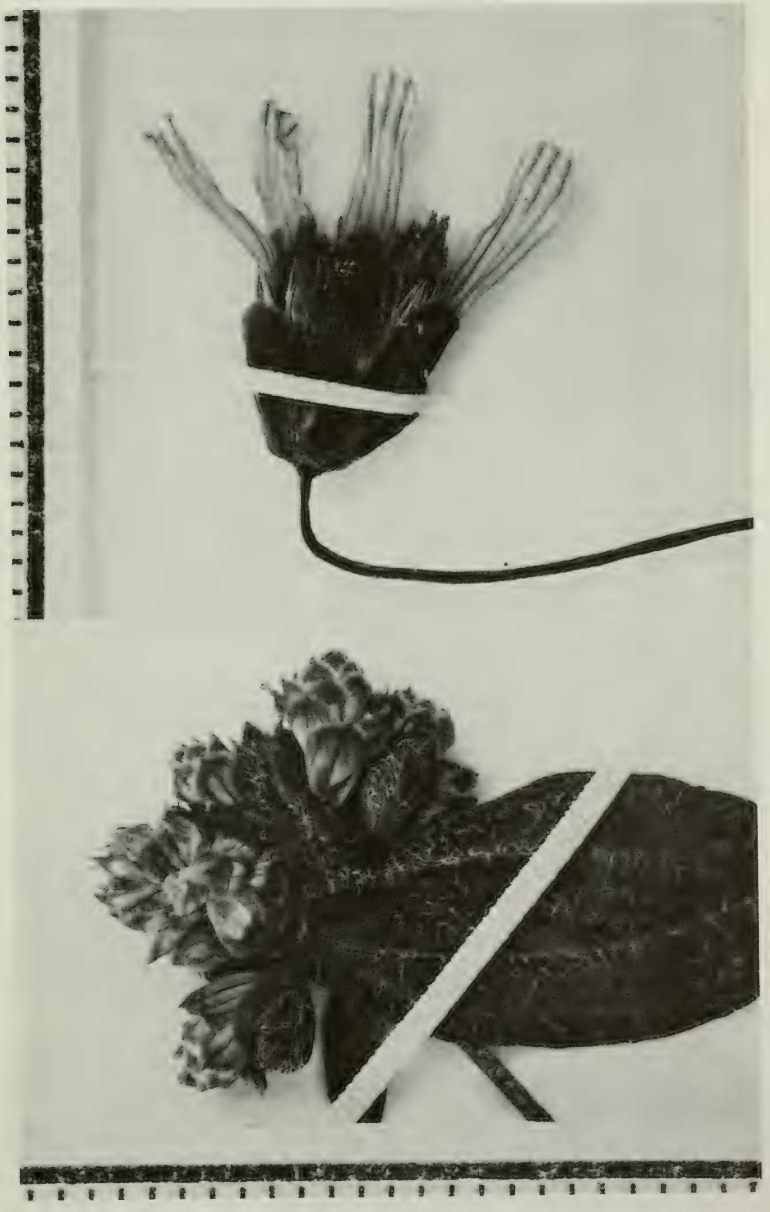
Ichthyothere davidsei H. Robinson, Isotype, United States National Herbarium.



Enlargements of heads. Top: *Calea bishopii*. Bottom: *Ichthyothere davidsei*.

LOASACEAE OF THE CHIHUAHUAN DESERT REGION

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The Chihuahuan Desert (CD) has been known to contain several species of Loasaceae that appear to be pivotal to understanding relationships among their near relatives from regions to the north and west. Previously these CD species have been represented only by scanty specimens, insufficient in detail to be useful in systematic studies. The project to produce a flora of the CD (Chihuahuan Desert Flora, M.C. Johnston and J. Henrickson, in preparation) has produced such excellent and critical collections of Loasaceae that we have not only been able to write a sound treatment of the family for the flora but also can now extend the earlier work on Eucnide (Thompson and Ernst, 1967) and clarify relationships within two taxonomically difficult species groups of Mentzelia; sect. Mentzelia and sect. Bartonia. Chromosome numbers are reported for 37 populations of 11 species, of which seven species were previously unknown cytologically. Distributions of CD endemics are given in detail and one new species of Eucnide is described. Voucher specimens are filed in the herbaria of the University of Texas (TEX), Sul Ross State University (SRSC), and the University of California, Los Angeles (LA). Chromosome counts have been made from aceto-carmine squashes of microsporocytes in meiosis. We are grateful to Marshall Johnston, James Henrickson, Jim Weedin, and Donald Pinkava for the opportunity to study their collections of Loasaceae from the Chihuahuan Desert Region (CDR).

EUCNIDE:- The most recent reviews of this genus (Waterfall, 1959; Thompson and Ernst, 1967) had no specimens of Eucnide from Durango and very little material from western Coahuila, so both treatments failed to understand and recognize E. floribunda S. Watson, placing it as a synonym of E. lobata (Hook.) A. Gray. Recent collections include a new species of Eucnide from Durango and provide abundant material of E. floribunda so that it can be recognized as a distinct endemic of the CD.

EUCNIDE DURANGENSIS Thompson and Powell

Herbae perennes. Laminae foliorum 4-7 cm longae late ovatae vel suborbiculares cordatae breve lobatae dense pubescentes margine dentatae. Inflorescentiae pauci- vel multiflorae;

corolla alba lobis effusis 12-16 mm longis; antherae excerae aureae conspicuae, stigma 1-2 mm longa. Fructus hemisphaericus vel oblongus 8-12 mm longus, pedicelli per anthesis ad 2 cm longi demum ad 5 cm longi.

Plants herbaceous perennials, up to 0.7 m tall and 1 m across, pubescent with simple, smooth, needle-like hairs up to 2 mm long and with shorter, reflexly barbed hairs up to 1 mm long; leaf blades rounded to broadly ovate, the largest 5-7 cm in diameter, cordate at base, irregularly and shallowly lobed, the petioles about as long as the blades; calyx lobes lanceolate, 5-7 mm long; petals white, yellow at base, ovate, 16-18 mm long, 10 mm wide, fused to the very short filament tube, the petals spreading at anthesis; stamens about 50, golden yellow, the filaments 12-14 mm long, all of those in a flower about the same length, the anthers about 1 mm long; style and stigma 11-13 mm long, the stigma up to 2 mm long; capsule ovate-oblong, 7-10 mm long, about 4-5 mm wide, pedicels up to 2 cm long in flower and elongating to be twice as long in fruit; seeds oblong, about 0.5 mm long, longitudinally ribbed; chromosome number n=21.

Holotype: James Henrickson 12405, MEXICO. Durango, ca. 14 air mi WSW of Torreón, 2 mi W of Hwy 40, in lower canyon on open vertical limestone cliff, 3800 ft., on road to Microondas Est. Sapioris. Near Lat. 25° 18' N, Long. 103° 43' W. 14 Aug 1973 (TEX, isotype LA).

Additional collections examined: MEXICO. DURANGO. 12 mi S of Rodeo in igneous roadcut on steep grade of Highway 45, 15 Aug 1967, Sikes and Babcock 366 (TEX); 14.7 mi S of Rodeo, McGill, Brown, Pinkava 9343 (ASU); Estación Microondas "Sapioris" ca. 30 km SW of Gomez Palacio on highway towards Durango. Lat. 25° 24' 30" N; Long. 103° 43' W, elevation 1400-1500 m, 25 Mar 1973, Johnston, Wendt, Chiang 10417. COAHUILA. ca. 27 (air) mi SE of Torreón, 9.6 (road) miles SW of La Rosita, Sierra de Himilco, 5700 ft, near Lat. 25° 12' N; Long. 103° 16' W, Henrickson 13223b (LA, TEX).

Eucnide durangensis is known from elevations of 1200 to 1700 m, growing on limestone cliffs or igneus roadcuts with Larrea, Fouquieria splendens, Agave lechequilla and A. falcata. It flowers in March, August and September, apparently whenever rains are favorable.

Eucnide durangensis is most similar to E. lobata and E. floribunda but is distinct in having the petals white and the base of the petals and the stamens, thus the center of the flower, golden yellow. The bases of the petals are narrow and thus do not overlap. In E. lobata and E. floribunda the entire corolla and androecium are golden yellow and the petals are broad and overlapping at the base. Eucnide floribunda is distinctive in this group by its nearly entire, sparcely pubescent leaves and

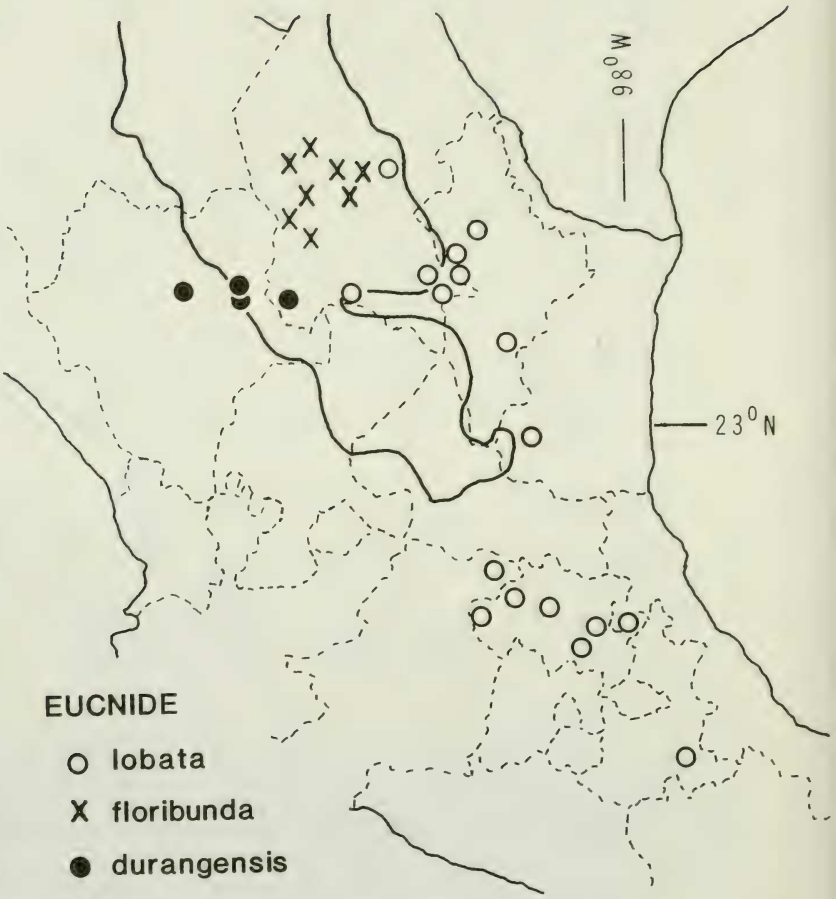

Figure 1. Distribution of Eucnide lobata, E. floribunda, and E. durangensis. The solid line showing the approximate limit of the Chihuahuan Desert is after M.C. Johnston 1977.

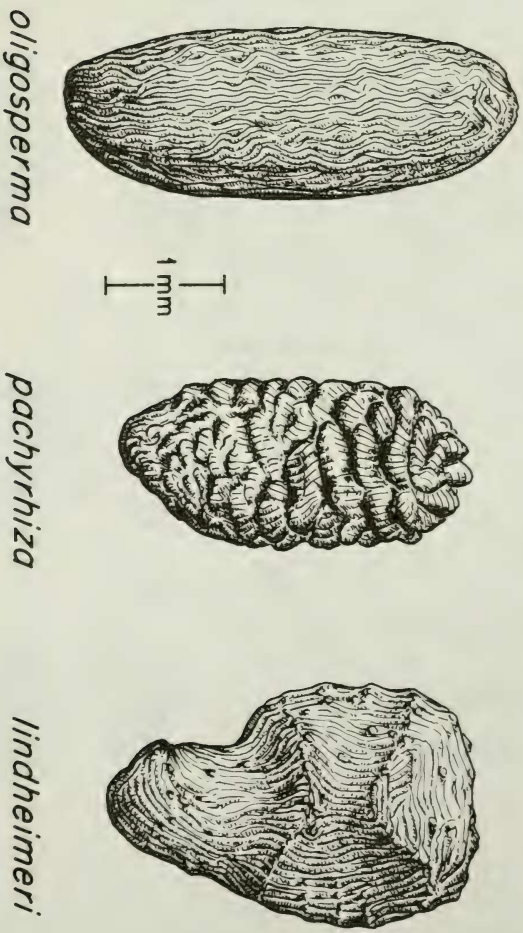

Figure 2. Drawings of the seeds of Menzelia oligosperma, M. pachyrhiza, and M. lindheimeri.

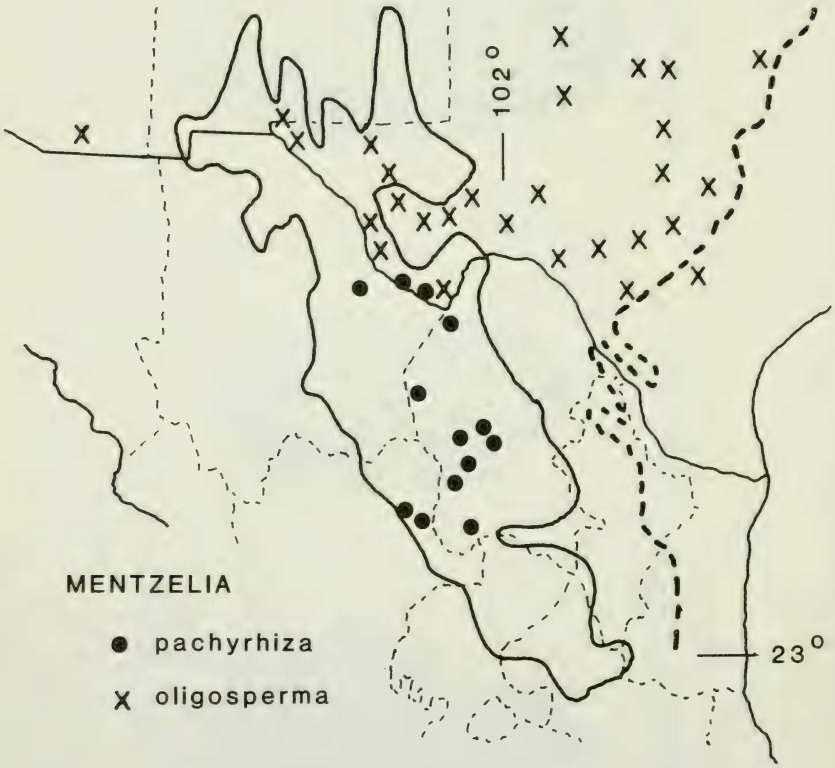

Figure 3. Distribution of Mentzelia pachyrhiza and the southern portion of the distribution of M. oligosperma.

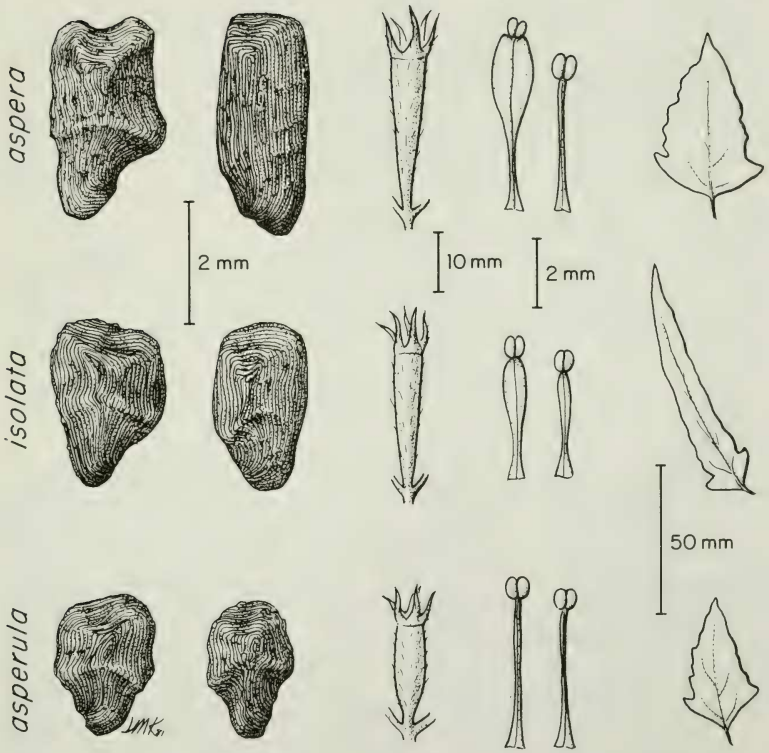

Figure 4. Morphological features of Mentzelia aspera, M. isolata, and M. asperula. Left to right the drawings are: uppermost and lowermost seed in capsule; mature capsule; outer and next inner stames; cauline leaves.

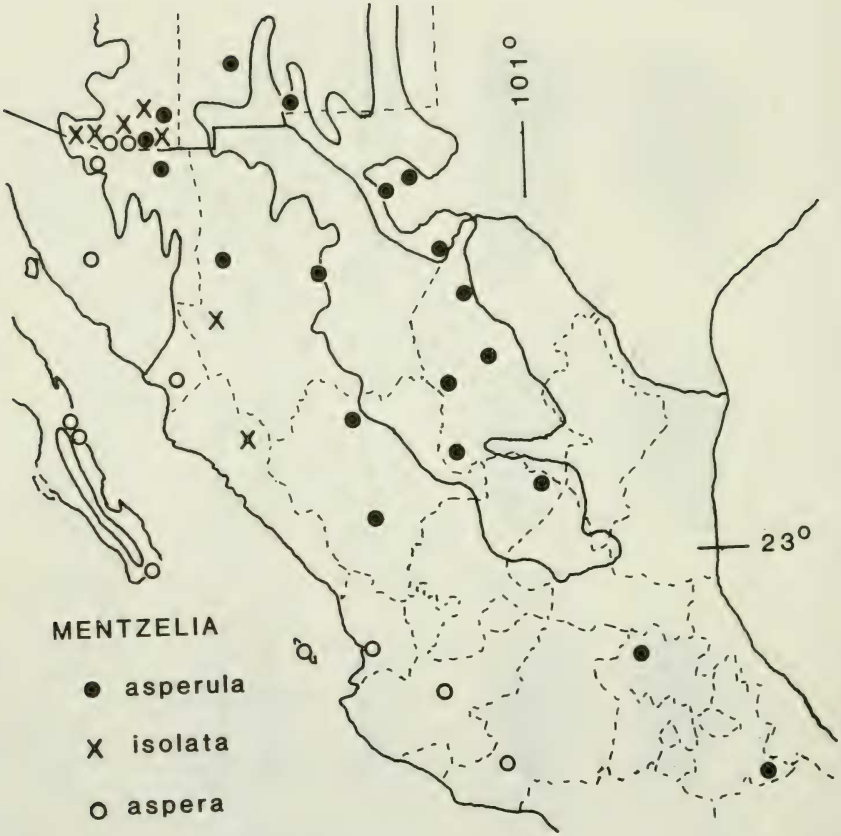

Figure 5. Distribution of Mentzelia asperula, M. isolata, and the northern portion of the distribution of M. aspera.

long (3 mm) stigma. In both E. lobata and E. durangensis the leaves are densely pubescent and shallowly lobed, and the lobes are coarsely dentate. Recent collections, particularly those of Pinkava from the Cuatro Ciénegas area, confirm the morphological and geographical distinctness of E. floribunda and confirm the wisdom of Watson who considered it to resemble, but to be distinct from, E. lobata.

Eucnide durangensis and E. floribunda are species of the CD while the closely related E. lobata occurs on the eastern boundary of the desert and extends southward along the eastern slope of the Sierra Madre Occidental from Monclova, Coahuila to Puebla (fig. 1). These three closely related species are allopatric, but the ranges of E. floribunda and E. lobata converge in the area between Monclova and Cuatro Cienegas. Collections in this region should be critical to the question of the genetic distinctiveness of these two species.

Eucnide floribunda S. Wats. was described from the collection Edward Palmer 832 and the locality given as "San Lorenzo de Laguna, 75 miles southwest of Parras." The direction given is incorrect, for McVaugh (1956) has shown that Palmer traveled northwest, not southwest, out of Parras and reached as far north as Acatita (Lat. 26° 30' N). Modern collections place the southern limit of E. floribunda in this area and it would have been here that Palmer collected his specimen.

We have grown one individual of E. durangensis (Thompson 77003) from seeds taken from Johnston et al. 10417. Numerous microsporocytes of this plant were observed to have 21 pairs of chromosomes. This plant was crossed with E. lobata as follows: lobata (T 3298) original seed from Waterfall 1532 (F) Monterrey female X durangensis (T 77003) male. Only one F_1 individual was grown to maturity. This plant (T 78002) was intermediate with pale cream corollas most similar to the pollen parent and very different from the golden yellow corollas of the seed parent. This hybrid grew vigorously but set no seeds when selfed nor when backcrossed with lobata pollen. Chromosome pairing could not be analyzed in detail because the chromosomes were "sticky" but pairing was not regular and univalents were observed in many cells. Less than 1% of the pollen of this hybrid stained with cotton-blue in lacto-phenol and there was much micropollen. We interpret the sterility of this F_1 hybrid to support the specific distinctness of E. durangensis and E. lobata.

MENTZELIA sect. MENTZELIA: Mentzelia pachyrhiza I. M. Johnston is an endemic of the CD, morphologically similar to M. oligosperma Sims to the north and M. grisebachii U. and G. of Argentina. These three species are distinct from the other species of the section by having woody, cylindrical, sessile capsules with only 2-3 seeds. The shape and surface texture of the seeds of these three species also separate them from the other

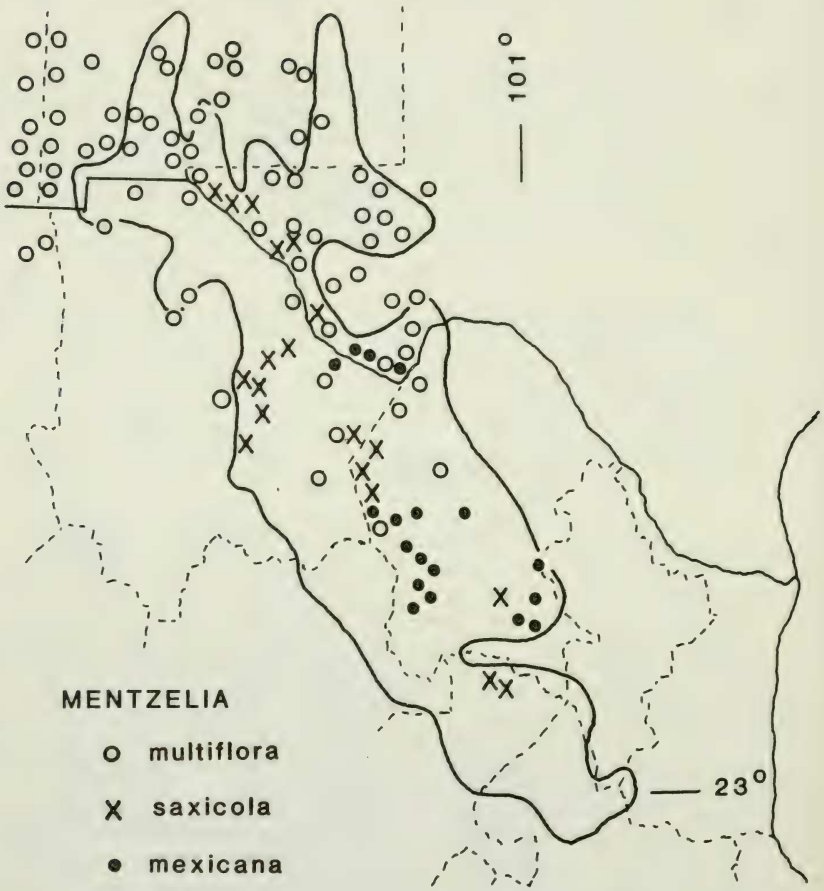

Figure 6. Distribution of Mentzelia saxicola and M. mexicana and the southeastern portion of the distribution of M. multiflora.

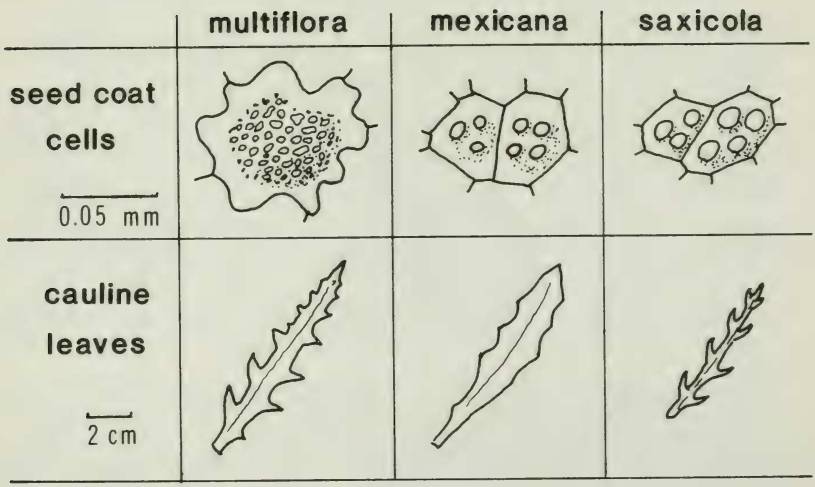

Figure 7. The morphological differences between Mentzelia multiflora, M. mexicana, and M. saxicola. The drawings of cells of the seed coats are tracings from SEM photographs made at 480X.

species of the section. Most of the species of sect. Mentzelia have seeds very similar to those of M. lindheimeri while seeds of M. oligosperma are unique in the genus in having parallel sides and lacking the prominent papillae. The seeds of M. pachyrhiza and M. grisebachii are intermediate between M. oligosperma and M. lindheimeri in shape and surface but are distinctive in having prominant, transverse folds (fig. 2). The thick roots of M. pachyrhiza, emphasized in the original description, are not a distinguishing characteristic, for such roots are present in most, probably all, of the perennial species of this section.

Mentzelia oligosperma, M. pachyrhiza, and M. grisebachii are all n=11, the only known occurrence of this chromosome number in sect. Mentzelia. The chromosome number of M. oligosperma was reported as n=11 (Thompson and Ernst, 1963) and we now report these additional counts; all n=11: TEXAS. Bexar Co.: Alamo Heights, Weedin 864 (SRSC): Brewster Co.: Pine Canyon, Big Bend Nat'l. Park, Powell, Powell, Weedin, Campbell 3233 (SRSC); Alpine, Weedin 907 (SRSC); Glass Mt., Powell 3329 (SRSC). Culberson Co.: Panther Canyon, Apache Mts., Powell 3376 (SRSC). Terrell Co.: 44 mi S of Sheffield, Powell 2762 (SRSC). A specimen of M. grisebachii (Turner 9208, ARGENTINA. Prov. Catamarca, TEX) has been annotated by John Bacon as having n=11. We now report the first counts of M. pachyrhiza, all n=11: TEXAS. Brester Co.: near Lajitas, Powell 2393 (SRSC); Big Bend Nat'l. Park near west entrance, Thompson 3727 (LA). Presidio Co.: 13 mi S of Redford, Powell, Powell, Weedin 2869 (SRSC).

Mentzelia oligosperma and M. pachyrhiza occur in different geographic areas as shown by the map in fig. 3 and where their ranges come together they occur in different habitats at different elevations. Mentzelia oligosperma grows with Larrea at only a few stations, as in Terrell Co., Texas, 6.7 mi E of Sanderson, Raven and Gregory 19201 (LA), but in west Texas and southwest New Mexico it occurs in juniper woodland, above the Larrea zone. In the Big Bend region of West Texas, where M. oligosperma and M. pachyrhiza occur in the same geographic region, the two species are separated in elevation with only M. pachyrhiza occurring with Larrea, usually below 1100 m and well below the juniper zone. Mentzelia pachyrhiza extends south in the CD to Lat. 25° N, growing at elevations between 775 and 1300 m with Larrea and Fouquieria.

In addition to the geographic, habitat, and seed differences between M. oligosperma and M. pachyrhiza the two species are different in petiole length and flower size. The leaves of M. oligosperma are sessile whereas those of M. pachyrhiza have petioles about 5 mm long. Flower size can be conveniently represented by one dimension, length of the outer filaments. In M. oligosperma flower size is uniform throughout its range with outer filaments 8-9.5 mm long. In M. pachyrhiza there is a gradient in flower size, with the smallest flowers (outer filaments 6-7 mm long) in the north and the largest flowers

(outer filaments 8-9 mm long) in the south. Thus in the region of overlap, M. oligosperma and M. pachyrhiza differ in flower size, with M. oligosperma having the larger flowers.

We have seen very little material of the South American M. grisebachii but it is in all respects very similar to M. pachyrhiza. In addition to the morphological similarities the two species are both associates of Larrea divaricata in desert habitats and the two species appear to add another example to the biogeographic pattern exemplified by Larrea divaricata, Mentzelia albescens, etc. (Raven, 1963).

Whereas most species of Mentzelia sect. Mentzelia are herbaceous perennials there are three summer annual species in the section, one of which, M. asperula Wooton and Standley occurs in and around the CD region. Because its two close relatives, M. aspera L. and M. isolata Gentry have been confused with M. asperula we have studied all three species to determine the status of the CD region plants. Mentzelia aspera is a widespread tropical weed and M. isolata occurs in the mountains between the CD and the Sonoran Desert. The three species occur together in only one geographic area, southeastern Arizona, where their sympatry has led to taxonomic confusion but provides an opportunity to determine the distinctiveness of the three species. All three species have small flowers, the petals 7-9 mm long and the longest filaments 5-6 mm long. We have grown collections of each species and find all self-pollinating and self-compatible.

The morphological differences between M. asperula, M. aspera, and M. isolata are in the leaves, outer filaments, capsules and seeds. The differences are shown in fig. 4, to which comments on the relationship between seed shape and position in the capsule and the number of seeds per capsule must be added. In M. asperula all of the seeds in a capsule are similar in shape to each other and to the seeds of most species of sect. Mentzelia (except M. oligosperma, M. pachyrhiza, and M. grisebachii). In M. aspera, on the other hand, the uppermost and lowermost seeds in a capsule differ in shape as shown in fig. 4. The shape of the lowermost seed appears to be determined by its confinement in the very narrow, somewhat woody base of the capsule. This condition in M. isolata is intermediate between M. asperula and M. aspera in that the lowermost seed is only slightly different from the uppermost and the capsule base is more rounded and less woody than in M. aspera. The seeds from the upper portion of the capsule of M. isolata are indistinguishable in shape from the seeds of M. asperula. In M. asperula and M. isolata there are 8-12 seeds per capsule whereas in M. aspera there are only 5-6 seeds per capsule. The lowermost seeds in the woody basal portion of the capsule of M. aspera are similar to the seeds of M. oligosperma where there are only 2-3 seeds in an entirely woody capsule. Thus the unusual seeds and capsules of M. oligosperma are connected by a series

with the general seed and capsule state characteristic of most species in sect. Mentzelia.

The geographic distributions of M. asperula and M. isolata and the northern portion of the range of M. aspera are shown in fig. 5. The northern station for M. aspera is in the Nogales area of southeastern Arizona where it occurs in moist sites at the lower elevations. We have determined the chromosome number of M. aspera as n=10 from material collected in ECUADOR, Galápagos Islands, Academy Bay, Isla Santa Cruz, Wiggins 18336 (LA, CAS).

Mentzelia isolata Gentry was described from a single collection, MEXICO, Sierra Surotato, Sinaloa, Gentry 6577 and has not been studied since the original description. It is now apparent that this species should include the narrow-leaved annuals in southeastern Arizona, which have previously been identified as either M. aspera or M. asperula and have caused a confusion of those two very distinct species. Mentzelia isolata occurs only in the mountains south of the Cochise filter barrier (Morafka, 1977) between the Sonoran and Chihuahuan deserts. We have not had the opportunity to observe M. isolata and M. aspera where they occur at the same collection localities such as at Patagonia, Arizona. Mentzelia isolata usually occurs below 1500 m, often with oaks but usually below junipers and pines. We have determined the chromosome number of M. isolata as n=10: ARIZONA, Patagonia, garden voucher specimen Thompson 3646 (LA) grown from seeds of a collection T. Zavortink s.n., 21 Sep 1970 (LA).

Mentzelia asperula usually occurs above 1300 m, usually with junipers and pines. In southeastern Arizona, where the distributions of M. asperula and M. isolata overlap the two species are separated by elevation with M. asperula above M. isolata. We have determined the chromosome numbers of plants from three populations of M. asperula. Two populations in the northwest portion of its range are both n=20: ARIZONA. Cochise Co.: N end of Mule Pass Tunnel, just N of Bisbee, Thompson 3724 (LA); and TEXAS. Jeff Davis Co: 13 mi N of Alpine, Thompson 3724 (LA). The third population of M. asperula, in the south-central portion of the range is n=10: ZACATECAS. 24 mi NE of Concepción del Oro, garden voucher Thompson 3738 (LA) grown from seed collected by James Henrickson, 9 Dec 1975, a recollection of Henrickson 6265 (LA, TEX). We are unable to detect morphological differences between our known diploid and tetrapoid voucher specimens that will separate the other collection into two groups. Where the ranges of the very similar species M. asperula and M. isolata overlap they have different chromosome numbers.

Mentzelia lindheimeri Urban and Gilg is an herbaceous perennial with an enlarged root and elongated stems that are often scandent in shrubs when they may be up to 2 m long. The flowers are medium in size for sect. Mentzelia with the petals 9-12 mm long. The longest stamens are 9-10 mm long and the stigma

is only 1 mm above the anthers. The flowers open soon after sunrise and close at midday.

We have determined chromosome numbers of n=10 in two populations of M. lindheimeri: TEXAS. Presidio Co.: plants grown from tubers collected on Chianti Peak, 6000-6500 ft, Butterwick and Lott 3914 (LA, SRSC); Jeff Davis Co.: plants grown from seed collected along Limpia Creek, just N of Fort Davis, 4900 ft, Thompson 3722 (LA, SRSC). The Fort Davis plants were self-compatible and self-pollinating, setting seed when left undisturbed in an insect-free screenhouse. In the natural population the plants were growing in a small flood-plain of Limpia Creek in very deep, sandy loam and in riparian vegetation with Salix, Populus, Juglans and often scandent in Baccharis glutinosa. No individuals of M. lindheimeri were found on adjacent dry slopes with Juniperus, Yucca, and Opuntia but the annual, M. asperula was encountered in this habitat. Mentzelia lindheimeri is abundant in eastern Texas, where its preferred habitat is more widespread, and ranges to west Texas and Cochise Co., southeastern Arizona. In the west it usually occurs at elevations above 1500 m.

Mentzelia hispida Willd. is an herbaceous perennial with an enlarged root and the largest flowers in sect. Mentzelia, with petals often 30 mm long. The stamens are in two distinct series, the outer 10 up to 25 mm long and the cluster of inner stamens about 10 mm long. The style is long, positioning the stigma above the longest stamens. We have determined the chromosome number as n=10 from one collection: MEXICO, HIDALGO, 5 mi NE of Buena Vista on road from Pachuca to Mezquititlan, 1350 m, garden voucher specimen Thompson 3389 (LA) grown from seed of the collection Breedlove 7204 (LA). The garden plants of this collection were self-incompatible and the flower opened soon after sunrise and closed about midday. These garden plants were visited and pollinated by a bumble bee (Bombus sp.). Mentzelia hispida ranges more or less continuously from southern Chihuahua to Oaxaca, usually above 1200 m elevation. It has been collected at outlying stations in northeastern Sonora (White 4654, ARIZ) and in southwestern New Mexico (Corodado (sic) Nat'l. Forest, north of Animas, Goodding s.n., 18 Sep 1937, ARIZ). The locality as given is probably in error because Colorado Nat'l. Forest is south of Animas.

MENTZELIA section BARTONIA:-- This section is taxonomically the most difficult group in Mentzelia. All of its 40 species occur in the United States, a few of them range into Mexico and one, M. albescens (Gill. and Arn.) Griseb. is amphitropical, occurring also in Argentina and Chile. Two species of this section, M. mexicana Thomps. and Zavor. and M. saxicola Thomps. and Zavor., are endemic to the CD. They have been known from relatively few collections and these have been confused with the widespread M. multiflora (Nutt.) Gray. New collections have added greatly to our understanding of these three species in the CDR.

Mentzelia multiflora is geographically and ecologically the most widespread species and it is also morphologically the most variable. It ranges from Wyoming in the north and the northern Sonoran Desert in the west into the CDR as far south as Lat. 27o in Coahuila near the Chihuahuan border. A chromosome number of n=9 has been determined for many populations, some reported from the northern portion of the range (Thompson, 1963), and now n=9 is reported from the following populations in the southeastern range of the species: TEXAS. El Paso Co.: Hueco Tanks State Park, Powell and Powell 3001 (SRSC). Presidio Co.: upper Pinto Canyon, Weedin 310 (SRSC); near Presidio, Thompson 3745 (LA). Hudsbeth Co.: Dell City, Powell, Powell and Weedin 2847 (SRSC). Jeff Davis Co.: jct. Hwys. 118N and 1837, Weedin 333 (SRSC). Ward Co.: Pecos, Thompson 2088 (LA). CHIHUAHUA. El Sueco, Thompson 3732 (LA).

In the CDR, M. multiflora occurs above 1400 m with only occasional stations at lower elevations. Along the Rio Grande M. multiflora ranges downriver as far as Presidio, elevation 800 m, where it may be a waif. Thus M. multiflora occurs in the northern and higher margins of the CD, but in the central portion of the desert it is replaced geographically by the gypsum endemics, M. mexicana and M. saxicola (fig. 6).

Mentzelia saxicola occurs at elevations between 800 and 1900 m and M. mexicana between 600 and 1300 m. The co-occurrence of these two species with M. multiflora is less than suggested by general geographical and elevational ranges for in specific areas M. saxicola and M. mexicana occur below M. multiflora, although the elevation of the turnover point varies with latitude, rainfall, and exposure. Mentzelia saxicola and M. multiflora occasionally occur as adjacent populations but we know of no such occurrence of M. multiflora with M. mexicana.

Some of the differences between these three CDR species of Mentzelia sect. Bartonia are presented in fig. 7. Observations of individual cells of the seed coats of these species made at a magnification of 200X with a compound light microscope show M. saxicola and M. mexicana to be very similar to each other but very different from M. multiflora. These cells in M. multiflora are twice as large as in M. saxicola and M. mexicana. The common (radial) walls of adjacent cells are sinuous in M. multiflora and the raised, central portion of the outer surface wall has numerous small, irregularly shaped papillae. In M. mexicana and M. saxicola the common walls of adjacent cells are straight and there are only 3-5 large papillae. When viewed with a hand lens (15X) the seeds of M. multiflora appear rough or papillose while those of M. mexicana and M. saxicola appear relatively smooth. The branching pattern differences between these three species are very conspicuous in plants flowering for the first time, that is, having just bolted from the primary rosette. Mentzelia multiflora is erect, usually over 0.5 m tall and often reaching a height of