson.



Cryptantha paradoxa (A. Nels.) Payson

55. Cryptantha bakeri (Greene) Payson

Cryptantha bakeri (Greene) Payson, Ann. Mo. Bot. Gard. 14:331. 1927.

Oreocarya bakeri Greene, Pitt. 4:92. 1899.

Oreocarya eulophus Rydb. Bull. Torrey Bot. Club 31:637. 1904.

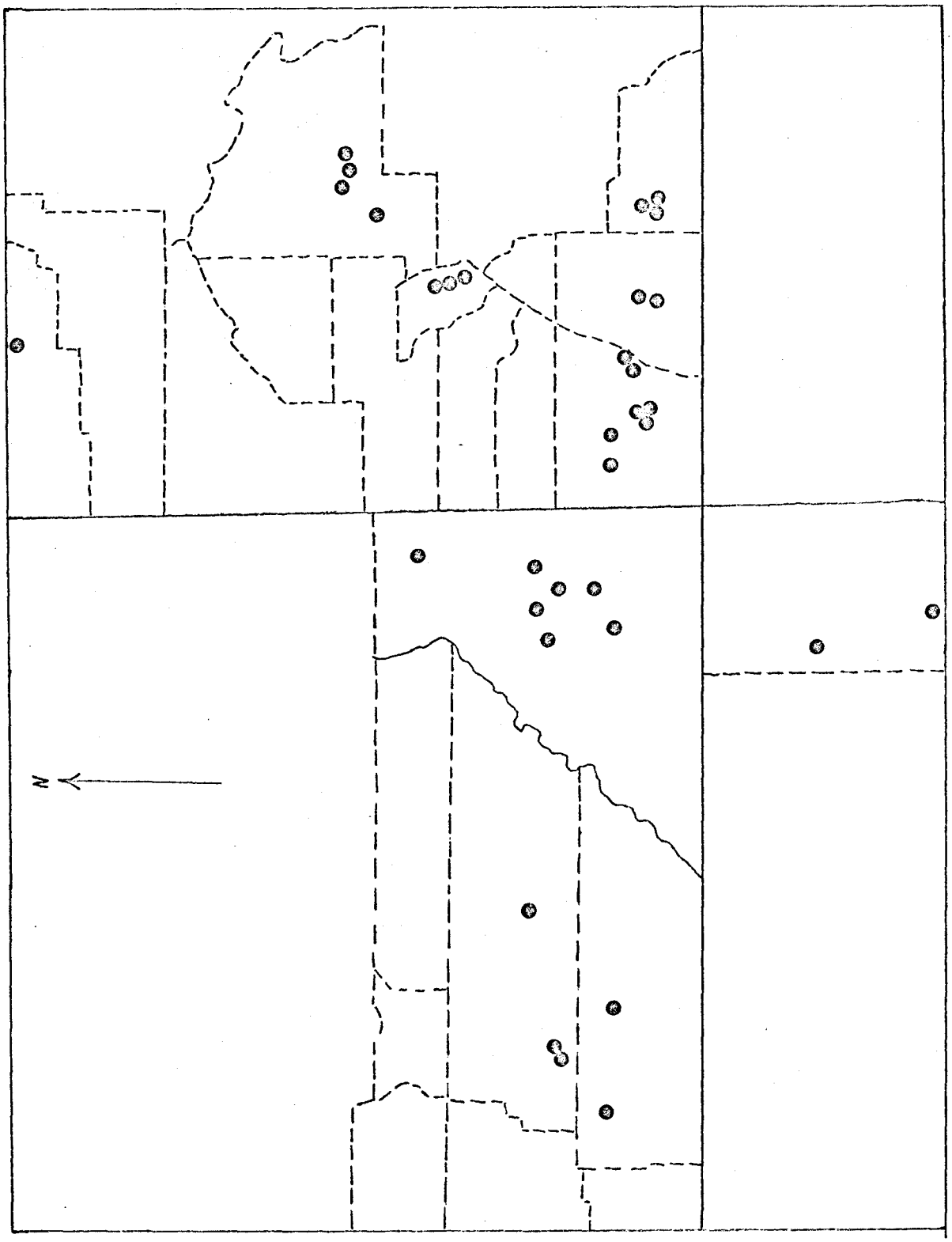
(Type: Delores, Colorado, 1892, Crandall s.n.)

Biennial or short-lived perennials, 1-3 dm tall; stems 1-4 (6), 0.5-1 dm long, spreading setose-hirsute; leaves oblanceolate, obtuse, mostly basal, 3-6 cm long, 0.5-1.2 cm wide, dorsal surface strigose and spreading setose, pustulate, ventral surface uniformly strigose and with few or no pustulate hairs; inflorescence narrow, 0.6-2.5 dm long, setose-hirsute, foliar bracts evident, slightly surpassing the individual cymes; calyx segments broadly lanceolate or ovate, in anthesis 3.5-4 mm long, in fruit becoming 6-8 mm long, conspicuously setose; corolla white, the tube 4-6 mm long, crests at base of tube lacking, fornices yellow, emarginate, 1-1.5 mm long, limb 6-8 mm wide; style exceeding mature fruit 1-2 mm; nutlets ovate-lanceolate, 2.5-3 mm long, 1.5-2 mm wide, 3-4 usually maturing, margins obtuse, nearly in contact, dorsal surface deeply and sharply rugose, ventral surface tuberculate and short rugose, scar closed, surrounded by a definitely elevated white margin. Collections: 44 (0); representative: Baker, Earle & Tracy 827 (ND-G); R. C. Rollins 2223 (RM, UTC); W. A. Weber 8732 (COLO); Eardman 39 (BRY, COLO); A. H. Holmgren 3374 (BRY, UTC); H. M. Schmoll 1281 (COLO, RM); A. Nelson 10408 (RM); D. Atwood 1539A (BRY).

Holotype: Baker, Earle & Tracy 827, collected on the Mancos River sage plains in southern Colorado, 8 July, 1898, ND-G. Photograph at BRY. Isotype at POM.

Distribution: Southwestern Colorado, northeastern Arizona, and

Map No. 55. Southwestern Colorado, southeastern Utah, and parts of adjoining states. Range of C. bakeri (Greene) Payson.



Cryptantha bakeri (Greene) Payson

southeastern Utah. Growing on sandy or clay soils, 4,000 to 8,000 feet. Map No. 55. May to August.

This species is very distinct, however, very closely related to C. flavoculata and often confused with it. It can be distinguished by its leaves which lack pustules on the ventral surface, shorter corolla tube, the shorter style, and the nutlets which have the scar tightly closed and the margin elevated.

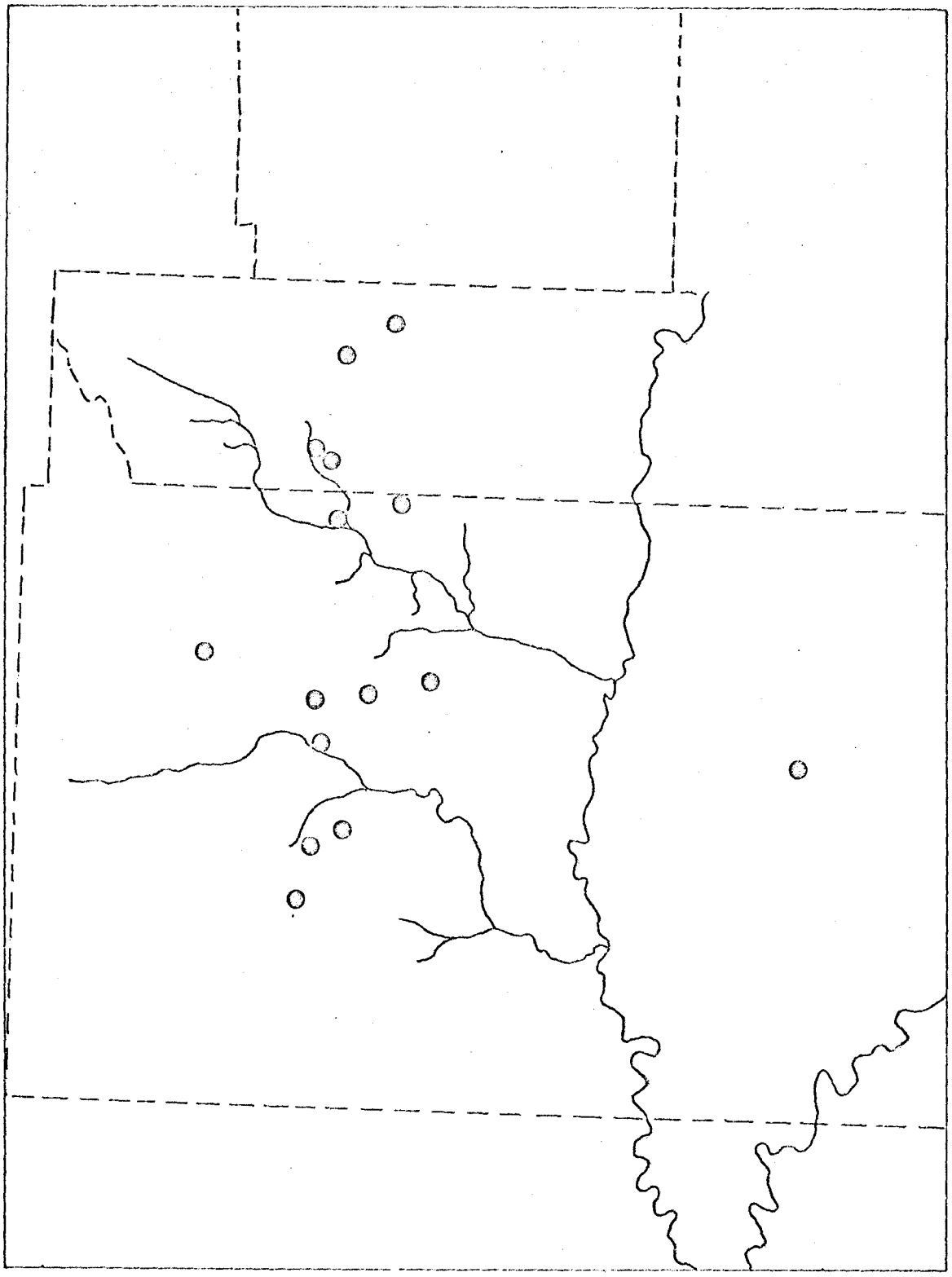
56. Cryptantha mensana (Jones) Payson

Cryptantha mensana (Jones) Payson, Ann. Mo. Bot. Gard. 14:333. 1927.

Krynitzkia mensana Jones, Contr. West. Bot. 13:4. 1910.

Oreocarya mensana (Jones) Payson, Univ. Wyo. Publ. Bot. 1:171. 1926.

Short-lived perennials, 1-1.5 dm tall; stems 1-several, 0.5-1.2 dm long, setose-hirsute, with some finer strigose hairs beneathl leaves oblanceolate to spatulate, obtuse, 3-8 cm long, 0.5-1.4 cm wide, lower surface setose with pustulate hairs, also finely strigose, ventral side strigose, less setose, and with fewer pustules; inflorescence broad, open, 0.4-1.2 dm long, setose, foliar bracts well developed; calyx segments lanceolate, in anthesis 4-5 mm long, in fruit becoming 7-8 mm long, setose-hirsute; corolla white, the tube 3-4 mm long, crests at base of tube lacking or nearly so, fornices yellow, rounded, slightly papillose, about 0.5 mm long, limb 5-8 mm wide; style exceeding mature fruit 1.5-2 mm; nutlets ovoid, 3-3.5 mm long, 1.6-1.9 mm wide, margins obtuse, not in contact, dorsal surface rugose, tuberculate and somewhat muricate, ventral surface conspicuously tuberculate, scar open, constricted at the middle and surrounded by a high elevated margin. Collections: 20 (vi); representative: B. F. Harrison 5625 (RM);



Cryptantha mensana (M. E. Jones) Payson

M. E. Jones 5445 (POM); S. L. Welsh 6915 (BRY); B. Maguire 18596 (UTC); A. Nelson 5625 (RM); G. L. Pyrah 15 (BRY); D. Atwood 1270, 1284 (BRY); Higgins & Reveal 1298 (BRY); Higgins & Welsh 1043 (BRY); L. C. Higgins 996, 1039, 1318 (BRY).

Holotype: M. E. Jones 5445p, collected in Emery County, Utah, 16 May, 1894, POM. Photograph at BRY. Isotype at US.

Distribution: Central and eastern Utah in Emery, Carbon, and Grand Counties. Growing on clay soils, 4,500 to 6,500 feet. Map No. 56. Late April to July.

Cryptantha mensana is closely related to C. flavoculata, but the short corolla and the more open inflorescence serve to distinguish it from that species.

57. Cryptantha flavoculata (A. Nels.) Payson

Cryptantha flavoculata (A. Nels.) Payson, Ann. Mo. Bot. Gard. 14:334. 1927.

Oreocarya flavoculata A. Nels. Erythea 7:66. 1899.

Oreocarya flavoculata spatulata A. Nels. Erythea 7:67. 1899.

(Type: from gravelly hilltops near Evanston, Wyoming, Nelson 2977, 29 May, 1897.)

Oreocarya cristata Eastw. Bull Torrey Bot. Club 30:244. 1903.

(Type: Grand Junction, Colorado, 17 May, 1892, Eastwood.)

Oreocarya shockleyi Eastw. Bull. Torrey Bot. Club 30:245. 1903.

(Type: Miller Mountain, Esmeralda County, Nevada, elev. 7,500 feet, Shockley 244.)

Oreocarya eastwoodae Nels. & Kennedy, Muhlenbergia 3:141. 1908.

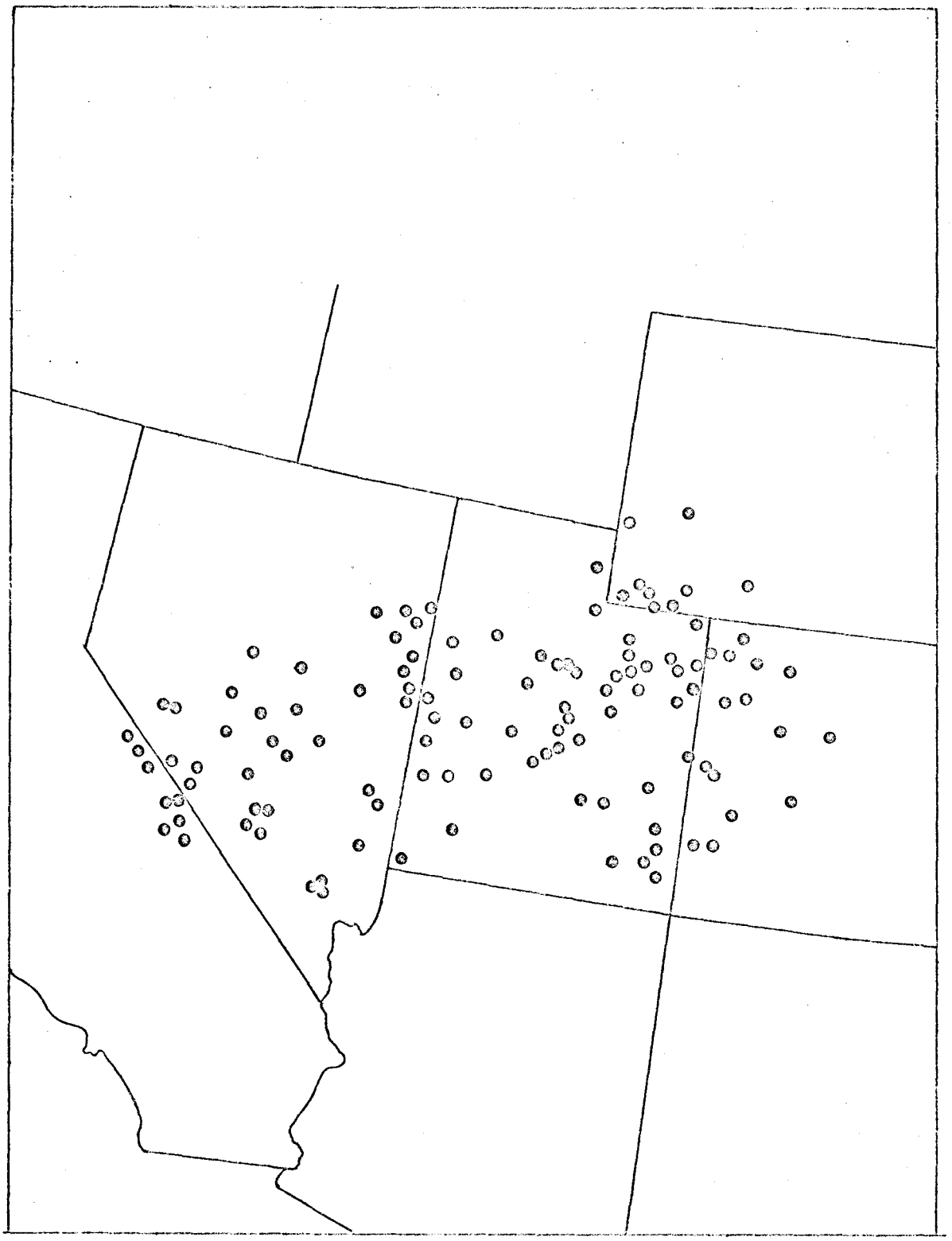
(Type: Mormon Mountains, Lincoln County, Nevada, P. B. Kennedy & L. N. Goodding 146.)

Caespitose perennial, 1-3.7 dm tall; stems 1-several, slender, 0.5-2 dm long, strigose and spreading setose with slender bristles; leaves linear-oblanceolate to spatulate, obtuse to sometimes acute, 3-11 cm long, 0.3-1.5 cm wide, densely strigose and weakly setose, dorsal surface conspicuously pustulate, ventral surface with few pustules or sometimes silky-strigose; inflorescence narrow, or sometimes slightly open and lax, 0.5-3 dm long, foliar bracts evident but not conspicuous; calyx segments in anthesis linear-lanceolate, 5-6 mm long, in fruit becoming 8-10 mm long and becoming broadly lanceolate to ovate; corolla white or pale yellow, tube 7-10 mm long, crests at base of tube lacking, fornices yellow, minutely papillose, 1-2 mm long, limb 8-12 mm wide; style exceeding mature fruit 4-8 mm (heterostyled); nutlets lanceolate to lance-ovate, 2.5-3.5 mm long, 1.8-2 mm wide, usually all 4 maturing, margins obtuse, in contact or slightly separated, dorsal surface muricate, tuberculate, and with conspicuously ridges, sometimes nearly foveolate, ventral surface tuberculate, rarely with ridges, scar open, constricted near the middle and surrounded by a high elevated margin. Collections: 188 (xix); representative: Maguire & Holmgren 26064 (ORE, UTC); I. W. Clokey 7668 (ARIZ, ORE, LL, UTC); B. Maguire 25234 (ARIZ, BRY, ORE, UTC); J. Beatley 4007 (BRY, LA); B. F. Harrison 10320 (BRY, UTC); A. Nelson 4572 (RM); A. Eastwood s.n. (UC); G. E. Osterhout 6006 (GH, RM, US); Kennedy & Goodding 146 (RM, US); Shockley 244 (UC) L. C. Higgins 557, 997, 1026, 1061, 1112 (BRY).

Holotype: A. Nelson 4572, collected at Piedmont, Wyoming, 7 June, 1898, RM.

Distribution: Southern Wyoming, western Colorado, Utah, Nevada, and southeastern California. Growing in a wide variety soils, 3,000 to 8,500 feet. Map No. 57. April to July.

Map No. 57. Parts of western United States. Range of C. flavoculata (A. Nels.) Payson.



Cryptantha flavoculata (A. Nels.) Payson

This widespread species may be distinguished by its long corolla tube, very rugose nutlets with the scar open and the margin elevated, and the only slightly heterostyled flowers.

This species possesses a number of different forms but they seem to be unworthy of named segregation from the main specific complex. In western Colorado the author is familiar with two forms, on the basis of setose-hispid and silky-strigose indument. For a limited locality it would seem that these two forms are worthy of some subspecific rank but on an examination of a series of specimens it appears the variation is only local. Oreocarya cristata has very narrow leaves and so has a slightly different aspect. On the same basis of leaf width spatulata shockleyi, and eastwoodae were described. At the present time the author can see no difference on which to separate them.

APPENDIX

Synonyms

The names presented in the following list consist of the synonyms of the species treated in the foregoing work. The names in the left column are the synonyms; those in the column on the right are the names of the species in the present treatment.

CYNOGLOSSUM	CRYPTANTHA
C. glomeratum Nutt. ex Pursh	C. celosioides (Eastw.) Pays.
CRYPTANTHA	
C. andina Johnst.	C. subretusa Johnst.
C. bradburiana Pays.	C. celosioides (Eastw.) Pays.
C. clemensae Pays.	C. nubigena (Greene) Pays.
C. confertiflora var. flava (A. Nels.) Brand	C. flava (A. Nels.) Pays.
C. confertiflora var. lutescens (Greene) Brand	C. flava (A. Nels.) Pays.
C. coryi Johnst.	C. palmeri (Gray) Pays.
C. echinoides (Jones) Pays.	C. fulvocanescens var. echinoides (Jones) Higgins
C. jamesii var. cinerea (Greene) Pays.	C. jamesii var. setosa (Jones) Johnst.
C. macounii (Eastw.) Pays.	C. celosioides (Eastw.) Payson
C. modesta Payson	C. abata Johnst.
C. nana var. commixta (Macbr.) Pays.	C. humilis var. commixta (Macbr.) Higgins
C. nana var. ovina Pays.	C. humilis var. ovina (Pays.) Higgins
C. nana var. shantzii (Tidestr.) Pays.	C. humilis var. shantzii (Tidestr.) Higgins
C. nana var. nana	C. humilis var. nana (Eastw.) Higgins
C. pustulosa (Rydb.) Pays.	C. jamesii var. pustulosa (Rydb.) Harringt.
C. sericea var. perennis (A. Nels.) Pays.	C. sericea (Gray) Pays.
C. sheldonii (Brand) Pays.	C. celosioides (Eastw.) Pays.

ERITRICHIUM

E. fulvocanescens Gray	C. fulvocanescens var. fulvocanescens
E. glomeratum A. DC.	C. celosioides (Eastw.) Pays.
E. glomeratum var. fulvocanescens S. Wats.	C. fulvocanescens var. fulvocanescens
E. glomeratum var. hispidissimum Torr.	C. thyrsiflora (Greene) Pays.
E. glomeratum var. humile Gray	C. humilis var. humilis
E. glomeratum var. virgatum Porter	C. virgata (Porter) Pays.
E. jamesii Torr.	C. jamesii var. jamesii
E. leucophaeum (Dougl.) A. DC.	C. leucophaea (Dougl.) Pays.
E. multicaule Torr.	C. jamesii var. multicaulis (Torr.) Pays.
E. setosissima Gray	C. setosissima (Gray) Pays.
E. virgatum Porter	C. virgata (Porter) Pays.

HEMISPHAEROCARYA

H. cinerea (Greene) Brand	C. jamesii var. setosa (Jones) Johnst.
H. laxa (Macbr.) Brand	C. jamesii var. laxa (Macbr.) Pays.
H. oblata (Jones) Brand	C. oblata (Jones) Pays.
H. palmeri (Gray) Brand	C. palmeri (Gray) Pays.
H. paysonii (Macbr.) Brand	C. paysonii (Macbr.) Johnst.
H. abortiva (Greene) Brand	C. jamesii var. abortiva (Greene) Pays.
H. suffruticosa (Torr.) Brand	C. jamesii var. jamesii
H. suffruticosa var. multicaulis (Torr.) Brand	C. jamesii var. multicaulis (Torr.) Pays.
H. suffruticosa var. pustulosa (Rydb.) Brand	C. jamesii var. pustulosa (Rydb.) Harringt.
H. suffruticosa var. setosa (Jones) Brand	C. jamesii var. setosa (Jones) Johnst.
H. suffruticosa var. typica	C. jamesii var. jamesii

KRYNITZKIA

K. depressa Jones	C. abata Johnst.
K. echinoides Jones	C. fulvocanescens var. echinoides (Jones) Higgins
K. fulvocanescens Gray	C. fulvocanescens var. fulvocanescens
K. fulvocanescens var. idahoensis Jones	C. propria (Nels. & Macbr.) Pays.
K. glomerata Gray	C. celosioides (Eastw.) Pays.
K. glomerata var. acuta Jones	C. wetherillii (Eastw.) Pays.
K. glomerata var. virginensis Jones	C. virginensis (Jones) Pays.
K. jamesii (Torr.) Gray	C. jamesii var. jamesii
K. leucophaea (Dougl.) Gray	C. leucophaea (Dougl.) Pays.
K. leucophaea var. alata Jones	C. confertiflora (Greene) Pays.

K. multicaulis var. abortiva (Greene) Jones	C. Jamesii var. abortiva (Greene) Pays.
K. multicaulis var. setosa Jones	C. jamesii var. setosa (Jones) Johnst.
K. mensana Jones	C. mensana (Jones) Pays.
K. oblata Jones	C. oblata (Jones) Pays.
K. palmeri Gray	C. palmeri (Gray) Pays.
K. pustulata Blankenship	C. celosioides (Eastw.) Pays.
K. sericea Gray	C. sericea (Gray) Pays.
K. setosissima (Gray) Gray	C. setosissima (Gray) Pays.
K. virgata (Porter) Gray	C. virgata (Porter) Pays.

MYOSOTIS

M. glomerata Nutt.	C. celosioides (Eastw.) Pays.
M. leucophaea Dougl. in Lehm.	C. leucophaea (Dougl. in Lehm.) Pays.
M. suffruticosa Torr.	C. jamesii var. jamesii

OREOCARYA

O. abortiva Greene	C. jamesii var. abortiva (Greene) Pays.
O. affinis Greene	C. celosioides (Eastw.) Payson
O. affinis perennis A. Nels.	C. sericea (Gray) Pays.
O. alata (Jones) A. Nels.	C. confertiflora (Greene) Pays.
O. aperta Eastw.	C. aperta (Eastw.) Pays.
O. argentea Rydb.	C. sericea (Gray) Pays.
O. bakeri Greene	C. bakeri (Greene) Pays.
O. breviflora Osterh.	C. breviflora (Osterh.) Pays.
O. caespitosa A. Nels.	C. caespitosa (A. Nels.) Pays.
O. cana A. Nels.	C. cana (A. Nels.) Pays.
O. capitata Eastw.	C. capitata (Eastw.) Johnst.
O. celosioides Eastw.	C. celosioides (Eastw.) Pays.
O. cilio-hirsuta Nels. & Macbr.	C. spiculifera (Piper) Pays.
O. cinerea Greene	C. jamesii var. setosa (Jones) Johnst.
O. commixta Macbr.	C. humilis var. commixta (Macbr.) Higgins
O. confertiflora Greene	C. confertiflora (Greene) Pays.
O. cristata Eastw.	C. flava (A. Nels.) Pays.
O. crymophila (Johnst.) Jeps. & Hoover	C. crymophila Johnst.
O. depressa (Jones) Macbr.	C. abata Johnst.
O. disticha Eastw.	C. jamesii var. disticha (Eastw.) Pays.
O. dolosa Macbr.	C. humilis var. shantzii (Tidestr.) Higgins
O. dura Nels. & Macbr.	C. thyrsiflora (Greene) Pays.
O. eastwoodae Nels. & Kennedy	C. flavoculata (A. Nels.) Pays.
O. echinoides (Jones) Macbr.	C. humilis var. humilis
O. elata Eastw.	C. elata (Eastw.) Pays.
O. eulophus Rydb.	C. bakeri (Greene) Pays.
O. flava A. Nels.	C. flava (A. Nels.) Pays.

O. flavoculata A. Nels.	C. flavoculata (A. Nels.) Pays.
O. flavoculata spatulata A. Nels.	C. flavoculata (A. Nels.) Pays.
O. fulvocanescens (S. Wats.) Greene	C. fulvocanescens (S. Wats.) Pays.
O. glomerata Greene	C. celosioides (Eastw.) Pays.
O. gypsophila Pays.	C. paradoxa (A. Nels.) Pays.
O. hispida Nels. & Kennedy	C. humilis var. humilis
O. hispidissima (Torr.) Rydb.	C. thyrsiflora (Greene) Pays.
O. hispidissima Wooton & Standl.	C. oblata (Jones) Pays.
O. hoffmannii (Johnst.) Abrams.	C. hoffmannii Johnst.
O. horridula Greene	C. longiflora (A. Nels.) Pays.
O. humilis Greene	C. humilis (Gray) Pays. var. humilis
O. insolita Macbr.	C. insolita (Macbr.) Pays.
O. interrupta Greene	C. interrupta (Greene) Pays.
O. jonesiana Pays.	C. jonesiana (Pays.) Pays.
O. lemmoni Eastw.	C. jamesii var. setosa (Jones) Johnst.
O. leucophaea (Dougl.) Greene	C. leucophaea (Dougl.) Pays.
O. longiflora A. Nels.	C. longiflora (A. Nels.) Pays.
O. lutea Greene	C. confertiflora (Greene) Pays.
O. lutescens Greene	C. flava (A. Nels.) Pays.
O. macbridii Brand	C. humilis var. humilis
O. macounii Eastw.	C. celosioides (Eastw.) Pays.
O. mensana (Jones) Pays.	C. mensana (Jones) Pays.
O. monosperma Osterh.	C. thyrsiflora (Greene) Pays.
O. multicaulis (Torr.) Greene	C. jamesii var. multicaulis (Torr.) Pays.
O. multicaulis var. cinerea (Greene) Macbr.	C. jamesii var. setosa (Jones) Johnst.
O. multicaulis var. laxa Macbr.	C. jamesii var. laxa (Macbr.) Pays.
O. nana Eastw.	C. humilis var. nana (Eastw.) Higgins
O. nitida Greene	C. fulvocanescens var. fulvocanescens
O. nubigena Greene	C. nubigena (Greene) Pays.
O. oblata (Jones) Macbr.	C. oblata (Jones) Pays.
O. osterhoutii Pays.	C. osterhoutii (Pays.) Pays.
O. palmeri (Gray) Greene	C. palmeri (Gray) Pays.
O. paradoxa A. Nels.	C. paradoxa (A. Nels.) Pays.
O. paysonii Macbr.	C. paysonii (Macbr.) Johnst.
O. perennis Rydb.	C. celosioides (Eastw.) Pays.
O. procera Osterh.	C. sericea (Gray) Pays.
O. propria Nels. & Macbr.	C. propria (Nels. & Macbr.) Pays.
O. pustulosa Rydb.	C. jamesii var. pustulosa (Rydb.) Harringt.
O. rugulosa Pays.	C. rugulosa (Pays.) Pays.
O. salmonensis Nels. & Macbr.	C. salmonensis (Nels. & Macbr.) Pays.
O. sericea (Gray) Greene	C. sericea (Gray) Pays.
O. sericea sensu Piper	C. celosioides (Eastw.) Pays.
O. setosissima (Gray) Greene	C. setosissima (Gray) Pays.

O. shantzii Tidestr.	C. humilis var. shantzii (Tidestr.) Higgins
O. sheldonii Brand	C. celosioides (Eastw.) Pays.
O. shockleyi Eastw.	C. flavoculata (A. Nels.) Pays.
O. spicata Rydb.	C. virgata (Porter) Pays.
O. spiculifera Piper	C. spiculifera (Piper) Pays.
O. stricta Osterh.	C. stricta (Osterh.) Pays.
O. subretusa (Johnst.) Abrams	C. subretusa Johnst.
O. suffruticosa (Torr.) Greene	C. jamesii var. jamesii
O. suffruticosa var. abortiva (Greene) Macbr.	C. jamesii var. abortiva (Greene) Pays.
O. suffruticosa var. cinerea (Greene) Pays.	C. jamesii var. setosa (Jones) Johnst.
O. suffruticosa var. multicaulis (Torr.) Pays.	C. jamesii var. multicaulis (Torr.) Pays.
O. tenuis Eastw.	C. tenuis (Eastw.) Pays.
O. thompsonii (Johnst.) Abrams	C. thompsonii Johnst.
O. thyrsiflora Greene	C. thyrsiflora (Greene) Pays.
O. tumulosa Pays.	C. tumulosa (Pays.) Pays.
O. urticacea Wooton & Standl.	C. thyrsiflora (Greene) Pays.
O. virgata (Porter) Greene	C. virgata (Porter) Pays.
O. virgata forma spicata (Rydb.) Macbr.	C. virgata (Porter) Pays.
O. virginensis (Jones) Macbr.	C. virginensis (Jones) Pays.
O. wetherillii Eastw.	C. wetherillii (Eastw.) Pays.

ROCHELIA

R. glomerata Torr.	C. celosioides (Eastw.) Pays.

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A REVISION OF CRYPTANTHA SUBGENUS OREOCARYA

An Abstract of

a Dissertation

Presented to the

Department of Botany

Brigham Young University

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

by

Larry C. Higgins

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ABSTRACT

This study is a taxonomic revision of Cryptantha subgenus Oreocarya (Boraginaceae), together with descriptions of species, synonyms, distribution maps, and discussions. The present treatment recognizes fifty-seven species and fourteen varieties, all separated by means of a comprehensive key. A history of the group, along with a discussion of the distribution, ecology, and phylogeny is presented.

As a basis for the comparison of taxa much of the research has been concentrated on morphological variation in herbarium specimens. Particular attention has been directed to a study of pubescence types, branching patterns, flowers, calyces, and the fruit. The herbarium research has been correlated with extensive field observations and collections made throughout most of western North America.