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JOURNAL OF THE PHILADELPHIA BOTANICAL CLUB

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A Preliminary Study of the Genus Chenopodium in North America ¹

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No group of plants of comparable size and wide distribution known to the writer has suffered the lack of understanding of the taxa involved as has the genus Chenopodium, especially those members of its Section Chenopodia that are closely related to C. album and C. Berlandieri. The reasons for this lie in (1) the ecological variability characteristic of weedy annuals, (2) the fact that important diagnostic characters are present in the seeds, which are of small size and often lacking from collected material, (3) the repetition of similar variations in habit and leaf shape in distinct species and (4) the lack of pubescence characters in most species.

The first comprehensive treatment of the North American species was that of Standley ² (12), in 1916. Although this work provided considerable clarification through the recognition of a dozen native species, the distinctions were, in some cases, based rather largely on habit and leaf shape and to a lesser degree on fruit characters. This led, especially in the album and Berlandieri complexes, to the inclusion of some unrelated plants under the same name and to the lack of recognition of other taxa. The species delimitations laid down by Standley were followed, however, by Fernald (6) and by Gleason (9) in their recent regional floras.

Adequate clarification of the genus was first accomplished by Aellen² (2), and later, with special reference to North American taxa, by Aellen and Just² (4). These two treatments might have resulted in a relatively complete under-

¹ Authorized for publication on March 25, 1954, as paper No. 1869 in the Journal Series of the Pennsylvania Agricultural Experiment Station, and as Contribution No. 185 from the Department of Botany, Pennsylvania State University.

² Since these important works are cited so frequently in the following pages, they are referred to simply as Standley, Aellen, and Aellen and Just, without citation of number.

standing of the genus had the characters separating the taxa been more clearly and accurately pointed out in the keys. That this was not done is indicated by the lack of acceptance of the results in the above-mentioned revisions of the northeastern flora. Fosberg (7), discussing the separation of species related to C. Fremontii, says the differences seem "scarcely enough to base species upon, even in Chenopodium" [italics mine]. This sums up the attitude expressed by many who have dealt with the genus.

In his 1929 paper Aellen described two native eastern American species of Chenopodium, one from Missouri and one from Cape Cod. The former, C. missouriense, turns out to be common and strikingly uniform, apparently throughout eastern U. S. south of about latitude 41°, although its distribution is as yet incompletely known. The latter, C. macrocalycium, is frequent as a coastal plant from Nova Scotia to southern New Jersey. It is almost invariably filed in herbaria under C. album or its var. lanceolatum (C. lanceolatum Muhl.) though not closely related to either. Collections of it have never been associated with C. Berlandieri, but additional material from the southern limit of its range may show it grading into this species, since it is closely related thereto. C. missouriense has most often been identified with C. album, the two being similar, although separable in the herbarium on the basis of seed size and other characters, and from a moving car at any time of the year; an ecological form of it is, however, the basis for part of C. Berlandieri of most American authors.

With these points in mind it seems that the expression "even in Chenopodium" may be inapropos. Perhaps "even in" is inapropos in all cases (including Rubus?), for in most critical and "troublesome" genera that have been subjected to really adequate study, differences of opinion are chiefly systematic. That is, they revolve around the question of whether a particular and generally recognizable entity should be considered as a species, to belong in some sub-specific category, or as not meriting nomenclatorial status at all. Confusing variations are especially frequent in weedy annual plants, of which Chenopodium is an outstanding example. They may best be resolved by field experience and various approaches of Experimental Taxonomy, although only after some understanding of the taxa involved has been attained. This stage of the taxonomic discipline seems to be late in arriving in several sections of the genus Chenopodium.

The work reported here started as an attempt merely to clarify those taxa especially closely related to the *C. album* series, incident to studies on the Flora of Pennsylvania. It has progressed, perforce, to a consideration of nearly all the North American taxa, but has stopped, temporarily and because of the press of other commitments, short of completeness and of monographic proportions. The hope is that reasonably adequate clarification of the species occurring east of the Mississippi River has been achieved. Some material of strictly western species has been studied (mostly found in herbaria under *C. album*) but the treatment of these is not presumed to be definitive. No doubt a large amount of material of

western species is in western herbaria, and it is hoped that this may be included in a further study. Final elucidation of the more closely related taxa probably will be achieved, however, only by a combination of herbarium, field, and perhaps experimental work.

Material has been studied from the collections in the herbaria of the New York Botanical Garden (NY.), University of Illinois (Ill.), University of Pennsylvania (Penn.), Academy of Natural Sciences of Philadelphia (PH.), U. S. National Museum (US.), Department of Agriculture, Ottawa, Canada (OTB.), Pennsylvania State University (PAC.), Gray Herbarium (GH.) and the Herbarium of the New England Botanical Club (NEBC.). The author is indebted to the curators and personnel of these herbaria for the use of this material and for additional services.

CHARACTERS IN CHENOPODIUM

FRUIT

Examination of any significant amount of material offers convincing evidence that characters exhibited by the fruits (commonly referred to as utricles, although hardly ever with an inflated pericarp) are of primary significance in separating "interbreeding populations". This is evident because of the relative distinctness between the fruits of individual species and because other characters are correlated with these fruit differences, not to mention the general acceptance of reproductive characters as of inherently greater diagnostic value than vegetative ones. Unfortunately the fruits are small, generally 0.5 to 2.0 mm. in diameter, and recognition of the characters, while they can usually be detected with a 10× hand lens, is often better obtained at a magnification of 15–20 diameters. Since the thickness of the pericarp is negligible in comparison to the width of the seed, measurements for seed and fruit may be used interchangeably.

While size, shape, and acuteness of the margins are valuable characters, those having to do with the attachment of the pericarp to the seed and with the surface markings of the pericarp (also present, though less apparent, on the seed) are diagnostic. In this paper, the pericarp is referred to as being attached to the seed if it does not rub off when the fruit is rolled between the thumb and fore-finger or when, on being scratched with the point of a dissecting needle, it separates only along the line of contact with this. It is considered separable when it comes off partially or entirely on rubbing (Fig. 1) or when it can be readily removed in flakes by a needle.

The surface of the fruit may be either smooth, reticulate, or variously roughened. In those described as being smooth, the surface of the nearly mature fruit, when sufficiently magnified, generally appears to be pebbled with tiny pustules. These may soon become detached leaving minute depressions, or they may remain as obscure roughenings, hardly visible at 10×. When completely mature these fruits become essentially smooth.

The reticulate condition consists of the presence of depressions (alveolae), usually roughly rectangular and elongate in a vertical direction on the fruit, and separated by continuous ridges (Figs. 8, 9, 15). This characteristic alveolate reticulation may often be seen even on young fruit but becomes more pronounced with age and is visible on the pericarps of mature fruits at a magnification of 10 diameters. Markings of an irregular nature, more or less intermediate between smooth and reticulate, may be present in some species, particularly in *C. urbicum* and *C. murale*.

A character which, to the writer's knowledge, has not been used heretofore, but which is useful in separating certain species, is the presence or absence of a style base. In C. album, for example, the style is divided to the base while in C. Berlandieri a minute stylopodium, hardly more than 0.1 mm. long but definitely recognizable, remains on the fruit. This is one of the few useful characters which may be observed on young fruit. The length of the style branches is often diagnostic for sections but relatively constant for related species.

The shape of the fruit, whether flattened dorso-ventrally (horizontal) or laterally (vertical) has long been recognized as a character of fundamental importance in the genus.

FLOWERS

Few features of diagnostic significance can be recognized in the flowers of this genus. That of the style base has been mentioned. A most useful character is found in the extent to which the midribs of the sepals are winged or keeled. While this character presents some variation within a species it is expressed in such extremes as to be of considerable diagnostic value. The extremes range from a complete lack of a keel (C. urbicum and others) to a wing which is as wide as the width of the sepal from the midrib to the lateral margin (C. Berlandieri) (Fig. 9). The last species can usually be separated from C. album by its extremely broadly winged sepals.

The extent to which the perianth parts (generally referred to as sepals) cover the fruit is diagnostic in certain cases. The width of the sepals varies to the extent that they may meet or overlap laterally, or they may be separated from each other by as much as their width.

Sequence of flowering, not ordinarily considered, is of importance in some cases. Since the inflorescences are basically cymose the central flowers are oldest and, in the very contracted cymes usually present (cymules, glomerules, heads), they occupy a terminal position. In these inflorescences the flowers and fruit may mature either uniformly or more or less prominently mixed. They are described as mixed when mature fruit is present before all perfect flowers in the same inflorescence have reached anthesis. In many cases later pistillate flowers are present and these may mature after all others.

As regards all the flowers or inflorescences on the same plant, they may mature almost simultaneously throughout or, more frequently, successively from top to base of the plant. In only one species seen, C. foliosum, is progression of flowering from the base to the tip of the plant, and here it is more markedly so than in any case of the reverse sequence.

LEAVES

In the earlier works (especially for taxa similar to *C. album*) leaf shape has been used to a considerable extent in separating species. While various species are indeed recognizable on this basis, the same leaf shape may occur in taxa which, according to flower and fruit characters, clearly represent different species. Wherever possible in the present work, however, leaf shape has been used in separating larger groups in the key, since it is the most obvious character and the one which is most often present. Mature seeds constitute the most important feature for recognition of species, but they may be lacking from herbarium material. Unfortunately, good primary leaves and mature fruits, the two most important diagnostic features, are rarely both present at the same time. Leaf texture is of fundamental importance but its well recognized ecological variability necessitates caution in interpretation.

PHOTOPERIODISM

Fuller (8) described the effect of photoperiod on C. Quinoa Willd. and summarized the previous literature. This phenomenon has apparently not been applied in connection with species delimitation in the genus. While the time of flowering may be more or less dependent on day length in various species, those which exhibit the most marked response in this respect are C. Bushianum, C. missouriense and, presumably, C. giganteum. The first of these flowers during the last week in August and the second during the second week in September, and this is independent of the age of the plant. Although no exhaustive attempt has been made to determine the exact length of the photoperiod which induces flowering, plants of C. missouriense grown from seeds sown in the greenhouse during the short fall and winter days have consistently flowered from the second or third node above the cotyledons and have never become more than a few inches high. Seeds sown in March and April produced plants which reached the roof of the greenhouse, had to be supported on stakes, and flowered on schedule the second week of September.

Under similar conditions C. album shows a preference for earlier flowering with shorter photoperiods but it may be found in flower any time from June until October. Examination of herbarium material has not disclosed a narrow photoperiod for other species but field observations may bring some cases to light.

KEY TO THE SECTIONS OF CHENOPODIUM

- 1. Plants variously both pubescent and glandular (inconspicuously vesiculose-pubescent in C. aristatum with diffuse dichotomous cymes and nearly linear and entire leaves).
 - 2. Perianth parts prominently veiny, united except the minute tips, entirely enclosing the utricle Sec. Roubieva, p. 6
 - 2. Perianth parts separate or fused only at the base.

 - 3. Seeds chiefly horizontal, 0.7-1.0 mm. broad.
- 1. Plants glabrous or farinose but not glandular or pubescent.
 - 5. Seeds vertical or both vertical and horizontal in the same inflorescence (early stages of C. glaucum and var. may appear to have all horizontal seeds); plants glabrous or farinose but if conspicuously farinose on lower leaf surfaces then farinules inconspicuous or lacking on perianth parts; perianth 3-, 4- or 5-parted.

 - 6. Perianth chiefly 3-parted (4-5-parted in horizontal flowers which are terminal in the glomerules), the divisions entire or apiculate; stigmas not over 0.5 mm. in length; plants annual.

 - 7. Flowers in glomerules, these either separate or forming contracted spikes in the axils of leaves or bracts or in small or large panicles; perianth parts membranaceous to coriaceous when young but becoming membranaceous in age, not deliquescent; terminal flowers of the glomerules (sometimes not apparent in later stages) with horizontal seeds, the lateral with vertical seeds, maturing successively from the former to the latter.
 - 8. Perianth parts of flowers with vertical seeds 3-4, united nearly to the tip; stigmas chiefly 0.2-0.3 mm. long, usually ascending in a V . . . Sec. Degenia, p. 9
 - 8. Perianth parts (usually 3) of flowers with vertical seeds free nearly to the base or some but not all in each flower united above the middle; stigmas hardly exceeding 0.1 mm., horizontally spreading Sec. Pseudoblitum, p. 11

Section Roubieva Rouy

1. C. multifidum L. (Roubieva multifida (L.) Moq.)

The veiny pericarp covering the fruit is distinctive. South American; adventive on the east and west coasts of N. A.

Section Orthosporum R. Br.

2. C. pumilio R. Br. (C. carinatum Auth.)

Sparingly adventive from Australia. Easily recognized by the small vertical seeds. Leaves lobed, the proximal margin of the lobe tapering, the distal margin at a right angle to the blade. Plants pubescent and glandular throughout.

Section Botryoides C. A. Meyer

This section is characterized especially by the conspicuously dichotomously cymose nature of the inflorescence. The plants are relatively small with small leaves, flowers and seeds.

- 1. Glands on perianth parts chiefly sessile or lacking; stems moderately to sparingly pubescent or glandular; perianth parts acute or obtuse, keeled or tuberculate; cymes diffuse, in racemes or panicles.

 - 2. Keel inconspicuous or lacking, the rib usually with a single sub-terminal tubercle; cymes scattered or paniculate.
 - 3. Perianth parts and lower surface of leaves glandular; leaves lobed . . 5. C. graveolens

3. C. Botrys L.

Widely distributed and generally recognized. The perianth parts are keel-less and densely covered with stalked glands. The plants occur especially on cinder dumps and railroad beds but also in gardens, on shores, etc.

4. C. foetidum Schrad.

Similar to C. Botrys in appearance but the cymes more diffuse and perianth strongly tuberculate-keeled and with the glands fewer and sessile. Probably essentially lacking in North America but two collections of plants grown from seed (as C. Botrys) at Dominion Arboretum and Botanic Garden at Ottawa, Canada, are in the Herbarium of the Department of Agriculture at Ottawa. No other records are known.

5. C. graveolens Willd. (C. incisum Poir.; C. cornutum (Torr.) Benth. & Hook.)

Several varieties in Central and South America. C. graveolens var. neomexicanum Aellen occurs in Arizona and New Mexico and this is the only material seen; it is also reported from Texas, Colorado, Maine, and Massachusetts. The plants are usually much branched with very numerous diffuse cymes and the perianth parts well supplied with orange-yellow sessile glands and each bearing a single prominent subterminal tubercle.

6. C. aristatum L.

Asiatic. Standley says "Reported from Alaska and Mexico" but known to the present author in the U. S. by a collection from Yonkers, New York: "about the Yonkers Cotton Mill", Bicknell, July 1, 1894 (NY.). The single specimen is an immature plant and although very distinct in appearance has passed as "a form of C. lanceolatum". The nearly linear, entire leaves are in striking contrast to the lobed leaves of other members of the section.

Section Ambrina (Spach) Hook. f.

7. C. ambrosioides L.

The variations of this complex species have not been studied and will be reserved for a future article.

Section Agathophyton (Moq.) Hook. f.

Members of the section are readily recognized by the erose sepals, long-tapering stigmas, flowers in dense cymes or glomerules forming a terminal often caudate inflorescence and duration perennial.

8. C. Bonus-Henricus L.

Widely distributed but local in eastern U. S. and southeastern Canada (Nova Scotia, New Brunswick, Quebec, Ontario). Adventive from Europe.

9. C. californicum S. Wats.

Known only from central and southern California; apparently native.

Section Eublitum (Moq.) Aellen

Characterized by the dense globose heads of flowers in terminal spikes and by the perianth parts becoming red and deliquescent in age. In the material seen the latter character has been noted only in *C. capitatum* although it probably occurs also in older plants of the other two species. The plants are similar in appearance to those of Sec. *Agathophyton*, from which they are readily distinguished by the entire sepals and shorter stigmas.

Terminal heads ebracteate; flowers maturing uniformly or from top of plant downward; sides of fruit convex.

10. C. capitatum (L.) Aschers. (Blitum capitatum L.)

Widely distributed but local. More common northward. In Canada it occurs in Nova Scotia (rare), Quebec, Ontario (n. to Fort Albany on James Bay) and apparently more frequently through Manitoba, Saskatchewan, Alberta and British Columbia; also in Alaska. In U. S. chiefly scattered in the northern states. A single plant from British Columbia, Tranquille, Dewdrop Spring, Bring 502, June 1936, is worthy of note because in this very good collection the pericarp is uniformly and markedly separable from the seed, while in all other plants seen in fruit in this species and section the pericarp is strongly adherent. Various observations, of which this is an example, during the course of this study indicate the need for critical analysis of material from the general region around Oregon.

11. C. Overi Aellen (Blitum hastatum Rydb.)

The specific epithet hastatum is preëmpted in Chenopodium. Aellen and Just, following Standley, give the range of this taxon as "Wyoming to Oregon, Nevada and New Mexico", and it is apparently native in the region as is C. californicum of the preceding section. It is not mentioned by Peck, "Manual of the Higher Plants of Oregon", though it is at least in part the basis for C. humile in that generally excellent work, or by Abrams, "Flora of the Pacific States". The following collections have been seen:

OREGON. Baker Co.: 8 mi. n.e. of Sumpter. Peck 10388, July 1921 (NY.). Wallowa Co.: Lostine Canyon, 18 mi. above Lostine. Peck 17830, July 1933 (NY.). Buckhorn Springs. Peck 18312, June 1934 (NY.). Montana. Flathead Co.: South fork of Flathead River, 7 mi. e. of Columbia Falls. Rogers and Rogers 1050, July 1942 (NY.). Wyoming. Yellowstone Lake. Nelson and Nelson 6613 (Ill.). Nevada. Clark Co.: Charleston Mts. Train 2107, July 1938 (OTB.). New Mexico. Bro. Arsene 21741 (US.).

The Oregon sheets were all distributed as C. humile and the Nevada sheet as C. capitatum. It is not certain from the material seen that this taxon is specifically separable from C. capitatum.

12. C. foliosum (Moench.) Aschers. (Blitum virgatum L.)

The specific epithet virgatum also preëmpted in Chenopodium. Differing from other members of the section in the bracteate inflorescence and prominently sharply lobed leaves and from these and other members of the genus in the marked acropetal sequence of flowering and fruiting.

In addition to the single record cited from Alberta, Can., by Aellen, the following American collections have been seen:

NEW YORK. Yonkers: About the Yonkers Wool Mill. Bicknell, May 19, 1895 (NY.) (as C. rubrum). South Dakota. Lawrence Co.: Spearfish. In flower garden. Bennett 115, June 1947 (OTB.).

Section Degenia Aellen

Characterized especially by the vertical lateral flowers with 3 sepals united nearly to the tips. Members of the section are known in North America almost entirely from saline habitats in western coastal states and seem to be incompletely understood as to the relationships of the taxa involved.

Leaves densely to sparingly farinose or glabrate beneath, chiefly deltoid to deltoid-ovate, variously dentate; free tips of sepals rounded to acute.

Leaves densely farinose beneath; plants robust, freely branching.

13a. C. macrospermum var. halophilum

Leaves sparingly farinose and glabrate beneath; plants smaller, to 3 dm. high, branching Leaves glabrous or promptly glabrate beneath, deltoid, rhombic or spatulate, shallowly dentate to entire; free tips of sepals minutely but definitely apiculate.

Plants prostrate or low-branching; leaves often entire.

14a. C. chenopodioides var. Degenianum

Plants upright; leaves usually shallowly dentate. 14b. C. chenopodioides var. Lengyelianum

13. C. macrospermum Hook. f. occurs in a series of forms in South America. Aellen and Just characterize ssp. crassicaule as a thick-leaved, prostrate form with axillary glomerules and "Seed large, 1.25-1.5 mm." occurring in the Falkland Islands and Tierra del Fuego, and ssp. halophilum as an upright form with glomerules in terminal panicles and "Seed 0.75-1 mm. in diam." It is not certain that seed width is meant in both cases but in the small amount of South American material seen the smaller seed size occurs more often on semi-prostrate plants with glomerules in axillary spikelets, rather than in the upright plants as stated. (Hicken 401, Argentina. Legrand 1466, Uruguay. Herter 1187, Uruguay.)

Forms occurring in the U.S. agree with ssp. halophilum in their generally upright stature and glomerules in terminal panicles, but have the larger seed size given for var. crassicaule. The American plants were originally included under C. murale, which they resemble in leaf shape, by Watson (14, p. 97) and were separated specifically by Standley as C. farinosum (S. Wats.) Standley. Abrams (1, p. 71) doubts that the plants are conspecific with C. macrospermum from the Falkland Islands but examination of even a small amount of South American material indicates they are. Standley (13) reduced the various formae listed by Aellen to synonymy under C. macrospermum var. halophilum and this name is here used for the previously reported North American plants with a series of collections from California and one station on ballast at Wilmington, North Carolina. The North Carolina plant is upright but has axillary glomerules and is in marked contrast in this respect with the California plants seen, these having the glomerules in terminal panicles. Both have the lower leaf surfaces densely and permanently whitish-farinose, the margins prominently undulate-serrate.

Also along and near the Pacific coast in California but extending northward to Vancouver Island, British Columbia, Canada, there are plants differing from the above in having leaves with lower surfaces glabrous or glabrate, and with entire to shallowly undulate or toothed margins. These correspond to C. macrospermum var. halophilum f. subviride Thellung and Aellen and this category is temporarily retained for them although it is thought that additional material and further study will show them to be worthy of varietal status. The following col-

lections of f. subviride have been seen:

British Columbia. Vancouver Island: Sidney. Macoun 86313, July 1908 (NY.). Washington. Snohomish Co.: Marysville, on Puget Sound. Grant, Aug. 1929 (Ill.). Whatcom Co.: Lumi Island, on Puget Sound. Muenscher 10499, July 1939 (NY., PH.). California. San Mateo Co.: Salada Beach. Wiggins 178, Nov. 1930 (NY.). Riverside Co.: Elsinore, margin of lake. Dec. 1891 (NY.).

They have been distributed as C. rubrum, C. rubrum var. humile and C. hybridum. Most of the distributed material is too young for ready identification.

14. C. chenopodioides (L.) Aellen (C. crassifolium Hornem.)

Plants of this species are most readily distinguishable from *C. macrospermum* by the relatively thinner sepals with definitely apiculate tips. Young stages of *C. chenopodioides* var. *Degenianum* (Aellen) Aellen are not easily separable from *C. macrospermum* var. *halophilum* f. *subviride* and, indeed, the present author has a feeling of uncertainty concerning some of the material assigned here. It seems desirable at the present time to maintain them as separate entities, at least as a course which would be most likely to stimulate further study of the group. In addition to those cited by Aellen the following records are assigned to var. *Degenianum*, the last three being range-extensions. All have been distributed and maintained as *C. rubrum* or var. *humile*.

Washington. Spokane Co.: Medical Lake. St. John, Bonser and Warren 6754, Sept. 1924. Alkali Lake, Amber. St. John, Mellen and Warren 4884, Sept. 1926. California. Borax Lake. Torrey 462, 1865. Nevada. Nye Co.: Meadow about thermal springs, Monitor Valley. Maguire and Holmgren 25768, July 1945. 1000 Spring Valley. Watson 978, Sept. 1865. Wyoming. Black Rock Creek. Tweedy 353, Aug. 1897. Colorado. Gunnison Watershed. Baker 935, 1901. New York. Yonkers Factory Grounds. Bicknell, June 3, 1894. (All NY.)

No material of *C. chenopodioides* var. *Lengyelianum* (Aellen) Aellen has been seen other than that cited by Aellen. It is characterized by its upright habit and broader, more nearly hastate leaves. The material has been distributed either as *C. rubrum* or *Atriplex* spp.

Section Pseudoblitum Hook. f.

Members of this section differ from those of Section Degenia in having the perianth in most cases free to the base. Sometimes, however, especially in C. rubrum and var. humile, a varying degree of fusion occurs, even to having adjacent sepals so entirely united that only two broadly rounded tips are apparent instead of the usual three in the lateral, vertical flowers. Even in these cases, however, the other parts in the same flower remain free to or nearly to the base. The two groups, C. glaucum and its var. salinum on the one hand and C. rubrum and its var. humile on the other, are so unlike in the amount and distribution of the farinosity and in the relative number of horizontal and vertical seeds as to cast doubt on the relationships within this section, as well as between it and Section Degenia. The degree of union of the perianth parts does however seem to be of primary importance.

Leaves densely whitish-farinose beneath, ovate or narrowly ovate, undulate or serrate, not hastate; perianth parts glabrous; horizontal seeds largely exposed by the sepals, numerous in the glomerules.

leaves; glomerules usually with a single horizontal flower.

15. C. glaucum L., var. glaucum

Widely distributed from Labrador (Goose Bay. Gillett and Findlay 5777 (OTB.)), Newfoundland, Prince Edward Island and New Brunswick, to Alberta, s. to Maryland, Dist. of Columbia and New Mexico. Much more abundant through southern Canada than in the southern part of its range. In the U. S. more frequent westward than eastward. The plants are readily distinguishable by the numerous small leaves chiefly 1–3 cm. long, very densely farinose beneath, and by the seeds, both horizontal and vertical, always more than half exposed by the small perianth parts.

C. glaucum var. salinum (Standley) Boivin (C. salinum Standley)

Differing from typical C. glaucum only in the more sharply serrate leaves and the more consistently bracteate inflorescence, the two varieties are almost always readily distinguishable in spite of the similarity between them, though not on the basis of seed size (6, p. 593) or length of petiole (4, p. 59). The illustrations in Gleason (9, Vol. 2, p. 91) are adequate in showing the essential differences. Although they are here maintained as varieties they may well be separate species.

More abundant in collections than typical C. glaucum, the range of var. salinum extends from s.e. Quebec and the James Bay region of Ontario to British Columbia, south to New Mexico and Arizona.

16. C. rubrum L.

In its typical form this species has been generally recognized but it and, more especially, its var. humile have, like C. album in the horizontal-seeded series, served as a catch-all for all sorts of vertical-seeded plants. Although the taxa included in the two sections, Degenia with sepals united nearly to the tips and Pseudoblitum with sepals free nearly to the base, were indicated by Aellen and Just, it is not easy to discover this from the key characters; "perianth—partly fused, 3-tipped—" leading to the former and "Perianth—3-5 tipped, free to the middle," leading to the latter. Neither does it help within Section Pseudoblitum (l.c., p. 59) to arrive at C. rubrum, which has leaves with often strongly hastate blades up to 15 cm. long, to have to choose in the key the alternative "Leaves usually smaller [than 5 cm. including the petiole]—not hastate." The contrast

in leaf size indicated here is between C. rubrum and C. mexicanum, the latter a clearly distinct species with horizontal seeds, closely related to C. urbicum and C. murale and without apparent relation to the members of Section Pseudoblitum. It is only when one recognizes in the key to Section Degenia (l.c., p. 57) the alternative "Leaves large, up to 10 cm. long and wide" etc., that one suspects

that the alternatives have become transposed.

Aellen has considered the smaller, often prostrate plant with leaves less prominently sinuate-serrate, often entire,—C. humile Hook., C. rubrum var. humile (Hook.) S. Wats.,—as merely a forma under C. rubrum, separating it on the basis of stature and "leaves entire, ovate-spatulate". Although in these respects var. humile expresses the same relationship to C. rubrum as do var. Degenianum to C. chenopodioides and ssp. crassicaule to C. macrospermum, it differs also in seed size. Here again it is a bit disconcerting to find, in all treatments that have come to the author's attention, that typical C. rubrum is described as having seeds 0.8–1.0 mm. broad and its var. humile as having seeds 0.5–0.6 mm. broad. Actually, seeds of C. rubrum are usually 0.6–0.8 mm. broad with an occasional terminal one to 1.0 mm. while those of var. humile are 0.8–1.0 mm. broad with the terminal ones to 1.2 mm. Some variation occurs, but the smaller seed size is definitely associated with the larger, upright, prominently undulate-serrate-leaved plants (C. rubrum, typical), and the larger seed size with the smaller, prostrate, often entire-leaved plants, var. humile.

The two taxa are illustrated in Gleason (9, p. 93), both as C. rubrum, the right hand illustration being the typical representative of that species, the left,

drawn from St. John 1218 (cited below) being var. humile.

Although most of var. humile is readily separable from typical C. rubrum, some intergrading does occur so that the taxon is here maintained in a varietal status. It is much more nearly a separate species than a forma. The following distributions are referred to var. humile:

CANADA: Nova Scotia. Sable Island, Wallace Beach. St. John 1218, Sept., 1913 (US., NY., PH.) (cited as C. rubrum by Aellen). Pictou Co.: Pictou. Erskine 1632, Sept. 1952 (OTB.). New Brunswick. St. John Co.: Fairville. Fernald, Long and Fogg 232, Sept. 1926 (NY., Penn.). Quebec. Amos. Groh, Sept. 1938 (OTB.). Saskatchewan. Bourgeau, 1957–8 (NY.) (with C. rubrum). Alberta. Bonnyville. Groh 1092, Sept. 1939 (OTB.). British Columbia. Kamloops. Macoun, June 1899 (NY.), cited as f. humile by Aellen.

U.S.A.: Massachusetts. Nantucket Island. Bicknell, Sept. 1899 (NY.). North Dakota. Benson Co.: Leeds. Lunell, Sept. 1909 (in part) (NY.). Butte. Lunell, Sept. 1907 (NY.). Nebraska. Grant Co.: 1 mi. n. of Whitman, Rydberg 1782, Sept. 1893. Cited as C. crassifolium (= chenopodioides var. Lengyelianum) by Aellen. The plants in the Rydberg collection are erect, to 2 dm. tall, with thinner leaves and with a slightly greater degree of union of sepals than is usual in var. humile. Being somewhat intermediate between this and typical rubrum, it is of interest that Rydberg also collected, 3 mi. n.w. of Whitman (Flora of the Sand Hills of Central Nebraska) an upright plant 7 dm. tall, with very numerous small seeds and also with thin leaves (Rydberg 1791 (NY.)), referred to ? C. crassifolium x rubrum by Aellen and to C. rubrum by the present author. These collections indicate that this area might be productive of additional significant material. A plant of similar interest, strictly upright, 4.2 dm. tall but otherwise characteristic var. humile was collected at Salina, N. Y., by G. W. Clinton, without date but at least before 1900 (PH.). These collections indicate a need for caution in separating rubrum and humile specifically and for additional study in this much misunderstood and misrepresented group. Washington. Klickitat Co.: Suksdorf, Nov. 1884 (US., NY.), cited as C. crassifolium var. Degenianum by Aellen.

Section Chenopodia (C. A. Mey.) Aellen

This section includes species with horizontal seeds and a regularly 5-parted perianth. There is considerable variation in leaf shape, in seed size, and in shape and rugosity of the pericarp. The section is divided into 4 sub-sections by Aellen and Just on the basis of the latter character and such a division seems generally to reflect natural relationships; it is not considered necessary, however, in the present treatment, to follow this subdivision. In view of the complexity of the section, the following brief synopsis, based on leaf shape, may be of interest:

Leaves linear or nearly so, entire, usually fleshy; western: nos. 20-23.

Leaves lanceolate to ovate, not prominently toothed but often hastate: nos. 17, 18, 19, 26, 29.

Leaves triangular, hardly broader than long, usually thin, mostly hastate and otherwise entire; western: nos. 25, 27, 30-34.

Leaves variously ovate, 1–3 times as long as broad, hardly hastate, variously toothed: nos. 28, 35–38, 40–48.

KEY TO THE SPECIES OF SECTION Chenopodia

- 1. Combination of characters not as above.
 - 2. Principal leaves linear to narrowly ovate or oblong, chiefly less than 1.5 cm. broad but occasionally to 2.0 cm. across the basal lobes, 2-many times longer than broad, entire or with basal lobes and sometimes additional low teeth in thin-leaved forms, 1-3 nerved or occasionally pinnately veined, petioles shorter than blade, usually less than half the length; pericarp separable and smooth or attached and granular-roughened, never reticulate or alveolate; sepals without definite apiculate tips (plants doubtful as to leaf shape excluded if fruit largely exposed at maturity and maturing prominently mixed in the glomerules).

 - 3. Leaves 3-many times as long as broad; seeds maturing nearly uniformly in the cymes; sepals largely covering fruit at maturity, at least laterally.
 - 4. Principal leaves narrowly lanceolate or broader, moderately thick to very thin, with or without basal lobes and few additional teeth, 3-nerved or occasionally pinnately veined.
 - 5. Pericarp markedly separable; seeds rounded dorsally, usually slightly exceeding 1 mm. in width, covered or exposed by the perianth.
 - 5. Pericarp attached, minutely granular-roughened; seeds flattened on top, rather prominently exposed; western.

- 7. Leaves thin, ovate-lanceolate or broader; seeds 1.2-1.5 mm. wide.
 29. C. incognitum
- 7. Leaves firm, ovate-lanceolate or narrower; seeds 1.0 mm. wide.

19. C. hians

- 4. Leaves linear or nearly so, chiefly fleshy, one-nerved, the margins entire; western.

 - 8. Pericarp attached.

 - 9. Sepals without an undulate collar from the sinuses.
- 2. Principal leaves deltoid, deltoid-rhombic or ovate, 1-3 times as long as broad, pinnately veined, entire or variously toothed.
 - 11. Leaves entire; sepals with definite minute apiculate tips; seeds 0.9-1.1 mm. broad, largely exposed; pericarp semi-separable to attached 39. C. polyspermum
 - 11. Leaves variously toothed or entire; sepals without definite apiculate tips.
 - 12. Leaf blades deltoid, rhombic-deltoid or variously ovate (if ovate or narrower, thin in texture) often with basal lobes but otherwise nearly or quite entire; western, except the widely distributed C. vulvaria (other eastern material keying out here would be either broader leaved C. Foggü, no. 18, or entire-leaved C. Standleyanum, no. 35, which see).
 - 13. Branches weak, often prostrate; leaves broadened above the base but not hastate; sepals variously united, at least some for \(\frac{3}{4} \) their length.

24. C. Vulvaria

- 13. Branches erect or if spreading not weak or prostrate; leaves with or without basal lobes; sepals united less than half their length.
 - 14. Pericarp separable.
 - 15. Leaves thin, the blades deltoid or ovate, seeds averaging more than 1.0 mm. broad, maturing mixed in the glomerules and exposed at maturity; plants upright, strict or variously branched.

 - 16. Blades ovate, 1.5 cm. broad or less, only occasionally with a basal lobe; seeds chiefly 1.0-1.3 mm. broad .. 26. C. atrovirens
 - 14. Pericarp attached.
 - 17. Pericarp smooth or granular-roughened.

 - 18. Seeds 0.7-0.8 mm. broad; leaves firm, ovate or deltoid, the largest less than 2 cm. long; plants low, bushy-branched.

 30. C. nevadense
 - 17. Pericarp variously cellular-reticulate.

- 19. Seeds sub-globose, entirely covered by the pointed sepals at maturity; pericarp slightly to prominently whitened; leaves broadest very near the base, the basal lobes not strongly developed; inflorescences prominently leafy.
- 19. Seeds more or less flattened, partially exposed at maturity; pericarp black; leaves usually prominently lobed above the base.
- 12. Blades deltoid, ovate or rhombic-ovate in outline, 2-10 (20) cm. long, longer than broad, at least the lower conspicuously deeply or shallowly toothed above the basal lobes (all but the lower may be entire in C. strictum var. glauco-phyllum).
 - 22. Leaves thin; fruit maturing very prominently mixed so that mature fruit and young perfect flowers are present in the glomerules at the same time (except in late stages); sepals weakly or not at all keeled, largely exposing mature fruit; pericarp usually separable; seeds more than 1 mm. broad (C. murale, with black, strongly adherent pericarp excluded).

 - 23. Leaves rounded, truncate or cordate at base, the teeth usually long-tapering and spreading; inflorescence ebracteate or the main branches subtended by rather well-developed leaves; seeds 1.5-2.5 mm. broad.
 - 22. Leaves thin, membranaceous or coriaceous; flowers in the glomerules in nearly the same stage of development (occasionally later pistillate flowers present, especially in late season forms).
 - 25. Leaves all strongly deltoid and prominently sinuate-dentate or only the few uppermost reduced to entire lanceolate bracts; stigmas short (0.1 mm. or less) and stout; seeds irregularly roughened; pericarp strongly adherent; sepals obtuse, largely exposing fruit; plants rarely exceeding 4.0 dm. in height.

26. Seeds 1.2-1.5 mm. broad, the margins acute; sepals keeled, farinose; inflorescences somewhat cymose, shorter than the leaves. 37. C. murale

- 26. Seeds 1.0-1.2 mm. broad, the margins rounded; sepals not keeled or farinose; inflorescences spicate or narrowly paniculate, usually exceeding the leaves 38. C. urbicum
- 25. Leaves rhombic-ovate, variously toothed, gradually reduced upward to entire lanceolate bracts (except in some southern robust plants more than 2 m. tall); stigmas long or short but not stout.
 - 27. Seeds essentially smooth; pericarp smooth or inconspicuously irregularly roughened; leaves chiefly membranaceous in texture; sepals usually not strongly keeled, the keel rarely as much as 1 the width of the sepal (C. opulifolium and some forms of C. album may have more strongly keeled sepals); style divided essentially to base.
 - 28. Pericarp thin and strongly separable; leaves moderately thin; sepals strongly farinose to the tip; s.e. U.S... 28. C. albescens
 - 28. Pericarp usually attached but varying to separable; sepals with a hyaline or yellowish less farinose border; widely distributed.
 - 29. Leaf blades rarely exceeding 6.0 cm. long, variously toothed but hardly sharply doubly sinuate-dentate, the upper reduced to entire lanceolate bracts.
 - 30. Seeds chiefly 1.1-1.5 mm. broad; plants not restricted in flowering time; sepals largely covering fruit.
 - 31. Blades little or not at all longer than broad, basal lobes often bipartite; sepals united to or above broadest part of fruit, usually strongly keeled. 41. C. opulifolium
 - 31. Length of blades 11 or more times the width; sepals not united to broadest part of fruit, variously keeled 42. C. album
 - 30. Seeds 0.9-1.2 mm. broad.
 - 32. Plants in flower second week in September; sepals largely covering fruit; inflorescence branches densely flowered, arching; lower and median leaves not more than 11 times as long as wide, coarsely toothed, the lower more or less doubly so at base 43. C. missouriense
 - 32. Plants not restricted in flowering time; sepals exposing fruit at maturity; flowers in distinct or close glomerules in strict axillary spikes or terminal loose panicles; lower leaves low-serrate, the median oblong, entire.

44. C. strictum var. glaucophyllum

29. Leaves large, the blades 5-10 cm. long, the lower doubly sinuate-dentate with sharp teeth, the upper reduced to sharply serrate or occasionally entire bracts, strongly farinose, the farinules often tinged red on young leaves; plants robust, 1-3 (?) m. high; plants presumably restricted in flowering time; southern states.

45. C. giganteum

- 27. Pericarp and surface of seeds foveolate-reticulate; leaves thinmembranaceous, membranaceous or nearly coriaceous in texture.
 - 33. Seeds chiefly 1.0-1.5 mm. broad; style base often prominent (though less than 0.1 mm. long); leaves thin to coriaceous; sepals with a prominent winged keel often equaling half the width of the sepal; chiefly Gulf states, Mississippi valley and westward 46. C. Berlandieri

- 33. Seeds 1.3-2.0 mm. broad; style base less prominent or lacking; leaves thin-membranaceous to membranaceous in texture; perianth parts less prominently winged.

 - 34. Seeds chiefly 1.4–1.6 mm. broad; leaves membranaceous or somewhat thinner, the larger ones 5–6 cm. long, the upper reduced to linear-lanceolate bracts which are conspicuous in the inflorescence; perianth parts usually enlarged around fruit and with prominent keels but not winged; generally smaller plants with spreading habit, chiefly on the coastal plain, frequently on sea beaches.

48. C. macrocalycium

17. C. pratericola Rydb. Bull. Torr. Bot. Club 39: 310. 1912.

The plants included here have been generally known under the name C. leptophyllum Nutt.; the proper application of this name is discussed under no. 23. They constitute a typically western group, fairly common in all the states west of the Mississippi River, but probably more so in the plains than in the montane areas. They also occur in Mexico, in the western Canadian Provinces north to the Mackenzie Basin, and in Alaska. Thus the species occupies essentially the same territory as C. Berlandieri (no. 46). It has been more successful than C. Berlandieri as an eastern immigrant, however, and is sparingly established in sandy areas in the eastern states, more frequently northward and along the Atlantic coast.

There is considerable variation in habit and leaf width and texture and some in seed size and sepal characters, but the small seeds, rounded upward to the style base and with the chocolate-brown to nearly black pericarp releasing freely from the seed with the slightest assistance, constitute a unifying set of characters.

17a. C. pratericola Rydb. var. pratericola

- C. petiolare var. leptophylloides Murr. in Bull. Herb. Boiss., 2 ser., 4: 994. 1904.
- C. pratericola var. Thellungianum Aellen in Ostenia 1933, p. 100.
- C. pratericola var. leptophylloides (Murr.) Aellen in Fedde Rept. Sp. nov. 26: 64. 1929. (As to western broad-leaved plants.)

The common form of the species is a generally upright plant, often strictly so, with lanceolate to narrowly ovate-lanceolate usually entire leaves but occasionally with prominent basal lobes. Rydberg's type and description refer to the broader-leaved extreme included under var. leptophylloides (Murr.) Aellen but the entire series seems referable to a single taxon.

Less common throughout the same general range but apparently better represented in the montane portion is the usually more spreading form with the tendency toward thicker, more oblong leaves and more obtuse, greener and more strongly keeled sepals. This intergrades continuously with var. pratericola. Maintaining it in a varietal category under C. pratericola necessitates the following combination:

- 17b. C. pratericola var. oblongifolium (S. Wats.) comb. nov.
 - C. leptophyllum var. oblongifolium S. Wats. in Proc. Amer. Acad. 9: 95. 1874.
 - C. desiccatum A. Nelson in Bot. Gaz. 34: 362. 1902.
 - C. oblongifolium Rydb. in Bull. Torr. Bot. Club 33: 137. 1906.
 - C. pratericola ssp. desiccatum (A. Nelson) Aellen in Fedde Rept. Sp. nov. 26: 136. 1929.

It is difficult to draw any clear-cut line of separation between var. pratericola and var. oblongifolium. Relatively more material would be included under var. oblongifolium on the basis of sepal characters used in the present treatment than had been included by previous authors chiefly on the basis of the low, spreading habit. The parallelism between typical C. pratericola and its var. oblongifolium and typical C. album and its var. lanceolatum is marked. In both cases the segregated var. has a more branching habit, narrower leaves and more obtuse, greener sepals with a generally more strongly winged midrib.

718. **C. Foggii** sp. nov. Fig. 1. Plantae gracile erectae, ramosae vel non-ramosae, 2–10 dm. altae. Laminae foliorum tenues, anguste ovatae, 1–4 cm. longae, 0.5–1.8 cm. latae, integrae vel sub medio 2–4 dentibus, subtus farinosae, basi in gracile petiolum minus quam dimidiam longitudinis laminae attenuatae. Flores in spicis brevibus ad apicem plantae. Perianthii laciniae 5, anguste carinatae, fructum in maturitate includentes. Pericarpium tenue, fuscum, minute echinatum, libere a semine separabile. Semen nigrum, lucidum, 1 mm. in diametro.

Plants slenderly upright, branched or unbranched, 2–10 dm. tall. Leaf-blades thin, narrowly ovate, 1–4 cm. long, 0.5–1.8 cm. broad, entire or with one or two pairs of teeth below the middle, farinose beneath, tapering at the base to a slender petiole less than half the length of the blade. Flowers in short spikes near top of plant. Sepals 5, farinose, narrowly keeled, covering the fruit at maturity. Pericarp thin, brown, minutely echinate, freely separable from seed. Seed black, shining, 1 mm. in diameter.

This noteworthy development of an eastern relative of the widely distributed western C. pratericola includes a series of plants with thin, ovate or narrowly ovate leaves and strict habit, in the Appalachian and Great Lakes Region of eastern North America, where they occur as native plants in woodland habitats. The leaf shape is essentially that of western C. incognitum of this treatment. The material has generally been referred to C. Standleyanum (as C. Boscianum), to which it may also be related. It differs from this species in having the fruit nearly or quite covered by the more farinose and more strongly keeled lobes of

the calyx and maturing relatively uniformly in the glomerules. In these respects it is similar to C. album and C. pratericola. From C. album it differs in the readily separable pericarp and thin, narrowly ovate leaves, entire or with basal lobes. It probably would be included under C. pratericola var. leptophylloides (Murr.) Aellen of Aellen and Just's treatment, although, as previously indicated, the varietal name leptophylloides refers to typical C. pratericola Rydb. It was collected in s.e. Va. and recognized as a probably undescribed taxon by my associate, Dr. John M. Fogg, Jr.

The following collections have been seen:

CANADA: Quebec. Pontiac Co.: Shallow soil on granite ledges, n. side of Ottawa River. Breitung 7133, July 1948 (OTB.). Leeds Co.: Thousand Islands, Smoke Islands. Bicknell,

Sept. 2, 1905 (NY.).

U.S.A.: Maine. York Co.: South Berwick. Parlin, Sept. 3, 1898 (GH., NEBC.). Androscoggin Co.: East Auburn. Merrill, June 21, 1896 (NEBC.). VERMONT. Orange Co.: Fairlee. Pease, Aug. 4, 1928 (NEBC.). NEW HAMPSHIRE. Coos Co.: Summit of Hart's Ledge, Hadley's Grant. Pease, Sept. 9, 1915 (NEBC.). Cheshire Co.: Rocky woods, Fall Mt., Walpole. Fernald, July 31, 1900 (GH.). Carroll Co.: Dry rocky woods, w. slope of White's Lodge, Bartlett. Pease, Sept. 8, 1915 (NEBC.). Grafton Co.: Haverhill. Fernald, Aug. 18, 1917 (NEBC.). Massachusetts. Berkshire Co.: New Marlboro. Hoffmann, Aug. 28, 1920 (NEBC.). Rocky woods, Bash Bish Falls, Mt. Washington. Hoffmann, Sept. 9, 1919 (NEBC.). New York. Rensselaer Co.: Nassau. McVaugh 2142, Aug. 1933 (Penn.). Westchester Co.: Lowerre. Bicknell 3996, July 1891 (NY.). Pennsylvania. Luzerne Co.: 1.5 mi. w. of Mountain Top. Glowenke 8823, Aug. 1946 (Penn.) [Type]. Pike Co.: Matamoras. Glowenke 2556, July 1938 (Penn.). Monroe Co.: Shawnee on Delaware. Glowenke 689, July 1937 (Penn.). Carbon Co.: Harrity. Wherry, Aug. 13, 1951 (Penn.). Berks Co.: Moselem (shaded hillside). Britton, July 4-8, 1915 (NY.). Bradford Co.: Overton Twp. Westerfeld 1045, Aug. 1941 (Penn.). Clinton Co.: Shintown (roadside along sandstone cliff). Westerfeld 5722, Aug. 1952 (PAC.). VIRGINIA. Rockingham Co.: Exposed, steep, cleared mountainside near top of Shenandoah Mt. Leeds 223, July 1931 (PH.). Giles Co.: dry slope of Peters Mt. 1 mi. n. of Narrows. Fogg 17367, July 17, 1940. NORTH CAROLINA. Haywood Co.: Chambert Mt., 3 mi. n. of Clyde. Smathers 79, July 1938 (PH.). Illinois. Will Co.: Mokena, open woods. Chase 2010, Sept. 1902 (Ill.). Mason Co.: Forest City, Oak woods. Steyermark 68849, Aug. 1949 (Ill.). MINNESOTA. Millelacs Co.: Milaca. Sheldon, July 1892 (Ill.).

19. C. hians Standley.

A greater amount of variation occurs between the plants included under C. hians than in other narrow-leaved taxa. Typically the plants are rather narrowly upright with moderately thick, ovate-lanceolate leaves, seeds 1.0 mm. broad, exposed by the sepals, and with the crowded spikelets of glomerules giving the entire plant a strongly virgate appearance. Occasionally, however, plants which seem to belong here are low-branching, and these occur especially toward the region of northwestern U. S. and southwestern Canada. An extreme is represented by several plants from west-central California (Inyo and Mono Counties), northern California (Siskiyou Co.) to s.w. Washington (Grant Co.) in which the leaves are narrower, the plants branched from the base and the glomerules separate in vertical leafless spikes. They are definitely toward C. leptophyllum as treated here and by Aellen;—C. inamoenum sensu Standley. They may represent only the variation within the species and, indeed, this type of variation is common in Chenopodium, being represented by var. lanceolatum in C. album, var. oblongifolium in C. pratericola, var. humile in C. rubrum, etc. However, the species

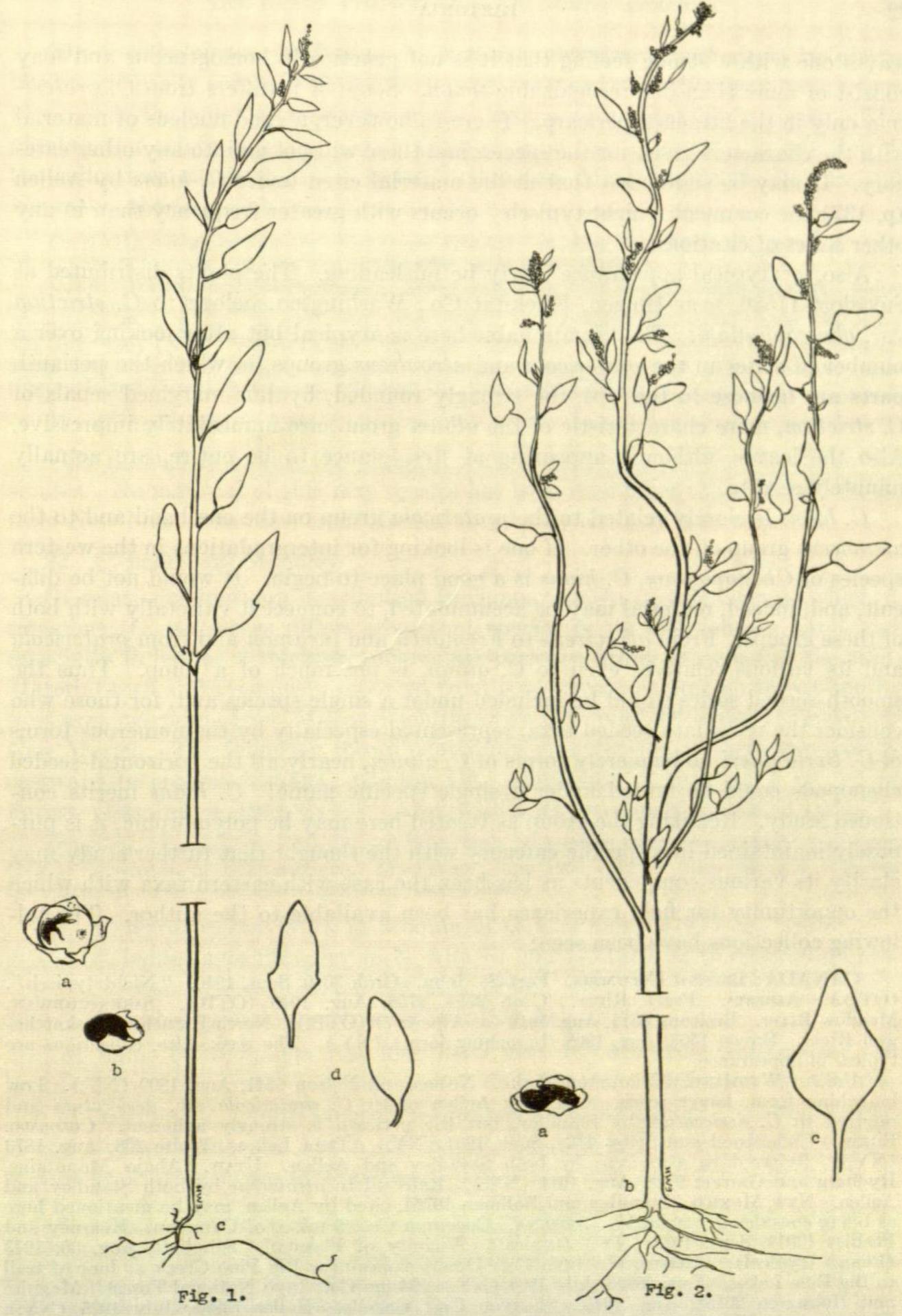


Fig. 1. Chenopodium Foggii: a, fruit and calyx; b, fruit and separable pericarp; c, plant;
d, lower leaves.
Fig. 2. Chenopodium incognitum: a, fruit and calyx; b, plant; c, lower leaf.

leaves one with a strong feeling that it is not genetically homogeneous and may consist of more than one recognizable taxon. Some of it differs from C. pratericola only in the attached pericarp. There is, however, a good nucleus of material with the characters given for the species and these will not go into any other category. It may be significant that in the material cited under C. hians by Aellen (p. 137) the comment "nicht typisch" occurs with greater frequency than in any other series of citations.

Also, a "typical appearance" may be misleading. The plants distributed as Suksdorf 11536, near Bingen, Klickitat Co., Washington, belong to C. strictum var. glaucophyllum. The virgate habit here is atypical but after looking over a number of series in the pratericola and atrovirens groups, in which the perianth parts are farinose to the tips, the strongly rounded, hyaline-margined sepals of C. strictum, more characteristic of the album group, are immediately impressive. Also the leaves, although appearing at first glance to be entire, are actually minutely serrate.

C. hians is closely related to the pratericola group on the one hand and to the atrovirens group on the other. If one is looking for intergradations in the western species of Chenopodium, C. hians is a good place to begin. It would not be difficult, and, indeed, material may be accumulated, to connect it varietally with both of these groups. From atrovirens to Fremontii and incanum and from pratericola and its various relatives even to C. album is not much of a jump. Thus the smooth-seeded series would be included under a single species and, for those who consider the reticulate-seeded taxa, represented especially by the numerous forms of C. Berlandieri, to be merely forms of C. album, nearly all the horizontal-seeded chenopods could be united under a single specific name! C. hians merits continued study. Realizing the group as treated here may be polymorphic, it is purposely maintained in a specific category with the thought that further study may clarify its various components as has been the case with eastern taxa with which the opportunity for field experience has been available to the author. The following collections have been seen:

CANADA: British Columbia. Fort St. John. Groh 3040, Sept. 1946. "Nicht typisch". (OTB.). Alberta. Peace River. Groh 2755, 2756, Aug. 1946 (OTB.). Saskatchewan. Meadow River. Breitung 8314, Aug. 1949 (or Alberta?) (OTB.). North Branch of Saskatchewan River. Brown 1508, Aug. 1908 (branching form) (NY.). The Sask.-Alta. collections are typical in appearance.

U.S.A.: Wyoming. Yellowstone Lake. Nelson and Nelson 6641, Aug. 1899 (NY.). Low branching form, larger seeds. Cited by Aellen under C. pratericola ssp. desiccatum and referred to C. desiccatum by Standley, but the pericarp is strongly adherent. Colorado. Pitkin. Underwood and Selby 413a, Sept. 1901 (NY.). Twin Lakes. Wolfe 258, Aug. 1873 (NY.). Referred to atrovirens by both Standley and Aellen. Utah. Abajo Mountains. Rydberg and Garrett 9728, Aug. 1911 (NY.). Referred to atrovirens by both Standley and Aellen. New Mexico. Standley and Bollman 10764, cited by Aellen, may be mentioned here as being considered "typical". Arizona. Coconino Co.: 5 mi. s. of Cameron. Kearney and Peebles 12914, Sept. 1935 (NY.) (typical). Vicinity of Flagstaff. Schollett, Aug. 30, 1943 (Penn.) (typical). California. Inyo Co.: Desert slopes near Big Pine Creek at foot of trail to Big Pine Lakes. Ferris 8976, July 1934 (NY.). Mono Co.: Inyo National Forest. Maguire and Holmgren 26158, Aug. 1945. Siskiyou Co.: Gazelle. Heller 13904, July 1925 (NY.). Washington. Grant Co.: Vantage. Thompson 6787 (NY.). Oregon. Klamath Falls. Peck 9452, July 1920 (NY.).

20. C. subglabrum (S. Wats.) A. Nelson is relatively northern in its distribution and easily recognizable by the narrow spikes of strongly separated glomerules. It is the only linear-leaved species known with separable pericarp. The plants occur chiefly in sandy places, often on sand bars in rivers. In addition to the collections cited by Aellen from Washington, Montana, South Dakota and Nebraska, the following have been seen:

CANADA: Saskatchewan. Saskatoon District. Hudson 786, Aug. 1951 (OTB.). Dis-

trict of Swift Current. Boivin and Lodge 6664, July 1949 (PAC.).

U.S.A.: WYOMING. Willow Creek. Nelson 628, July 1894 (Ill.). NORTH DAKOTA. Slope Co.: Stevens 887, July 1946 (OTB.). SOUTH DAKOTA. Cheyenne River. Wallace, 1896 (NY.). Nebraska. Pine Ridge. Webber, July 1889 (NY.). Scotts Bluff Co.: Scotts Bluff. Rydberg 320, July 1891 (NY.). Sheridan Co.: Hatcher, July 1886 (NY.). Cherry Co.: Chesterfield. Bates 6662, Aug. 1917 (NY.). Colorado. Wooton. Rusby, Sept. 1909 (NY.). Utah. Carrington Island (Great Salt Lake). Watson 971, June 1869 (NY.).

21. C. cycloides A. Nelson

Very distinct in having the perianth with a collar-like proliferation from the sinuses. No material of this rare species has been seen other than the two sheets from New Mexico and one from Kansas (the type) cited by Aellen, p. 153.

22. C. pallescens Standley

Of relatively southern distribution in comparison to *C. subglabrum*, which it resembles, *C. pallescens* differs from that species in its less delicate habit and especially in having a thickish, tuberculate pericarp firmly attached to the seed. Material seen and previously reported from a relatively narrow northeast-southwest area extending from Missouri southwestward through Oklahoma, Texas and New Mexico. The following record constitutes an extension of this range northeastward to central Indiana: Clinton Co.: south side of railroad 1 mi. w. of Forest. Ek, July 4, 1941 (NY.). Also, within its previously indicated range:

Missouri. Jackson Co.: Courtney. Bush 8613, Aug. 1918 (NY., Ill.); 11942, Aug. 1930 (NY.). Barrens w. of Independence. Mackenzie, June 1899 (NY.). New Mexico. Chaves Co.: Roswell. Earle and Earle 326, Aug. 1900 (1920?).

- 23. C. leptophyllum Nutt. in Moquin in D. C. Prodr. 13(2): 71. 1879.
 - C. inamoenum Standley in N. Am. Fl. 21: 15, 1916, as to description and plants considered, but not as to type.
 - C. leptophyllum in part sensu Standley, l.c., p. 14.

The name leptophyllum has long been used by American authors for the broader leaved, separable-pericarp species, C. pratericola Rydb., but the description by Moquin "... foliis lanceolato-linearibus vel linearibus ..." would seem to exclude that name, and Aellen (3) reports the type at Kew is indeed the plant treated as C. inamoenum by Standley.³ The plants may be strict or branched in

³ Standley's type of C. inamoenum was actually not the same as the plants described, so the name can also stand, but not in the sense in which it has been used by American authors. The type of C. inamoenum, Mearns 2286, Mexican boundary near White Water, Sept. 11, 1893, U. S. National Herbarium No. 233970, consists of the upper portion or end of a branch of a plant on which the leaves are oblong-linear, to 5.0 mm. broad, but the lower leaves must have been nearly ovate. The seeds are about 1.0 mm. wide, relatively flat and with pericarp attached. It does not agree with any other material seen.

habit and it is entirely possible that more than one taxon is here included. In comparison to the other linear-leaved species, *C. leptophyllum* has an essentially Rocky Mountain distribution, occurring in Montana, Wyoming, Colorado, Utah, New Mexico, Arizona and Nevada, with one collection from western Texas (Fort Davis), one from Oregon ("P" Ranch) and the original report from California.

Wyoming. Laramie. Johnson 88, July 1905 (NY.). Hams Fork and La Barge. Curtis, July 1900 (NY.). Snake Cankon. Wehmeyer, Martin and Loveland 5410, July 1940 (NY.). Colorado. Buena Vista. Underwood and Selby, Sept. 1901 (NY.); Sheldon 5816, July 1892 (NY.). Cheyenne Mt. Clarke, Sept. 1895 (NY.). Wray. Schantz (NY.). Gunnison. Underwood and Selby, Sept. 1901 (NY.). Twin Lakes. Jones 907, Sept. 1878 (NY.). New Mexico. Socorro County.: Foothills east of Rentfrow's "desert claim". Eggleston 19363, Sept. 1923 (NY., US.). Utah. Southeastern Utah. Abajo Mts. Rydberg and Garrett 1954, Aug. 1911 (NY.). Between Moab and Monticello. Rydberg and Garrett 9117 and 9119, July 1911 (NY.). Summit Co.: Stevens Dairy Farm (NY.). Modena. Davis, Sept. 1930 (NY.). Nevada. Esmeralda Co.: Indian Creek. Archer 7227, Sept. 1938 (NY., OTB.). 3 mi. s. of Hubbard C.C.C. Camp on U.S. 93. Holmgren 1584, July 1941. The two Nevada sheets differ in having reddish stems.

24. C. Vulvaria L.

A native of Europe, widely introduced elsewhere, this species probably is not closely related to the others here included. It is semi-prostrate in habit and in its vegetative features resembles overgrown Stellaria media.

25. C. Fremontii S. Wats.

This species is the best known and most widely distributed of the triangular-leaved group and is characterized by the broad, thin, hastate leaves, hardly longer than broad (Fig. 14), upright habit, and seeds free from the pericarp maturing mixed in the glomerules and largely exposed. Like some other species such as *C. album* and *C. rubrum* the name has been too comprehensively used on herbarium sheets, although the botanists of the early part of the century distinguished it well.

Fosberg (7) considered *C. atrovirens* and *C. incanum* as being only varietally distinct from *C. Fremontii*, but the relationships assume an entirely different aspect when all the taxa are separated. The recognition of *C. incognitum* removes the apparent continuity between *Fremontii* and *atrovirens* and the following forma (which may be better treated as a variety) includes those plants which seem to intergrade with *C. incanum*.

- C. Fremontii f. farinosum Aellen, Fedde Rept. Sp. nov. 26: 142. 1929. The smaller, thicker, more grayish-farinose leaves of this form resemble those of C. incanum but the habit and seed characters are those of typical Fremontii.
- C. Fremontii is widely distributed from Saskatchewan to Texas, westward to the Cascade Mts. Citations of the abundant typical material are not thought necessary but the following may be of interest as representing forma farinosum:

CANADA: British Columbia. Radium Hot Springs. Groh, Aug. 1933 (OTB.).
U.S.A.: Oregon. Wheeler Co.: Mitchell. Peck 10113, July 1921 (NY.). Crook Co.: Along Deschutes River 6 mi. below Bend. Peck 9744, Aug. 1920 (NY.). Utah. Slope of Aquarius Plateau. Ward 468, July 1875 (PH.). La Verken. Jones 5184, May 1894 (NY.)

(though cited by Aellen under C. incanum, it has the larger, flatter seeds of C. Fremontii). Texas. Davis Mts., Trans-Pecos. Hinckley 973, July 1937 (NY.) (good extreme). Brewster Co.: Near Castellan. Palmer 34220, May 1928 (NY., PH.). Chisos Mts. Mueller, July 1932 (Ill.) (good extreme). Arizona. Tucson. Griffiths and Thornber 3351, Sept. 1902 (NY.). Near Powell. Griffiths 1558, Sept. 1900 (NY.). Nevada. Clark Co.: Kyle Canyon. Clokey 7913, Aug. 1938 (NY.). Storey Co.: 2½ mi. n. of Virginia City. Aellen 493, Aug. 1937 (OTB.) (good extreme).

C. Fremontii var. Pringlei (Standley) Aellen (C. Pringlei Standley), cited from North Dakota and Mexico, differs in having the leaves serrate. The few sheets seen give the impression of representing specific rather than varietal distinctness. It has not been studied.

26. C. atrovirens Rydb.

Related to but distinct from C. Fremontii, in its different leaf shape and generally firmer texture, and in having slightly smaller seeds, C. atrovirens is also closely related to C. hians, from which it may not really be distinct, as discussed under the latter species. Small plants are characteristic in having axillary inflorescences shorter than the strongly upright-ascending leaves, but in larger plants the inflorescence becomes terminal and diffuse. Such larger plants might be confused with small plants of the eastern C. Standleyanum if their ranges overlapped, although the serrate leaves and the more exposed fruits of the latter are distinctive.

Some of the variation within the species might be resolved if the smaller, stouter plants with more densely spicate inflorescences, C: aridum A. Nelson (C. Wolfii Rydb.), could be segregated. They may form a connecting link between this and C. hians.

The species occupies essentially the montane portion of the range of *C. Fremontii*. Previously reported from North Dakota ("in garden" and so probably introduced) to New Mexico, west to Oregon and California, the following record extends its range to

British Columbia. Five miles w. of Fort St. James. McCabe 7489, June 1940 (NY.).

27. C. incanum (S. Wats.) A. A. Heller.

This is a relatively easily recognizable and fairly uniform taxon, characterized by its low, bushy habit and small, thick leaves, with a prominent, often sharp, lobe on either side above the base. The seeds average about 1.0 mm. in diameter and are covered by the sepals at maturity.

Aellen has cited a number of collections and others have been seen indicating a range from South Dakota south and southwest to Texas, Mexico and southern California. It is a plant of arid rather than montane habitats, with its greatest concentration in the southwestern states. In view of this distribution, it is a bit surprising to find the following two collections from southern Canada:

Dry alkaline flat (a few plants) 20 mi. w. of Govanloch, s. Saskatchewan-Alberta border. Frankton and Bibby 276, June 1947 (OTB.). Saskatchewan. Dry soil near Battle Creek. Breitung and Budd 5229, July 1947 (OTB.).

28. C. albescens Small

Material to be referred to this species has been somewhat in doubt and there seems to be little of it in herbaria. A sheet of the type collection from Kerrville, Kerr Co., south-central Texas, Heller 1928, June 1894, in the collection of the Academy of Natural Sciences of Philadelphia, shows a portion of a plant which must have been nearly or quite 1 meter high, freely branching, and generally resembling C. album in appearance. The basally lobed leaves, not strongly serrate above the lobes, the sepals strongly farinose to the very tips and the thin, separable pericarp place it apart from this species and characterize it as a relative of the western representatives of the genus with more or less deltoid basally lobed leaves centering around C. Fremontii, C. incanum, etc. It is certainly the most album-like member of its group.

In addition to the type mentioned above, only the following three collections have been seen: Texas. Bexar Co.: San Antonio. Jermy (NY.). Bexar Co.: Jermy, June 1904 (NY.). The two sheets probably represent the same collection, not far from the type locality. Nevada. Lander: Vicinity of Trout Creek. Goodner and Henning 1040, Aug. 1937 (NY.). One can hardly say the previous doubt about the species has been as yet cleared up.

29. C. incognitum sp. nov. Fig. 2. Plantae erectae, 3–12 dm. altae, e basi ramosae, ramis arcuate ascendentibus. Laminae foliorum tenues, ovatae vel deltoideo-ovatae, 1.5–3.5 cm. longae, non-lobatae vel lobis parvis basalibus, subtus farinosae. Flores in spicis glomeratis terminalibus et axillaribus condensati. Perianthii laciniae 5, farinosae, anguste carinatae, fructum usque ad dimidium in maturitate includentes. Pericarpium minute rugosum, semini adnatum. Semen nigrum, complanatum, 1.2–1.5 mm. diametro, margine rotundato.

Plants upright, 3–12 dm. tall, branched from the base, the branches arcuate-ascending. Leaf blades thin, ovate to deltoid-ovate, 1.5–3.5 cm. long, unlobed or with small basal lobes, farinose beneath. Flowers crowded in terminal and axillary glomerate spikes. Sepals 5, farinose, narrowly keeled, about half covering the fruit at maturity. Pericarp finely rugose, attached to the seed. Seed black,

flattened, 1.2–1.5 mm. in diameter, the margin rounded.

The recognition of *C. incognitum* as a species closely related to the *atrovirens-Fremontii* complex materially clears up the specific relationships and segregations in this group. It has the ovate leaf shape of the former, the seed size and general habit of the latter and an attached pericarp definitely unlike either. The smaller plants, up to 4 dm. high, are strikingly similar in appearance to *C. atrovirens*, but the plants may reach three times this height and then have a marked habital resemblance to *C. Fremontii*. A large plant, Standley and Bollman 11012, is the basis of Aellen's report of the eastern *C. Standleyanum* in New Mexico.

Material is known from Wyoming, Colorado, Utah, New Mexico, Oregon and California. Thus it occurs within the range of both *C. atrovirens* and *C. Fremontii*. Habitats indicated on some of the sheets suggest it is more of a woodland species than its relatives and that it may flourish in disturbed soil. These are also the habitat preferences of *C. Standleyanum*. The following distributions have been seen:

WYOMING. Carbon Co.: Copperton. Tweedy 4499, Aug. 1901 (NY.). Colorado. Sheephorn Divide, near a corral. Shear and Bessey 4012, Sept. 1898 (NY.). Near Pagosa Peak. Baker 301, Aug. 1899 (NY.). Mt. Elbert, El. 10,000 ft. Coulter, July 27, 1873 (PH.). Utah. Wasatch Mountains, e. of Manti. Coville and Tidestrom 45, Aug. 1908 (US.). Elk Mountains, near Scorupis Camp. Rydberg and Garrett 9556 and 9556a, Aug. 1911 (NY.). Abajo Mountains. Rydberg and Garrett 9645, Aug. 1911 (NY.). Sevier Co.: Fish Creek Canyon. Garrett 2574, Aug. 1909 (NY.). New Mexico. Rio Arriba Co.: Pine Woods, vicinity of Brazos Canyon. Standley and Bollman 11012, Sept. 1914 (US.) [Type]. Oregon. Baker Co.: Cornucopia. Jones, July 1935 (a bit young but seems to be this rather than atrovirens) (Ill.). California. Siskiyou Co.: South Fork of Salmon River near Big Flat. Howell 13316, July 1937 (NY.). Siskiyou Co.: Janes Canyon, Siskiyou Mts. Wheeler 3709, July 1935 (NY.). Tehama Co.: Red Fir Forest, South Yolla Bolly Mts. Munz 16892, July 1951 (PAC.). Plumas Co.: Little Grizzly Ranger Station. Eggleston 7576, Aug. 1911 (NY.). Tulare Co.: Head, East Fork of Kaweah. Culbertson 4582, Aug. 1904 (NY., Penn.). Los Angeles Co.: Mt. Islip, San Gabriel Mts. Fosberg and Ewan 35523, Aug. 1931 (NY.). On disturbed soil, Swartout Valley, San Gabriel Mts. Munz 7659, Aug. 1923 (NY.).

30. C. nevadense Standley

This is one of the "neatest" of species in its small compact appearance as a plant, its distinctness from other taxa, and in its definite and limited geographic range. Its characteristics have been adequately described by Fosberg (7). The very small seeds and numerous pedicellate flowers are distinctive. The latter feature occurs in a few other species but in no case is it nearly so pronounced.

It has been generally recognized in its older stages (August) by its compact habit and small seeds but when collected in the young condition (June) it presents a somewhat different aspect and is not always correctly identified by collectors. In its younger stages it is a relatively delicate plant with gracefully spreading branches, small rhombic-hastate strongly ascending leaves and often red stems. The compact habit develops later and the leaves are often completely shed while the plant is still in good fruit. It has the most marked development of a distinct, though small, tap root that has been observed in *Chenopodium*.

To the citations given by Fosberg showing a range limited to central and western Nevada, the following may be added:

NEVADA. Nye Co.: Smoky Valley. Maguire and Holmgren 25359, June 1945 (NY., PH.).

It has not been possible from the material at hand adequately to separate the taxa which may be present in the following group of southwestern plants with more or less *Fremontii*-type leaves and reticulate pericarp. The key presented by Aellen and Just is particularly lacking in usefulness at this point since the alternatives "Alveolae of seed surface abutting" and "Canals separating the alveolae of seed surface" remain uninterpretable by the present author, as do also the alternatives "Plants foetid" and "Plants not foetid" when dealing with dried material. Some of the following species (Nos. 31–34) are clear-cut and some are not.

31. C. Watsoni A. Nelson. Bot. Gaz. 34: 362. 1902.

This is the clearest and most generally recognized species of its group. Rather suggesting large C. incanum, it is characterized by the somewhat whitened reticulate pericarp and by the conspicuously leafy inflorescence. The sepals entirely

enclose the thick, globose fruit at maturity. Their connivent, acute tips appear in strong contrast with those species in which the mature fruit is partially exposed.

Aellen, p. 120, cites material from South Dakota, Montana, Colorado, New Mexico and Arizona. The following citation extends its range into another state:

Kansas. Hamilton Co.: Hitchcock, Aug. 1895 (NY.).

32. C. glabrescens (Aellen) stat. nov.

C. Watsoni forma glabrescens Aellen in Fedde Rept. Sp. nov. 26: 120. 1929.

In the material seen, this species differs constantly from C. Watsoni in the pedicellate flowers and more diffuse and less leafy inflorescence. It also has thinner leaves and a more strongly whitened pericarp, is generally larger, and with the basal branches often exceeding the central stem. C. Watsoni is freely branched but usually pyramidal in aspect because of the strong central stem.

Aellen recognized it as a forma but it is much more than that. Whether it can continue to be maintained in the specific category is not at present certain, but the characters are of sufficient magnitude and are of the same nature as those that separate species in other cases. Aellen (p. 120) cited only a single collection from Ute Park, Colfax Co., New Mexico (indicated as Mexico—obviously a slip), Standley 13505 (US.). The following additional material is referred here:

New Mexico. Sierra Co.: Animas Creek, near Caballo. Fogg 18893, Aug. 1941 (Penn.). Grant Co.: 8 mi. w. of Silver City. Barkley 14657, Sept. 1944 (Ill.). Fort Bayard. Mulford, 594, Aug. 1895 (Ill., NY.). Sandoval Co.: Guadalupe Canyon. Eggleston 18734, July 1923 (US.). Socorro Co.: Datil. Eggleston 16180, Sept.-Oct. 1919 (US.).

In addition there are two sheets in the University of Illinois Herbarium, of plants grown from seed, one indicated as being "Seed from Utah, 1873. Cult. by E. Hall", the other "From Powell's Arizona Seeds. E. Hall, 1873". These can scarcely be taken to constitute distribu-

tion records.

C. neomexicanum Standley. N. Amer. Fl. vol. 21, p. 19. 1916.
 C. lenticulare Aellen. Fedde Rept. Sp. nov. 26: 152. 1929.

Aellen and Just refer C. neomexicanum to C. Watsoni forma glabrescens, from which it, however, differs markedly. C. lenticulare as described by Aellen and maintained by Aellen and Just seems to be the same as Standley's C. neomexicanum. Its range probably includes w. Texas, New Mexico, and Arizona.

C. Palmeri Standley. N. Amer. Fl. vol. 21, p. 19. 1916.
 C. arizonicum Standley. N. Amer. Fl. vol. 21, p. 19. 1916.

Aellen referred C. Palmeri to C. Berlandieri ssp. eu-Berlandieri and maintained C. arizonicum separately, but the types of both species represent the same taxon. That of C. arizonicum is a small plant lacking all but some of the inflorescence leaves, while that of C. Palmeri is the top of a large plant with the secondary leaves present. Both have the same small Berlandieri-like seeds and are representatives of a well-marked taxon with small Fremontii-type leaves, the primary ones usually with bi-partite basal lobes; upright habit with basal spreading branches and a strong development of a terminal leafless inflorescence. In the

latter character and in seed shape and markings it is closely related to typical C. Berlandieri while in habit and in leaf shape and texture it approaches the C. Fremontii group.

The following collections are referred here (all US.).

ARIZONA. Pima Co.: Boboquivari Mts. Kearney and Peebles 14966, Aug. 1940. Boboquivari Mts. Peebles 8915, Aug. 1932. Santa Rita Mts. above range. Griffiths 6011, Sept.—Oct. 1903. New Mexico. Agua Zarca, vicinity of Las Vegas. Bro. Arsene 18504, Aug. 1927. Texas. Houston. Fisher 277, Sept. 1918. Brownsville. Runyon 287, 1922. Olmito. Rose and Russell 24185, Oct. 1927.

35. C. Standleyanum Aellen

C. Boscianum Moq. of authors, not as to type

C. Standleyanum is the widespread uniform eastern species which most nearly resembles, in its thin leaves and fruits maturing successively and largely exposed at maturity, the western Fremontii-atrovirens complex. It is readily recognizable by its rounded sepals hardly more than curling well over the margins of the mature fruit (Fig. 10), strongly separable pericarp and delicate branching habit. From the Fremontii-type species it differs especially in having the primary leaves variously serrate-margined, although many of the upper ones are entire. The tendency in the western taxa is always toward leaves with a hastate base. This tendency is almost lacking in Standleyanum but is observed to a slight extent in the western part of its range. There also, in the region inhabited by C. album var. Stevensii (Illinois and northwestward), the leaves may be moderately firm in texture.

In the Fremontii-atrovirens complex the tendency is toward plants branched near the base, the branches then spreading and producing a pyramidal habit, or, more often in the thin-leaved forms, becoming strongly upright and with a more conic or nearly cylindric habit. This tendency is entirely lacking in the eastern representative, branches being produced more often from the upper half of the plant, so that in both branching and leaf outline it more nearly resembles C. album. It is perhaps most closely approached in appearance by the western C. incognitum which, as mentioned under that species, constituted the record for it in New Mexico.

Although it is generally known as a woodland plant its habitat is in lightly wooded areas with a decided preference for recently disturbed soil, often on cliffs or banks where the soil is not entirely stationary. In the author's experience it has been of markedly evanescent occurrence, becoming abundant in a single season in recently disturbed shale, sometimes to disappear entirely during subsequent seasons. Under such disturbed conditions it grows luxuriantly and may produce strong plants 5–6 ft. high while in the normal woodland situations it may persist year after year and exhibit its characteristic delicate habit. Its similarity to western species and its habitat preferences suggest it has come into eastern U. S. during relatively recent geologic time as an off-shoot of western (probably southwestern) progenitors. Such widely distributed eastern representatives of genera with numerous western species are commonly recognized.

It is widely distributed from South Dakota and eastern Texas to Southern Quebec (rare) and Florida, probably being most abundant near the middle of its north-south range.

- [C. hybridum L. Native of Europe. Not known in North America.]
- 36. C. gigantospermum Aellen in Fedde Rept. Sp. nov. 26: 144. 1929.
 - C. hybridum var. gigantospermum (Aellen) Rouleau in Nat. Canada LXXI. 268. 1944.
 - C. hybridum Amer. auth. Incl. C. gigantospermum var. Standleyanum Aellen, l.c., p. 147.

The characters of the seed coat and of the perianth are sufficiently clear-cut to separate the American material specifically from the European C. hybridum L. The difference is not only in seed size as held by Fernald (5),—"Surely Chenopodium gigantospermum . . . differs [from C. hybridum] only in its larger seeds. It is so like true hybridum that acute botanists from Pursh to Standley have detected no difference " Seeds of European C. hybridum are usually 1.5-2.0(2.2) mm. in diameter; Fernald gives the seed size of the American representative as 1.5-2.0 mm. in diameter, with var. Standleyanum having seeds 2.0-3.0 mm. More than 100 sheets of American material at hand show a wide distribution, with only one plant (to 2.7 mm.) having seeds more than 2.4 mm. in diameter. The seed size, although of significance in a genus in which 1.0 mm. is small and 2.0 mm. is large, is by no means as impressive as the contrast betwen the thick, black, strongly reticulate, attached pericarp of the European material and the thinner greenish-hyaline, less reticulate, separable to attached pericarp of American material; the lenticulate seed with strongly rounded margin of the former and the umbonate-lenticulate seed tapering from the raised center to the sharply defined margin of the latter; the broad sepals with green center and strongly contrasting hyaline margin covering much more of the fruit in the former (Fig. 12) and the narrow sepals with less contrasting coloration in the latter (Fig. 11); the inflorescence and the leaf base. Actually those acute botanists from Pursh to Standley also missed C. missouriense and C. macrocalycium, largely misinterpreted C. Berlandieri, and consistently referred these and sundry others to C. album and C. lanceolatum!

Aellen described *C. gigantospermum* var. *Standleyanum* as having seeds to 3.0 mm. broad and with the pericarp not adhering. Such a plant may exist but it has not been seen. In the material at hand the larger-seeded material has the pericarp more firmly attached, while it becomes more separable in the smaller-seeded plants. Specimens annotated by Aellen as var. *Standleyanum* have seeds to 2.4 mm. broad with pericarp relatively thicker and attached. Unless additional evidence for the existence of the variety comes to hand, the entire series, actually fairly variable in seed size and separation of pericarp, may be retained as a unit. The formae described by Aellen exist as such but they represent chiefly age or habitat differences and are not included here.

C. gigantospermum is widely distributed in North America except in the south-eastern states and becomes more abundant northward. Its close relationship to C. hybridum indicates that the two were derived from a widespread species of relatively northern distribution, probably at a time when a more continuous flora occupied the American-Eurasian area.

37. C. murale L.

38. C. urbicum L.

These two species are characterized by their relatively broadly deltoid or triangular leaves prominently toothed throughout, by the irregularly reticulate, attached, black pericarp and the short stout stigmas. They seem to be closely related to each other and also to C. mexicanum, and to be members of Subsection Undata. The inclusion by Aellen and Just of C. urbicum in Subsection Lejosperma, with smooth-seeded species, and of C. mexicanum in Section Pseudoblitum, with vertical seeds, is difficult to understand. They are, however, possibly more closely related to vertical-seeded groups than are other species with horizontal seeds.

Both species seem to be relatively urban in habitat in North America, where they occur as introduced plants. They are widely distributed but not common except that *C. murale* may be fairly abundant near the west coast. The leaves of both are moderately thin in texture. Several collections of young material of *C. murale* from Oregon have been seen suggesting the presence of a thicker leaved form in this region.

39. C. polyspermum L.

The relationship of this little species is uncertain but there should be no question concerning its recognition,—the apiculate sepals are distinctive, and the small exposed seeds and thin ovate entire leaves with glomerules of flowers in spikes or cymes from the axils of nearly the lowermost to the uppermost, set it clearly apart.

Aellen and Just included it in Subsection Undata along with C. murale, but the affinity of the latter is surely with C. urbicum and C. mexicanum which are included under other section and subsection categories. Standley retained it in a separate group of its own, which seems reasonable, though the present author would be inclined to associate it and C. Vulvaria. Both Standley and Aellen place C. Vulvaria in close relationship with C. Watsoni and its relatives (C. incanum, etc.), a course which does violence not only to the appearance of the plants but to the fact that the former, along with C. polyspermum, is of Old World origin while C. Watsoni belongs to the considerable group of plants apparently native in arid and mountainous regions of the western parts of the Americas.

The two varieties of *C. polyspermum* are, in their extremes, strikingly different in appearance. Var. *obtusifolium* Gaudin, spreading or prostrate and with diffuse axillary cymes, has been seen from:

Ballast grounds (along the Delaware River near Philadelphia, Pa., or Camden, N. J.). Brinton, Aug. 1879 (Penn.); and Montreal, Quebec, Hart 11, Aug. 1944 (OTB.).

Var. acutifolium (Sm.) Gaudin, the generally upright form with glomerules in axillary and terminal spikes, has been sparingly introduced in the U. S. but is apparently of frequent occurrence along the St. Lawrence river in Quebec and Ontario, Canada.

CANADA: New Brunswick. Charlotte Co.: St. Andrews. Groh, July 31, 1936. Quebec. Nicolet Co.: Nicolet. Frere Allyre 2763, Sept. 1947. Rouville Co.: Rougemont. Lionel Cinq-Mars, Sept. 1948. Chambly. Terrill 6090, Sept. 1949. St. Hyacinthe. Marie-Anselme 19, Sept. 1948. Yamaska. Marie-Victorin, Rolland-Germain and Rouleau 2210, Aug. 1943. Ile Ste.-Therese, Richelieu River. Marie-Victorin and Rolland-Germain 2004, Oct. 1934. Ontario. Ottawa. Groh and Dore, Aug. 10, 1935. Minshall 153, June 1939. Saskatchewan. 6 mi. w. of Wallwort. Breitung 479, Aug. 1939. (Can Field Nat. 54: 58. 1940.) (All OTB.) U.S.A.: Pennsylvania. On ballast, Philadelphia. Burk (no date but probably in the 1880's) (Penn.).

40. C. serotinum L.

C. ficifolium Smith

Of very infrequent occurrence in North America is this distinctive species which is widespread through Eurasia. The leaves are lobed at base, usually 1.5–3.0 cm. wide across the basal lobes, above which the median lobe continues with the sides relatively parallel and usually prominently but remotely serrate nearly to the tip (Fig. 13). The blades taper gradually to the petiole and are quite farinose beneath, causing small, young plants to be mistaken for *C. glaucum*. The length of the blade is usually about 5 times the width above the basal lobes. The perianth parts are united farther above the base than is the case in *C. album* and the small seeds with the pericarp minutely but definitely reticulate are distinctive.

The type of leaf described here, with basal lobes and the median lobe with parallel sides, is of not infrequent occurrence in varieties of both C. album and C. Berlandieri and will be mentioned under those species. It is developed to its best extreme in C. serotinum. The present species, as indicated by its reticulate pericarp, may be distantly related to C. Berlandieri and is included in Subsection Cellulata by Aellen and Just, but it is more album-like in appearance and, having developed in Eurasia, probably has its affinities more nearly with that group.

This taxon has long been known under the name C. ficifolium Smith, but Aellen (3) finds that the type of C. ficifolium is referable to C. rubrum L. It has not previously been reported from North America. The following collections have been seen:

Pennsylvania. Bucks Co.: rubbish-dumps and fills on Turkey Hill. Long 67220, May 1945 (in early anthesis) (PH., Penn.). Philadelphia Co.: Bustleton. Wikoff 408, July 1, 1945 (fully mature) (PH.). Florida. Pensacola. Baker 1579, Apr. 1898 (NY.).

41. C. opulifolium Schrad.

C. flabellifolium Standley in N. Am. Fl. 21: 19. 1916. (probably)

C. viride L. in part, of Standley, l.c., p. 21.

Another European plant of the C. album group that has been introduced in North America but has not become abundant is C. opulifolium, characterized by somewhat thicker leaves with basal lobes often bipartite and the median lobe short, so that the blade is hardly longer than wide. It is much more album-like in appearance and less readily separable from it than is C. serotinum. There seems to be some variation in the presence or absence of bipartite basal lobes and all of the material with relatively shorter leaves cannot be satisfactorily placed. The sepal characters given in the key are of some help but unfortunately they are not always clearly applicable.

CANADA: Ontario. Nos. 1116 and 1117 in Herbarium of the Department of Agriculture at Ottawa "grown from seed of a plant collected in a street of Hamilton". Essex Co.: Sand-

wich (extreme s.w.). Macoun 54723, July 1901 (NY.).

U.S.A.: Pennsylvania. Philadelphia Co.: Navy Yard. Martindale, Aug. 1865 (PH.). Delaware. Wilmington. Commons, June 30, 1900 (PH.). Maryland. Cited by Aellen from Cumberland. Steele, 1898 (US.). Indiana. Allen Co.: Ft. Wayne. Deam 14466, July 1914 (NY.). Illinois. Cited by Aellen and material seen from streets of Rockford, "thoroughly established". Bebb, 1880 (NY.). Mt. Carmel. Schenck, July 1894 (NY.).

Several other collections that probably belong here have been seen from the region of eastern seaports in New York, New Jersey and Pennsylvania, but the material is not in such

stages as to afford positive separation from C. album.

42. C. album L.

Leaves of ordinary texture, chiefly less than twice as long as wide, the teeth prominent but hardly sharp.

Plants relatively strict in habit; glomerules chiefly contiguous; sepals more often pointed and yellow-margined; flowers all sessile; leaves more broadly ovate and serrate but grading into lanceolate entire bracts; widespread and common var. album Plants with spreading branches; glomerules conspicuously separate; sepals more often obtuse and whitish-margined; individual stalked flowers often present; leaves more narrowly ovate to lanceolate, those of the inflorescence entire; widespread and common.

var. lanceolatum

Leaves thicker, firm but brittle, not coriaceous, generally twice as long as wide and sharply toothed; plants chiefly robust; seeds in the larger size range; Illinois, northeastward and var. Stevensii northwestward

And so we come at length, but not last, to C. album, the most commonly encountered member of the genus and a favorite of the taxonomic conservative. Abrams (1), admits to reducing "34 subspecies, varieties, and forms in North America" to it, including the numerous variants of C. Berlandieri. Gleason (9) goes one step farther and adds C. Bushianum. Included also have been C. missouriense, C. macrocalycium and C. strictum var. glaucophyllum because they have been unrecognized. The actual limits of the species are extensive enough, geographically, genetically and ecologically. It remains, even after the elimination of the extraneous inclusions, probably one of the most widespread and variable of plant species and the most abundant species of Chenopodium in American collections. Aellen's statement that most American material identified as C. album actually belongs to C. Berlandieri ssp. Zschackei is not entirely correct,

but his work in distinguishing these and other taxa has served as the first basis for an understanding of much of the American material. It is to be regretted that his critical determinations have not been more widely appreciated.

Of the various sub-species, varieties and forms recognized by him, however, it is deemed advisable, because of the great amount of ecological variability involved, to recognize fewer categories for the North American material. Typical C. album (Fig. 4) is characterized by its relatively upright habit; by most of the leaves being of the relatively broader type and more prominently, usually abundantly, toothed; by the more often yellow-margined sepals; relatively non-glomerate (the glomerules contiguous) inflorescence and by its habitat, which is largely restricted to recently disturbed soil.

From this, var. lanceolatum (Muhl.) Coss. & Germ. Fl. Paris 451, 1845, (C. lanceolatum Muhl.) (Fig. 3) differs in its more spreading habit, narrower and less prominently toothed leaves, usually whitish-margined sepals and by the strongly glomerate inflorescence (the glomerules separate, therefore apparent). These characters occur in such a bewildering series of combinations and intergradations that the variety probably would be dispensed with entirely were it not that the extremes present entirely different aspects in the field and the narrowleaved, spreading, glomerate type of plant also departs markedly from the upright broader-leaved type in its habitat. Typical C. album is a plant of cultivated places, rarely occurring in soil not recently disturbed. Var. lanceolatum, while it also grows in recently cultivated soil, will grow and persist in undisturbed soil. It is more characteristically a plant of waste places, often urban, while the common garden and corn-field weed, in the author's experience, is the typical variety. One may not assume that the habit is entirely a response to the habitat since the spreading habit of the variety is recognizable even when the plants are crowded, and the upright habit of typical C. album persists in isolated plants. There is, of course, considerable variability within the upright and spreading categories. The habitat difference, more or less obligate in some taxa, is an important feature and one that can be appreciated only from field experience. It will be referred to also under C. missouriense.

Aellen, and Aellen and Just have treated var. lanceolatum as a forma. Its characters indicate it to be at least of varietal status (the differences are not just ecological) even though no separate geographic range can be assigned to it. Field observations strongly suggest it is genetically isolated from the typical variety, but attempts to separate any considerable amount of material on morphological characters leave many apparent intermediates. As treated here it would include f. glomerulosum (Reichenb.) Aellen and f. cymigerum (Koch) Aellen, of Aellen and Just's treatment. Relatively more material would be referred to it, including some considered as the typical variety by Aellen, since the sepal characters and the presence of occasional pedicellate flowers are considered of importance. In the considerable amount of material at hand the number of sheets under var.

lanceolatum exceeds those under var. album. This may not actually reflect their relative abundance since collectors are more apt to pick up material from waste places than from cultivated fields. It does definitely reflect the fact that a large number of collections by the late B. F. Bush, the indefatigable collector of chenopods, are from "waste places" around Courtney, Independence and Kansas City, Missouri.

The differences between var. album and var. lanceolatum are paralleled by the differences between typical C. pratericola and its var. oblongifolium, the variety in each case having a more spreading habit, narrower leaves and with the sepals relatively more blunt and greener.

From Illinois northeastward and northwestward there occur thicker leaved forms, variable in leaf outline but with a definite tendency toward basal lobes and the terminal lobe with parallel sides. Although the leaves are thicker they remain brittle and do not take on the coriaceous texture more common in C. Berlandieri and other native western forms. These are considered deserving of varietal recognition as

var. Stevensii Aellen, Fedde Rept. Sp. nov. 26: 130. 1929, including in synonymy var. dacoticum Aellen, l.c., p. 131, and ssp. fallax Aellen, l.c., p. 131.

In this relatively drier region (into the Dakotas and Manitoba) one might expect ecological variants with thicker leaves and reduced size. Plants placed here are, however, usually of large stature and with seeds in the maximum size range for the species, thus indicating genetic rather than ecological variation. It may be a native American development from the *C. album* complex. The taxa here included under var. *Stevensii* have been reported only from North Dakota. The following range-extensions may be noted:

CANADA: Quebec. Shefford Co.: Frere Fabius 385 (NY.). Longueuil Co.: DeChambly. Fr. Marie-Victorin and Rolland-Germain 43636 (OTB.). Ontario. Ottawa. Minshall, Aug. 9, 1935 (OTB.). Manitoba. Brandon. Stevens 265 (OTB.).

U.S.A.: Illinois. Champaign Co.: 15 mi. w. of Urbana. Jones 14030 (Ill.). Near Urbana. Jones 12479 (Ill.). Michigan. Keweenaw Co.: West Bluff. Richards 2445 (OTB.). MINNE-

SOTA. Cass Co.: Lake Winnibigoshish Dam. Stevens 70 (OTB.).

Var. microphyllum Boenningh. This may be a good enough variety, since the leaves not only are smaller but the upper ones and bracts continue to be more serrate than in other forms. It is difficult to separate because the older, larger, leaves are not always present in collected material. The variety is not included in the key because of its tenuous status. The following may be referred here in addition to the Washington, D. C., collection cited by Aellen:

FLORIDA. Western shore of Lake Okeechobee. Small 9182, May 1917 (NY.). Missouri. Courtney. Bush 8052, July 1917 (Ill.). More than one Bush sheet is numbered 8052 but only one is referred here.

Thin-leaved forms of C. album are present in some of the northwestern States—North Dakota to Oregon, and in s. Canada—and these often have the flowers in pronounced flat-topped clusters. The relationships here are not clear but this material probably grades into C. ferulatum Lunell which is included by Aellen

and Just in C. Berlandieri ssp. Ludwigianum Aellen. The latter category is used to include the relatively strict, generally northern forms related to C. Berlandieri var. Zschackei, but C. ferulatum is essentially a thin-leaved variation in the album series and is not related to Berlandieri. More study of this material is needed before the proper category or categories for it may be decided.

- 43. C. missouriense Aellen in Bot. Notiser, Lund, 1928, p. 206.
 - C. missouriense var. Bushianum Aellen in Fedde Rept. Sp. nov. 26: 156. 1929.

Described from material from Missouri and Tennessee, this very characteristic and uniform species is common and widely distributed in eastern North America south of New England and the Great Lakes.

This taxon has been generally included with either C. album or C. Berlandieri, both of which it resembles in general appearance and leaf form. Although it may be separated from either by its smaller seeds (Fig. 5), the most useful field character is its unfailing habit of coming into anthesis about the second week in September, regardless of how early or late the particular plant began growth. Once this behavior is recognized it becomes very easy to distinguish the species in the field at any time of the year. C. album, with which it might be confused in general appearance (C. Berlandieri is almost entirely absent from the eastern states), flowers any time after the plants have been growing from 4 to 8 weeks, so they may be met with in fruit from early July until October. Even those plants of C. album which grow from late germinating seeds and which are in the flowering stage at the same time as C. missouriense are readily distinguishable in the field by the stiffer habit of the inflorescence in both flower and fruit as well as by their more glomerate arrangement. The inflorescence of C. missouriense is relatively flexuous and arching (Fig. 5). Plants of it that start from seed late in the summer flower at the same time as the earlier well grown plants and, especially if partially shaded, develop a slender, delicate inflorescence with the flowers more glomerulate (Fig. 6). It is such forms of this species, along with other similar growth forms (and including true southern C. Berlandieri and var. Boscianum), that have been treated as C. Berlandieri by American authors.

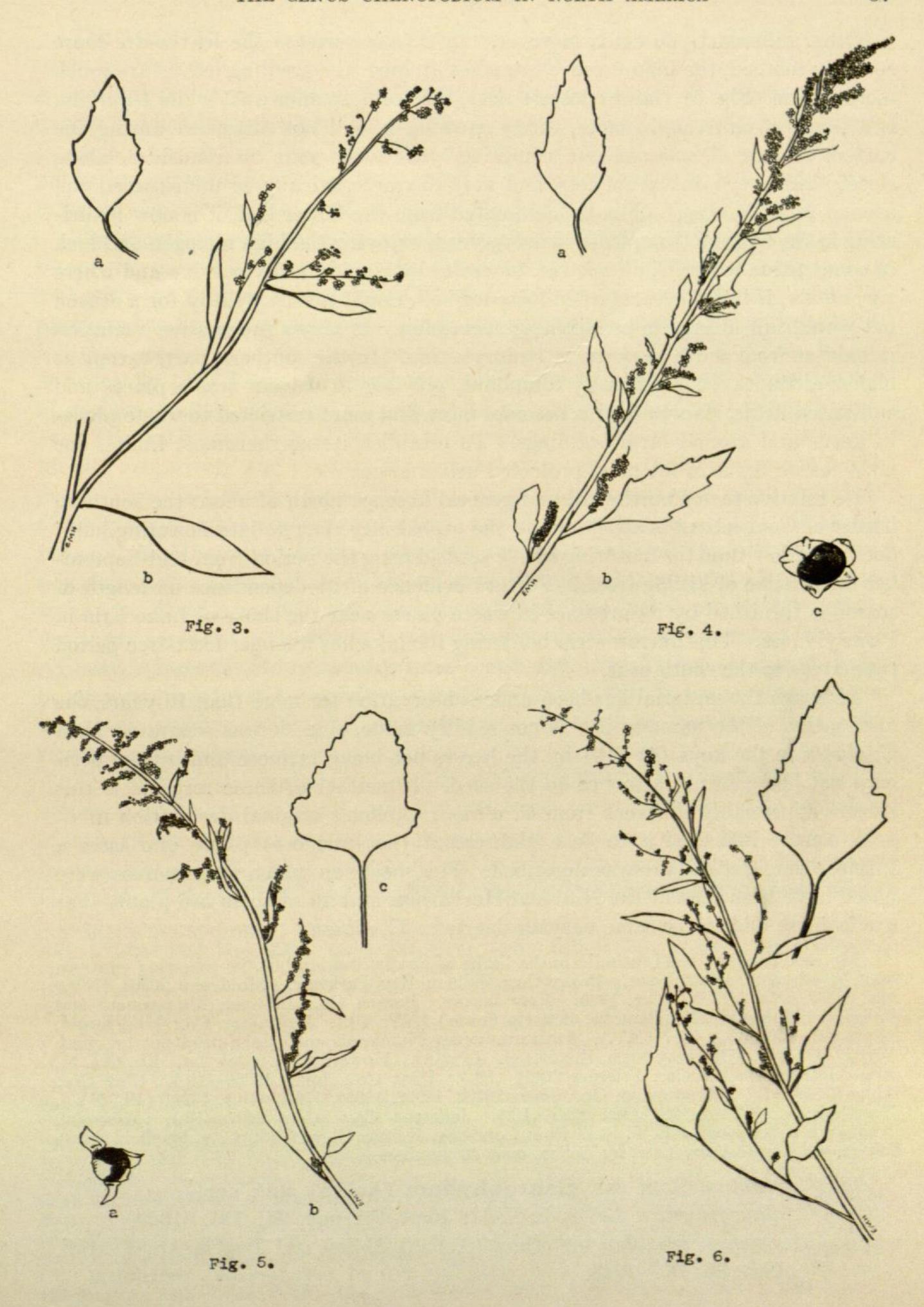
It is separated in the 8th edition of Gray's Manual (as C. Berlandieri) partly on the basis of being ill-scented. Although the author has collected it on many occasions in all stages of growth and for a few years kept a colony growing at the side of the house, where it constantly had to be weeded out to allow room for what are considered, by some, to be more desirable cultigens, he has never noticed any difference in odor between this and C. album.

Fig. 3. Chenopodium album var. lanceolatum: a, lower leaf; b, branch of inflorescence.

Fig. 4. Chenopodium album var. album: a, lower leaf; b, terminal portion of plant; c, fruit and calyx.

Fig. 5. Chenopodium missouriense: a, fruit and calyx; b, branch of inflorescence; c, lower leaf.

Fig. 6. Late growth phase of Chenopodium missouriense: branch of inflorescence and lower leaf.



Other differences do exist, however. In C. missouriense the leaves are more coarsely toothed, the inflorescence branches arching, the seedling leaves are much more obtuse (Fig. 5) (later ones are not), the seeds smaller and, while C. album is a plant of cultivated places, rarely growing in soil not disturbed during the current season, C. missouriense comes up year after year on roadsides, along streets and alleys, in vacant lots, and very characteristically in undisturbed soil around farm buildings. Finally eliminated from the flower bed, it is now luxuriating in the writer's trampled-down dog-yard, enjoying the high nitrogen and lack of competition where C. album var. lanceolatum would hardly survive and where var. album, if it did get a start in loosened soil, might persist weakly for a season but would fail utterly in establishing succession. It shows progressive variation in habitat from south to north in Pennsylvania. In the southern part, except at higher altitudes, it is generally abundant, growing in various waste places and cultivated fields. Northward it becomes more and more restricted to waste places in towns and around farm buildings. To establish its northernmost limits, one must search for it in the most protected urban areas.

Its relative rarity northward and general absence north of about the southern border of Connecticut is attributed to the probability that its late-flowering habit does not allow time for maturing of the seeds during the period from mid-September to the time of killing frosts. Further evidence of its dependence on length of season is furnished by its presence in waste places near the shore of Lake Erie in Pennsylvania. This narrow strip bordering the lake has a longer frost-free period than areas to the south of it.

Although the material has been under observation for more than 10 years, the application of the name to it was not readily made, since it was separated from C. album in the keys (4) (10) by the leaves not being farinose and by the pericarp not being firmly attached to the seed. In neither of these respects is this species appreciably different from C. album. Aellen's original description of C. missouriense indicated it to be a glabrescent (not farinose) plant, and later a farinose var. Bushianum was described. The sheets on which these names were based have been seen at the National Herbarium and all of them are plants that are farinose and to the same varying degree as C. album.

Material is not at hand to indicate the limits of its distribution but the following citations may be of value: New York. Bronx Co.: Pelham Bay Parkway. Moldenke 20563 (NY.) and 20567 (NY., OTB.), Oct. 1949. New Jersey. Bergen Co.: Between Moresemere and Palisade. Moldenke 8299, Sept. 26, 1934 (in flower) (NY., Ill.). Burlington Co.: Lindenwold. Mackenzie 8232, Oct. 1917 (NY.). Pennsylvania. Numerous collections need not be cited. Wahl 1423, 1453, 1510 have been distributed. Indiana. Howard Co.: fallow lot. Ek, Oct. 11, 1940. Illinois. Cass Co.: Friesner 10112 (Ill.). Piatt Co.: Jones 19356 (Ill.). Clay Co.: Ahles 5160A (Ill.). Champaign Co.: Jones 10732, 14922, 14954, 17670 (Ill.), 13281 (Ill., NY.). Tazewell Co.: Chase 3516, Oct. 1920 (Ill.). Jefferson Co.: Ahles 5467 (Ill.). Missouri. Numerous collections by B. F. Bush from Courtney, Kansas City, Webb City, Sheffield, bearing, in addition to those cited by Aellen, over 40 numbers.

- √44. C. strictum Roth var. glaucophyllum (Aellen) stat. nov.
 - C. glaucophyllum Aellen in Fedde Rept. Sp. nov. 26: 155. 1929.
 - C. strictum ssp. glaucophyllum (Aellen) Aellen and Just in Amer. Midl. Nat. 30: 67. 1943.

The Asiatic C. strictum may be recognized by its prominently serrate, oblongovate leaves 3 or more times as long as wide. American material referable to this species has the lower leaves only about twice as long as wide, the margins abundantly but shallowly serrate, the median becoming oblong and entire, the upper lanceolate and entire (Fig. 7). Some exceptions in length of leaf occur and the plants present a markedly different appearance from base to tip, but most of our material seems varietally separable from the Asiatic.

The plants respond markedly to habitat and may be 3-5 dm. tall and then often with only a few upwardly curved basal branches or they may be 2 m. tall and with the profuse branching habit of C. album, etc. Not having seen the plants in the field, it is difficult to formulate a relatively exact idea of their habit but they seem characteristically to produce a few basal branches which project horizontally 1.0-1.5 dm. and then turn sharply upward, a habit also characteristic of various western species of the Fremontii group. In the present species, however, this habit seems not always to be expressed and the central stem may proliferate extensively and produce lanceolate leaves unlike the oblong-ovate basal ones. There is a distinct possibility that more than one taxon is being included. Canadian and other northern collections are characteristic as are also others as far south as Missouri; however, collections from Illinois, some from Missouri and especially some from Arkansas are referred here only tentatively. It is hardly to be considered a native plant, and the northern material is clearly adventive, yet in its southern extension it is not behaving as other introduced chenopods. Axillary inflorescences are usually spicate and stiff (Fig. 7) but terminally they become paniculate and variously spreading, though hardly ever assuming the gracefully nodding habit of C. missouriense. In shade it simulates the shade form of missouriense.

The bulk of the material is readily determinable by the shallowly serrate oblong lower leaves and small seeds but collections including only upper branches of large plants in flower or fruit at the same time as missouriense may not always be certainly named. Most collections are from the Mississippi basin, New England and s. Canada, but there are a few others. The following have been seen:

CANADA: Manitoba. Winnipeg. Dudley 83, Sept. 1938; 81, July 30, 1939. Denike 763, Aug. 1, 1939; 1855, Aug. 1944. Groh 3223, Sept. 1946. (All OTB.) Quebec. Ottawa West. Groh 1571 and 1572, Sept. 1, 1941. Gatineau Park. Groh 1629. Senn and Zinck 874, Sept. 1941. Vaudreuil Co.: Rigaud. Fr. Edmond Roy 3973, Aug. 1935. (All OTB.) The Canada

sheets are all very characteristic. U.S.A.: MAINE. Sagadahoc Co.: Topsham. Furbish, Aug. 29, 1912 (NEBC.). Canton. Growing densely in railroad yard. Parlin 2702, Aug. 11, 1908 (GH.). York Co.: North Berwick. Parlin, Sept. 30, 1896 (GH.). NEW HAMPSHIRE. Wilton. Batchelder, Sept. 12, 1918 (NEBC.). VERMONT. Westminster. Blanchard, Sept. 24, 1901 (GH). MASSACHUSETTS. Essex Co.: Haverhill. Harris 728, Sept. 24, 1932 (pars.) (NEBC.). Middlesex Co.: Ayer. Ordway and Bullard, Sept. 15, 1933 (NEBC.). Cambridge. Collins, 3780, Sept. 26, 1916 (NEBC.). Kidder, July 31, 1918 (GH.). Spontaneous Flora of Arnold Arboretum. Palmer 46550, Sept. 1942 (PH., GH.). Suffolk Co.: Back Bay, Boston. Williams, Sept. 17, 1910 (US.). Norfolk Co.: West Quincy. Kidder, Aug. 14, 1898 (NEBC.). Worcester Co.: Woodward, Sept. 28, 1914 (NEBC.). Hampden Co.: Springfield. Andrews 7, Sept. 21, 1911; 18, Sept. 5, 1905; 21, Sept. 21, 1911 (GH.). RHODE ISLAND. Washington Co.: Westerly. Bissell, Harger and Weatherby, Aug. 21, 1913 (NEBC.). Connecticut. Hartford Co.: Hartford. Bissell, Sept. 6, 1903 (GH., NEBC.). Farmington. Andrews 19, Sept. 12, 1907 (NEBC.). Middlesex Co.: Middletown. Blewett, Aug. 18, 1915 (NEBC.). New Haven Co.: Waterbury. Blewett 429, Aug. 30, 1910. New York. About the Yonkers Wool Mill. Bicknell, July 1, 1894 (NY.).

Pennsylvania. Bucks Co.: Bristol. Fretz, Aug. 1, 1899. Northampton Co.: Slateford. Schaeffer 25303, Sept. 11, 1946. Lehigh Co.: Allentown. Pretz 11553, Sept. 17, 1922. (All PH.) MICHIGAN. Kalamazoo Co.: Vicksburg. Rapp 3719, Aug. 6, 1940, and 3571, Sept. 1, 1940 (suggesting var. strictum) (both NY.). Illinois. Vermilion Co.: Jones 14993, Oct. 1941 (Ill., NY.). Lake Co.: Zion. Brown, Sept. 7, 1949 (Ill.). MINNESOTA. Ramsey Co.: St. Paul. Rosendahl, Sept. 1949 (OTB.). Iowa. Iowa Co.: West of Amana. Easterly 948, Aug. 1950 (OTB.). Missouri. Aellen cited 46 collections by Bush from Sheffield, Courtney and Webb City. The following have been seen in addition: 8065, 8065A, 8095, 8108, 8108A, 8110, 8111, 8195, 8196, 8844, 11865 (all Ill.), 8195A (PH.), 8546B (NY.). NORTH DAKOTA. Cass Co.: Fargo. Stevens 9, Sept. 1917 (US.). Stevens, Sept. 11, 1932 (PH.). Stevens, Sept. 3, 1950 (OTB.). Muenscher 11756, Sept. 1937 (NY.). Walsh Co.: Park River. Stevens 77, Sept. 1936 (ОТВ.). South Dakota. Northville. Brenkle, Sept. 30, 1937 (Penn.). Mellette. Brenkle 40-49, Sept. 6, 1940 (GH.). Nebraska. Valentine. Bates, Sept. 1, 1900 (GH.). Washington. Klickitat Co.: Near Bingen. Suksdorf 11536, Sept. 1923 (NY., PH., US.) (leaves longer, depauperate growth form). California. Stanislaus Co.: Turlock. Howell 15380, Oct. 1939 (US.). Monterey Co.: Chualar. Reed 2064, Aug. 1949 (PAC.). San Joaquin Co.: Sims Station. Keck 1315 (NY.).

Collections referred here tentatively are: Missouri. Bush 7063, 7063A and 7063B from Courtney, Aug. 26, 1913 (NY.) (which were named as C. album f. lanceolatum by Aellen). Bush 8223 and 11641–11645, Sept. 22, 1928 (US.); 11698–11701, Sept. 29, 1929 (NY.). Arkansas. Garland Co.: Hot Springs. Demaree 15802, Aug. 1937. Jefferson Co.: Pine Bluff. Demaree 16248A, Sept. 1938. Randolph Co.: Pocahontas. Demaree 23694, Aug. 1942. Yell Co.: Darda-

nelle. Demaree 20026, Aug. 1939. (All NY.)

45. C. giganteum Don, Prodr. Pl. Nepal. 75. 1825.

C. amaranticolor Coste and Reynier, Bull. Soc. Bot. France 54: 178. 1907.

There is no certainty in the author's mind as to the identity of the taxon indicated here. The names used above are given by Aellen and Just but the U. S. records questioned.

In Florida and Georgia there occur very large plants (to 3 m. according to Small, Manual of the Southeastern Flora, 1933, p. 465) with large, sharply doubly-serrate leaves, heavily farinose when young and then often presenting a dull red appearance. Pre-flowering material seen indicates the plants are photoperiodic, flowering in September, and is almost but not quite matched by robust C. missouriense and essentially matched by some C. Bushianum. If Richards 3827 from waste ground, Athens, Georgia, Nov. 2, 1927 (Penn.) represents the same taxon in fruit, however, then it is neither of these.

Nothing more can be done with the material at hand. It fairly well matches European material called *C. amaranticolor*. Observation of it with reference to photoperiodic response may be rewarding.

46. C. Berlandieri Moq.

The most abundant and widespread species of Chenopodium in western North America, at least in the plains region and possibly excepting the pratericola group, C. Berlandieri has, until the work of Aellen, generally gone unrecognized in whole or in part. In general aspect and in size and shape of fruit it resembles C. album but is sharply set off from that by the prominently reticulate pericarp (Fig. 9). When fruit is not present the characters of usually thicker leaves, broadly keeled sepals, and the definite style base serve to distinguish it, even though the first two characters are somewhat variable and the third is a bit difficult to apply. Almost always, even in only partially mature fruit, the pericarp shows a yellow area around the base of the style and there is a much more noticeable progression of flowering from tip to base of the plants than in C. album.

Associating it in any way with *C. album* does violence to phylogeny. There can hardly exist a reasonable doubt, after a study of the material, that the *C. Berlandieri* complex has come up from the south, in a manner comparable to that recently so competently elaborated for the *Prunus serotina* phylad by McVaugh (11), while *C. album* is of Old World origin.

Disregarding the primary origin of the group, the reticulate-seeded chenopods constitute an assemblage of related taxa in which speciation has taken place in the relatively arid and montane areas of Central America and western North and South America. A postulate of the origin and ramifications of the *Berlandieri* complex in North America is readily arrived at from representative series of collections, with the works of Aellen, and Aellen and Just, as a background.

In the region of eastern Texas and northeastern Mexico are the relatively small-seeded (1.0–1.3 mm.) and small-leaved (2.0–3.0 cm. long) forms with a terminal bractless proliferation of the inflorescence, included by the cited authors in ssp. yucatanum Aellen and ssp. eu-Berlandieri Aellen. Progressing eastward through eastern Texas and the other Gulf states to Florida, the northward limits undetermined but surely not extensive, is ssp. Boscianum (Moq.) Aellen, with the same small seeds, more sharply serrate small leaves (Aellen and Just say 0.5 cm. wide, but the primary ones, though usually much smaller, are up to 2.5 cm. wide and occasionally 4.0 cm. long) and a well defined delicate, terminal, bractless inflorescence. This branch of the phylad presumably includes the progenitors of C. macrocalycium of the northern coastal plain.

Westward from the original plexus through the southwestern states and northern Mexico to southern California the tendency is toward plants with leaves becoming progressively larger, thicker, and with the terminal lobe of the leaves with parallel sides, a tendency previously noted in other species. This constitutes ssp. pseudo-petiolare Aellen, which reaches an extreme of its development on the west coast, and especially on some of the islands (Clokey 4817 from Santa Barbara) off the s.w. coast. (Aellen also provides var. californicum under ssp. Zschackei, with similar characters.)

Back again to the Mexico-Texas-Gulf area, this time moving northward and out onto the Great Plains, we follow the most extensive development of the complex, breaking with considerable abruptness, strongly suggesting specific segregation, from its postulated progenitors. The plants in this series are characterized by having generally larger seeds, strongly keeled sepals, usually thicker leaves, a more leafy inflorescence and a general aspect which has been understandably responsible for their inclusion under C. album. A large majority of these plants are included in var. Zschackei (Murr.) Murr. (ssp. Zschackei (Murr.) Zobel, of Aellen and Just's treatment), ranging from Texas, Arkansas, Missouri and Illinois, north to James Bay and the Mackenzie Basin, west to the coast, in a prolific and intricate series of variations, with names available for many.

Concerning C. Berlandieri as a whole we are content at present to suggest the following provisional and conservative treatment:

- 1. var. Berlandieri. Including C. Berlandieri ssp. yucatanum Aellen and ssp. eu-Berlandieri Aellen. Leaves membranaceous, 2.0-3.0 cm. long, more or less trilobed, the basal lobe often bipartite; seeds 1.0-1.3 mm. in diam.; inflorescence largely terminal and leafless. Texas and Mexico.
- 2. var. sinuatum Murr. comb. nov. C. petiolare Kunth var. sinuatum Murr. in Bull. Herb. Boiss., 2. ser., t. IV, p. 994. 1904. C. Berlandieri ssp. pseudopetiolare Aellen in Fedde Rept. Sp. nov. 26: 60. 1929. Leaves firm, with basal lobes, the terminal lobe elongate, toothed, the margins parallel to near the tip; seeds 1.0-1.3 mm. in diam.; inflorescence somewhat leafy. S.w. U. S. and Mexico.
- 3. var. **Boscianum** (Moq.) comb. nov. C. Boscianum Moq. in Chenop. enum. 21. 1940, in part. C. Berlandieri ssp. Boscianum (Moq.) Aellen in Fedde Rept. Sp. nov. 26: 61. 1929. Leaves membranaceous, 2.0-4.0 cm. long, rhombic-triangular, not prominently trilobed, conspicuously dentate or the upper becoming entire, especially abundant on the branches; upper portions of the inflorescence more delicate and becoming bractless; seeds 1.0-1.3 mm. in diam. East Texas to Florida.
- 4. var. Zschackei (Murr.) Murr. in Festschrift Aschers. 70. Geburtst., p. 227. 1904. C. Zschackei Murr. in Deut. bot. Monatschr. XIX: p. 39. 1901. C. Berlandieri Moq. ssp. Zschackei (Murr.) Zobel in Verz. Anhalt Phanerog. III, p. 70. 1909. Leaves thin to coriaceous, variable in size and shape but larger than other varieties; sepals usually strongly keeled; seeds 1.2–1.5 mm. in diameter; inflorescence leafy. Central and western U. S. and Canada, e. to Ont., Ill., Ark. and Tex. Also two collections seen from s.e. Pa. and one from s.w. Va.

As here considered, var. Zschackei is a variable taxon and includes the following named varieties and subspecies of Aellen and Just's treatment:

var. foetens (Ludwig) Aellen, smaller leaved, more farinose plants possibly grading into var. farinosum;

var. farinosum (Ludwig) Aellen, C. dacoticum Standley, and possibly better in the specific category;

var. californicum Aellen, similar to and perhaps better included with var. sinuatum;

ssp. Esauae Aellen, with often entire leaves and glomerate inflorescence (simulating C. album var. lanceolatum);

Fig. 7. Chenopodium strictum var. glaucophyllum: a, lower leaf; b, branch of inflorescence; c, fruit and calyx.

Fig. 8. Chenopodium macrocalycium: a, lower leaf; b, plant; c, fruit and calyx.

Fig. 9. Chenopodium Berlandieri var. Zschackei: fruit and calyx.

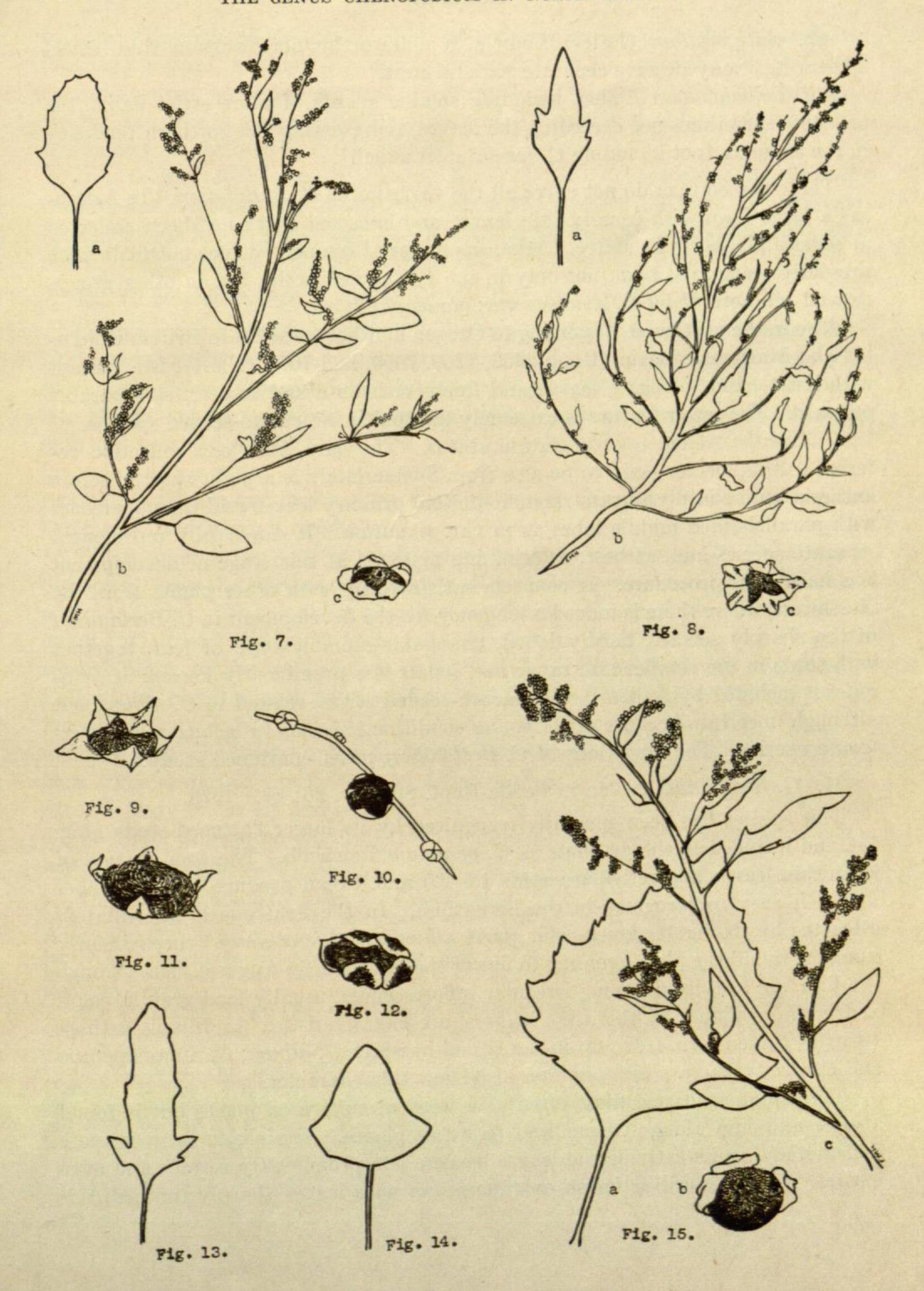
Fig. 10. Chenopodium Standleyanum: portion of branch of inflorescence with young and mature fruit.

Fig. 11. Chenopodium gigantospermum: fruit and calyx.

Fig. 12. Chenopodium hybridum: fruit and calyx.

Fig. 13. Chenopodium serotinum: lower leaf. Fig. 14. Chenopodium Fremontii: lower leaf.

Fig. 15. Chenopodium Bushianum: a, lower leaf; b, fruit and part of calyx; c, branch of inflorescence.



ssp. platyphyllum (Issler) Ludwig, a noteworthy northwestern thin-leaved series which may deserve separate varietal rank;

ssp. Ludwigianum Aellen, including smaller plants of more strict habit, the branches sometimes not exceeding the leaves, representing the northern tendency in the complex (not including C. ferulatum Lunnell).

These named taxa do not cover all the variation in *C. Berlandieri*. In Arkansas a large form with usually thin leaves and enlarged calyx has been collected at several places by Demaree. Arkansas material frequently does not fit in with presently recognized taxa, not only in the *Berlandieri* series but in other groups as well (cf. note under *C. strictum* var. *glaucophyllum*).

Also in the northwest, Wyoming to Oregon and northward into British Columbia and Mackenzie Basin (Raup 2263, 2269, 7060, and 7079 (NY.)), is a variant with strict habit, elongate leaves and finely reticulate and sometimes separable pericarp. The latter feature is extremely unusual in reticulate-seeded species.

C. Covillei Aellen is of uncertain status. The only American collection referred to this species (said to be also from Switzerland) is a plant shortly before anthesis, with sharply serrate rhombic-deltoid primary leaves and the upper ones with parallel-sided middle lobes as in var. sinuatum. It can hardly represent a separate species and, at best, determining material at this stage of development is a hazardous procedure. It connects satisfactorily with other plants from the Northwest, where there is indeed a tendency for the development in C. Berlandieri of the sharply serrate, hardly lobed, triangular-rhombic type of leaf, together with seeds in the smaller size range and sepals less prominently keeled. C. Covillei is included by Aellen in the smooth-seeded series, related to C. album, but although uncertain because of its young condition it seems to belong to the Berlandieri series. The variations of C. Berlandieri merit continued study.

47. C. Bushianum Aellen in Fedde Rept. Sp. nov. 26: 63. 1929.

This species has been generally recognized by its larger flattened seeds (Fig. 15) and included in the manuals as *C. paganum* Reichenb. The combination of large thin leaves and reticulate seeds 1.5–2.0 mm. broad produced in September makes it easy to recognize in the herbarium. In the field one is immediately attracted by the lighter green color (than album and missouriense) through early summer; by all the plants coming to flower the last week in August; then, through the Fall, the heavily drooping irregular inflorescences, usually lead-grey in color, and often on plants by this time leafless, are characteristic. In Illinois a thick (brittle) leaved form turns up in the region in which *C. album*, *C. Standleyanum* and *C. strictum* var. glaucophyllum also show this character.

C. Bushianum occurs most often as a weed of cultivated places but is found also in alluvium along streams and in waste places. The shade form is more delicate, and in its extreme the leaves become less prominently serrate and even entire. Aellen described forma acutidentatum with leaves sharply toothed, this

occurring throughout the range. Var. cinerascens Aellen refers to the ordinary late-season stage in which the inflorescence takes on its characteristic lead-grey color. It does not have varietal significance. The stems often become red-striped, but this is a characteristic of any of the species that flower later in the season and are exposed to direct sunlight.

It is widely distributed in eastern North America; Massachusetts, Quebec, Ontario and North Dakota, south to Virginia and western Missouri. It probably exceeds these limits somewhat, but its relatively greater abundance in cooler regions indicates it may not be common south of the range given.

48. C. macrocalycium Aellen in Fedde Rept. Sp. nov. 26: 123. 1929.

Closely similar to some forms of *C. Berlandieri*, this species with its characteristic coastal distribution is distinguished by its generally thinner, coarsely but sparingly toothed, rhombic, lower leaves reduced upward to conspicuous lanceolate bracts; by its spreading pyramidal habit, less conspicuous or absent style base and enlarged calyx (Fig. 8). It is clearly separable from *C. album* and var. lanceolatum, to which collected material has most often been assigned, by its reticulate pericarp and lower leaves with little more than basal lobes, rather than being sinuate-dentate throughout.

Three possibilities as to its relationships suggest themselves: (1) it may have developed from the northeastern branch of the Berlandieri var. Zschackei complex (unlikely), (2) it may be a coastal development from the inland C. Bushianum, (3) (most likely) it may be a northward development, following the coastal plain, of the southeastern extension of C. Berlandieri var. Boscianum. Collections from the southern coastal plain, North Carolina to Florida, may throw light on this postulate and might even connect the groups varietally. Virginia material cited by Aellen under C. Berlandieri ssp. Boscianum probably belongs here. The material is in flower and determination is uncertain but the inflorescence is leafy to the tip and entirely suggestive of macrocalycium. Godfrey and Tryon 1562, Charleston Co., S. C. (US.) is also doubtful but probably belongs with C. macrocalycium.

The following citations indicate its distribution: CANADA: Newfoundland. Woody Island. Fernald, Long and Fogg 230 (leaves not typical) and 231 (typical), Sept. 1926 (both Penn. and PH.). New Brunswick. Youghal. Adams, Aug. 29, 1937 (OTB.). Prince Edward Island. Port Borden. Bassett 1689, Aug. 1950. Nova Scotia. Yarmouth Co.: Pembroke Shore. Fernald and Linder 21139, Oct. 1920 (PH.). Lunenburg Co.: Chester. Zinck 638, Aug. 1940 (NY., OTB.).

U.S.A.: Maine. York Co.: Ocean Park. Moldenke 6258, Aug. 1931 (NY.). Massachusetts. Rockport, Cape Ann. Bartram, Sept. 13, 1908 (PH.). Truro, Cape Cod (type locality). Reese, July 31, 1944 (PAC.). Barnstable Co.: Barnstable. Knowlton, Sept. 16, 1916 (PH.). Marion. Vail, Sept. 1888 (NY.). Duke Co.: Pasque Island. Fogg 3757, Aug. 1928 (Penn.). Martha's Vineyard. Seymour 1188, Sept. 1916 (NY., PH.). Nelson and Nelson 2558, Sept. 1937 (Ill.). Nantucket Island. Bicknell, Sept. 16, 1899, Aug. 4, 1906, Sept. 16, 1907, and 4018, Aug. 1909 (all NY.). Harshberger, Sept. 1, 1914 (Penn.). Rhode Island. Block Island. Fernald, Long and Torrey 9433, Sept. 1913 (NY., PH.). "W.B." (?), Aug. 9, 1929

(Ill.). NEW YORK. Long Island. Ferguson, July 27 and Aug. 28, 1920; 980, 1921; 3211 and 3234, 1924; 5197, 1926; Kearney, Oct. 6, 1894; Taylor 1543, 1903; Bicknell 3982, 1909 and 4014, 1914; Gilly 240, 1939; (all NY.). Bicknell 4010, 1914 (PH.). Staten Island. Hollick and Britton, June 27, 1916 (NY.). Harlem. Leggett, Fall of 1866 (NY.). Harlem River, Bicknell 3985, 1891 (NY.). Bronx Co.: Bronx. Moldenke 20566, Oct. 1949 (NY.). New Jersey. Bergen Co.: Oradell. Mackenzie 2492, Sept. 1906. New Durham. Mackenzie 4501, Oct. 1909. Ocean Co.: Barnegat Bay Beach. Harshberger, July 21, 1900 (NY.). Cape May Co.: Ocean City. Eckfeldt, Aug. 9, 1912; Reeds Beach, Ludwig 563, Sept. 1937; Town Bank, Ludwig 603, Oct. 1937; Green Creek, Ludwig 643, Oct. 1937 (all Penn.). Delaware. Kent Co.: Sandy beach, Persimmon Hummock. Larsen 1057, Sept. 1935 (Penn.) (somewhat uncertain). North CAROLINA. Carteret Co.: Sand banks near Beaufort. Lewis 122, 1906 (NY.). INDIANA. Howard Co.: Ek, Sept. 21, 1940 (NY.). Where the ranges of macrocalycium and Berlandieri overlap it could be difficult to separate the former from thin-leaved forms of the latter. The Ek plant, although representing an isolated station and within the range of C. Berlandieri, is such characteristic material that one can have no hesitation to assign it to C. macrocalycium; the occurrence of Coastal Plain species in the Upper Mississippi-Great Lakes region is well known. Illinois. Champaign Co.: 8 mi. n.e. of Rantoul. Franklin, July 30, 1949 (Ill.). Atypical in appearance, in flower and very young fruit, this plant matches well the doubtful Delaware plant. No other disposition of the two presents itself.

As is the case with various other taxa in the genus *Chenopodium*, recognition of *C. macrocalycium* and study of its variations at the limits of its range may throw additional light on its specific relationships.

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The illustrations accompanying this article were drawn by Miss E. M. Hitch (now Mrs. Allen M. Woodruff). As figured the fruits are about 6 times natural size.