

TAXONOMIC STATUS OF *BARROETEA GLUTINOSA* (ASTERACEAE,
EUPATORIEAE) AND ITS ALLIES: MORPHOLOGICAL EVIDENCE FOR THE
TRANSFER OF *BARROETEA* TO *BRICKELLIA*

B.L. Turner, K.-J. Kim, & J. Norris

Department of Botany, University of Texas, Austin, Texas 78713 U.S.A.

ABSTRACT

The phyletic position of the taxonomically controversial *Barroetea glutinosa* T. Brandege, is investigated using microcharacters of flowers and fruits. It is concluded that the species stands somewhere between the genera *Barroetea* and *Phanerostylis* (sensu King & Robinson). Since the latter taxon is positioned *within* the genus *Brickellia* by several recent workers, all of *Barroetea* is transferred to *Brickellia*. This has necessitated the following name changes: **Brickellia problematica** B. Turner, *nom. nov.* (= *Barroetea glutinosa* T. Brandege; non *Brickellia glutinosa* A. Gray); **Brickellia laxiflora** (T. Brandege) B. Turner, *comb. nov.*; **Brickellia pavonii** (A. Gray) B. Turner, *comb. nov.*; and **Brickellia subuligera** (Schauer) B. Turner, *comb. nov.*

KEY WORDS: *Barroetea*, *Brickellia*, Eupatorieae, Asteraceae, México

Treatment of the small genus *Barroetea* for the Asteraceae of México (Turner & Nesom, in prep.) has led the senior author to pursue at some length a problem relating to the position of an anomalous member of this genus, *B. glutinosa*. The latter was first described by Brandege (1908) who noted that it was "a very distinct species, differing from the others of the genus in having alternate leaves and being glandular." He also called attention to the enlarged style branches and corollas which "are campanulate rather than tubular." Indeed, on an isotype of *B. glutinosa* (GH!), Brandege appended a hand written notation, "*Biclavella glutinosa* Brandg.," as if he had contemplated the erection of a new genus, *Biclavella*, to accommodate the species. Nevertheless, B.L. Robinson (1911) retained the species, along with four others, in his revisionary treatment of *Barroetea*.

Barroetea glutinosa was maintained in *Barroetea* until King & Robinson (1972) transferred the species into their newly erected *Phanerostylis* (A. Gray)

King & H. Robins., a small genus of four or five species which was originally described as a subgenus within *Eupatorium* by A. Gray, but subsequently transferred to *Brickellia* by Turner (1978), following the suggestions of Harcombe & Beaman (1967). King & Robinson (1987), however, maintained all three genera: *Brickellia*, a large, mostly shrubby, desert group of about 100 species; *Barroetia* with six annual species; and *Phanerostylis*, except for the annual, *P. glutinosa*, a perennial, suffruticose or subshrubby group of four species. These several genera are accommodated next to each other in their treatment of the tribe Eupatorieae.

According to King & Robinson (1987), *Barroetia glutinosa* "has precisely those characters that were given by King & Robinson for *Phanerostylis*, distichous pappus barbulae, flaring corollas, rather large sinuous hairs on the basal styler node, comparatively triangular and papillose corolla lobes, and densely papillose style branches." They maintain that these characters "are all foreign" to the genus *Barroetia*, especially the form of the corolla."

While most of their morphological observations regarding *Barroetia glutinosa* are valid, what they have not called to the fore are those characters which relate the species to *Barroetia* itself. Table 1 lists those characters which *B. glutinosa* shares with the three taxa, *Barroetia*, *Phanerostylis*, and *Brickellia* (sect. *Bulbostylis*). Casual examination of this listing will show that the species in question is closer to *Barroetia* in habit, capitulescence, and characters of the mature fruit; however, it appears closer to *Phanerostylis* in characters of the corolla and style. In short, all three genera are certainly closely related and should probably be positioned together, but it would appear that *Barroetia* and *Phanerostylis* are especially close. Indeed, *Barroetia glutinosa* appears to stand somewhere between *Barroetia* and *Phanerostylis*, but where? and how might these best be treated taxonomically?

The above taxonomic dilemma is not uncommon among the numerous genera recognized by King & Robinson (1987) in their monumental treatment of the closely knit tribe Eupatorieae. Most generic segregates of these authors have one or more species which are difficult to position because they stand somewhere *between* their neatly demarcated groupings. King & Robinson often recognize this themselves, but draw upon the belief that "intergeneric hybridization is common in the family [meaning tribe, we think]."

In any case, the senior author, in his preparation of a treatment of the Eupatorieae for México, is faced with several taxonomic options: 1.) to retain *Barroetia glutinosa*; 2.) position this in *Phanerostylis* as part of *Brickellia* but maintain *Barroetia*; or 3.) to merge all of *Barroetia* in an expanded subgenus *Phanerostylis* of *Brickellia*. While there are yet other taxonomic options, we view these as excessive. The purpose of the present paper, then, is to choose from among the several options posed above.

METHODS AND EXPERIMENTAL

Since much emphasis is placed upon the microfeatures of floral and fruit characteristics by King & Robinson (1987; Grashoff & Turner 1970), we documented the characteristics of achene, pappus, style, corolla, and leaves using scanning electron microscopy (SEM). Leaves and flowers were removed from herbarium specimens (Table 1), hydrated in a modified Hoyer's solution (3:1:1:10; Aerosol OT: Glycerin: Chloral hydrate: H₂O; v:v:v:w), fixed in FAA solution, dehydrated by a graded ethanol series, and critical point dried. The dried samples were then mounted on a stub with double sided cellophane tape and vacuum coated with gold (25-35 nm thickness). The specimens were observed with a Phillips 515 SEM (10-20 KeV) and photographed using Polaroid Type 55 P/N film. For achene observation, mature seeds were soaked in 50% acetone, dehydrated through a graded acetone series and then dried at room temperature. Dusts on the seed surface were removed by 3-4 minutes of ultrasonification. The subsequent steps were the same as described for the preparation of leaf and flower materials.

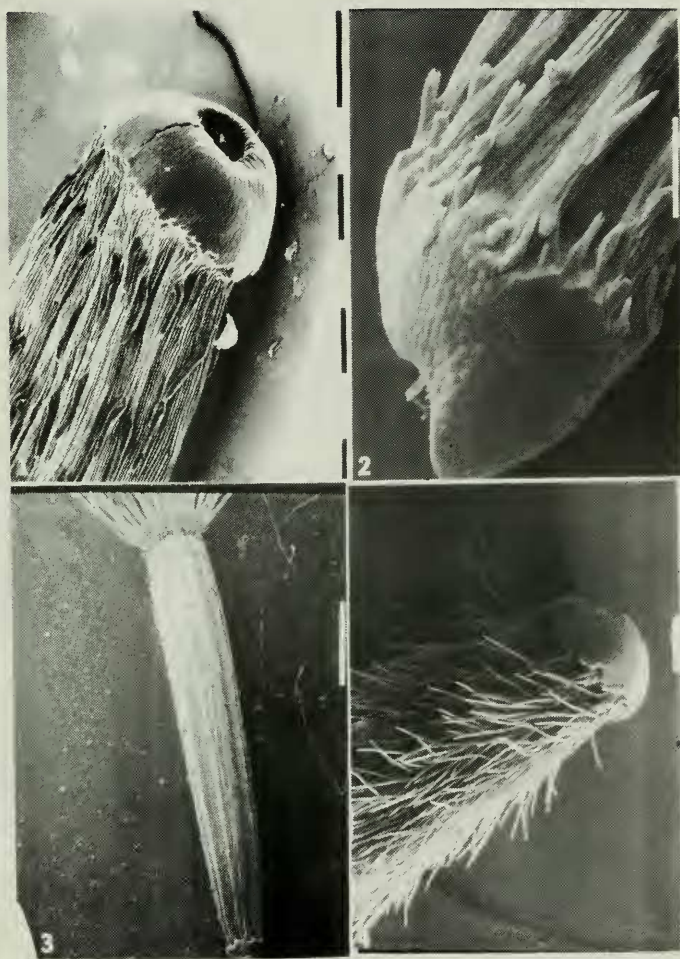
We have examined the following taxa, vouchers for which are given below in Table 2 (deposited in TEX). For convenience, except for *Barroetia glutinosa*, these are listed by their treatments in King & Robinson (1987).

RESULTS

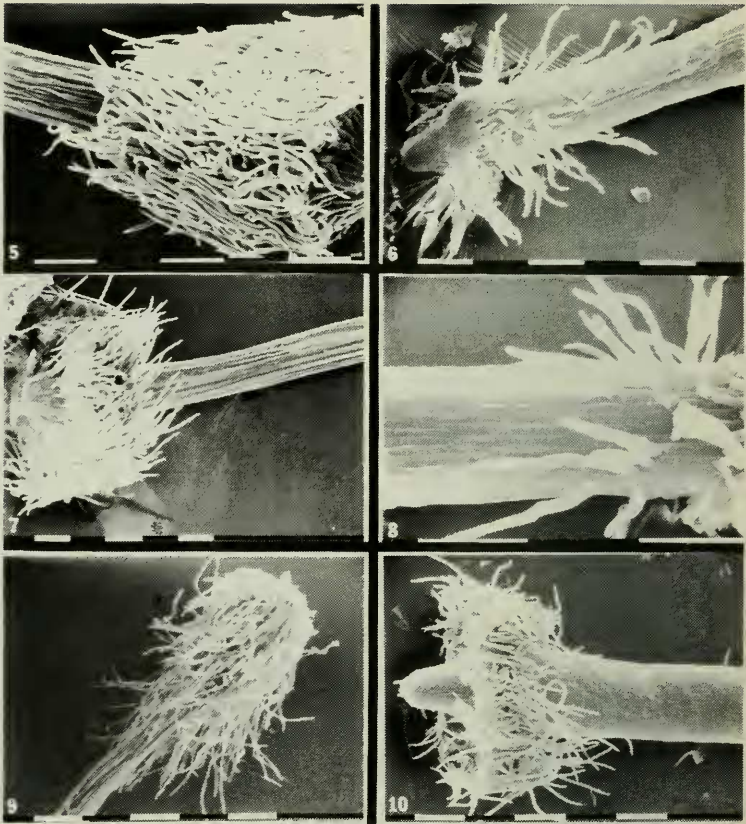
Achenes - The achenes of *Brickellia* (Fig. 23a, 23b) are characteristically columnar or prismatic, 4-5 sided; possess 8-9 pronounced ribs; and the exocarp is firmly fused to the achene, and does not normally peel, as is characteristic for *Barroetia* and *Phanerostylis*. The latter is also true for *Brickellia coulteri* and the annual, *Brickellia diffusa* both of which superficially resemble *Barroetia* in habit. *Phanerostylis* also has prismatic or columnar achenes, but these are mostly 4 or 5 ribbed, with achenal walls very much like those of *Barroetia* (Figs. 24b, 25b). Achenes of the latter, including *Barroetia glutinosa*, differ from those of *Phanerostylis* in being tangentially flattened with 4-5 major ribs (or with 8-10 ribs when intercalary ribbing occurs).

The carpodium of all species of *Brickellia* examined were characteristically rather symmetrical and "stopper shaped" (Fig. 1-3), but occasional species such as *Brickellia veronicifolia* may have asymmetrical carpodia (Fig. 4); carpodia of *Phanerostylis* are similar but markedly asymmetrical, composed of thick walled cells, and from a side view much resemble the profile of an open jawed shark (Figs. 24, 25); those of *Barroetia*, including *Barroetia glutinosa*, differ from both of the aforementioned, in having a flattened carpodium with thinner, less pronounced cells (Figs. 11, 14a, 20a, 21a, 22a).

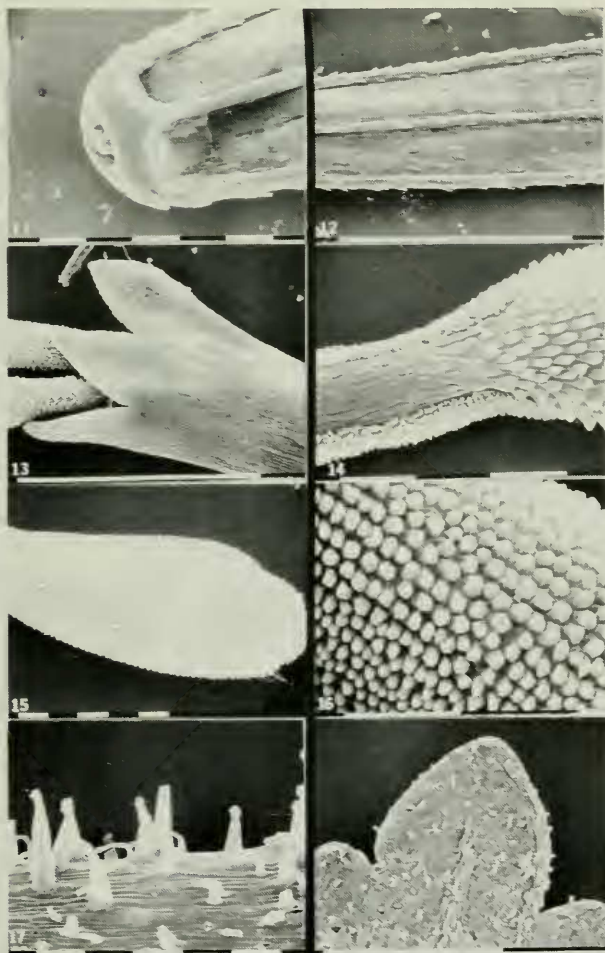
The pappus bristles found in *Brickellia* vary from nearly ebarbellate to plumose. The bristles of both *Phanerostylis* and *Barroetia* are mostly evenly



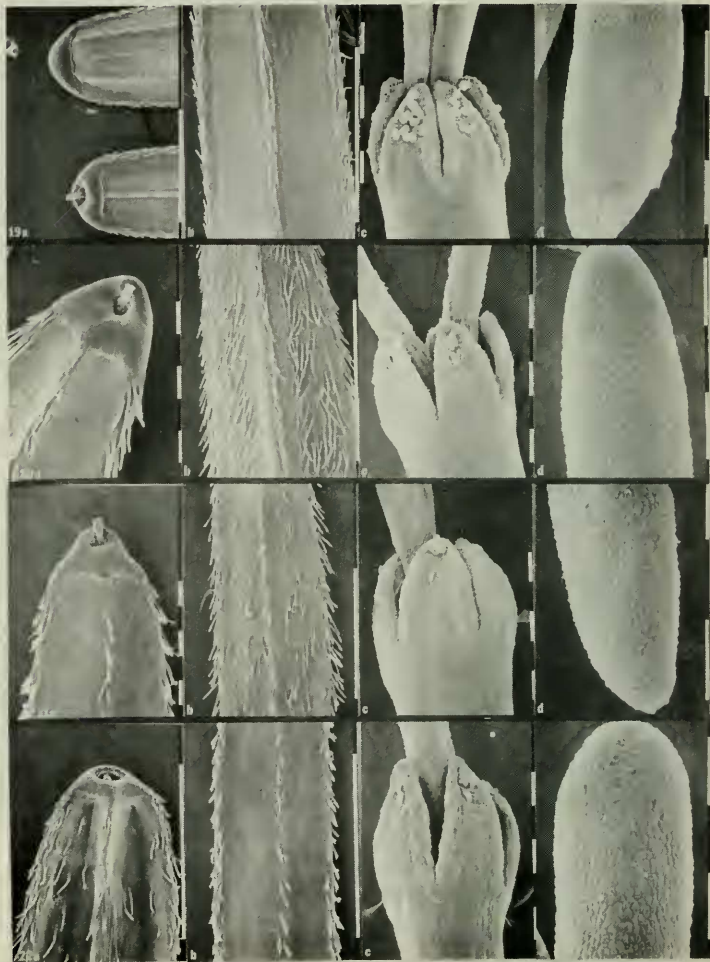
Figs. 1-4. Achenes of *Brickellia*, showing carpodia - 1. *B. cordifolia*; 2. *B. coulteri*; 3. *B. lanata*; 4. *B. veronicifolia*. The size of the bar units shown for each figure is 0.5 cm except for the following: fig. 1, 1 cm.



Figs. 5-10. Basal stylar shafts showing pubescent nodes - 5. *Brickellia coulteri*; 6. *Brickellia (Phanerostylis) coahuilensis*; 7. *Brickellia (Phanerostylis) pedunculosa*; 8. *Barroetia glutinosa*; 9. *Barroetia glutinosa* (lower portion of shaft, basal node excluded); 10. *Brickellia sonorana* ined. The size of the bar units shown for each figure is 0.5 cm.



Figs. 11-18. Floral, vestiture, and leaf features of *Barroetia glutinosa* - 11. carpopodium; 12. midportion of adaxial surface of achene; 13. upper portion of corolla with protruding style branches; 14. upper portion of stigmatic lines, where these join the appendage; 15. apical portion of styler appendages; 16. closeup of surface of Fig. 15; 17. glandular trichomes along stem; 18. apical portion of leaf. The size of the bar units shown for each figure is 0.5 cm except for the following: fig. 18, 1 cm; figs. 12 and 13, 2 cm.



Figs. 19-22. Fruit and floral details of Barroeteoid species of *Brickellia* (top to bottom: a. carpopodia, adaxial surfaces; b. midportion of achenes, adaxial surfaces; c. corolla lobes; d. stylar appendages) - 19. *B. sonora* ined.; 20. *B. laxiflora*; 21. *B. subulgera*; 22. *B. pavonii*. The size of the bar units shown for each figure is 0.5 cm except for the following: figs. 19a, 19b, 20b, 21c, 22a, and 22b, bar = 2 cm.

Table 1. Comparison of *Barroetea glutinosa* with selected related taxa.

	<i>Barroetea</i>	<i>B. glutinosa</i>	<i>Phanerostylis</i>	<i>Brickellia coulteri</i> (Sect. <i>Bulbostylis</i>)
1.	annuals	annual	strong perennials	shrubs
2.	leaves setose	not setose	not setose	not setose
3.	leaves punctate	punctate	punctate or not	not punctate
4.	heads in cymules	in cymules	solitary	in cymules
5.	corolla tubular	flaring	flaring	tubular
6.	corolla lobes minute	large	large	minute
7.	style branches a. narrow b. smooth	a. broad, b. papillose	a. broad, b. papillose	a. narrow, b. smooth
8.	shaft abruptly nodular	gradually swollen	gradually swollen	abruptly nodular
9.	pappus short ciliate or eciliate	long ciliate	long ciliate	variously ciliate
10.	pappus w/o cup	strong cup	strong cup	w/o cup
11.	achenes flat	achenes flat	4-5 sided	4-5 sided
12.	achenes with 6-8 ribs	3 ribbed	4-5 ribbed	8-10 ribbed
13.	carpopodium flattened	flattened	rounded	rounded symmetrical
14.	Achene outer surface peeling	peeling	peeling	not peeling

Table 2. Specimens and taxa examined by SEM for micromorphological features.

Taxon	Voucher
<i>Brickellia cordifolia</i> Ell.	Correll 10558
<i>Brickellia coulteri</i> A. Gray	Correll 30626
<i>Brickellia diffusa</i> (M. Vahl) A. Gray	King 3888
<i>Brickellia lanata</i> (DC.) A. Gray	Paray 3410
<i>Brickellia sonorana</i> ined.	Flyr 110
<i>Brickellia veronicifolia</i> (H.B.K.) A. Gray	Flyr 258
<i>Barroetia glutinosa</i> T. Brandegee	Tenorio 4751
<i>Barroetia pavonii</i> A. Gray	Sundberg 3029
<i>Barroetia laziflora</i> (T. Brandegee) B. Turner	Lott 3409
<i>Barroetia subuligera</i> (Schauer) A. Gray	Sundberg 2821
<i>Phanerostylis coahuilensis</i> (A. Gray) King & H. Robins.	Lundell 5384
<i>Phanerostylis nesomii</i> (B. Turner) King & H. Robins.	Lavin 4888
<i>Phanerostylis pedunculosa</i> (DC.) King & H. Robins.	McVaugh 176

ebarbellate with fringed, apically acute hairs along the margins. Towards the apices of the bristles, the marginal hairs lose their neat arrangement, becoming contorted or twisted.

In summary, the achenes of *Barroetea* and *Phanerostylis* are very similar, those of the latter differing primarily in their columnar shape with relatively massive carpodia. The achenes of *Barroetea glutinosa* resemble more closely those of *Barroetea* in that they are tangentially flattened with very similar carpodia.

Corollas - The corolla lobes of *Barroetea* (s.s.) characteristically possess glandular hairs (Figs. 19, 20, 21, 22). Corollas of *Barroetea glutinosa* are eglandular (Fig. 13), like those of most species of *Brickellia* examined. In addition, the upper portion of the tube tends to flare in *Barroetea glutinosa*, much as in *Phanerostylis*; most species of *Brickellia*, however, tend not to flare, as is the case for all species of *Barroetea* (s.s.).

Styles - The base of the styler shafts of *Barroetea*, *Brickellia*, and *Phanerostylis* are very similar in possessing pubescent nodes (Figs. 5-10). The nodes are not as pronounced in *Phanerostylis* and *Barroetea glutinosa* as they are in most species of *Brickellia* and *Barroetea*, but this appears to be more a matter of vestiture restriction than nodal size, the hairs of *Phanerostylis* and *Barroetea glutinosa* being more loosely arranged along the base of the shaft (Fig. 6-10).

The styler appendages of *Barroetea glutinosa* (Figs. 14-16) are very similar to *Phanerostylis* (Figs. 24d, 25d), both possessing markedly papillate surfaces. Those of the remaining species of *Barroetea*, and those species of *Brickellia* examined, have relatively smooth surfaces (Fig. 19d, 21, 22, 23d).

In summary, the microfeatures of the corolla and styles of *Barroetea glutinosa* are more like those of the *Phanerostylis* group of *Brickellia* than they are to the genus *Barroetea* (s.s.), the latter having essentially the same features as those of typical *Brickellia*.

Vegetative features - The leaves of *Barroetea* (s.s.) differ from most species of *Brickellia*, *Phanerostylis*, and *Barroetea glutinosa* in possessing callous prickles at the leaf apex and upon the apices of denticulations along the margins of the blade. This character, taken alone, can be used to distinguish *Barroetea* (s.s.) from *Phanerostylis*. Nevertheless, *Barroetea glutinosa* does tend to develop a callosity at the apices of its leaves (and often on denticulations), but these do not form obvious prickles (Fig. 18). Thus, leaf morphology, as relates to callosity, remains ambiguous.

In its annual habit and branching aspect, *Barroetea glutinosa* is much more similar to *Barroetea* than it is to *Phanerostylis*, the latter being composed of few headed, often rhizomatous, perennials.

DISCUSSION

As can be seen by the comparison of characters given in Table 1, *Barroetia glutinosa* stands somewhere between *Barroetia* and *Phanerostylis*: floral and stylar characters suggest a close relationship with *Phanerostylis*, while achenal features and habit suggest a closer relationship with *Barroetia*. Both *Barroetia* and *Phanerostylis* appear closely related to *Brickellia*, so much so that some workers (Beaman & Harcombe 1967; Turner 1978; McVaugh 1984) have included *Phanerostylis* in *Brickellia*. So treated, it would be difficult to exclude *Barroetia* from *Brickellia* since *Barroetia glutinosa* marks the two taxa as sister groups.

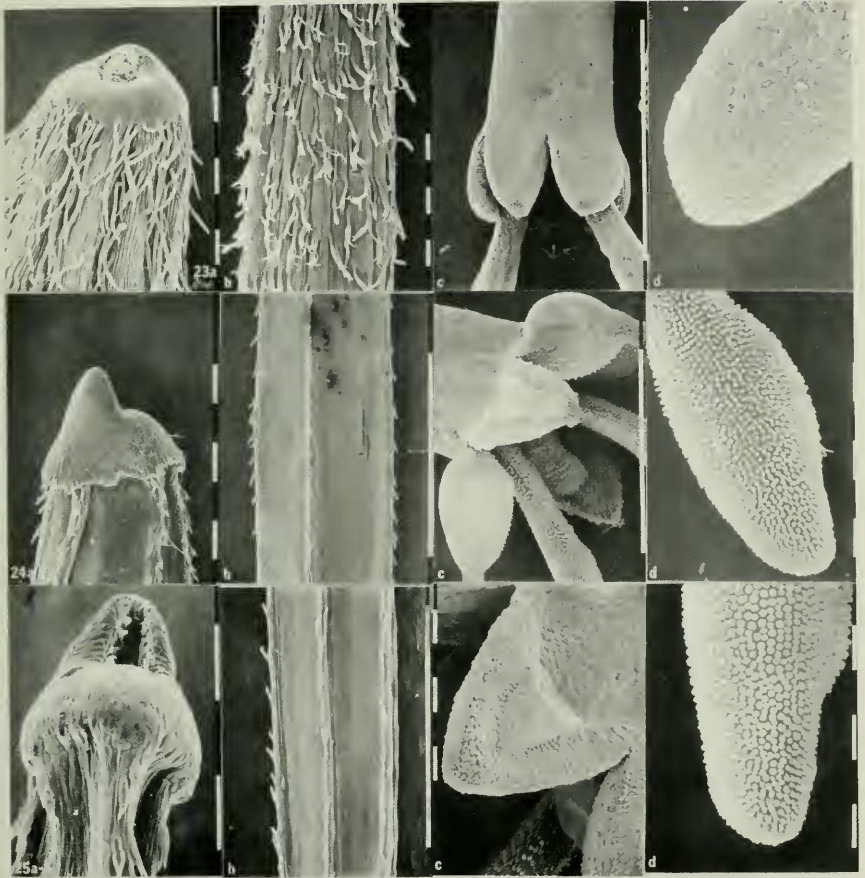
Barroetia, *Brickellia*, and *Phanerostylis* have base chromosome numbers of $x = 9$, share numerous similar microfeatures, and all are centered in mostly xeric habitats of central and northern México. Indeed, a preliminary cladistic analysis (Nesom & Turner, in prep.) of *Brickellia* (sensu King & Robinson), using the characters touted here, strongly suggests that *Barroetia* and *Phanerostylis* are readily imbedded within *Brickellia*, regardless of the position of *Barroetia glutinosa*. Thus, the generitype of *Brickellia* is a shrublet with flaring corollas, large corolla lobes, as in *Phanerostylis*; the style branches also flare as in the latter taxon, but their surfaces are essentially smooth, as in *Barroetia*. In short, the inclusion of *Barroetia* in the subgenus *Phanerostylis* within a broadly conceived *Brickellia* makes good phyletic sense, both on morphological and biogeographical grounds. The following nomenclature to accomplish this arrangement is proposed by the senior author:

Brickellia problematica B. Turner, *nom. nov.* Based upon *Barroetia glutinosa* T. Brandege, *Zoe* 5:262. 1908. Not *Brickellia glutinosa* A. Gray, *Proc. Amer. Acad. Arts* 21:385. 1886.

Brickellia laxiflora (T. Brandege) B. Turner, *comb. nov.* BASIONYM: *Barroetia laxiflora* T. Brandege, *Univ. Calif. Publ. Bot.* 4:93. 1910. My concept of this taxon includes *Barroetia brevipes* B.L. Robins.

Brickellia pavonii (A. Gray) B. Turner, *comb. nov.* BASIONYM: *Barroetia pavonii* A. Gray, *Proc. Amer. Acad. Arts* 17:206. 1882. My concept of this taxon includes *Barroetia sessilifolia* Greenm.

Brickellia subuligera (Schauer) B. Turner, *comb. nov.* BASIONYM: *Bulbostylis subuligera* Schauer, *Linnaea* 19:718. 1847. My concept of this taxon would include *Barroetia setosa* A. Gray.



Figs. 23-25. Fruit and floral details of - 23. *Brickellia coulteri*; 24. *Brickellia (Phanerostylis) nesomii*; and 25. *Brickellia (Phanerostylis) coahuilensis* (a. carpopodium; b. midsection of achene, adaxial surface; c. corolla lobes; d. stylar appendages). The size of the bar units shown for each figure is 0.5 cm except for the following: figs. 23b, 23c, 24b, and 24c, bar = 2 cm.

ACKNOWLEDGMENTS

The SEM work for this paper was performed solely by the junior authors. The senior author conceived of the work, wrote the paper, and is responsible for the taxonomic judgments rendered. We are grateful to Dr. Guy Nesom and Dr. A.M. Powell for reviewing the paper.

LITERATURE CITED

- Brandege, T. 1908. *Barroetia glutinosa*. *Zoe* 5:262.
- Grashoff, J. & B. Turner. 1970. "The new synantherology" - a case in point for points of view. *Taxon* 19:914-917.
- Harcombe, P.A. & J. Beaman. 1967. Transfer of two species of *Eupatorium* to *Brickellia* (Compositae). *Southwestern Naturalist* 12:127-133.
- King, R. & H. Robinson. 1972. Studies in the Eupatorieae (Asteraceae) LXXXI. The genus *Phanerostylis*. *Phytologia* 24:70-71.
- . 1987. The genera of the Eupatorieae (Asteraceae). *Monographs Syst. Bot., Missouri Bot. Gard.* 22:1-581.
- McVaugh, P. 1984. *Brickellia*, in *Flora Novo-Galičiana* 12:153-187.
- Robinson, B.L. 1911. Revision of the genus *Barroetia*. *Proc. Amer. Acad. Arts* 47:202-206.
- Turner, B. 1978. A new species of *Brickellia*, subgenus *Phanerostylis* (Asteraceae). *Brittonia* 30:342-344.
- . 1985. A new species of *Brickellia* subgenus *Phanerostylis* (Asteraceae) from Nuevo Leon, Mexico. *Phytologia* 58:492-496.