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REVISION OF THE MILLIPED GENERA BORARIA AND GYALOSTETHUS (POLYDESMIDA: XYSTODESMIDAE) [1]

By Richard L. Hoffman [2]

Introduction

The present paper is the sixth part of a monographic study of the diplopod family Xystodesmidae begun in 1956. In recent years, largely through the efforts of Leslie Hubricht, the quantity of available study material in this group has been increased vastly and the preparation of additional generic synopses correspondingly has been accelerated. Completion of the series is anticipated within the next four years.

The two genera considered in the following pages belong to a group that has been recognized recently (Hoffman, 1960) as the tribe Rhysodesmini. Species of this tribe are of interest in their departure from the usual xystodesmid structural relationships. Normally in this family species differ chiefly in gonopod form; here the various species differ strikingly in body structure while the gonopods remain essentially similar even among different genera. This condition is particularly true of the nominal genera centered around *Rhysodesmus*

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such as *Cruzodesmus, Acentronus, Cibularia, Howellaria, Stenodesmus,* and *Boraria,* which are distinguished by apparently trivial characters of the gonopods that scarcely would be considered as specific in genera such as *Nannaria, Brachoria,* and *Sigmoria.*

It, therefore, becomes necessary to rely heavily upon nonsexual characters in the definition of rhysodesmine genera and, furthermore, to utilize a variety of characters taken in combination to achieve this purpose. As a result, generic distinctions are perhaps more subtle than usual but certainly of equal importance with single gonopod characters such as those which separate *Apheloria* from *Brachoria* or *Pachydesmus* from *Dicellarius.*

Students of the Diplopoda who regard gonopodal characters as the sine qua non for generic recognition may disagree with this point of view, and so it may be well to restate my conviction that characters of taxonomic importance vary considerably from one group to another and that we must judge each group on its own merits and not by the rigid application of some traditional Procrustean formula. A colleague, C. A. W. Jeekel, has expressed to me the opinion, with which I agree entirely, that, from the taxonomic point of view, small variations in the shape of a basically simple gonopod may well be as significant as large-order variations affecting more complex gonopods. I think that this view applies very aptly to the Rhysodesmini. In a future paper, now in preparation, I shall consider the genera of Mexico and the western United States, the classification of which, I might add, is in a state of the greatest confusion. The present paper treats four species of the eastern United States that have been referred to the genera *Boraria* and *Howellaria.*

Review of the literature.—The first species of *Boraria* to have been described scientifically was collected in western North Carolina by the arachnologist Eugene Simon and was named by H. W. Brolemann (1896) as *Fontaria tennesseensis* var. *stricta.* Four years later, realizing that *stricta* was not related closely to Bollman's species *tennesseensis,* Brolemann raised his form to the rank of a full species of *Fontaria.* Despite the good (and readily available) original description, this name fell into obscurity until 1958[3] when it was resurrected and allocated to *Boraria* (Chamberlin and Hoffman, 1958).

In 1918, R. V. Chamberlin named another Appalachian form under the combination *Nannaria media.* Since the description of *N. media* did not include illustrations of the gonopods, this form promptly fell

[3] Graf Attems was of course cognizant of the name *stricta* but did not mention it in print between 1899 (as *Fontaria stricta*) and 1938, when he referred it to the genus *Rhysodesmus.*

into obscurity along with *F. stricta* and was not mentioned again in the literature for more than 30 years.

Twenty years later, Dr. Chamberlin set up the new genus *Aporiaria* for a new species, *texicolens*, from southern Texas, without stating how either of these taxa differed from a variety of existing genera and species. In the following year (1939), Dr. Chamberlin published a brief but important paper in which numerous new genera and species were described from the eastern United States. Two of these species were published in *Aporiaria* as *A. carolina* and *A. geniculata*, both coming from western North Carolina. Neither was compared with any of the small xystodesmids already known from that region.

Several contributions from Chamberlin's pen appearing in 1943 contain major changes and additions to the system. In the first (1943a), the two new species *Aporiaria fumans* and *A. brunnior* were described from eastern Tennessee. The second paper (1943b) contains the information that *Aporiaria texicolens* is a typical species of *Rhysodesmus* and that, consequently, *Aporiaria* must be synonymized under the older name *Rhysodesmus*. Dr. Chamberlin observed, however, that the eastern species described in *Aporiaria* actually are not congeneric with *texicolens*, and for them he proposed the new genus *Boraria* with *Aporiaria carolina* as the type species.

Prior to the publication of the name *Boraria*, Nell B. Causey (1942) had described *Aporiaria deturkiana*, a rather aberrant species from western North Carolina. Somewhat later, I (1950) designated *A. deturkiana* as the type of the new genus *Howellaria*, which I think must now be relegated to the synonymy of *Boraria*.

In February of 1949, I studied the type series of *Nannaria media* in the Museum of Comparative Zoology, and the species was brought into its correct genus in the following year (Wray, 1950).[4]

The following list of names, arranged chronologically and cited by their original combinations, summarizes the foregoing history:

Fontaria tennesseensis var. *stricta* Brolemann, 1896 (North Carolina)
Nannaria media Chamberlin, 1918 (Tennessee)
Aporiaria carolina Chamberlin, 1939 (North Carolina)
Aporiaria geniculata Chamberlin, 1939 (North Carolina)

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[4] The original manuscript for the Class Diplopoda in Dr. Wray's second supplement to the "Insects of North Carolina" was supplied by me with the nomenclature up-to-date and correct as of early 1950. Before publication, however, my list was changed and incorrect combinations and nomina nuda were introduced to the extent that I do not believe that, as published, it should be considered as written by me. It seems preferable to credit the material in question to the authorship of Dr. Wray, even though new nomenclatorial material from my own research is included.

Aporiaria deturkiana Causey, 1942 (Tennessee)
Aporiaria fumans Chamberlin, 1943a (Tennessee)
Aporiaria brunnior Chamberlin, 1943a (Tennessee)
Boraria monticolens Chamberlin, 1951 (Tennessee)

MATERIALS.—Of the four species admitted as valid in the following pages, I have examined approximately 218 specimens, the majority of which were obtained either by me or by Leslie Hubricht. Some additional material, including type specimens, was examined either at the particular museum or by loan from several museum collections, all of which are indicated by the following abbreviations:

AMNH—American Museum of Natural History, New York
ANSP—Academy of Natural Sciences, Philadelphia
MCZ—Museum of Comparative Zoology, Cambridge
RVC—R. V. Chamberlin collection, University of Utah, Salt Lake City
USNM—United States National Museum, Washington

The adequacy of any revisionary work on millipeds is known to be largely a direct result of the study of typical material. I have been fortunate in being able to see some kind of type for all but one of the names of the foregoing list.

holotypes	paratype
Aporiaria geniculata (RVC)	*Fontaria stricta* (USNM)
Aporiaria deturkiana (ANSP)	topotype
Nannaria media (MCZ)	*Aporiaria carolina* (RLH)

No typical material of *Aporiaria brunnior* has been seen; this name is allocated tentatively on the basis of its published description.

Friends and colleagues who kindly loaned specimens from collections under their care or who permitted the examination of material at various museums include the following: Ralph E. Crabill, Jr., P. J. Darlington, W. J. Gertsch, and J. A. G. Rehn. I owe a particular note of thanks to Dr. Ralph V. Chamberlin for his generous loans of type specimens and to Prof. Max Vachon, who kindly exchanged a male paratype of *Fontaria stricta* from the Museum National d'Histoire Naturelle de Paris.

Much of my field work, prior to 1962, was made possible by financial assistance from the Highlands [North Carolina] Biological Station. I am under a continuing debt to numerous friends who have assisted in collecting or who independently have picked up millipeds for me. The name of Leslie Hubricht continues to head this roster.

Drawings have been made with a binocular microscope fitted with an ocular recticule. Measurements of length were taken to the nearest whole millimeter; those of width, to the nearest tenth of a millimeter with a vernier-scale calipers.

All of the localities mentioned may be located in the "Rand-McNally Commercial Atlas of the United States."

Taxonomic Characters

As in preceeding papers in this series, I wish to preface the taxonomic treatment with a consideration of various structural characters that have been found useful in the separation of genera and species or in the recognition of similarities between such taxa. The following account may appear somewhat extended, but this is due to the fact that it contains both the description and evaluation of the characters involved; also, it is due to the fact that, in some cases, I can now attempt the classification of certain features, such as the sterna as they occur in the Xystodesmidae at large and not just as they occur in the genera discussed in this paper.

It is patently impossible to utilize, for practical taxonomic purposes, all of the points of similarity and difference that can be recognized in groups of related species. I think, however, that in diplopod systematics we should go beyond mere "key characters"—at least in formal descriptions or definitions of species. The present consideration of sexual dimorphism is a case in point, for even though series of both males and females may be needed to establish the extent of size or proportion of dimorphism, the phenomenon itself is certainly a valid part of the makeup of many species and, therefore, should be taken into account. We need not rely upon the stronger dimorphism of *Boraria deturkiana* to separate that species from *B. media*, but it is nonetheless a point of difference and one which is useful in determining comparative levels of divergence in this genus. The same point might be made for differences in life history, habitat preferences, and so on, when this information becomes available.

Body form.—The relative proportions of the body offer useful comparative data on relationships of species even though they may not be of immediate value in identifying individual specimens. One factor which influences the mensural proportions is the degree of development of the paranota: specimens with well-developed paranota naturally appear much broader in relation to the body length, and this is reflected in the ratio of width divided by length (referred to hereinafter as the W/L ratio). Normally males tend to have a higher ratio since the paranota are larger in comparison to the diameter of the segmental body cavity. This is not always true, however, and among the species here considered, the ratio tends to be about 1% greater in females. The ratio is not obtainable with a high degree of accuracy since the length of preserved specimens is difficult to determine, but with a little practice one can at least secure uniform measurements. This matter is discussed in some detail in my previous paper (1960) on *Cherokia*. The range of variation in the W/L ratio in small series runs about 2% at the most. Part of this is due to measurement errors, part to normal variability in the species. To illustrate the specific differences, I give here a list of the four species described herein, with the average W/L ratio for males in terms of percentages:

Boraria stricta 17.5	*Boraria deturkiana* 19.4
Boraria media 20.4	*Gyalostethus monticolens* 22.1

Sterna.—The metazonal sternal areas, unless produced into conspicuous subcoxal spines, have been generally disregarded by previous workers on the Xystodesmidae, yet during the past few years I have come to consider the sterna of paramount importance in the classification of this family. In a previous paper (1958) I proposed the anatomical term podosternum to describe the form occurring in the genus *Pachydesmus*, and I can now outline a rough classification of easily distinguishable variations. Generally speaking, the sternal areas are much the same in both sexes, except for being proportionately wider in females, and tend to be much the same in most or all members of a given genus. We can consider, therefore, the sterna to be usually generic in value as regards their systematic utility.

(a) Unmodified: In essentially unmodified sterna, the coxae are attached to slight subcoxal elevations, there is no tendency for the development of subcoxal spines, and usually such sterna are glabrous. Normally the central area of each sternum is about the same elevation as the adjoining part of the prozonite, and the interzonal furrow or suture is thus not immediately followed by a raised surface. The caudal edge of the metasternum is preceded by a flat margin, which usually becomes wider at the midventral area. This type of sternum occurs in *Boraria, Dixioria*, and some other genera.

(b) Bilobed: In this category, the sternal surface slopes upward from the interzonal suture, often is interrupted partially by a transverse groove originating between the two pairs of legs, and culminates in two broad obtuse lobes located between the coxae of the posterior pair. Usually there is a short transverse row of setae between the anterior legs, and an irregular field of setae on the lobes. In extreme forms of this type, the posterior lobes may become produced into acute subcoxal spines, and the sternal surface between them forms a thin transverse edge that may overhang the true ventral edge of the segment. Genera with this kind of sternum include *Cherokia, Rhysodesmus, Cleptoria, Dynoria*, and *Sigmoria*.

(c) Spined: In spined sterna, the surface is not elevated above that of the prozonite or is but slightly so, and there are no lobations between the posterior coxae. Instead, the sternum is produced into acute, often curved, subcoxal spines that include the ventral coxal condyle. This form occurs most characteristically in *Nannaria.*

(d) Podosterna: In a few xystodesmid genera (and in genera of other families) the metasternum is elevated sharply and prominently, the anterior face of this elevation sometimes being perpendicular to the surface of the prozonite. The legs thus appear to be set on the lateral sides of ventral tumidities. There is no tendency for the formation of subcoxal spines or transverse grooves. This type of sternum occurs in *Pachydesmus* and *Dicellarius* in almost indistinguishable form, and this similarity is reinforced by numerous other structural concordances among members of these two genera.

(e) Excavate: In this type, the sterna become proportionately very broad and the surface between the posterior legs is depressed deeply and conspicuously. There is no formation of subcoxal spines. The posterior edge of the metasternum takes the form of a transverse ridge or rim bounding the depression. I know this sternal form only in *Gyalostethus;* presumably it is a rare type of specialization.

I judge that the sterna are less liable to change than the gonopods, and, therefore, provide useful criteria for the determination of affinities as well as a means of identifying female specimens.

In the three species here referred to *Boraria,* the sterna are unmodified while those of *Gyalostethus monticolens* are totally different in formation. This in itself would be sufficient prima facie evidence for generic segregation of *G. monticolens.*

Coxal spines.—Previously the presence or absence of distal spines on the basalmost podomere has been considered to be of generic importance. I have found this character to be a mutable one, however; in some genera (*Dixioria, Boraria, Rhysodesmus*) the coxal spines may be present or absent. There is no trace of them in *B. stricta* and *B. media,* but *B. deturkiana* has prominent spines, and, partly for this reason, I segregated the species into a separate genus some years ago. Apparently this character varies among different groups and may be consistent in some, mutable in others.

Tergal sculpture.—The species treated here are mostly smooth dorsally. *B. stricta* is an exception; the metatergites are provided with several transverse rows of distinct, setiferous tubercules that become larger and more prominent on the posterior body segments. Most xystodesmids have transverse rows of microsetae; normally, however, these are set on extremely small tubercules that can be seen only when the tergum is dry and illuminated from a particular angle. The rows of tubercules apparently tend to become most pronounced in the tribe Rhysodesmini. Several species of *Rhysodesmus* are tuberculate; one, *R. toltecus*, is characterized by several transverse rows of metatergal raised areas.

Sexual dimorphism.—In most xystodesmids the females tend to be slightly larger than males from the same locality. Usually the antennae are relatively smaller in females and the sterna relatively broader than in males of the same size. In some species, particularly in the Rhysodesmini, the size difference between the sexes becomes pronounced and the extreme condition occurs in *Boraria deturkiana* in which the female may attain nearly twice the bulk of the male. Presumably, pronounced sexual size dimorphism is accountable as an evolutionary specialization and, in this case, affords a useful criterion in judging affinities. Taking the case of *B. deturkiana*, the combination of coxal spination, strongly depressed paranota, and difference in size between male and female sets the species in apposition to *B. stricta* and *B. media* and perhaps warrants retention of the name *Howellaria* as a subgeneric designation.

Epicranial suture.—In all polydesmoids there is a distinct median suture on the vertex of the head capsule that is reflected internally as a median septum upon which the mandibular adductor muscles originate. In earlier literature the suture was referred to as the vertigial sulcus, but I think that it is essentially homologous to the epicranial suture of insects and should be so designated. In most species the suture becomes indistinct in the interantennal isthmus, but in a few it is ventrally bifid, and the two lateral branches extend nearly or quite to the antennal sockets. This is the case in *Boraria media* and *B. deturkiana*, and, along with the nearly identical gonopods, attests a close relationship between these two species. In *B. stricta*, at least in the adult condition, the two ventral branches are obscure or invisible although they are distinct in young or recently moulted specimens.

Probably only specific value can be assigned to the ventrally bifid condition since *B. media* and *B. stricta* are undoubtedly congeneric and quite similar in nearly all other characters. We could consider this feature, perhaps, a retention of a juvenile character, but, since it occurs so prominently in *B. deturkiana*, a species that obviously is specialized in other details, an equally good case could be made for interpreting the bifid epicranial suture as some kind of specialized development.

Gonopods.—I have remarked previously (1960) the tendency among rhysodesmines toward conservatism in gonopod form even though the body structure may vary considerably among species. This condition is particularly true in *Rhysodesmus* itself, the species of which share an essentially identical gonopod pattern. In *Boraria* the telopodite is simple and distally laminate, with a slender, acicular prefemoral process. In *B. media* and *B. deturkiana* the gonopod is similar in most respects (cf. figs. 10, 18), distally the telopodite is accuminate. In *B. stricta* the corresponding region is hastate with a distal and two subterminal acute projections, but, with low magnification, the gonopods of all three species are nearly identical. The gonopod of *Gyalostethus monticolens* is somewhat different in structure. There is a much shorter prefemoral process, the glabrous part of the telopodite is much less laminate than in *B. stricta*, and the distal extremity is expanded and laciniate when examined with sufficient magnification. In this character alone *G. monticolens* is as different from the three species of *Boraria* as the latter are from Mexican *Rhysodesmus*. In association with the many other structural pecularities of *G. monticolens*, this difference leaves no doubt that the species is not congeneric with *B. stricta* and, in fact, is probably not even closely related to it.

Within the limits of the species here considered, the gonopods are virtually identical. The prefemoral process in *Gyalostethus monticolens* varies a little in length but only as sporadic individual variation. In *Boraria media* there is a slight variant in the shape of the telopodite just below the prefemoral process (cf. figs. 9, 10), and the two gonopod forms that are so characterized do occur in vicarious populations. Some authors would instantly accord specific status to these populations, but I think that, at the present, a conservative treatment is desirable (see the discussion under "Variation" in the account of *B. media*).

Cyphopods.—The transverse sympleurite of the third segment in female xystodesmids is modified rarely into any special kind of epigynal structure although there may be enlarged lateral lobes of the anterior edge as in *Pachydesmus* and some other genera. The sternum and legs of the second pair likewise tend to be quite uniform, but as a rule the cyphopods themselves may be different from one species to another and sometimes even differ among subspecies (cf. my *Pachydesmus* paper, 1958, figs. 5*a–f*). One highly variable cyphopodal element is the basal receptacle, which may be a semiglobose or semicircular shielding structure that extends on both sides of the valves. In others the receptacle is reduced to a flat, simple plate just large enough for muscle attachment; in a few, such as *Cherokia*, the receptacle is not present. In both of the genera treated here, it is reduced in size but not otherwise differing between the two groups. In *Boraria* *stricta* the receptacle is set with a number of prominent macrosetae that are absent from the structure in *B. media* and *B. deturkiana*.

There is also some difference in shape of the valves. In some genera they are rather broad and prominently corrugate and enclose a flattened, transversely striate intervalvular area. In most of the Rhysodesmini the valves tend to be compressed and closely applied to each other; usually one is distinctly larger than the other. Internally the valves contain one or more seminal receptacles of variable size and shape. In *Boraria* there appear to be two such structures (fig. 5); in *Gyalostethus*, one only. So far, I have not studied the condition in other xystodesmid genera, but such a study should be made and probably would be entirely rewarding.

Stigmata.—Insofar as I have been able to determine, the openings of the tracheal system in the Diplopoda have never been considered for their possible utility in classification. During the past few years, I have been noting the size, shape, and position of the stigmata and find they offer excellent generic and familial characters that correlate closely with those of the genitalia and other traditional diagnostic structures. In the Xystodesmidae the stigmata tend to be essentially similar among related genera, usually subequal in size, obverse pyriform in shape, and located just in front of (often upon) the dorsal coxal condyle. In some cases the stigmata may be located upon slight elevations or the dorsal edges may be slightly flared. In *Gyalostethus* the anterior stigmata are distinctly larger than the posterior, an unusual condition in the family and one which warrants special recognition.

Taking all of the preceding matters into account, I think the point is sufficiently made that *G. monticolens* is not congeneric with the three species *B. stricta*, *B. media*, and *B. deturkiana*. We may place it in a monotypic new genus, separable from *Boraria* by the characters cited in the preceding section and in the generic diagnoses that follow. Some of the more conspicious characters may be cited in the following couplet:

1. Sterna of metazonites unmodified; sides of segments without a longitudinal ridge above coxal sockets; pretarsi about ⅓ as long as tarsi, not concealed by long tarsal setae; stigmata not strikingly unequal in size; posterior corners of paranota of only the caudalmost segments produced; distal end of gonotelopodite simple, laminate . . . . **Boraria**, p. 315

   Sterna of metazonites unusually broad and depressed, saucer-like; segments 3–15 with a distinct longitudinal ridge just above coxal sockets; pretarsi very short, largely concealed by long, slender distal tarsal setae (fig. 23); anterior stigmata about 3 times as large as posterior; caudolateral corners of paranota of segments 6–19 acutely produced; distal end of gonotelopodite expanded, cupulate, the edges finely laciniate . . . . **Gyalostethus**, p. 338

Genus *Boraria* Chamberlin

Aporiaria (part) Chamberlain, 1939, p. 6.
Boraria Chamberlin, 1943b, p. 143.—Chamberlin and Hoffman, 1958, p. 22.
Howellaria Hoffman, 1950, p. 26.—Chamberlin and Hoffman, 1958, p. 37. [New synonymy.]

Type species.—*Boraria: Aporiaria carolina* Chamberlin, 1939, by original designation; *Howellaria: Aporiaria deturkiana* Causey, 1942, by original designation.

Diagnosis.—A genus of small to moderate-sized xystodesmids with the following characteristics:

Body composed of head and 20 segments in both sexes; small to moderate in size, slender to moderately robust, the W/L ratio varying from 17 to 23% among the 3 species. Head of normal proportions, smooth, with the usual facial setae present; genae with median impression, or, in 1 species, the impression is continuous laterally to the margin; antennae long and slender, separated by a broad isthmus. Epicranial suture distinct; ventrally bifid in 2 species.

Body segments generally smooth and polished, metatergites with several transverse rows of small tubercules in 1 species, prozonites and metazonites of about the same diameter, meeting at a shallow interzonal stricture dorsally. Paranota subhorizontal to strongly depressed, the posterior corners rounded on anterior segments, becoming acutely produced only on the last 4 or 5 segments; scapulorae submarginal; pores large, dorsolateral, in large depressions on the broadened, flat peritremata; pore formula normal.

Posterior segments normal in form, segment 20 sometimes slightly telescoped but about average in size for xystodesmids; hypoproct large, smooth, with or without a prominent median projection.

Sterna broad, the legs widely separated; sternum of metazonites scarcely modified, only slightly elevated at bases of legs, no tendency for development of subcoxal spines or paramedian lobation; surface smooth and glabrous.

Legs moderately long and slender; coxae unspined except in 1 species where provided with prominent ventrally directed, acute distal spines; prefemora with small, short distal spines. Pretarsi of normal size and shape; slightly curved, compressed, without dorsal carinae, about ⅓ as long as tarsi. Sides of segments smooth and polished, unmodified. Anterior and posterior stigmata of about same size and shape, subovoid or pyriform, largest dorsally, not rimmed or auriculate.

Sterna and legs of anterior segments of males without special processes or other modifications except low paramedian knobs between

4th pair of legs. Gonopod aperture of moderate size (fig. 2), oval, the posterior edge with a flared rim.

Gonopods rather small in relation to body size, extending cephaled between 6th pair of legs only; coxae simple, without apophyses, connected by a small indistinct sternal remnant. Telopodites set against coxae at a right angle, nearly straight, the prefemoral region not greatly expanded, with a slender, elongate, prefemoral process which nearly attains apex of telopodite proper. Distal end of telopodite flattened, laminate, without branches or distinct lobes. Prefemur about 60–75% of total length of telopodite.

Cyphopods of the form shown in figures 5 and 11; the receptacle present but reduced in size; valves large, approximate in size, apparently 2 seminal receptacles are present. Both valves and operculum, and, in other species, also the receptacle, heavily setose. No special modifications of 2nd legs or epigynal region of 3rd segment.

Synonymy.—There is no longer justification for retention of the name *Howellaria*. This genus was set up at a time when, not knowing *B. media*, I was impressed by the numerous differences between *B. stricta* and *B. deturkiana*.

In most details of body form, *B. media* and *B. stricta* are similar, and contrast rather strongly with *B. deturkiana*. The last named form, however, shares with *B. media* the branched epicranial suture, and the same gonopod formation. The relationships are mentioned in greater detail under the discussion of *B. media*.

Species of uncertain status.—One name, *Aporiaria brunnior* Chamberlin, 1943a, has been based upon a member of this genus, the status of which remains uncertain. I have been unable to restudy the holotype and have seen no material that agrees entirely with the original description. I therefore quote this in its entirety:

> This, the smallest of the known species of the genus, has the dorsum brown with keels and a transverse band over caudal border of metazonites yellow, thus contrasting with the other known species in which the dorsum is black. Antennae and legs light.
>
> Keels without anterolateral denticle, the margin being smooth throughout; posterior corners produced beginning with the 5th or 6th, the production becoming more pronounced in posterior segments as usual.
>
> All coxae without spines.
>
> Gonopods of male as shown in fig. 10.
>
> Length of male holotype, about 20 mm.; width, 4 mm.
>
> Locality.—Tennessee: Gt. Smoky Mts. Nat. Park. June 5, 1941. One male taken by J. Miller.

All of the information given, including the gonopod sketch, indicate that this name is based upon a milliped similar to, if not identical with, *Boraria media*. The smallest specimen of *B. media* that I could measure precisely was about 24 mm. in length, but it is entirely possible that local populations may exist with even smaller individuals. The coloration of *B. brunnior* is not singular, for in the description of Chamberlin's previously named *Aporiaria geniculata* occurs the statement "Dorsum black *or nearly so* [italics mine], with the keels yellow, the tergites in part also narrowly margined with yellow across caudal border." In the specimens of *B. media* that I have seen, brownish coloration occurs sporadically, and occasional specimens, particularly recently moulted ones, tend to show transverse tergal stripes of yellowish.

My inclination is to regard the name *B. brunnior* as a junior synonym of *B. media*, but perhaps it is best to withhold final judgment until the holotype, or fresh topotypes, can be studied. Possibly *B. brunnior* can be retained as a subspecific designation.

Range.—Southern Appalachian region from Virginia to Georgia. Two of the species are confined to western North Carolina and extreme eastern Tennessee. The generic distribution coincides closely with the Southern Section of the Blue Ridge Physiographic Province.

Species.—Three are recognized as valid, along with a possible fourth, which was discussed in a preceeding paragraph. It seems unlikely that any undescribed species of *Boraria* remain to be found.

Key to the Species of *Boraria*

1. Epicranial suture poorly defined, not branched between the antennae; metatergites with several transverse rows of conspicuous tubercules; dorsum glossy black with bright lemon-yellow paranotal spots, sides of segments also black; distal end of gonopod subhastate in shape (fig. 3). **stricta** Brolemann

   Epicranial suture distinct, branched between the antennae (fig. 14); metatergites smooth and polished except for faint rugosity at bases of paranota; dorsum dark brown to blackish, sides of segments lighter, paranotal spots orange or red; distal end of gonopod slender, acuminate (fig. 8) 2

2. Coxae not spined; paranota set high on sides and not strongly depressed; dorsum blackish, with reddish paranotal spots; epicranial suture without a row of punctures . . . . **media** Chamberlin

   Coxae with prominent ventrally directed terminal spines (fig. 16); paranota strongly depressed, the dorsum thus appearing nearly terete; dorsum blackish, with paranotal spots and transverse tergal bars orange yellow; epicranial suture with a row of small punctures . . . **deturkiana** Causey

Boraria stricta (Brolemann)

Figures 1–7

Fontaria tennesseensis var. *stricta* Brolemann, 1896, p. 63, figs. 17, 18.
Fontaria stricta Brolemann, 1900, p. 101, fig. 31.
Rhysodesmus strictus Attems, 1938, p. 144, fig. 167.

Aporiaria carolina Chamberlin, 1939, p. 6, fig. 10 [new synonymy].
Aporiaria fumans Chamberlin, 1943a, p. 37, fig. 9 [new synonymy].
Borraria carolina Chamberlin, 1943b, p. 144.—Hoffman, 1949, p. 379; 1950, p. 23.—Chamberlin and Hoffman, 1958, p. 22.
Boraria stricta Chamberlin and Hoffman, 1958, p. 23.
Boraria fumans Chamberlin and Hoffman, 1958, p. 22.

Type specimens.—Cotypes of *Fontaria tennesseensis* var. *stricta*, Museum National d'Histoire Naturelle de Paris and USNM D-730; collected in "North Carolina" by Eugene Simon. Holotype and paratypes of *Aporiaria carolina*, RVC, from Soco Gap Falls, Jackson Co., N.C., collected April 29, 1939, by Nell B. Causey. Holotype of *Aporiaria fumans*, CNHM, from Greenbrier Cove, Great Smoky Mountains National Park, Sevier Co., Tenn., collected June 13–19, 1942, by Henry S. Dybas.

Diagnosis.—A species of *Boraria* characterized by the color pattern (dorsum black with lemon-yellow paranotal spots), by the unbranched epicranial suture; by the distinct transverse rows of metatergal tubercules; by the unspined coaxe; and by the hastately lobed apex of the gonopod telopodite.

Description.—Male from Mount Squires, Blount Co., Tenn. Total length ca. 33.0 mm., greatest width 5.5 mm., W/L ratio 16.7%. Body slender, parallel sided, the paranota set high on sides and nearly horizontal, the dorsum thus appearing distinctly flattened.

Head capsule, dorsum *and sides* of metatergites, distal half of antennae dark gray to black; labrum tan; paranotal spots and tip of epiproct bright yellow; sternites and bases of legs burnished brown; legs tinged with black.

Head of normal shape and proportions, the surface smooth and very finely punctate. Epicranial suture distinct, shallow, not branched in the interantennal isthmus; latter broad (1.1 mm.), about 16% of the antennal length. Genae nearly flat, with pronounced broad median depression. Antennal sockets not rimmed. Antennae long (6.9 mm.) and slender, 1st article large, globose, with 4 long macrosetae on the dorsal side, otherwise glabrous; 2nd article clavate, distinctly geniculate at base, distally exceeding genal apex; articles 3–6 subsimilar in size and shape, each cylindric, clavate, with sparse and scattered erect setae and a subterminal whorl of 3 or 4 macrosetae; 7th article small, subconic, distally truncate, densely setose, with sensory areas or fields; 4 small terminal sensory cones.

Collum large, convex, about as wide as head across mandibles and not as wide as 2nd segment, the entire front edge evenly curved, the rear edge distinctly emarginate across dorsum, laterally bent forward to the rounded ends of the collum. Surface smooth and polished;

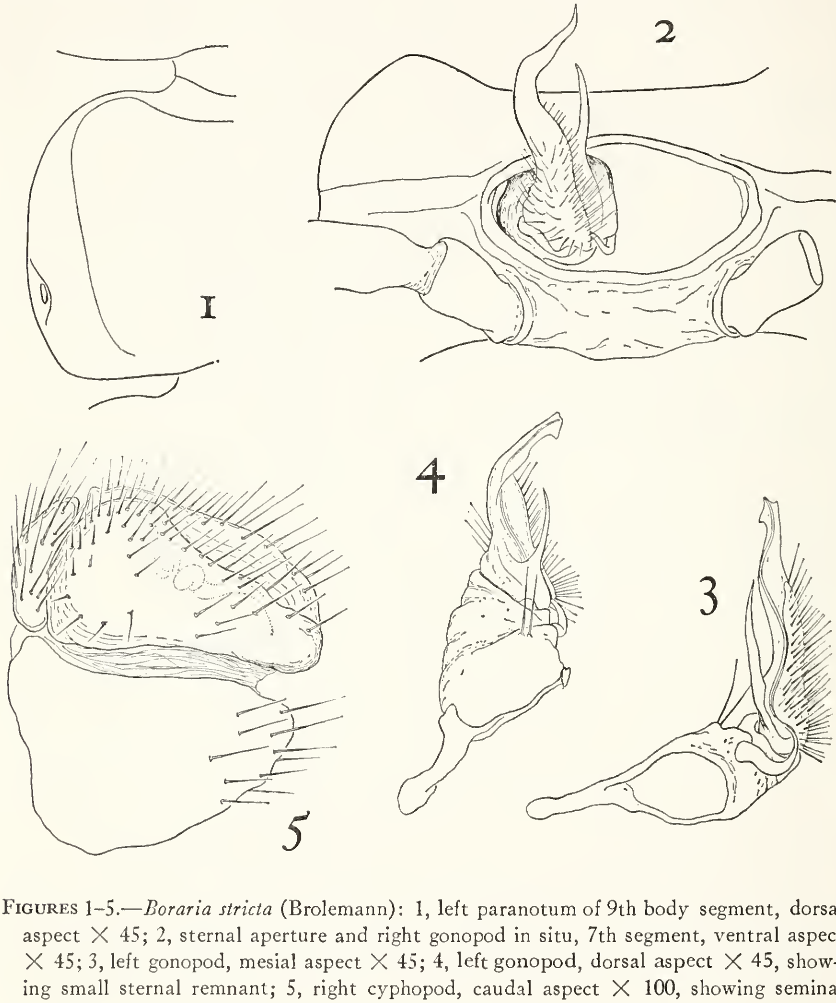
cephalolateral marginal ridge distinct nearly to middle of collum, set off by a prominent, broad, submarginal depression.

Body segments smooth, evenly convex and flat, the prozonites and metazonites approximately equal in length, and meeting dorsally at a fine sutural line, forming the anterior edge of the interzonal furrow; latter distinct and sharply defined across dorsum of anterior segments, becoming broader and less well defined on posterior segments. Metatergites of anterior segments smooth, those of midbody and posterior segments becoming increasingly tuberculate, those of segments 14–18 with about 3 to 5 transverse rows each of 16–18 small but distinct setiferous tubercules visible to the unaided eye. Paranota smaller than average for xystodesmids, set high on segments and only slightly depressed, thus scarcely interrupting slope of middorsum. Paranota of anteriormost segments bent forward, overlapping, with both lateral corners rounded, the anterior and lateral edges set off by a prominent submarginal depression. Paranota of midbody segments not overlapping, the caudal corners rectangular; those of segments 11–19 with the caudal corners caudally produced, the anterior corners rounded. Scapulorae entirely marginal; peritremata flat but prominent; ozopores rather large and located in conspicuous dorsolateral peritrematic depressions (fig. 1), posterior edge of all paranota essentially straight, without basal lobe. Paranota of segment 19 small, rounded lobes; epiproct small, partially retracted, dorsally convex, without special modification.

Paraprocts glabrous, smooth, nearly flat, with prominent elevated median edges, the ventral seta set on a tiny tubercule slightly removed from the rim, the dorsal seta set on an enlargement of the rim near its dorsal end. Hypoproct large, smooth, flat, semicircular in outline, without distinct median apical projection; paramedian tubercules small, removed from the edge; the setae very long.

Ventral surface of prozonites smooth and polished, set off from metazonites by a shallow, sinuous interzonal furrow. Legs set on subcoxal elevations which form a low but well-defined glabrous podosternum; no subcoxal spines developed. Sterna of midbody segments 1.2 mm. in width, the legs of both pairs about equally separated.

Legs relatively long and slender, the distalmost 4 podomeres visible beyond paranota when extended laterad; coxae much shorter than prefemora and without trace of distal spine, prefemoral spine very short and acute, both of these leg segments with 2 or 3 large ventral setae; femora longer, clavate; postfemora and tibiae short, as broad as long; tarsi longer, set with numerous erect setae; pretarsi long, slender, and compressed, a 3rd as long as tarsi, not enclosed by the distal tarsal setae. Podomeres in decreasing order of length: 3>6>2>5=4=1.



FIGURES 1–5.—*Boraria stricta* (Brolemann): 1, left paranotum of 9th body segment, dorsal aspect × 45; 2, sternal aperture and right gonopod in situ, 7th segment, ventral aspect × 45; 3, left gonopod, mesial aspect × 45; 4, left gonopod, dorsal aspect × 45, showing small sternal remnant; 5, right cyphopod, caudal aspect × 100, showing seminal receptacles by dotted lines.

Interzonal furrow distinct down sides of segments, most sharply defined in front of anterior stigma; lateral surfaces finely wrinkled, otherwise unmodified. Stigmata similar in size and shape, both are asymmetrically pyriform, slightly elevated but without flared rims, both are in contact with the dorsal coxal condyle.

Anterior legs unmodified, without distinct processes. Sterna of

5th segment with 2 knobs between the 4th pair of legs, other sterna unmodified.

Gonopod aperture (fig. 2) moderate in size, transversely oval, posterior edge with an erect flared rim. Sternum between 8th pairs of legs depressed. Coxae of gonopods large, almost in contact medially, connected by a small elongate sternal remnant as shown in figure 4. Gonopods elongate, extending cephalad between legs of the 6th segment, the sternum of which is depressed to accommodate gonopodal apices. Coxae somewhat flattened dorsoventrally, the dorsal side without apophysis, with 2 macrosetae. Telopodite typically set at nearly a right angle to coxite, slender, without indication of segmentation. Prefemoral region setose, elongate, about 60% of the entire telopodite length, with a slender acicular prefemoral process. Distal 3rd of telopodite thin and hyaline, bent medially at about a 30° angle from the median axis of telopodite, the terminal, and tridentate, the distalmost lobe carrying the seminal groove (figs. 2, 3, 4).

Female (Mount Squires, Blount Co., Tenn.): Total length 37 mm., width 7.1 mm., W/L ratio 19.2%. Structurally similar to male with the following exceptions:

Body proportionately more robust, gradually increasing in width back to segment 15; paranota smaller than in male, the corners more rounded, posterior corners acutely produced only on segments 15–19. Dorsal tubercules much more prominent, easily visible without magnification. Interzonal groove more distinct, longitudinally vaguely costulate. Podosterna broader and not quite so elevated, legs set about 2.7 mm. apart on midbody segments. Color essentially as described for male.

Cyphopods of the form shown in figure 5.

Variation.—There appears to be no appreciable structural variation within the range of *Boraria stricta.* I have closely compared specimens from Georgia and Virginia with each other and with material from North Carolina and can find no departures aside from individual and sexual variation in size. Even this is highly sporadic in distribution, and I could locate no particular area where populations tended to be larger or smaller than the average for the species. As usual in the genus, females are distinctly larger than males and have a higher W/L ratio, as shown by the following table (averages in parentheses), which is based on 10 specimens of each sex selected at random:

sex	*number*	*length (mm.)*	*width (mm.)*	*W/L ratio (%)*
males	10	26.0–30.5 (28.7)	4.5–5.3 (5.0)	16.7–18.5 (17.5)
females	10	30.0–37.0 (33.6)	5.4–7.0 (6.4)	18.0–19.9 (18.9)

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Both the largest male and largest female are from one collection made on Mount Squires in the Great Smoky Mountains, N.C.: the male 33 mm. long, the female 37 mm. long. The smallest male (26 mm.) is from Soco Gap, less than 20 miles from Mount Squires; the smallest female (30 mm.), from the Chattooga River southeast of Highlands, N.C. Probably the cited extremes nearly approximate the variation to be expected within the species. Insofar as length is concerned, all but one of the males are less than 31 mm. and all but one of the females are more than 30 mm. in length.

Synonymy.—Insofar as I can determine, *Boraria stricta* is a homogeneous and essentially unvariable species over its entire distribution. Both of the junior synonyms *Aporaria carolina* and *A. fumans* were proposed without cognizance of Brolemann's name; *A. fumans* was said to differ from *A. carolina* because of a small difference in the edge of the telopodite blade. This ostensible distinction does not exist. The illustration of the gonopod of *A. fumans* is accurate, but that of *A. carolina* appears somewhat stylized and cannot be matched exactly by any of the dozen male topotypes which I have seen.

Biological notes.—The paucity of published records for *Boraria stricta* is certainly curious in view of the fact that, in my own experience, this species is one of the most abundant and easily collected xystodesmids of the Southern Appalachians. Perhaps it has escaped the notice of general collectors because of its predilection for unusually moist environments. The following excerpts from field notes made on the scene will give a good impression of the habitat preference:

Asheville, N.C.: " . . . in black wet mud under flat rocks."

Grimshawes, N.C.: " . . . four under debris on the sandy bank of the Chattoga River."

Rabun Co., Ga.: "1 female *stricta* under a rock by a rushing stream."

Johnson Co., Tenn.: "Male in black mud by stream."

Soco Falls, N.C.: " . . . in wet , muddy seepage, on a steep hillside."

Jonas Ridge, N.C. "1 male *stricta* by stream in sand mud, under wet leaves."

Bat Cave, N.C.: "*B. stricta* in a muddy spring seepage."

Altapass, N.C.: "Numerous specimens of *stricta* under leaves and debris along a small stream, virtually in the water."

All of the material which I have collected originated from localities less than 100 feet from streams or spring areas. The species is more nearly semiaquatic than any other milliped I know, with the possible exception of *Oxidus gracilis*. In places where the mud is fairly firm, *B. stricta* occurs in burrows apparently of its own making, both in the adult and late nymphal stages.

Despite the abundance of the species, I have found mated pairs only once, at Indian Gap, Sevier Co., Tenn., on Aug. 3, 1958.

So far the egg chambers have not been discovered. On one occasion I found the moulting chambers of *B. stricta* and made the following notes:

> Sept. 4, 1961. Asheville, N.C. Collected on Beaucatcher Mountain for several hours; conditions very dry; . . . located a small trickle down through the dry woods, here found *B. stricta* under rocks in wet places. Several adult females, and immatures in two different stages, either in or constructing "igloos." These are oblate spheroid, with a "chimney" and attached at the base, usually found in animal burrows in the wet black mud under flat rocks. . . . The large ones (made by the penultimate instars?) are about the diameter of my thumbnail = ca. 15 mm.

The typical appearance is about as shown in the accompanying figure. The chambers being constructed were in the early stages, less than half completed, the milliped working from the inside and apparently using both mouthparts and paraprocts alternately. The occupant must come and go until the last stages, and then complete the roof and chimney with the paraprocts, as the chimney could scarcely be formed by the mouthparts from the inside.

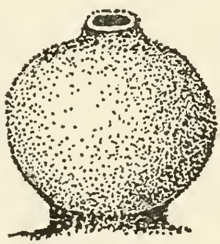


FIGURE 6.—*Boraria stricta* (Brolemann): moulting chamber constructed by last nymphal instar, sketched from life, actual diameter about 15 mm.

DISTRIBUTION.—The known range of this species coincides closely with the Southern Section of the Blue Ridge Physiographic Province as defined by Fenneman (1938) and as shown by the dotted line in figure 7. Within this area, *B. stricta* is abundant and easily collected in moist or wet habitats. The altitudinal range extends from around 1000 feet in western South Carolina up to 5200 feet or more in the Iron, Black, and Great Smoky Mountains. Probably the existing records depict the actual distribution closely although I would anticipate some slight range extensions at both the northern and southern extremities.

Specimens (personally collected, and in my collection unless otherwise indicated), have been examined from the following localities:

Virginia: Franklin Co.: headwaters of Shooting Creek, ca. 4 miles SW. of Endicott, 1♂, 1♀, May 28, 1957. Grayson Co.:

Mount Rogers, 5000′, 2♂, July 1, 1947; Helton Creek at U.S. Highway 58, ca. 4000′, 2♂, 3♀, June 19, 1950, J. A. Fowler and R. L. Hoffman. Patrick Co.: Pinnacles of Dan, 4 miles SW. of Vesta, 1♂, 2♀, May 30, 1951, W. B. Newman and R. L. Hoffman.

Tennessee: Blount Co.: Mount Squires, 4500–4800′, E. of Cades Cove, 1♂, 3♀, July 7, 1955, R. Highton and A. VanPelt. Greene Co.: Tusculum College near Greeneville, 1♂, Apr. 18, 1947, M. Wright. Johnson Co.: along Beaverdam Creek, 5 miles NE. of Shady Valley, 1♂, July 11, 1962. Sevier Co.: west side of Indian Gap, 5000′, Great Smoky Mountains National Park, 7♀, 2♂, Aug. 4, 1958.

North Carolina: Ashe Co.: Mill Hill, near Jefferson, 3♂, 6♀, July 1922, C. M. Breder (AMNH). Avery Co.: between Banner Elk and Newland, 3♂, June 14, 1954. Buncombe Co.: Asheville, 2♀, 2 imm., Sept. 4, 1961; Black Mountain, 1♀, June 16, 1935, W. J. Gertsch (AMNH). Buncombe-Transylvania Cos.: Pisgah Mountain campground, 5♂, June 15, 1953, Hubricht. Burke Co.: 4 miles SE. of Jonas Ridge on N.C. Highway 181, 1♂, July 13, 1962. Graham Co.: Stratton Gap, 4300′, Unicoi Mountains, 4♂, May 27, 1958, Hubricht. Haywood Co.: Wagon Road Gap, 4 miles S. of Cruso on U.S. Highway 176, 1♂, 1♀, June 5, 1952. Haywood-Transylvania Cos.: Pisgah Ridge, 2♀, July 17, 1955, A. VanPelt. Henderson Co.: 1 mile SW. of Bat Cave on U.S. Highway 64, 2 imm., July 13, 1962. Jackson Co.: Chattooga River near Grimshawes, 2♂, 2♀, July 24, 1949; Soco Gap Falls, 12 miles E. of Cherokee on U.S. Highway 19, 4♂, 3♀, July 28, 1949; also 8♂, 2♀, May 20, 1956, W. T. Keeton, W. C. Lund, and R. L. Hoffman. Macon Co.: Cowee Bald, N. of Franklin, 1♀, July 21, 1952, Thelma Howell; also 2♂, July 18, 1958. Cullowhee Gap road, north of Cullasaja, 2♂, July 10, 1958; Highlands, 4000′, 1♂, July 13, 1949; 1♀, July 25, 1949; 3.5 miles N. of Highlands, 1♂, Aug. 3, 1958; Otter Creek, west side of Wesser Bald, 2♀, July 29, 1949, F. Bryson and R. L. Hoffman; Shuler's Ruby Mine, ca. 5 miles N. of Franklin on Cowee Creek, 3♂, 2♀, July 22, 1961. Mitchell Co.: Altapass, 6♂, 6♀, May 20, 1956, Keeton, Lund, Hoffman. Swain Co.: near Blowing Spring, 3 miles NE. of Nantahala, 2♂, May 6, 1951, Hubricht; base of Cliff Ridge at Nantahala, 3♂, 7♀, May 6, 1951, Hubricht. Transylvania Co.: along U.S. Highway 176 just below Looking Glass Falls, 2♂, 2♀, June 5, 1952. Watauga Co.: Boone, 1♀, Aug. 11, 1948, M. Wright. Yancey Co.: Blue Ridge Parkway below the Pinnacles, 2♂, 2♀, June 28, 1951, Hubricht; summit of Mount Mitchell, 6600′, 3♂, 6♀, June 26, 1950, Hubricht; Spivey Gap, U.S. Highway 19E about 1 mile E. of the Tennessee state line, 1♀, June 2, 1952.

South Carolina: Oconee Co.: Chattooga Ridge, 2 miles N. of Mountain Rest, 1♀, July 21, 1958.

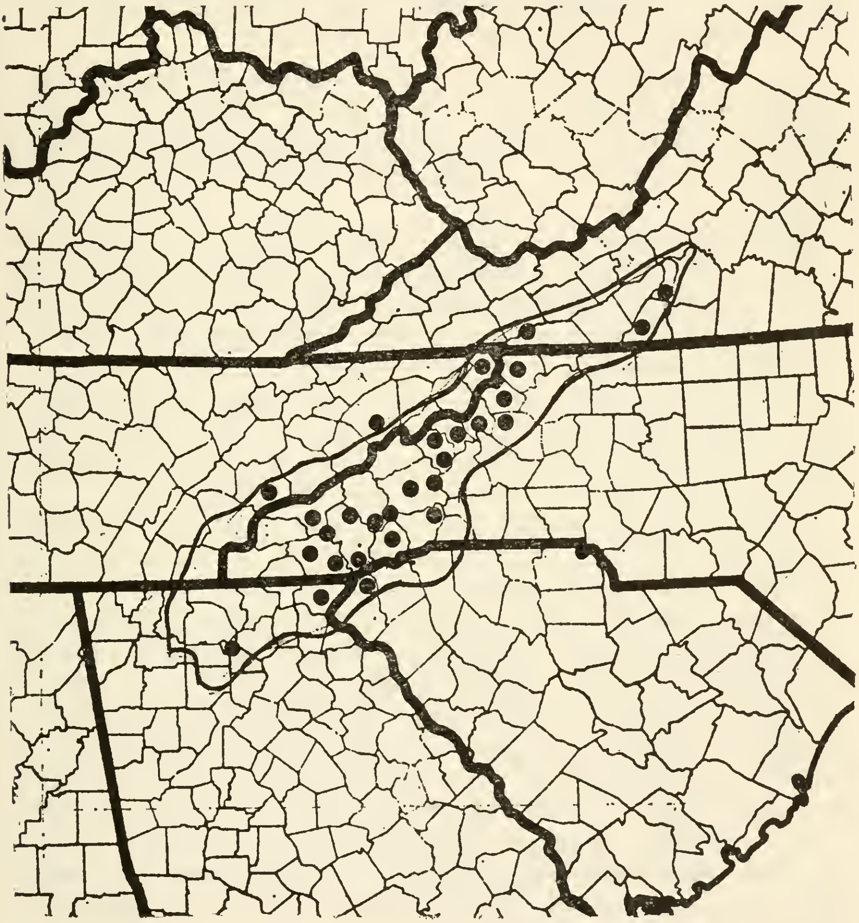


Figure 7.—Distribution records for *Boraria stricta* (Brolemann). Each dot is a collecting locality except for closely approximate sites where one dot may cover several places. Enclosing line shows limits of Southern Section of Blue Ridge Physiographic Province (Fenneman, 1938) to which *B. stricta* appears to be endemic.

Georgia: Dawson Co.: Amicalola Falls State Park, 1♂, Nov. 6, 1960, Hubricht. Rabun Co.: Clayton, 1♂, July 1910, W. T. Davis (AMNH); Glade Mountain, E. of Satolah, 1♀, July 27, 1949; Burrell's Ford road, E. of Pine Mountain, 1♀, Sept. 6, 1961.

Boraria media (Chamberlin)

FIGURES 8–12

Nannaria media Chamberlin, 1918, p. 125.—Attems, 1938, p. 199.
Aporiaria geniculata Chamberlin, 1939, p. 6, fig. 10; 1940, p. 56 [new synonymy].
Boraria media Wray, 1950, p. 44.—Chamberlin and Hoffman, 1958, p. 22.
Boraria geniculata Chamberlin and Hoffman, 1958, p. 22.

TYPE SPECIMENS.—Holotype and paratypes of *Nannaria media* (MCZ), from Burbank, Carter Co., Tenn., collected by Roland Thaxter. Holotype and paratype of *Boraria geniculata* (RVC), from Soco Falls, Jackson Co., N.C., collected Apr. 29, 1939, by Nell B. Causey.

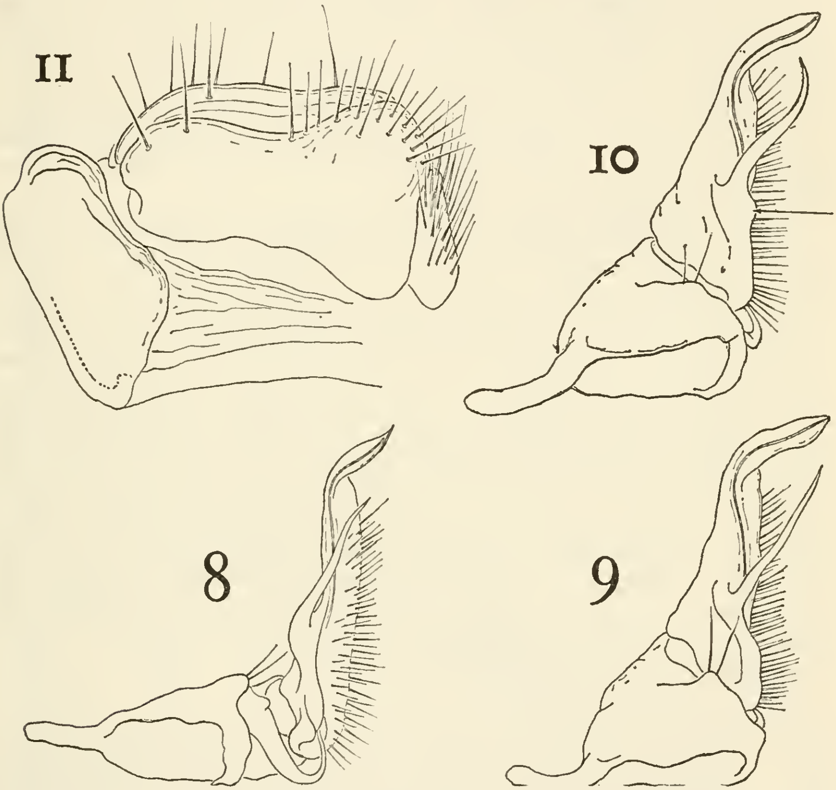
DIAGNOSIS.—Dorsum brownish black, paranota with reddish or chestnut spots; epicranial suture distinct and ventrally branched in the interantennal isthmus; metatergites without rows of small tubercules; some, however, tend to be finely rugulose laterally; coxae unspined; legs longer than in *B. stricta*, tibiae twice as long as broad.

DESCRIPTION.—Male topotype, 2 miles S. of Burbank, Tenn. Body length 24 mm., greatest width 4.9 mm., W/L ratio 20.4%. Dorsum nearly black, the paranotal spots reddish chestnut; underparts nearly white, distal 2 segments of legs becoming yellowish.

Head of normal proportions in relation to body size, the surface smooth and polished. Epicranial suture distinct, not punctate, branched in the interantennal isthmus, the lateral arms extending to the antennal sockets. Genae flat with prominent median impression, not margined laterally. Facial setae: 2–2 supra-antennal; 1–1 frontal; 1–1 clypeal; 4–4 genal. Interantennal isthmus broad (1.0 mm.), about 19% of the antennal length. Antennal long (5.3 mm.) and slender, 1st article large, globose, with 4 long macrosetae on the dorsal side, otherwise glabrous; 2nd article elongage, clavate, slightly geniculate basally, distally exceeding genal apex; articles 3–6 similar in size and shape, cylindric, slightly clavate, with sparse scattered erect setae and a subterminal whorl of 3 or 4 macrosetae; 7th article small, subconic, truncate, densely setose, without sensory areas; 4 small terminal sensory cones.

Collum large, convex, about as wide as head across mandibles, not as wide as following tergite; entire front edge evenly curved, the rear edge nearly straight across dorsum and not emarginate, laterally curved forward toward the rounded lateral ends. Surface smooth and polished, cephalolateral submarginal ridge distinct nearly up to median area.

Body segments smooth, evenly convex, nearly flat, the 2 subsegments of approximately equal length and diameter, meeting dorsally at a fine sutural line, interzonal furrow distinct across dorsum, narrowly and sharply defined on anterior segments but becoming broader, less well defined, and distinctly punctate on posterior segments. Metatergites smooth and polished, with only irregularly scattered, very small tubercules, dorsum of segments 17–19 becoming longitudinally wrinkled laterally. Paranota smaller than average for the



Figures 8–11.—*Boraria media* (Chamberlin): 8, left gonopod, mesial aspect × 45, topotype from Burbank, Tenn.; 9, left gonopod, same as fig. 8, dorsal aspect × 45 (type 1 gonopod, distribution shown in fig. 12); 10, left gonopod, dorsal aspect × 45, specimen from southeastern Buncombe Co., N.C. (type 2 gonopod, arrow indicates marginal indentation at base of prefemoral process, occurrence shown in fig. 12); 11, left cyphopod, caudal aspect × 100.

family, depressed from the horizontal but slightly interrupting the dorsal convexity, those of midbody segments not overlapping. Paranota of anteriormost segments sloped forward, overlapping, with both outer corners rounded, the anterior and lateral edges set off by a prominent submarginal depression. Paranota of segments 14–19 with posterior corners caudally produced, anterior corners rounded, scapulorae entirely marginal, peritremata flat but prominent, the pores rather large and located in deep pits. Posterior edge of all paranota essentially straight, without basal lobes. Paranota of segment 19 small, broadly rounded lobes; epiproct small, partially retracted into preceeding segment, of the usual subtriangular profile.

Paraprocts glabrous, smooth, nearly flat, with prominent elevated median edges, the ventral seta set on a tiny tubercule slightly removed from the rim, the dorsal seta set on an enlargement of the rim near its dorsal end. Hypoproct large, smooth, strongly flattened, depressed toward lateral ends, semicircular in outline with a distinct median apical projection; paramedian setiferous tubercules small, removed from the edge, the setae very long.

Ventral surface of prozonites smooth, separated from metazonites only by a fine, indistinct groove. Legs set on prominent subcoxal elevations, but no distinct elevated podosternum formed; caudal margin of sternum broadened medially, with a small but distinct raised rim. All sternal areas smooth and glabrous, no subcoxal spines formed. Sterna of midbody segments about 1.5 mm. wide, legs of both pairs equally separated. Coxae much shorter than prefemora and without trace of distal spine; prefemoral spine very short and acute, both coxa and prefemur with 2 or 3 ventral macrosetae; femora elongate, clavate, postfemora distinctly longer than broad, tibiae twice as long as broad; tarsi longer, set with numerous erect setae increasing in length toward end of segment; pretarsi long, slender, and compressed, ⅓ as long as tarsi. Legs relatively long, the distalmost 4 podomeres visible beyond paranota when extended laterad. Length relationships of podomeres: $3>6>2>5>4>1$.

Interzonal furrow distinct down sides of segments, best defined in front of anterior stigma; lateral surfaces of segments smooth, unmodified. Stigmata similar in shape, the anterior stigma somewhat larger than posterior, slightly elevated but without flared rims, both stigmata in contact with the dorsal coxal condyle.

Anterior legs unmodified. Sterna of segment 5 with 2 low paramedian knobs between the 4th pair of legs, other sterna not modified.

Gonopod aperture moderate in size, transversely oval, posterior edge with very low marginal rim. Sternal surface between 8th pair of legs depressed only at center. Gonopods relatively large, of the form as shown in figures 8 and 9.

Female (from Roan Mountain, Tenn.): Body length ca. 28 mm., greatest width 6.3 mm., W/L ratio 22.5%. Similar to male in most details of body structure and color pattern. Body proportionately broader, and increasing in width back to about 14th segment; tergites distinctly more convex than in the male; paranota smaller than in male, the posterior corners produced only on segments 17–19. Antennae proportionately longer and more slender than in males, 6.0 mm. in length. Legs widely separated, the intercrural distance at midbody about 1.9 mm.; podosterna very low and with a deep, prominent transverse groove separating anterior and posterior leg pairs. Interzonal furrow distinct but shallow with a single row of punctations. Spines of prefemora longer than in males, and slightly curved upward.

Cyphopods of the form shown in figure 11; the receptable smaller than in *Boraria stricta* and lacking macrosetae.

VARIATION.—*Boraria media* differs from its two congeners in showing considerable geographic variation in at least 2 characters. Aside from the usual amount of individual and sexual variation in size and proportions (summarized below), there is an appreciable difference in body form which is related to geography, and two, largely vicarious, variant forms in the gonopod structure. There is at present not sufficient material at hand to permit a good analysis of these phenomena, but some preliminary inferences can be drawn and commended to the attention of some future worker. Unfortunately, few of the female specimens are in satisfactory condition for accurate length measurements, so that the following remarks have to be based largely upon members of the male sex.

As usual in this genus, females tend to be distinctly larger and more robust than males. This is suggested by the following summary of measurements (averages in parentheses):

sex	*number*	*length* (*mm.*)	*width* (*mm.*)	*W/L ratio* (%)
males	10	24.0–33.0 (29.3)	4.9–6.7 (6.0)	19.1–22.9 (20.4)
females	5	–	6.3–7.1 (6.8)	–

Geographic variation in body proportions: On the basis of male specimens only, it can be shown that variation in the body form can be related in a general way to the species' horizontal distribution. The narrowest specimen measured has a W/L ratio of 18.1%; the broadest, 22.9%. Individual ratio figures, when plotted on a map, tend to sort out with the highest percentages near the center of the range, the lowest figures at peripheral points (fig. 12). Elsewhere in the Xystodesmidae, there seems to be a tendency for broader body form to be associated with more specialized genera and species, and so perhaps we have here a case of centripetal widening of the body. But the available data must be supplemented by far more evidence, particularly from peripheral populations.

Gonopod form: There are two distinct variants in gonopod form

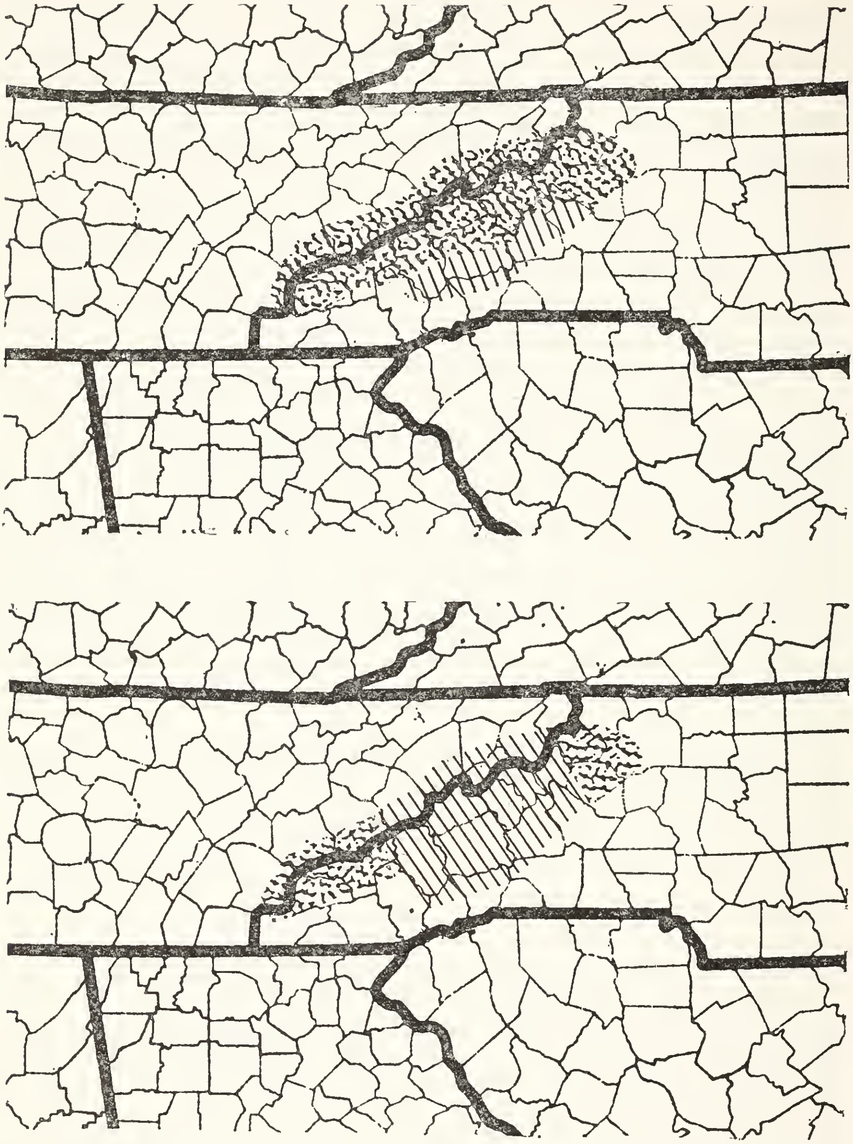


FIGURE 12.—Geographic variation in two characters in *Boraria media*. Upper map: distribution of gonopod types 1 (heavy stippling) and 2 (oblique shading). Lower map: distribution of broad vs. narrow body form in males, populations in which W/L ratio is less than 20.0% (heavy stippling) vs. populations in which this ratio is greater than 20.0% (shading).

within the species *Boraria media.* In one phase, the medial edge of the telopodite (as seen in dorsal aspect) is convex at the base of the prefemoral process, as indicated by the arrow in figure 10. In the other phase, this same edge is distinctly concave in profile, as shown in figure 9. These differences do not show up when the gonopod is viewed in mesial aspect. The two gonopod types essentially are geographically vicarious, type 1 being peripheral, type 2 central (fig. 12). In a general way, there is some coincidence in the distribution of gonopod types and body form. But as the maps show, there is not a very close concordance in the northern part of the range. At one locality (Mount Mitchell), both gonopod types occur. There seems to be some sort of differentiation going on within this species, but I do not think that we are justified for the present at least in recognizing even subspecies of *B. media.* If a distinction were to be made on gonopod form alone, type 1 would represent the nominate form, type 2 would carry the name *B. geniculata.* But the magnitude of the difference is certainly of a low order and hardly sufficient for the basis of subspecific names.

Color pattern variations: The normal coloration in this species is that described in a preceeding paragraph: the dorsum dark brown to blackish, with reddish or pink paranotal spots. Occasionally the dorsum is lighter brown, with the spots more orange; in a few specimens, chiefly those which recently have moulted, there is a tendency for the metatergites to have a light transverse caudal stripe. Such specimens are sporadic and have been seen at various parts of the range (Roan Mountain, Grandfather Mountain, Soco Gap) and have no systematic or nomenclatorial significance.

Synonymy.—*Nannaria media* was described without illustrations of the gonopods and fell into complete obscurity. In 1949 I examined the types at Harvard and discovered that the species is not congeneric with *Nannaria minor,* described in the same paper, but that it is congeneric with *Boraria stricta.* Subsequently, through the kind cooperation of Dr. Chamberlin, I examined the male type of *B. geniculata* and found it to agree in all essential respects with that of *B. media.*

Biological notes.—Specimens of *B. media* have been collected from April to September, but this period obviously represents the active season of collectors rather than the milliped. I have collected *B. media* at about six localities and am unable to make any generalization about habitat preferences. On Roan Mountain, specimens were abundant under stones near the edge of grassy fields; elsewhere I have found the species under logs in oak woods, in the leaf litter in laurel thickets, in hemlock-rhododendron stands, and on wet exposed rock cliffs. None have yet been found in copulation, and I know nothing of the immature stages. *B. media* certainly cannot be collected as easily as its congener *B. stricta* although it is often locally abundant and occurs over nearly as great a geographic area.

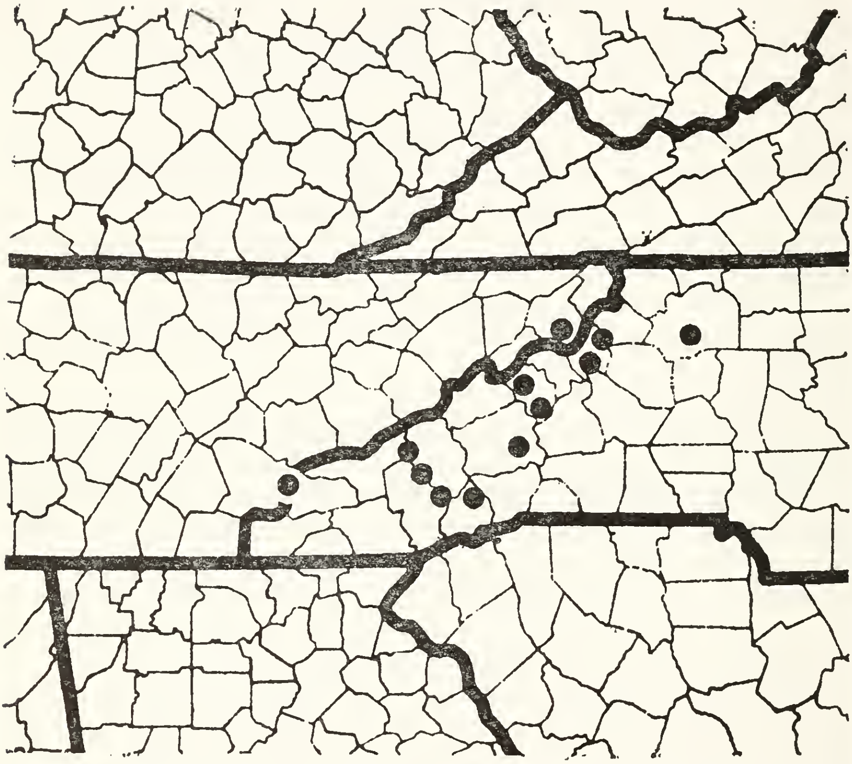


FIGURE 13.—Distribution records for *Boraria media* (Chamberlin). Except in two cases, each dot is a separate collection; near Grandfather Mountain, N.C., several adjacent sites are covered by a single dot.

DISTRIBUTION.—The mountains of western North Carolina and adjacent east Tennessee (fig. 13). Almost certainly the species occurs in north Georgia and southwest Virginia and is to be expected in these areas. All but one of the known localities are in the higher mountain region, at elevations ranging from 3000 to 6600 feet. The exceptional locality—in Wilkes County, North Carolina—is considerably lower and somewhat to the east of the Blue Ridge, but the specimens from there are entirely typical and similar to those from the center of the range.

Specimens have been examined from the following localities:

North Carolina: Avery Co.: east side of Grandfather Mountain on U.S. Highway 220, about 2 miles NE. of Linville, 1♀, June 1, 1954; between Banner Elk and Newland, 1♂, June 15, 1953; near Linville Falls, 1♀, Aug. 3, 1949. Buncombe Co.: between Bat Cave and Black Mountain, on N.C. Highway 9, 1♂, July 5, 1955. Haywood Co.: Beech Gap, S. of Sunburst, 1♂, June 14, 1953, Leslie Hubricht. Jackson Co.: below Jones' Knob, 5000′, Plott Balsam Mountains, 1♂, May 26, 1958, Hubricht. Transylvania Co.: 1.5 miles N. of Looking Glass Rock, U.S. Highway 276, 1♂, May 26, 1958, Hubricht. Wilkes Co.: Pores Knob, Brushy Mountains S. of Moravian Falls, 1♂, April 5, 1952, Hubricht. Yancey Co.: Spivey Gap, U.S. Highway 19W, 1 mile E. of the Tennessee state line, 1♂, June 2, 1952; top of Mount Mitchell, 6600′, 2♂, Sept. 9, 1950, B. D. Burks (USNM).

Tennessee: Carter Co.: Burbank, ca. 2 miles S. of Roan Mountain Station, ♂ holotype, Roland Thaxter (MCZ); S. of Burbank, at 4000′, 8♂, 9♀, May 2, 1951, Hubricht (USNM); Roan High Bluff on Roan Mountain, 5♂, 4♀, June 20, 1950, J. A. Fowler and R. L. Hoffman. Monroe Co.: Little Haw Knob, 5000′, Unicoi Mountains, 2♂, May 27, 1958, Hubricht (locality astride the state line and could also be cited in Graham Co., N.C.).

Boraria deturkiana (Causey)

Figures 14–19

Aporiaria deturkiana Causey, 1942, p. 169, fig. 8.
Howellaria deturkiana Hoffman, 1950, p. 26, figs. 7, 8, 13.—Chamberlin and Hoffman, 1958, p. 37.

Type specimen.—Male holotype, ANSP, from Highlands, Macon Co., N.C., collected June 14, 1940, by William DeTurk.

Diagnosis.—A species of *Boraria* characterized by the strongly depressed paranota, punctate epicranial suture, prominent coxal spines, and acuminate apex of the gonopod telopodite.

Description.—Male topotype, Highlands, N.C. A slender, smooth, strongly convex species, the paranota depressed and continuing slope of dorsum; body essentially parallel sided from segments 6 through 16. Color in life dark greenish black dorsally, paranotal spots and a narrow transverse stripe on the caudal border of each metatergite yellowish orange; prozonites, antennae, mandibles, legs, and tip of epiproct yellowish white. Total length 28.5 mm., width 5.6 mm., W/L ratio 19.7%. Segment 13 height 3.9 mm., width 5.6 mm., H/W ratio 69.6%.

Head proportionately rather small, about 3.5 mm. across genae; the surface convex, smooth, polished; a deep rounded depression between the antennae; epicranial suture distinct, with a single row of small punctations, conspicuously branched between the antennae (fig. 14). Genae equally divided into: (1) a broad, flat, lateral margin; (2) a prominent subantennal swelling that does not extend to genal apex. Facial setae: supra-antennal 2–2, frontal 1–1, subantennal 1–1, clypeal about 13–13, labral about 14–14, genal 3–3. Interantennal isthmus wide (1.1 mm.), about 22% of antennal length.

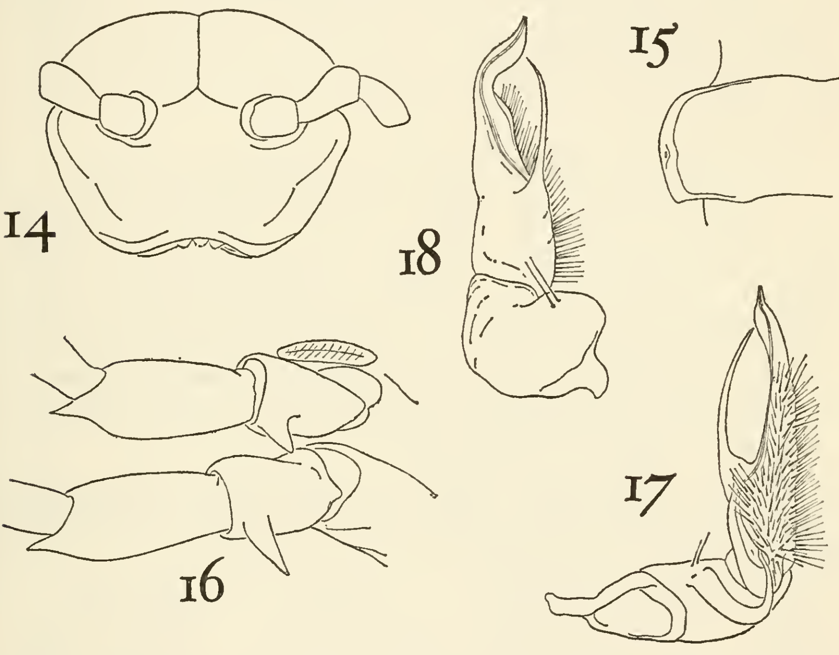
Antennae of moderate length (5.0 mm.) and slender, extending caudad to 4th segment. 1st article globose with 5 macrosetae; 2nd article not distinctly geniculate basally, short, not extending beyond cranial margin; articles 2–6 essentially similar in size and shape, the distalmost articles densely setose; article 7 small, subconical, with 4 small sensory cones.

Collum small, ends broadly rounded and much shorter than ends of 2nd segment. Surface smooth and polished, marginal ridge extends along caudal edge nearly to mid-dorsum. Tergites of body segments smooth and polished, paranota strongly depressed ventrally, continuing slope of dorsum. Both subsegments about equal in diameter, metazonite distinctly the longer, the two separated dorsally by a sharply defined stricture. Paranota of segments 17–19 less depressed, nearly horizontal, their surface coriaceus.

Paranota small (fig. 15), widely separated from each other except on the anteriormost segments, anterior corners rounded back to about segment 12, thence becoming distinctly angular; posterior corners rounded on segments 2–4, thereafter becoming increasingly acutely angular. Anterior, lateral, and posterior paranotal edges margined on all segments. Scapulorae submarginal; ozopores large, opening laterally about at midlength of the elongate peritremata. Paranota of posterior segments join sides of the body cylinder at a re-entrant angle.

Epiproct small, triangular in outline, the lateral tubercules inconspicuous. Paraprocts prominently wrinkled, basal seta set on a nearly centrally located elevation of the discal surface, dorsal seta located at the broadest point of the smooth, thickened margins. Hypoproct flat, smooth, broadly triangular, with a prominent median projection.

Legs of midbody segments widely separated (1.5 mm.), the anterior legs of each segment slightly farther apart than the posterior. Legs attached to prominent subcoxal elevations which, on the caudal half of the body, become transversely connected to form moderately distinct podosterna; all sternal areas smooth, glabrous, without trace of subcoxal spines. Legs long and slender, the distalmost 3 podomeres visible beyond sides of body when extended laterad. Coxae large, with prominent ventrally curved, terminal spines (fig. 16); prefemora twice as long as wide, with small, acute terminal spines; femora long, slender, clavate. Tarsi cylindrical, considerably longer than postfemora and tibiae combined, densely setose on the dorsal surface; pretarsi long, slender, distally curved, more than 1/3 as long as tarsi. Length relationship of podomeres: 3>6>2>1>5>4.



Figures 14–18.—*Boraria deturkiana* (Causey): 14, front of head and basal antennomeres, to show branching of epicranial suture; 15, left paranotum of 9th segment, dorsal aspect × 15; 16, coxae and prefemora of legs of a midbody segment, ventral aspect × 45, to show coxal spines; 17, left gonopod, specimen from Highlands, N.C., mesial aspect × 45; 18, same gonopod, dorsal aspect × 45.

Sides of metazonites finely wrinkled and punctate, the stricture very broad and deep down the sides, nearly obliterated near mid-ventral line. Caudal edge of sides with a fine, elevated rim. Stigmata similar in shape and position, with small marginal rims, both stigmata are turned conspicuously caudad and lying upon the upper coxal condyle.

Anterior legs unmodified, the first two pairs reduced in size; coxae of 2nd legs with elongate, conical processes. Sterna of anterior segments narrow, without lobes or processes. Gonopod aperture small, narrowly ellipsoid, the posterior edge elevated into a high, sharp rim. Stigmata of segment 7 large and oval, located in a prominent deep depression in front of the coxae.

Gonopods relatively small, the coxae small and depressed, with 2 setae on the dorsal side. Solenite large, heavy at the base. Telopodite set on coxa at a right angle, the prefemur long (about 70% of the telopodite length) and setose, with a long, slender, acicular prefemoral process. Distal end of telopodite thin, flat, spatulate, terminally acute, the entire gonopod similar to that of *Boraria media.*

Female (Highlands, N.C.): Total length 37.5 mm., width 7.2 mm., W/L ratio 19.2%. Structurally similar to male with the following exceptions:

Body proportions about the same, but dorsum appearing more vaulted owing to the much smaller and more depressed paranota, the outer surface of which is nearly vertical on midbody segments. Antennae short (5.7 mm.) and slender, reaching back only to middle of paranota of 3rd segment. Sterna proportionately broader than in male (1.5 mm. at midbody), coxal and prefemoral spines larger and more acute; legs smaller and more slender than in male. 3rd segment not modified ventrally, the sympleurites forming a narrow, simple, transverse strip behind the 2nd pair of legs. Cyphopods very similar to those of *Boraria media.*

Variation.—Within the small range of this species there is little in the nature of geographic variation. There is, however, pronounced individual and sexual variability in size, as indicated by the following table (averages in parentheses):

sex	*number*	*length (mm.)*	*width (mm.)*	*W/L ratio (%)*
males	6	21–30 (26)	4.1–5.8 (5.1)	19.0–20.0 (19.4)
females	8	31–37 (35)	5.5–7.3 (6.6)	18.0–19.5 (18.8)

In the 14 specimens measured, there was no overlap at all between the total lengths for males and females, the average length being 10 mm. greater in females. There was virtually no overlap in width values for the two sexes; here the females averaged 1.5 mm. wider than males. There can be no doubt that sexual dimorphism in overall size is far greater than in the other species of *Boraria,* and, in fact, than in any other xystodesmid known to me.

The females tend to be about the same size in both of the two areas where this species has been found (the Great Smoky Mountains and the vicinity of Highlands, N.C.: 2 specimens from Highlands average 6.9 mm. in width, 6 from the Smokies average 6.6 mm.); however, there is apparently a striking divergence between males from these two localities. Three males from Highlands average 5.6 mm. wide, whereas 3 from the Smokies average only 4.6 mm. in width, a difference of a full millimeter. Of course, the series examined are far too small to show the full range of variation in the two regions, yet they unquestionably indicate that a size differential does exist. It is the more remarkable that only the male sex seems to be involved.

In all other respects (structural details, color pattern, gonopods), all of the specimens appear to be quite uniform and invariable.

FIGURE 19.—Distribution records for *Boraria deturkiana* (Causey). Each dot is a separate locality.

BIOLOGICAL NOTES.—Virtually nothing is known of the biology of this species. The available material was all collected during June and July, but the period of activity is undoubtedly much longer. All of the specimens from Highlands, N.C., were found in the rhododendron thicket surrounding Lake Ravenel at the Biological Station; those from Heintooga Ridge were also from rhododendron litter. The specimen from Chimneys Camp Ground in the Smokies came from mixed hardwood and hemlock cove forest; those from Clingman's Dome presumably are from the evergreen forest which covers the upper thousand feet of that mountain.

Boraria deturkiana seems clearly to be a high-altitude species; the known localities range between about 3000 and 6600 feet.

763-237—65——3

Distribution.—The higher mountain areas of western North Carolina and eastern Tennessee. Specimens have been examined from the following localities:

North Carolina: Haywood County: Heintooga Ridge, near Black Camp Gap, 2♂, 1♀, June 18, 1953, T. Howell, M. J. Westfall, R. L. Hoffman. Macon County: Highlands, 1♂, July 13, 1949; 1♂, June 23, 1950, L. Hubricht; 2♀, June 2, 1954.

Tennessee: Blount County: Mount Squires, on state line above Cades Cove, 4♀, July 7, 1955, R. Highton and A. VanPelt. Sevier County: Chimneys Camp Ground, Great Smoky Mountains National Park, 1♂, July 29, 1949; Clingman's Dome, 4♂, 2♀, June 14, 1954, H. E. and M. A. Evans; between Gatlinburg and Newfound Gap, 2♀, June 1960, J. G. Barker.

These localities fall into two distinct areas: one centered in the Great Smoky Mountains, the other at Highlands, N.C., about 35 miles to the southeast. Almost certainly *B. deturkiana* occurs in the intervening area, but so far it has not been found despite repeated collecting in the Balsam and Cowee ranges. There appears to be no evident difference between specimens from the two regions.

Gyalostethus, new genus

Type species.—*Boraria monticolens* Chamberlin, 1951.

Diagnosis.—A genus of small rhysodesmine xystodesmids characterized by the following structural details:

Body composed of head and 20 segments in both sexes; small, robust, sexually dimorphic: W/L ratio about 22% in males, 23% in females. Head proportionately large, smooth, with only clypeal and labral setae; genae not impressed medially; antennae long and slender, separated by a broad interantennal isthmus.

Body segments smooth, polished, prozonites and metazonites forming a perfectly flat surface dorsally, meeting at a suture line only, no interzonal furrow. Paranota depressed, the posterior corners produced from segment 6 to segment 19, the posterior edges deeply concave; scapulorae entirely marginal; pores small, dorsolateral, in elongate peritremata, the pore formula normal.

Posterior segments of the usual form, segment 20 somewhat smaller proportionately than usual for xystodesmids, hypoproct large, flat, semicircular, without median apical projection.

Legs widely separated, the anterior pair of each segment set farther apart and higher up on sides than posterior pair, sternum of metazonite deeply depressed and excavated, with an elevated thin posterior rim between the coxae of the posterior legs; sterna smooth and glabrous, no subcoxal spines formed.

Legs fairly long, 3 distal podomeres visible beyond edges of paranota when extended laterad; coxae unspined, prefemora with small, short distal spines (fig. 22); pretarsi very small, evenly curved, largely concealed by the long, slender, terminal tarsal setae. Sides of segments smooth and polished except for a horizontal ridge just above coxae of posterior pair of legs on segments 3–15 or 16, the ridge largest (and tuberculate) on anterior segments, becoming smaller caudally. Anterior stigma about 3 times as large as posterior, subcrescentic in shape, neither stigma with elevated rims or otherwise modified.

Legs and sterna of anterior segments without special processes or other modifications. Gonopod aperture small, oval, the posterior edge elevated into a distinct smooth flange.

Gonopods large, extending cephalad between legs of 5th segment; of the form shown in figure 24; coxae simple, without ventral apophyses, telopodite attached at a right angle, slender, the prefemoral region not much enlarged, with a short, acicular prefemoral process; telopodite beyond prefemur, a narrow, nearly straight, subterminally bigeniculate blade, the end expanded and lamellate, finely laciniate; no separate solenomerite developed. Prefemur about 50% of the total length of telopodite.

Cyphopods of the form shown in figure 25; the receptacle present but greatly reduced in size to a simple rolled plate for muscle attachment; valves approximately subequal, but inner valve smaller toward its distal end; a large simple rounded seminal receptacle present. Both valves and operculum densely set with long slender macrosetae. No special modifications of 2nd legs or epigynal region of 3rd segment.

Range.—Southern Appalachian region from Virginia to Georgia and Alabama (fig. 26).

Species.—One. *Gyalostethus monticolens* is a not uncommon endemic form of the southeastern United States.

The name *Gyalostethus* derives from the Greek *gyalos* (concave) plus *stethos* (chest).

Gyalostethus monticolens (Chamberlin), new combination

Figures 20–26

Boraria monticolens Chamberlin, 1951, p. 26, fig. 16.—Chamberlin and Hoffman, 1958, p. 23.

Type specimen.—Male holotype (RVC) from the Great Smoky Mountains National Park, Sevier Co., Tenn., collected by H. Hanson [date and exact locality unknown].

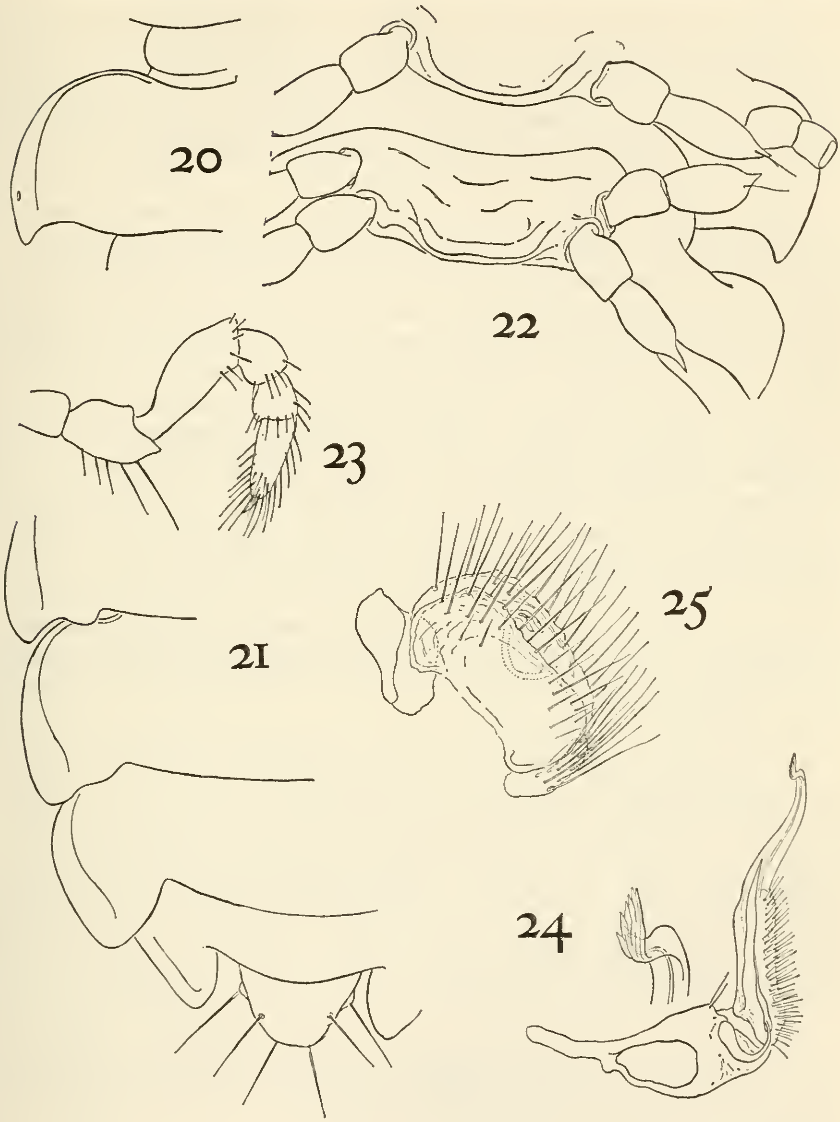
Diagnosis.—With the characteristics of the genus.

Description.—Male, Sequatchie Co., Tenn. Body length 16.8 mm., greatest width 3.8 mm. Dorsum uniformly light testaceous brown; antennae, prozonites, and sides below paranota almost colorless.

Head rather proportionately large, smooth, polished, evenly convex; epicranial suture distinct but not impressed or punctate; interantennal isthmus broad (ca. 0.56 mm.), exceeding length of 2nd antennal article. Genae moderately convex, not margined, without median groove. Antennal socket not rimmed. Antennae long (ca. 3.0 mm.) and slender, 1st article large, globose, with 2 long macrosetae on the dorsal side, each ca. 0.45 mm. in length, otherwise glabrous; 2nd article clavate, distinctly geniculate at base, distally exceeding genal apex; articles 3–6 subsimilar in size and shape, each cylindric, clavate, with sparse and scattered erect setae and a subterminal whorl of 3 or 4 macrosetae; 7th article small, subconic, truncate, densely setose, without sensory fields or areas; 4 small terminal sensory cones.

Collum large, convex, broader than head across mandibles and exceeding ends of 2nd segment, ca. 2.8 mm. wide and 0.95 mm. long; the entire front edge evenly curved, the rear edge nearly straight and distinctly emarginate across dorsum, thence bent forward to the rounded lateral ends of the collum. Surface smooth and polished; cephalolateral submarginal groove distinct only near ends.

Body segments smooth, evenly convex, and flat, the prozonites and metazonites approximately equal in length and meeting dorsally at a fine sutural line, no interzonal furrow present, and both subsegments of exactly the same diameter. Paranota moderately large, depressed, but slightly interrupting the dorsal convexity, those of midbody segments not overlapping. Anteriormost paranota sloped forward, overlapping, with both corners rounded, the anterior and lateral edges set off by a prominent submarginal depression. Paranota of segments 6–19 with posterior corners acutely produced, the anterior corners rounded, scapulorae entirely marginal, peritremata flat but prominent, pores small, dorsolaterally located, not in depressions. Posterior edge of paranota concave, with a rounded lobe at the base, this lobe becomes increasingly prominent on segments 15–16, thence much smaller on segment 17, and absent from segment 18 (fig. 21). Paranota of segment 19 small subtriangular lobes; epiproct small, partially retracted, broadly rounded.



FIGURES 20–25.—*Gyalostethus monticolens* (Bollman): 20, left paranotum of 9th segment, dorsal aspect × 45; 21, left side of posterior end of body, dorsal aspect × 45, showing basal lobation of caudal edge of paranota of segments 16 and 17; 22, sterna and bases of legs of two midbody segments, ventral aspects × 45; 23, leg from midbody segment × 45, showing very small pretarsus and proportions of podomeres; 24, left gonopod of male, medial aspect × 100, also distal end of telopodite × 430 to show details of structure; 25, cyphopod, caudal aspect × 100.

Paraprocts glabrous, smooth, nearly flat, with prominent elevated median edges, the ventral seta set on a tiny tubercule slightly removed from the rim, the dorsal seta set on an enlargement of the rim near its dorsal end. Hypoproct large, smooth, flat, semicircular in profile, no median apical projection; paramedian tubercules small, removed from the edge, the setae very long (ca. 0.40 mm.).

Ventral surface of prozonites smooth and polished, set off from metazonites by a shallow, sinuous interzonal furrow. Legs set on small subcoxal elevations, but entire sternal area between legs deeply depressed, a thin elevated rim extending between the posterior legs of each segment, bounding a concave, saucer-like area (fig. 22), the surface of this depression different in texture from prozonite, frequently rugulose punctate. All sternal areas smooth and glabrous, no subcoxal spines developed. Sterna of midbody segments ca. 1.0 mm. wide, anterior legs of each segment distinctly wider apart than the posterior, and set higher up on side of segment. Coxae and prefemora short, subequal in length and shape except prefemora with short acute spine, both sparsely setose; femora longer, clavate; postfemora and tibiae short, as broad as long, tarsi longer, set with numerous erect setae increasing in length toward the end, pretarsi very small and short, concealed within the terminal tarsal setae. Legs relatively long, the distalmost 3 podomeres visible beyond paranota when extended laterad.

Interzonal furrow distinct down sides of segments, best defined in front of anterior stigma; lateral surfaces smooth and polished except for a short horizontal ridge above the posterior coxae, this ridge most prominent, and distinctly tuberculate, on anterior segments but extending back about to midbody. Stigmata very different in size and shape, the anterior stigma larger, crescent shaped, posterior much smaller, straight, elongate oval, less than ½ as long and wide as anterior; both stigmata lack elevated rims, both are distinctly separated from dorsal coxal condyles.

Anterior sterna and legs unmodified, without processes. Sternum segment 6 with a subcoxal elevation at base of posterior leg pair, the space between depressed for tips of gonopods.

Gonopod aperture small, regularly oval, the posterior rim elevated around to the lateral ends of the aperture. Gonopods relatively large, extending cephaled between legs of 5th segment, of the form shown in figure 24.

Female (Jackson Co., Ala.): Length of body 22 mm., width ca. 4.8 mm., body widest near segments 15–16. In details of body structure agreeing closely with foregoing description of male, except for the usual sexual differences of wider sterna, more highly arched tergites, slightly shorter antennae. Third segment without special epigynal modifications. Bases of 2nd pair of legs and cyphopods as shown in figure 25; receptable small, valves flat, ovate, similar in size, the outer valve with evenly curved profile, the inner constricted at midlength, both are densely set with long setae. A single, rounded, median seminal receptacle.

Variation.—There is no geographic variation in structural characters. Individually there is considerable range in size, and females tend to be considerably larger than males. The largest specimen measured is a female from Jackson Co., Ala., ca. 22.0 mm. long and 4.8 mm. wide, the next largest female is 21.4 by 4.9 mm. The smallest measureable female (Blacksburg, Va.) is 16.8 mm. long and 3.9 mm. wide. The largest male (Morgan Co., Ala.) measures 17.5 by 3.9 mm., the smallest (Giles Co., Va.) is 14.0 by 3.1 mm. A badly fragmented male from Newport, Tenn., appears to be even smaller but cannot be measured precisely. I believe that these figures give *G. monticolens* the distinction of being the smallest known species of the family Xystodesmidae.

Female specimens are not only larger in size, but also are distinctly broader in proportion to width. The following chart shows values for length, width, and ratio of width divided by length (averages in parentheses):

sex	*number*	*length (mm.)*	*width (mm.)*	*W/L ratio (%)*
male	5	14.0–17.5 (16.2)	3.1–3.9 (3.6)	21.5–22.6 (22.1)
female	4	16.8–22.0 (20.1)	3.9–5.0 (4.6)	22.8–23.2 (23.0)

Synonymy.—The original description of this species (Chamberlin, 1951) is extremely brief and consists of a color description and comparison of the gonopods with those of *B. brunnior* and *B. geniculata.* The right gonopod is illustrated in situ, with a fairly adequate drawing, although the characteristic appearance of the apex does not show up with the magnification used.

The legend for figure 16 contains the spelling "*Borarja monticolene,*" presumably an uncorrected typographical error.

It is indeed curious that an eastern milliped with so extensive a geographic range should not have been described until 1951. I had received two specimens from eastern Tennessee as early as 1948 but until recently lacked the opportunity to study them closely.

Biological notes.—There seems to be no definite limitation regarding preferred habitat. I have found the species at 5 localities, 3 of them in fairly dry limestone areas, one in shale terrain, the other in moist mesic woods underlain by metamorphics although no bedrock was near the surface. A field note with one collection reads: "under rock at edge of creek."

Apparently *G. monticolens* is active throughout the year under clement weather conditions. The 15 collections at hand are distributed through the following months: February, March, July, September, and November, 1 each; April, 4; and May, 6. Curiously, I have not collected immature specimens referable to this species. Presumably there is a summer-long mating season, but I have found mated pairs only in September.

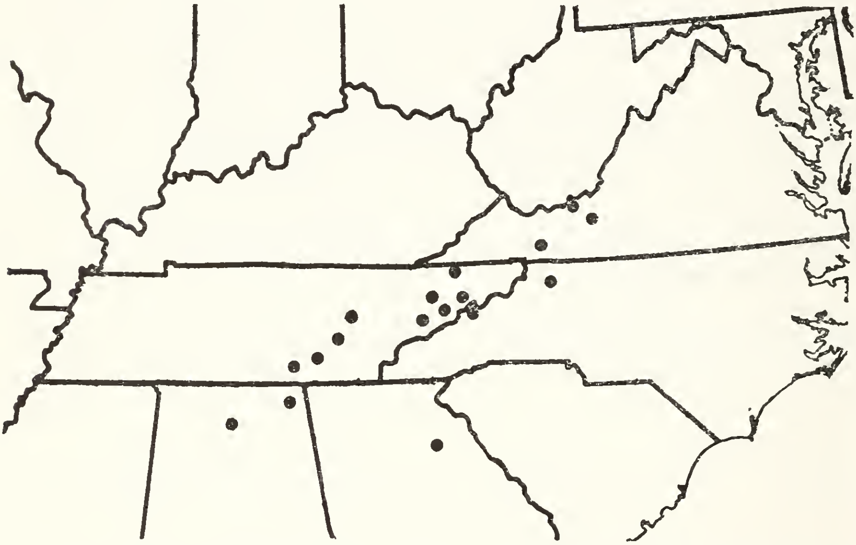


FIGURE 26.—Distribution records for *Gyalostethus monticolens* (Bollman): Each dot is a separate locality.

DISTRIBUTION.—In and adjacent to the Southern Section of the Blue Ridge Physiographic Province. The known range extends from southwestern Virginia south to north Georgia and west to north-central Alabama. There are as yet no records for South Carolina, Kentucky, and West Virginia, although the species surely occurs in all these states. Altitudinally, *G. monticolens* ranges from about 600 feet in the Georgia Piedmont to 5000 feet at Mount Rogers, Va.

Specimens have been examined from the following localities:

Alabama: Jackson County: 1.5 miles NE. of Hodge, May 21, 1961, 1♂, L. Hubricht. Morgan County: base of Doss Mountain, 1.7 miles SE. of Florette, Feb. 28, 1961, 1♂, Hubricht.

Georgia: Clarke County: wooded hillside, 9 miles W. of Athens, May 6, 1961, 1♀, Hubricht.

North Carolina: Madison County: wooded ravine along U.S. Highway 70, west side of Walnut Gap, July 22, 1961, 1♂, Hoffman, Wilkes County: Brushy Mountains, 1 mile S. of Oakwood, April 5, 1952 3♀, Hubricht.

Tennessee: Cocke County: English Creek at Carson's Spring, near Newport, April 17, 1946, 1♂, M. Wright. Greene County: Tusculum College, near Greeneville, March 12, 1946, 1♂, Wright. Hawkins County: 4.3 miles NE. of Surgoinsville, May 19, 1956, 1♂, Hoffman, Keeton, and Lund. Jefferson County: Strawberry Plains, 1887, 2♀, J. C. Branner [USNM]. Marion County: mountainside just W. of Ketner Gap, May 22, 1961, 1♂, Hubricht. Roane County: Clinch River bluff at Harriman, May 21, 1961, 1♂, Hubricht. Sequatchie County: 5.4 miles S. of Dunlap, April 3, 1960, 1♂, Hubricht.

Virginia: Giles County: sinkhole along U.S. Highway 460, 2 miles W. of Newport, Nov. 2, 1953, 1♂, Hubricht and Hoffman. Grayson County: east side of Mount Rogers, ca. 5000′, May 10, 1957, 1♂, R. Highton and Hoffman. Montgomery County: 5 miles NE. of Blacksburg, Sept. 17, 1957, 1♂, 1♀, Hoffman; Prices Fork, April 1962, 1♂, Hoffman.

The species has also been recorded, under the name *Boraria monticolens*, from Gatlinburg, Sevier Co., Tenn. (Chamberlin, 1951).

Relationships

The relationships of the two genera treated in this paper cannot be established with any degree of precision at the present. *Boraria* seems without doubt to have a close relative in the Mexican genus *Acentronus*—of which, unfortunately, I have not seen representatives—and doubtless also with the large genus *Rhysodesmus*. I think that in the past there must have been a continuous distribution between tropical Mexico and the southern Appalachians linking the three genera mentioned. There is, in fact, a remnant of such a continuum still extant in the Ozark region, a rhysodesmine species named *Cibularia profuga*.

Other genera of the Rhysodesmini represented in the eastern United States (such as *Cherokia*, *Pleuroloma*, and *Erdelyia*) are quite distinct among themselves and have little relationships to the *Boraria-Acentronus-Rhysodesmus* complex.

Gyalostethus is unquestionably a specialized genus endemic to the eastern United States. In most characters it seems more similar to the species of *Cruzodesmus* and *Cibularia* than to *Boraria* and, as previously observed, probably has little close affinity to *Boraria*.

The three species of *Boraria* are superficially similar in gonopod structure but differ trenchantly among themselves in other ways and can be identified readily in the female sex and even in late instar nymphs. Since all three are sympatric, probably the external characters have been emphasized to minimize the chances of hybridization. A distinct sequence in level of specialization can be observed: *B. stricta* departs less from the typical characters of the tribe in general, it has fewest specialized structures of the three, and sexual dimorphism is least pronounced. *B. deturkiana* is clearly a specialized form in nearly all of its features and, if *B. media* did not exist, would require a separate generic standing. But *B. media* forms the connecting link and is appropriately named even though it was originally proposed in a different genus as the second (hence intermediate) of three new species.

Interestingly enough, the structural relationships of these three species is paralleled inversely by their distributions. *B. stricta,* the least specialized, has the greatest range and is relatively abundant. *B. media* is more restricted and not so easy to find. *B. deturkiana* is known only from a limited area and is confined to elevations above 3000 feet. Most of its characters suggest that *B. deturkiana* is a localized derivative of *B. media.*

What is needed now are data of a comparative nature on the life histories and behavior of these three species.

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