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STENASELLID ISOPOD CRUSTACEANS IN THE WESTERN HEMISPHERE—A NEW GENUS AND SPECIES FROM MÉXICO—WITH A REVIEW OF OTHER NORTH AMERICAN FRESHWATER ISOPOD GENERA

By Gerald A. Cole and W. L. Minckley
Department of Zoology, Arizona State University,
Tempe 85281

Until recently, the freshwater isopod family Asellidae was divided into two subfamilies, the Asellinae and the more primitive Stenasellinae. The former included the North American genus *Lirceus* Rafinesque 1820, the Old World genus *Synasellus* Braga 1944, and the abundant, Holarctic *Asellus* G. St.-Hilaire 1764. Stenasellinae, proposed by Vandel (1964) and later diagnosed by Magniez (1966b), included the North African genus *Johanella* Monod 1924, and isopods that originally were assigned to the genus *Stenasellus* Dollfus 1897. Henry and Magniez (1968, 1970) elevated each of the subfamilies to family rank, a reasonable taxonomic shift, and separated *Asellus* into a number of different genera, as will be discussed later in this report.

Species of *Stenasellus* (in the broad sense) are widely distributed in subterranean waters of Europe, especially in the peri-Mediterranean area (Birstein, 1964; Magniez, 1966b, 1968). Twelve forms were recently listed from Europe (Straškraba, 1967), not including *S. hazeltoni* Collinge (1946), which Chappuis (in Racovitza, 1950) believed to be an oniscoidean, a judgment later confirmed (Husson, 1957). One form lives in Turkemenia, east-central Asia (Birstein and Starostin, 1949), and at least six species have been described from tropical Africa-Portuguese Guinea, the Belgian Congo, and Somalia (Remy, 1938; Monod, 1945; Braga, 1950; Chappuis, 1951, 1952; Lanza, 1966). When Magniez (1966b) diagnosed the subfamily Stenasellinae, he included the Algerian *Johanella purpurea* Monod, and split the old genus *Stenasellus* into *Stenasellus* (sensu stricto), *Parastenasellus*, and *Metastenasellus*. *Parastenasellus* includes Remy's *S. leleupi*, *S. congolensis*, and *S. dartevellei* from the Congo basin in west-central Africa. Lanza (1966) described a new species of *Stenasellus* (s.s.) from East Africa, and in the same paper erected a new genus, *Magniezia*, to include *S. africanus* Monod and possibly *S. guineensis* Braga. The present contribution describes yet another new genus and species of this family, the first from the Western Hemisphere, from thermal waters of the Mexican state of Coahuila. Studies upon which this report are based were supported by Grants GB-2461 and GB-6477X from the National Science Foundation. We thank the personnel who aided us in the field and in the laboratory, and the Mexican Government for granting permits and providing encouragement for continuation of our work within the northern Mexican Plateau.

The principal taxonomic literature on the stenasellids, in addition to that cited above, includes papers by Racovitza (1924a, b), Karaman (1954), Braga (1962), Buresch and Guéorguiev (1962), and Magniez (1966a). Husson (1957) and Vandel (1964) provide ecological data for the group.

Mexistenasellus new genus

Diagnosis: Bright red in life; eyeless. Pleonites 1 and 2 well developed. Exopod of antenna 2 absent, or represented (perhaps) by a stout seta. Maxilla 1, inner plate with four setae. Dactyls of pereopods 2–4 with one spine, those of pereopods 5–7 with two spines. Male pleopod 1, protopodite lacking coupling spines. Male pleopod 2, protopodite with distolateral corner produced and armed with setae; exopod narrow and sub-cylindrical, bearing a single seta on distal segment; endopod two segmented, enclosing a sharp spike that protrudes terminally. Pleopods 3–5, endopods non-bifid, respiratory; exopods non-bifid, non-respiratory. Plumose setation absent from all pleopods. Uropods slightly shorter than pleotelson.

Type-species: *Mexistenasellus coahuila* Cole and Minckley, by monotypy.

Mexistenasellus coahuila new species
Figures 1–31

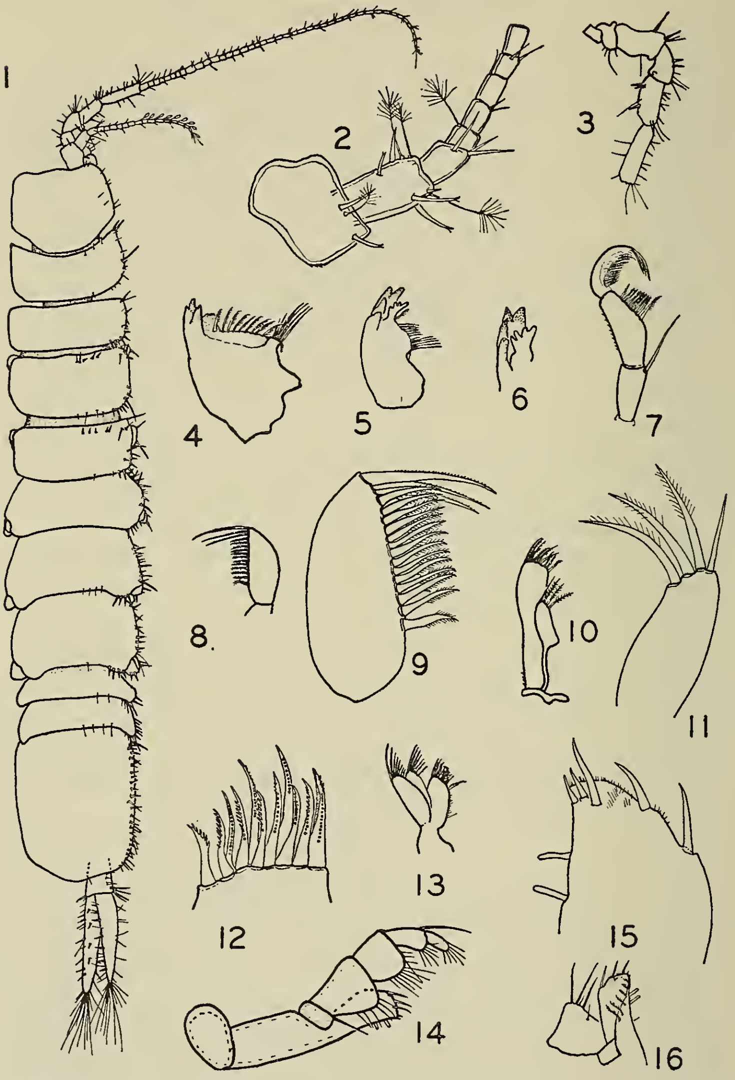
Material: Ten specimens are known, all from thermal springs of the Cuatro Ciénegas basin, central Coahuila, northern México. The holotype (8.2 mm ♂), the allotype (7.4 mm, non-ovigerous), and three paratopotypes (7.2 mm ♂, 5.7 mm ♂, 5.3 mm ♂) are from the eastern end of Laguna Juan Santos, 8.5 km south and 8.0 km west of Cuatro Ciénegas de Carranza, 16 August 1967; collectors, G. A. Cole, W. L. and Robert L. Minckley. Five additional specimens, designated as paratypes, are from the following localities: Laguna Escobeda, 9.8 km south, 2.3 km west Cuatro Ciénegas, 6 August 1968 (6.9 mm ♂); small (unnamed) spring, 8.2 km south, 8.4 km west Cuatro Ciénegas, 15 August 1968 (5.5 mm ♂); small (unnamed) spring, 8.8 km south, 4.0 km west Cuatro Ciénegas, 19 August 1968 (4.8 mm ♂); "Pozo Barbado," 9.4 km south, 7.9 km west Cuatro Ciénegas, 20 August 1968 (4.4 mm ♀, non-ovigerous); and small (unnamed) seep near "Pozo Barbado," 2 September 1970 (4.2 mm ♀, non-ovigerous). All collections from 1968 were made by G. A. Cole, R. L., W. L., and R. K. Minckley; the specimen from 1970 was caught by J. Jerry Landye. Two specimens (5.3 mm ♂, 16 August 1967 and 4.4 mm ♀, 20 August 1968) are in the Nacional Coleccion de México, México, D. F., the specimen from 1970 was deposited with Professor Guy Magniez, and the remainder is in the National Museum of Natural History, Washington, D. C.

Description: Male (based on the holotype and the three largest paratypes). Body slender, elongate, length about 5 × width (Fig. 1). Cephalon length about 0.85 × width, anterior margin slightly convex medially; anterolateral rostral angles rounded, salient. Pereonites 1 and 2 shortest; pereonites 6 and 7 longest. Pleonites 1 and 2 free, subequal, with produced posterolateral corners. Pleotelson 1.3 × longer than broad, median process not conspicuous.

First antenna (Figs. 1, 2), when reflected, extending slightly posteriad to anterior margin of pereonite 1; peduncle of four segments, the last scarcely wider than articles of flagellum; plumose setae on segments 1, 2, and 4. Flagellum of 10–14 articles, distal 6–9 articles with slender lammae olfactoriae, each about 1.5 × length of article bearing it.

Second antenna (Figs. 1, 3), about 0.6 × body length; peduncle of six articles, flagellum of 33–44 articles.

Mandible (Figs. 4–9), with four-toothed incisor. Right mandible with spine row of eight or nine pectinate setae, molar lobe with six–nine closely-set, smooth setae. Left mandible with four-toothed lacinia, spine row of seven faintly-plumose setae, distal one inserted at base of lacinia, molar lobe indistinct, with six–nine smooth setae. Palp with proximal article 0.55 × length of penultimate; penultimate segment of palp 1.4 to 2.0 × ultimate, and with 10 stout, toothed setae on distal half anterior margin; ultimate segment of palp with three long, distal setae, and 14 shorter, stout setae along nearly-straight margin.



FIGS. 1–16. *Mexistenasellus coahuila* new genus and species. 1. Male holotype, 8.2 mm. 2. Antenna 1, paratype, 7.2 mm; peduncle and first four flagellar segments. 3. Antenna 2, holotype; peduncle. 4. Right mandible, holotype. 5. Left mandible, allotype, 7.4 mm. 6. Left mandible, holotype; lacinia and incisor. 7. Mandibular palp, paratype, 7.2 mm. 8. Mandibular palp, paratype, 7.2 mm; distal segment. 9. Mandib-

Maxilla 1 (Figs. 10–12), outer ramus with 12 pectinate, apical teeth; inner ramus with three plumose and one smooth outer setae.

Maxilla 2 (Fig. 13), inner plate with distal setae in two ranks, one of five, grossly-plumose setae, inclined slightly laterad, the other of nine slender, smooth setae; largest, robust, sub-apical seta thick, with faint, transverse suture, curving inward and bearing plumosities on outer, proximal surface. Other plates with 7–10 medially-curving setae, each faintly pectinate on inner surface.

Maxilliped (Figs. 14–16), masticatory lobe with two coupling spines, two stout, marginal setae on distal surface, and one slightly-submarginal seta near mediodistal corner, two smaller spines at mediodistal corner; curved inner surface with seven faintly-plumose setae, decreasing in size distally, fine apical hairs present. Palp, second segment largest, outer margins of three proximal segments unarmed, with long, distal seta on fourth segment.

Pereopods (Figs. 17–23), increasing in length posteriad; extended pereopod 7 about 1.6 × length of pereopod 1. Pereopod 1 prehensile, straight palmar margin of propodus armed with many short setae and two robust spines at posterior corner. Pereopods 2–7 ambulatory. Dactyls of pereopods 2–4 armed with one spine in addition to terminal claw; pereopods 5–7 with two spines on dactyl. Pereopods 2–7, basis with two to six plumose, sensory setae on posterior surfaces; carpus with one such seta at posterodistal corner; propodus of pereopods 5 (rarely), 6, and 7, with subterminal, sensory seta.

Pleopod 1 (Fig. 24), peduncle with concave medial margin and no coupling spines. Exopod oval, bearing 25 or more smooth setae, medial six setae much longer than others.

Pleopod 2 (Figs. 25, 26), peduncle sub-pentagonal, base about 0.7 × widest part, length about equal greatest width; outer, distal corner with five or six smooth setae. Exopod narrow, two jointed, 0.5 × length of peduncle, curving laterad, with one stout, terminal seta on distal segment. Endopod two jointed, stouter than exopod, sigmoid, curving laterad, enclosing a sharp, styliform process which protrudes terminally.

Pleopod 3 (Fig. 27), exopod with transverse suture in distal half, sparsely armed with spinules, especially on outer margin of basal half.

Pleopod 4 (Fig. 28), exopod with diagonal suture from near inner, proximal side, to slightly midway on outer margin; both rami lacking setation.

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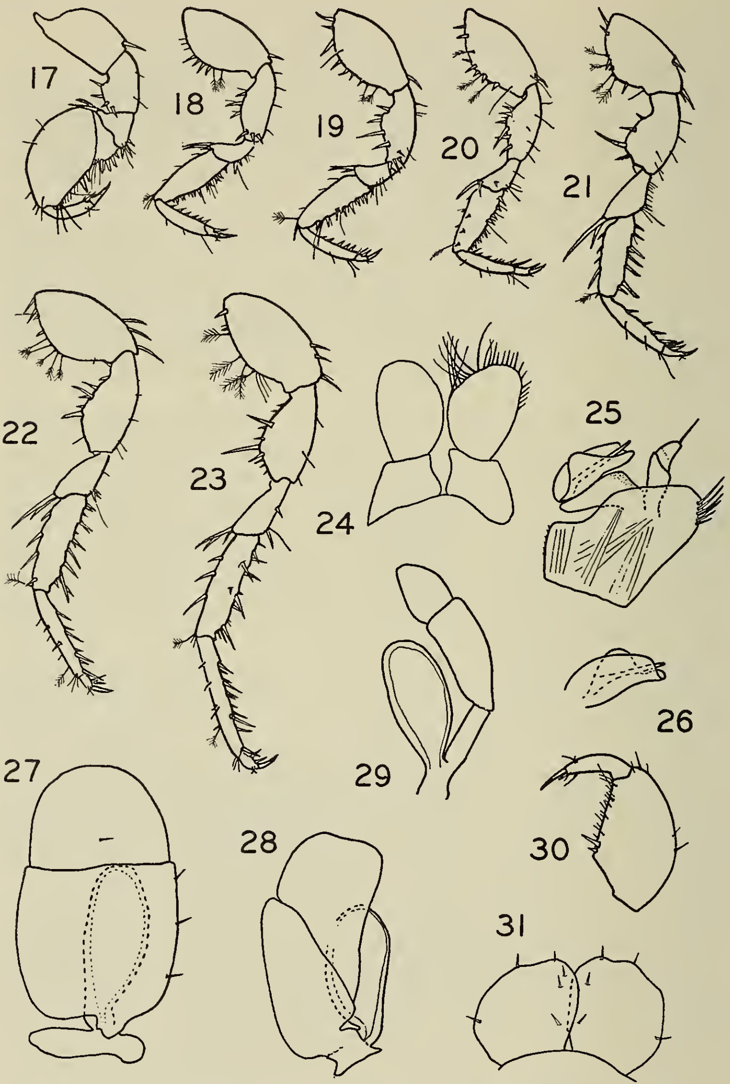
ular palp, holotype; distal segment. 10. Maxilla 1, paratype, 5.7 mm. 11. Maxilla 1, holotype; inner plate. 12. Maxilla 1, holotype; outer plate, distal surface. 13. Maxilla 2, paratype, 5.7 mm. 14. Maxilliped, holotype. 15. Maxilliped, holotype; masticatory lobe apex. 16. Maxilliped, allotype; masticatory lobe and basal segments of palp.



FIGS. 17–31. *Mexistenasellus coahuila* new genus and species. 17. Pereopod 1, holotype. 18. Pereopod 2, holotype. 19. Pereopod 3, holotype. 20. Pereopod 4, holotype. 21. Pereopod 5, holotype. 22. Pereopod 6, holotype. 23. Pereopod 7, holotype. 24. Pleopod 1, holotype. 25. Pleopod 2, holotype. 26. Pleopod 2, holotype; endopodite, distal segment. 27. Pleopod 3, holotype. 28. Pleopod 4, paratype, 5.7 mm. 29.

Pleopod 5 (Fig. 29), exopod elongate, narrow, with transverse suture in distal half, extending well beyond endopod; both rami without setation.

Uropod (Fig. 1), rami subequal, much longer than peduncle; exopod somewhat dorsal to endopod. Lateral and dorsal surfaces of exopod and lateral surface of endopod setose, all other surfaces spinose; each ramus with a tuft of long, terminal setae.

Female (allotype only). Similar to male in most details, including prehensile pereopod 1 (Fig. 30). Fewer setae on mandible and maxilla 2 (perhaps a function of smaller size). Pleopod 2 (Fig. 31), scarcely longer than broad, sub-circular, with broadly crenulate margins armed with few spinules.

Remarks on relationships of Mexistenasellus: Most morphological features of *Mexistenasellus coahuila* differ little from those of Old World forms, although the lack of ovigerous females makes some interpretations tentative at best. The New World organism differs from other stenasellids by: lacking an exopodite on the third peduncular segment of the second antenna; the male pleopod 2 having a distolateral process armed with setae and with the rami inserted sub-terminally (recalling *Parastenasellus*, but quite different from *Stenasellus*, s.s.); the presence of a different number of spines on the dactyls of pereopods 2–4 from those of 5–7; and of course the unique terminal segment of the endopodite of male pleopod 2. In addition, the lack of plumose setae on all pleopods of *Mexistenasellus*, the single distal seta on the exopod of male pleopod 2, and the oval shape of pleopod 1 recall species of *Synasellus*. The significance of such similarities cannot yet be interpreted.

The occurrence of stenasellids from more than one presumed phyletic line in Equatorial Africa was considered by Chappuis (in Racovitza, 1950) as evidence for a very ancient dispersal of the group, and perhaps for its origin in Africa. Birstein (1964) disagreed, but offered no firm alternative in the statement that "*Stenasellus* is a remnant from an ancient warmwater tropical fauna occupying a vast range in the Tertiary, from Equatorial Africa to Central Asia." In light of the presence of *Mexistenasellus* in North America, an origin prior to the Tertiary must now be considered.

Habitat and ecology: In 1967, our five specimens were taken from a single block of travertine pulled from the bank of Laguna Juan Santos, about 25 cm below the water surface. Another individual was in the same block, but escaped. The animals were in tiny crevices and tube-like channels in the soft, porous stone, and retreated rapidly toward the interior when disturbed. Many hours were spent that summer seeking additional material of the isopod in travertines and other habitats of Juan Santos, and elsewhere, but to no avail.

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Pleopod 5, paratype, 5.7 mm. 30. Pereopod 1, allotype, 7.4 mm; propodus and dactylus. 31. Pleopod 2, allotype.

Juan Santos waters originate from thermal springs along the margins and from two or more deep (5 m) depressions near its center. Water temperatures were an uniform 31° C where we were collecting. The filtrable residue of the water, determined by evaporating samples at 103° C, was 2.1 gm/liter. The laguna is more than 100 m wide and supports a large and diversified fish fauna (Minckley, 1969). The only other crustaceans we have found there are the amphipod *Hyalella azteca* (Saussure) and the decapod *Paleomonetes suttkusi* Smalley.

During summer 1968, the four specimens were found singly in widely different habitats. The male from Laguna Escobeda was taken from soft, copropelic sediment about 3 m below the water surface. Water temperature was 34.2° C. The male collected 15 August was in a small, spongy fragment of travertine taken from the bottom of a detritus-choked spring inlet, 50 cm below the surface; water temperature was 33° C. On 19 August, a male *Mexistenasellus* was found in soft detritus beneath a floating mat of vegetation at the outlet of a small limnocrene. The temperature at that point was 31° C. The female specimen, taken 20 August from "Pozo Barbado," was inadvertently secured along with amphipods; its habitat relations are unknown. Water of that pozo was 30.5° C. Landye's specimen was sieved from detrital materials in a small, almost-filled spring, where water temperatures also exceeded 30° C. Definition of the ecology of this form must obviously await accumulation of additional specimens.

More detailed information on the ecology of the waters of the Cuatro Ciénegas basin is available in papers by Taylor (1966), Minckley and Cole (1968a), and Minckley (1969); Holsinger and Minckley (1970) describe smaller seeps and springs of that area in considerable detail.

Distributional relations of North and Middle American freshwater Isopods: A review of the occurrences of freshwater isopods in the inland waters of North America seems appropriate, although perhaps 50 years "behind the times" when compared to literature of the Eastern Hemisphere.[1]

At least three genera of sphaeromatid isopods live in freshwaters of western Europe and the Southern Alps (Vandel, 1964). Most isopods of this family recorded from North American freshwaters are secondarily derived from nearby estuarine or oceanic habitats (Menzies, 1954); however, *"Exosphaeroma" thermophilum* (Richardson) is known from warm springs in the Río Grande basin at Socorro, New Mexico, and *"E." dugesi* (Dollfus) from the state of Aguas Calientes, México. Rioja (1950) considered the two species to be closely related, on the basis of his comparisons of the Mexican form with descriptions and figures provided by Richardson (1897, 1905) for the northern species.

Cirolanid isopods are widely distributed in subterranean waters of

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[1] Since this was written an admirable revision of the North American epigean species of *Asellus* appeared (Williams, 1970). We regret that we were not able to consult this work.

western Europe (Racovitza, 1912), and also in similar habitats of North and Middle America (Bowman, 1964, 1966). Eight genera are known in freshwaters of the Western Hemisphere, including a marine genus *Conilera* Leach 1818, with a referred species that is presently unidentifiable (*"Conilera" stygia* Packard, from Monterrey, Nuevo Leon, México). The genus *Antrolana* Bowman 1964 has one species in the Appalachian Mountains, Virginia. *Cirolanides* Benedict 1896 is represented by *C. texensis* Benedict, widespread and abundant in caves of the Edward's Plateau of Texas (Reddell, 1965). *Speocirolana* Bolivar 1950, represented by at least three species, lives in northeastern México (Rioja, 1953; Bowman, 1964; Cole and Minckley, 1966). One species, *S. thermydronis* Cole and Minckley, may occur only within the Cuatro Ciénegas basin (Minckley and Cole, 1968b), as perhaps does *Mexistenasellus*. The cirolanid genus *Sphaerolana* Cole and Minckley 1970, also presently known only from the Cuatro Ciénegas basin, includes two described species (Cole and Minckley, 1970). Other genera, *Creaseriella* Rioja 1953, from the Yucatan Peninsula, and *Troglocirolana* Rioja 1956 and *Haptolana* Bowman 1966, both from Cuba, complete an arc of cirolanids about the Gulf of Mexico (Bowman, 1964, 1966).

Asellid isopods are the most widespread and abundant freshwater group in North America, including both epigean and subterranean forms. Two genera were formerly recognized, *Lirceus* (= *Mancasellus* Harger 1876), which seems taxonomically stable, and *Asellus* (including *Caecidotea* Packard 1888), long in need of revision (Chappuis, 1955; Bowman, 1967), and which has been re-evaluated by Henry and Magniez (1970). *Lirceus* is an endemic North American genus, generally distributed in eastern United States (Hubricht and Mackin, 1949), and with relationships thought to be transatlantic with *Synasellus* and *Johanella*.

Henry and Magniez (1968, 1970) have elevated some subgenera of *Asellus* to generic rank and proposed a number of new genera. According to them, *Asellus* (sensu stricto) is represented in North America only by *A. aquaticus* (Linnaeus) in Greenland, where it may have been introduced by man. The Western American forms in the United States, *Asellus californicus* Miller and *A. tomalensis* Harford, were considered by Birstein (1964) to belong to the subgenus *Mesoasellus* Birstein 1939, and to have invaded North America via the Bering Straits (see also van Name, 1936). Henry and Magniez (1970) agreed with derivation of the two species from Asia, but suggested that *Mesoasellus* and *Phreatoasellus* Matsumoto 1962 were poorly differentiated subgenera and should be combined under *Asellus* (s.s.). They tentatively referred *Asellus californicus* and *A. tomalensis* to the genus *Nipponasellus* Matsumoto 1962, a group otherwise distributed in the Japanese Archipelago (Matsumoto, 1962).

Eastern American species all were referred to *Conasellus* Collinge 1945, a former subgenus of *Asellus*. This group is endemic to North America, insofar as known at present, and was thought by Racovitza

(1920) to be closely related to *Proasellus* Dudich 1925, of peri-Mediterranean distribution (Henry and Magniez, 1970). The range of *Conasellus* in the Western Hemisphere is now known to include the southern Mexican Plateau, in the Pacific drainage, with the discovery and description of *Asellus puebla* Cole and Minckley (1968). An additional locality for *Asellus puebla* is the mainstream of the Río Lerma, ca. 28 km north of Toluca at Hwy 55 Crossing, state of México, México, 23 May 1969; collectors, C. D. Barbour and R. J. Douglass. This stream, a major tributary of the Río Grande de Santiago system, is part of one of the more complex drainage systems in México (Meek, 1904). Occurrence of asellids in both the Santiago and Balsas hydrographic basins (the latter drainage from which *A. puebla* was described) indicates a much wider dispersion on the Mexican Plateau that we anticipated, and may predict discovery of a substantial aquatic isopod fauna in that area when collecting is accomplished.

Pseudobaicalasellus Henry and Magniez 1970 is the fourth asellid genus of North America, erected to include Bresson's (1955) three eyeless species from Virginia (*Asellus henroti, A. simonini*, and *A. vandeli*). Their superficial resemblance to *Baicalasellus* Stammer 1932, a group limited to the Lake Baïkal hydrographic basin, prompted the name, but no interpretations of their relationships have appeared.

Discussion: Direct relationships between certain faunal elements of North and Middle America and the Mediterranean—African region seems apparent. This is especially obvious in Crustacea, and was recently emphasized by discovery of *Monodella texana* Maguire, a representative of the Old World crustacean order Thermosbaenacea in waters of the Edward's Plateau of Texas (Maguire, 1964, 1965). The present record of a stenasellid in México also is significant. Similar relations are mapped by Taylor (1966) for the principally-subterranean hydrobiid snail tribe Horatiini, from the peri-Mediterranean area to the Cuatro Ciénegas basin. These ranges, transgressing the Atlantic, substantiate direct biogeographic affinities of the continental masses, at least for some of the more ancient, subterranean faunal elements. Myers (in Greenwood et al., 1966) implies a similar possibility for some South American and African, obligate freshwater fishes.

Origins of some of the invertebrate groups are known to date well into mid-Mesozoic (Racovitza, 1912; Chilton, 1918; van Straelen, 1928; Birstein, 1964), and their present distributions, when better understood, may serve to support geophysical findings in the area of continental drift (reviewed by Dietz and Holden, 1970; and others).

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