

**NEW AND UNREPORTED SPECIES OF NEOTYRRELLIA,
PROTOLIMNESIA (PROTOLIMNESELLA) AND
CENTROLIMNESIA (ACARI: HYDRACHNIDA: LIMNESIIDAE)
FROM THE UNITED STATES**

IAN M. SMITH*
DAVID R. COOK**

RESUMEN

Para documentar la presencia de sus respectivos géneros en los Estados Unidos de América, se describen los adultos de *Neotyrrellia anitahoffmannae* sp. nov. (Tyrrellinae), *Protolimnesia (Protolimnesella) ventriplacophora* sp. nov. (Protolimnesiinae) y *Centrolimnesia bondi* Lundblad (Limnesiinae).

Palabras clave: Acari, Hydrachnida, Limnesiidae, *Neotyrrellia*, *Protolimnesia*, *Centrolimnesia*, especies nuevas, Estados Unidos de América.

ABSTRACT

Adults of *Neotyrrellia anitahoffmannae* sp. nov. (Tyrrellinae), *Protolimnesia (Protolimnesella) ventriplacophora* sp. nov. (Protolimnesiinae) and *Centrolimnesia bondi* Lundblad (Limnesiinae) are described to document occurrence of their respective genera in the United States.

Key words: Acari, Hydrachnida, Limnesiidae, *Neotyrrellia*, *Protolimnesia*, *Centrolimnesia*, new species, United States.

* Centre for Land and Biological Resources Research, Agriculture Canada, Ottawa, Ontario, Canada K1A 0C6

** 7836 North Invergordon Place, Paradise Valley, Arizona 85253. USA

INTRODUCTION

The family Limnesiidae was previously known to be represented in North America by members of six genera in four subfamilies. Numerous species of the worldwide genus *Limnesia* Koch (Limnesiinae) inhabit streams, lakes and ponds, and although the genus probably originated in Pangea most North American species belong to species groups with essentially Holarctic distributions and probable Laurasian origins. The genus *Kawamuracarus* Uchida (Kawamuracarinae) has a temperate Holarctic distribution, and probably originated in Laurasia. Species of *Tyrrellia* Koch (Tyrrellinae) and *Neomamersa* Lundblad, *Meramecia* Cook and *Arizonacarus* Smith & Cook (Neomamersinae) are distributed in tropical and warm temperate regions of both North and South America. These taxa apparently represent clades that originated either in South America after its separation from Gondwanaland or in tropical North America during the Cretaceous or early Tertiary. Species of these clades subsequently dispersed between the two continents by a filter bridge during the early Tertiary or across the Isthmus of Panama beginning during the Pliocene.

The purpose of this paper is to describe adults of new species of *Neotyrrellia* Lundblad (Tyrrellinae) and *Protolimnesia* Viets (Protolimnesiinae), and to redescribe adults of *Centrolimnesia bondi* Lundblad (Limnesiinae), in order to document the occurrence of these genera in the United States. In the following description, measurements are expressed as ranges in micrometres (μm). The terminology, abbreviations and measurement conventions follow Smith & Cook (1991). All specimens were collected by D.R. Cook (DRC) or I.M. Smith (IMS) and are deposited in the Canadian National Collection (CNC), Centre for Land and Biological Resources Research, Ottawa, Ontario, except where noted otherwise. The abbreviation "GAW" refers to the preservative also known as Modified Koenike's Solution (Barr, 1973; Cook, 1974).

Neotyrrellia Lundblad, 1938

Neotyrrellia Lundblad, 1938. Zoologischer Anzeiger 122: 9.

Neotyrrellia: Cook, 1974. Memoirs of the American Entomological Institute 21: 160.

Neotyrrellia: Viets, 1987. Sonderbände des Naturwissenschaftlichen Vereins in Hamburg 8: 548, 849.

Type-species: *Neotyrrellia petricola* Lundblad. Original designation.

Diagnosis. See Cook (1974).

Habitat. Streams and seepage areas.

Distribution. South America, West Indies, southern North America.

Remarks. The genus *Neotyrrellia* Lundblad includes three described species from widely scattered localities in South America and the West Indies. The type species, *Neotyrrellia petricola* Lundblad was described on the basis of specimens

collected in seepage areas in Brazil and Paraguay (Lundblad, 1938, 1941) and was subsequently reported from the Caribbean island of St. Vincent (Viets, 1976). The other two described species, *N. polypora* Lundblad and *N. recurva* Lundblad, are known from streams in Columbia (Lundblad, 1953). We have seen specimens of an apparently undescribed species of *Neotyrrellia* from a stream in Ecuador.

Neotyrrellia is the sister genus of *Tyrrellia*, and appears to have originated in South America and dispersed into southern North America after the Panamanian Isthmus became established during the Pliocene.

Neotyrrellia anitahoffmannae sp. nov.
(Figs. 1-8)

Description of adults. Character states as in generic diagnosis (see Cook 1974, page 160), such that:

Male (Fig. 4). Idiosoma with denticulate projections covering integument relatively long and prominent. Genital field confined to genital bay and bearing fewer than 30 acetabula on each acetabular plate. Pedipalps with stout ventral seta on femur directed ventrally.

Measurements (based upon two individuals): Length anterior dorsal plates 146-153, width anterior dorsal plates 92, length posterior dorsal plate 299-336, width posterior dorsal plate 171-196, length coxal plates 623-671, width coxal plates (one side, medial angle of plate I to tip of condyle at insertion of leg III) 336-342, length genital field 179-187, width genital field 157-164. Lengths pedipalp segments: Tr 55-57, Fe 185-195, Ge 100-108, Ti 146-159, Ta 70-75. Lengths distal leg segments: IGe 108-122, ITi 177-186, ITa 176-200; IIGe 134, IITi 190, IITa 217; IIIGe 160-174, IIITi 212-225, IIITa 198-221; IVGe 224-257, IVTi 257-280, IVTa 250-254.

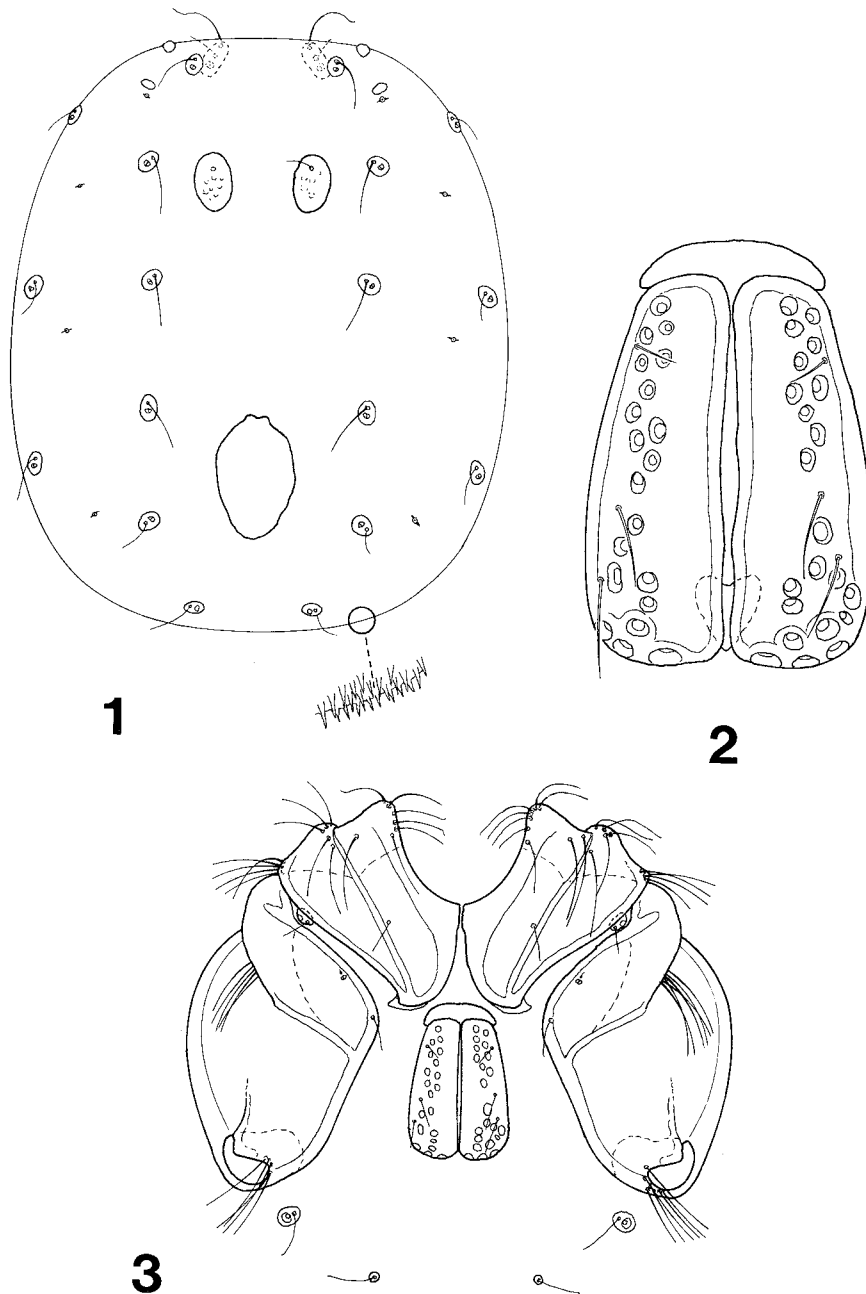
Female (Figs. 1-3, 5-8). Similar to male except for genital field (Fig. 2).

Measurements (based upon two individuals): Length anterior dorsal plates 128-134, width anterior dorsal plates 85-92, length posterior dorsal plate 268-323, width posterior dorsal plate 171-177, length coxal plates 695-702, width coxal plates (one side, medial angle of plate I to tip of condyle at insertion of leg III) 366-378, length genital field 264-272, width genital field 169-187. Lengths pedipalp segments: Tr 52-65, Fe 229-238, Ge 138-148, Ti 183-187, Ta 95-98. Lengths distal leg segments: IGe 161-169, ITi 209-221, ITa 185-195; IIGe 166-177, IITi 233-237, IITa 234-239; IIIGe 202-207, IIITi 241-247, IIITa 225-229; IVGe 278-293, IVTi 315-320, IVTa 268-274.

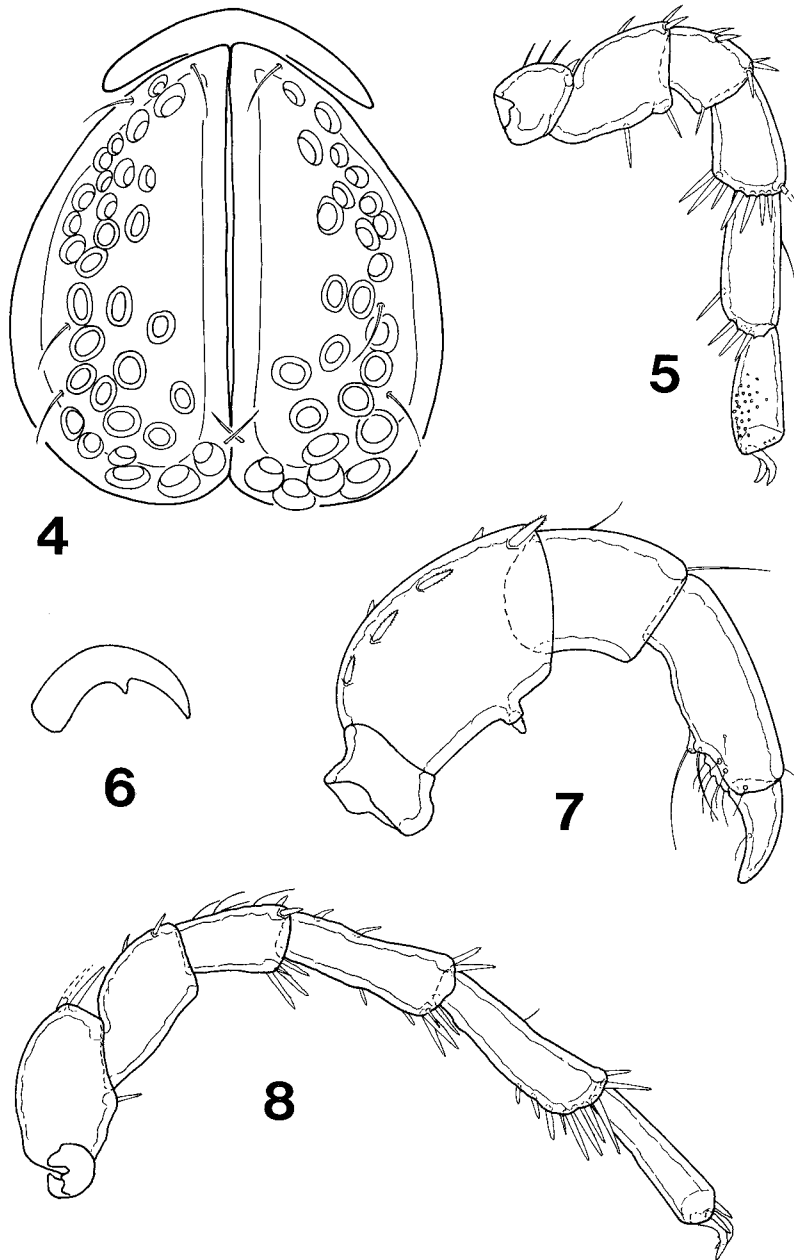
Derivation of species name. Named in honour of Dra. Anita Hoffmann.

Habitat. Moss on rock-faces in waterfalls and on large rocks in riffles areas of streams.

Distribution. Known from the type locality in southeastern Arizona and from central Texas.



Figs. 1-3. *Neotyrrellia anitahoffmannae* sp. nov., female adult; 1, dorsum of idiosoma; 2, genital field; 3, venter of idiosoma.



Figs. 4-8. *Neotyrrellia anitahoffmannae* sp. nov., adults. 4, male, genital field; 5, female, leg I, medial view; 6, female, claw of leg II; 7, female, pedipalp, lateral view; 8, female, leg IV, lateral view.

Types. Holotype (CNC type number 22211): Female adult (slide) collected from East Turkey Creek beside road just east of Rustler Park turnoff, Chiricahua Mountains, Cochise County, Arizona on 16 July 1987 (IMS). Paratypes (CNC, FMNH): USA: ARIZONA: Cochise County: From same locality as holotype 2♂♂, 1♀ (slides) collected on 10 October 1993 (IMS); TEXAS: Bandera County: From Sabinal River at Lost Maples State Natural Area 4♂♂, 1♀ (GAW) collected on 27 September 1995 (IMS).

Remarks. Adults of *N. anitahoffmannae* differ from those of *N. petricola*, *N. recurva* and *N. polypora* in that they are much larger in size and have the denticulate projections covering the integument of the idiosoma relatively long and prominent. They also differ from adults of *N. recurva* in that the stout ventral seta on the femur of the pedipalps is directed ventrally rather than proximally, and from those of *N. polypora* in that females have the genital field confined to the genital bay and fewer than 30 acetabula on each acetabular plate.

Protolimnesia Lundblad, 1927

Protolimnesia Lundblad, 1927. Archiv für Hydrobiologie 18: 409.

Protolimnesia: Cook, 1974. Memoirs of the American Entomological Institute 21: 163.

Protolimnesia: Viets, 1987. Sonderbände des Naturwissenschaftlichen Vereins in Hamburg 8: 659-660, 849.

Type-species: *Limnesia unguiculata* Walter. Original designation.

Diagnosis. See Cook (1974).

Habitat. Surface and interstitial waters of streams.

Distribution. Southern South America to southern North America.

Remarks. The genus *Protolimnesia* Lundblad comprises seven described species from South and Central America and the West Indies. The nominate subgenus of *Protolimnesia* includes the type species, *P. (s. s.) unguiculata* (Walter) from Peru (Walter, 1919; Lundblad, 1924, 1927, 1930), and *P. (s. s.) longa* Besch and *P. (P.) setifera* Cook from Argentina (Besch, 1963; Cook, 1980), all inhabitants of surface waters of streams. The only known species of the subgenus *Voldroguella* Cook, *P. (V.) hispaniolae* Cook, was described from hyporheic gravels in Haiti (Cook, 1981). The subgenus *Protolimnesella* Cook contains three described species from interstitial waters in South and Central America.

Protolimnesia appears to have originated in South America. Certain species have dispersed to southern North America following establishment of the Isthmus of Panama during the Pliocene.

***Protolimnesia (Protolimnesella)* Cook, 1980**

Protolimnesella Cook, 1980. *Memoirs of the American Entomological Institute* 31: 73-74.

Protolimnesella: Viets, 1987. *Sonderbände des Naturwissenschaftlichen Vereins in Hamburg* 8: 660, 849.

Type-species. *Protolimnesia (Protolimnesella) interstitialis* Cook. Original designation.

Diagnosis. See Cook (1980).

Habitat. Interstitial waters in the hyporheic zone of streams.

Distribution. As for genus.

Remarks. The type species, *P. (Protolimnesella) interstitialis* Cook, has been reported from Argentina (Cook, 1980; Fernández, 1987, 1994) along with *P. (P.) sorpresa* Cook (Cook, 1980; Fernández, 1994). *P. (P.) mesoamericana* Cook was reported from Alajuela State, Costa Rica (Cook, 1980), previously the most northerly locality for a described species of *Protolimnesella*.

***Protolimnesia (Protolimnesella) ventriplacophora* sp. nov.**

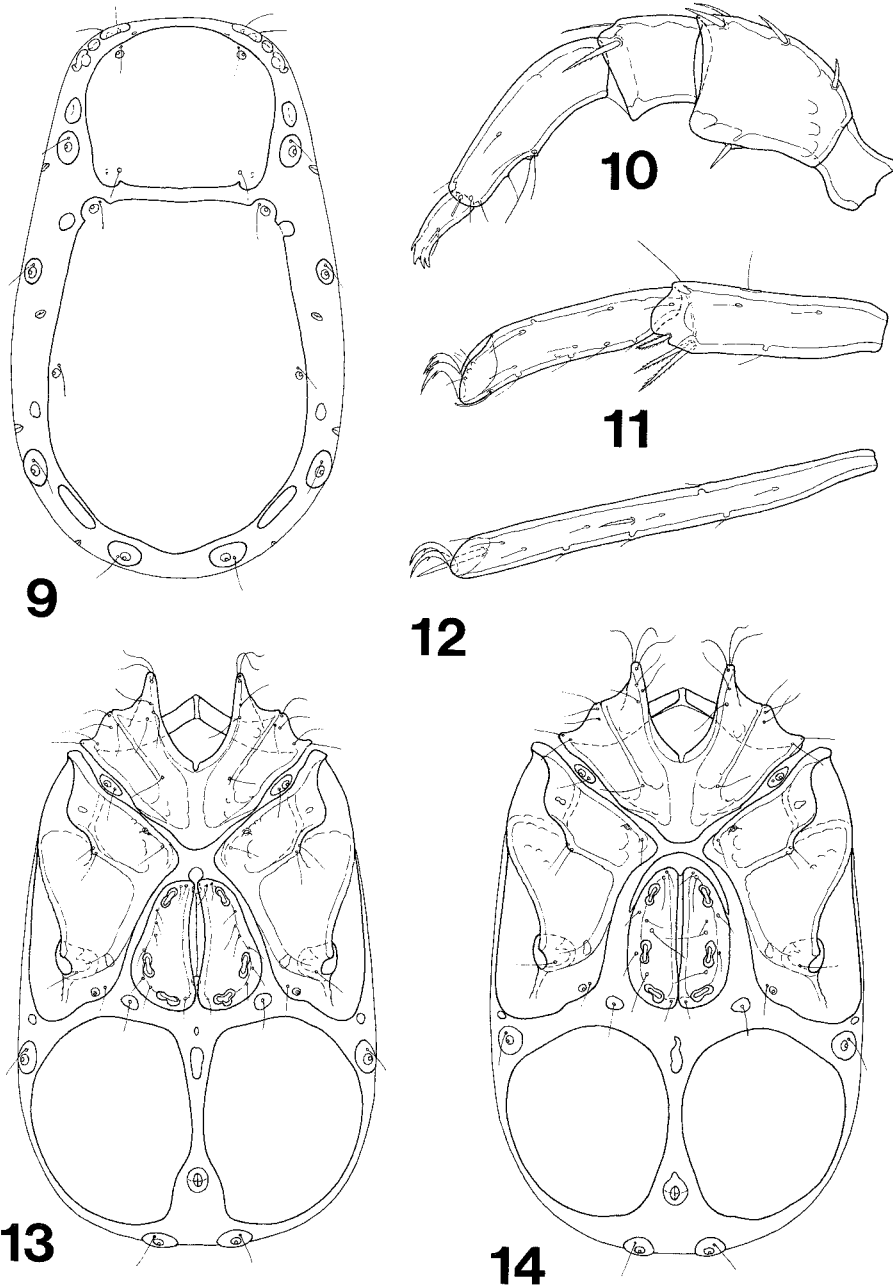
(Figs. 9-14)

Protolimnesia (Protolimnesella) sp. Cook, 1980. *Memoirs of the American Entomological Institute* 31: 74.

Description of adults. Character states as in subgeneric diagnosis (see Cook, 1980, pages 73-74), such that:

Male (Figs. 9, 13). Idiosoma with anterior dorsal plate (Fig. 9) bearing 1 pair of dorsoglandularia anterolaterally and postocular setae posterolaterally; rounded anteriorly, widest just posterior to level of dorsoglandularia, tapering slightly posteriorly, slightly lobed posterolaterally. Posterior dorsal plate (Fig. 9) bearing 1 pair of dorsoglandularia mediolaterally, and often incorporating a second pair of dorsoglandularia anterolaterally. Venter (Fig. 13) with coxal plates IV extending posteriorly only slightly beyond level of posterior edge of genital field; region posterior to coxal plates and genital field nearly covered by pair of large plates that are separated medially and do not incorporate excretory pore. Pedipalps, distal segments of legs I and tarsus of legs IV (as in Figs. 9, 10 and 11, respectively) typical for subgenus.

Measurements (based upon three individuals): Length anterior dorsal plate 121-130, width anterior dorsal plate 172-176, length posterior dorsal plate 312-322, width posterior dorsal plate 226-256, length coxal plates 317-326, width coxal plates (one side, medial angle to tip of condyle at insertion of leg III) 99-107, length posterior ventral plates 182-198, width posterior ventral plates 143-147, length genital field 127-134, width genital field 116-121. Lengths pedipalp segments: Tr 22-26, Fe 59-62, Ge 36-39, Ti 68-72, Ta 25-29. Lengths distal leg seg-



Figs. 9-14. *Protolimnesia (Protolimnesella) ventriplacophora* sp. nov., adults. 9, male, dorsum of idiosoma; 10, female, pedipalp; 11, female, distal segments of leg I; 12, female, tarsus of leg IV; 13, male, venter of idiosoma; 14, female, venter of idiosoma.

ments: IGe 65-70, ITi 75-83, ITa 100-104; IIGe 65-70, IITi 86-87, IITa 107-109; IIIGe 100-108, IIITi 126-131, IIITa 105-113; IVGe 98-100, IVTi 124-130, IVTa 111-121.

Female (Figs. 10-12, 14). Similar to male, except for genital field region (Fig. 14).

Measurements (based upon five individuals): Length anterior dorsal plate 116-152, width anterior dorsal plate 163-198, length posterior dorsal plate 303-319, width posterior dorsal plate 229-247, length coxal plates 342-364, width coxal plates (one side, medial angle to tip of condyle at insertion of leg III) 85-107, length posterior ventral plates 169-198, width posterior ventral plates 133-148, length genital field 130-147, width genital field 103-111. Lengths pedipalp segments: Tr 23-30, Fe 61-65, Ge 39-42, Ti 73-79, Ta 26-29. Lengths distal leg segments: IGe 66-70, ITi 82-83, ITa 99-100; IIGe 68-74, IITi 85-91, IITa 105-116; IIIGe 104-112, IIITi 125-133, IIITa 107-120; IVGe 101-108, IVTi 130-134, IVTa 118-130.

Derivation of species name. From the Latin *venter* meaning "belly", the Greek *plac* meaning "flat, round plate", and the Greek *phoreus* meaning "bearer"; referring to the large posterior plates on the venter of the idiosoma.

Habitat. Gravel deposits in the hyporheic zone of desert streams.

Distribution. Southwestern United States (Arizona, western Texas).

Types. Holotype (CNC type number 22212): Male adult (slide) collected from Sonoita Creek beside Rt. 82 south of Patagonia, Santa Cruz County, Arizona on 17 July 1987 (IMS). Paratypes (CNC, FMNH): USA: ARIZONA: Cochise County: From Cave Creek near Stewart Campground, Chiricahua Mountains 1♀ (GAW) on 15 May 1991. Santa Cruz County: With same collection data as holotype 1♂, 2♀♀ (slides) + 1♀ (GAW). From Sycamore Creek in Sycamore Canyon near Rt. 289 west of Nogales 1♂, 3♀♀ (slides) + 1♂ (GAW) on 18 July 1987 (IMS); 3♂♂, 5♀♀, 2 deutonymphs (GAW) on 14 October 1993 (IMS); 1♀ (GAW) on 19 September 1994 (IMS). TEXAS: Jeff Davis County: From stream beside Rt. 17, 10 miles (16 km) north of Fort Davis 1♂, 1♀ (slides) on 13 May 1977 (DRC). From stream beside Rt. 118, 14.8 km southeast of Rt. 166, 4♂♂, 3♀♀ (GAW) on 25 September 1994 (IMS). From stream beside Rt. 118, 8.7 km east of Rt. 166 near Lawrence E. Wood Picnic Area 1♂, 1♀, 40 deutonymphs (GAW) on 25 September 1995 (IMS).

Remarks. Adults of *P. ventriplacophora* differ from those of all other described species of *Protolimnesia* in that the ventral plates in the region posterior to the coxal plates and genital field are relatively large but separated medially. This is the species, then unnamed, from the southwestern United States referred to by Cook (1980).

Centrolimnesia Lundblad, 1935

Centrolimnesia Lundblad, 1935. Archiv för Zoologi 28A: 5.

Centrolimnesia: Cook, 1974. Memoirs of the American Entomological Institute 21: 169.

Centrolimnesia: Viets, 1987. Sonderbände des Naturwissenschaftlichen Vereins in Hamburg 8: 208, 849.

Type-species: *Centrolimnesia bondi* Lundblad. By monotypy.

Diagnosis. See Cook (1974).

Habitat. Ponds and pools in streams.

Distribution. Central South America to southern North America.

Remarks. The genus *Centrolimnesia* contains eight described species from ponds and backwater areas of streams in the Neotropical and southern Nearctic regions. The type species, *C. bondi* Lundblad, was described from Haiti (Lundblad, 1935), and was subsequently reported from Suriname (Viets, 1954a), Brazil (Viets, 1954b), Mexico and Costa Rica (Cook, 1980). Five other species have been described from Brazil and Paraguay, namely *C. schubarti* Viets (Viets, 1938; Lundblad, 1941), *C. geniculata* Lundblad and *C. shadei* Lundblad (Lundblad, 1938), *C. vietsi* Lundblad (Lundblad, 1941) and *C. lundbladi* Viets (Viets, 1954b). *Centrolimnesia shadei* was also reported from Columbia (Lundblad, 1953). *Centrolimnesia geijskesi* Besseling is known only from the type locality in Suriname (Besseling, 1949). Recently, Cook (1980) described *C. motasi* Cook from Mexico.

Centrolimnesia appears to have originated in South America, and a few species of the genus have recently dispersed to southern North America across the Isthmus of Panama.

***Centrolimnesia bondi* Lundblad**
(Fig. 15)

Centrolimnesia bondi Lundblad, 1935. Arkiv för Zoologi 28A: 5-8, figs. 2-3; ♂.

Centrolimnesia bondi: Viets, 1954a. Arkiv für Hydrobiologie 49: 66-67, figs. 59, 60, 62; ♂, ♀.

Centrolimnesia bondi: Viets, 1954b. Revue Suisse d'Hydrologie 16: 116, fig. 38; ♂.

Centrolimnesia bondi: Cook, 1980. Memoirs of the American Entomological Institute 31: 79, figs. 428-430, 432, 434; ♂, ♀ (?).

Centrolimnesia sp. Cook, 1974. Memoirs of the American Entomological Institute 21: 169.

Description of adults. Character states as in generic diagnosis (see Cook, 1974, page 169), such that:

Male. See Cook (1980, page 79, figs. 428-430, 432, 434). Dorsum of idiosoma with pair of small platelets near posterior end relatively short. Venter of idiosoma with setae at anterior angle of coxal plates I relatively thick; medial edges of coxal plates I long and contiguous but separate; coxal plates IV with pronounced notches at anteromedial angles posterior to Glandula Limnesiae. Genital field with concavity associated with gonopore occupying most of area of genital plate; often fused laterally with platelets bearing coxoglandularia II. Legs III with tibia and tarsus exhibiting characteristic modifications of genus; with distodorsal projection of tibia extending slightly beyond base of tarsus, and tarsus clavate but only slightly shorter than tibia, attaining its greatest height at level of base of claw socket

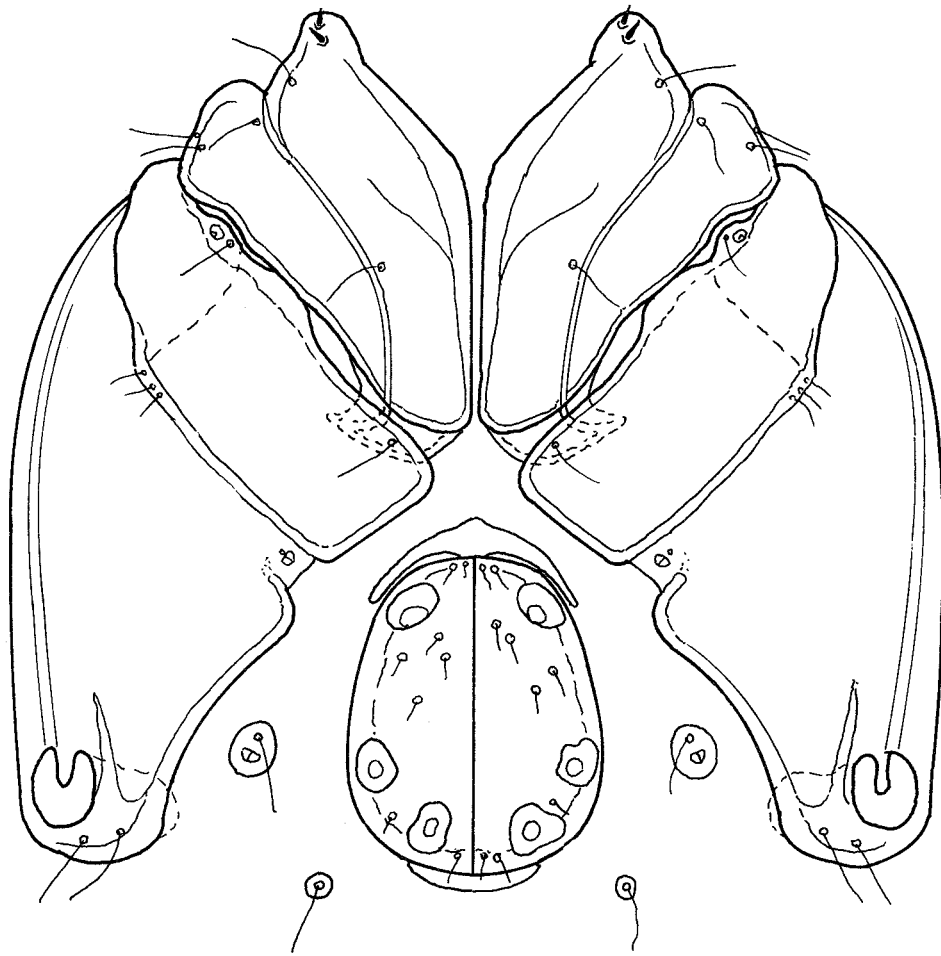


Fig. 15. *Centrolimnesia bondi* Lundblad, female adult, venter of idiosoma.

and with setae in row on distolateral surface all relatively thick and similar in shape.

Measurements (based upon five individuals): Length dorsal platelets 42-49, width dorsal platelets 21-25, length coxal plates 482-543, width coxal plates (one side, medial edge to insertion of leg IV) 201-250, length genital field 159-182, width genital field 127-143. Lengths pedipalp segments: Tr 20-26, Fe 60-66, Ge 53-60, Ti 70-74, Ta 31-34. Lengths distal leg segments: IGe 111-121, ITi 118-129, ITa 111-127; IIGe 176-189, IITi 183-192, IITa 166-176; IIIGe 140-155, IIITi 182-192, IIITa 169-187; IVGe 137-150, IVTi 138-157, IVTa 144-155.

Female. (Fig. 15). Similar to male except for genital field (Fig. 15).

Measurements (based upon four individuals): Length dorsal platelets 36-47, width dorsal platelets 23-31, length coxal plates 101-116, width coxal plates (one side, medial edge to insertion of leg IV) 49-55, length genital field 195-221, width genital field 133-150. Lengths pedipalp segments: Tr 26-27, Fe 65-68, Ge 52-57, Ti 72-78, Ta 31-33. Lengths distal leg segments: IGe 104-117, ITi 120-133, ITa 117-122; IIGe 176-189, IITi 176-189, IITa 151-170; IIIGe 143-153, IIITi 156-169, IIITa 143-150; IVGe 169-173, IVTi 163-179, IVTa 156-182.

Habitat. As for genus.

Distribution. South America (Brazil, Suriname), Central America (Costa Rica), Caribbean Islands (Haiti) and southern North America (Mexico - Campeche and Veracruz States; United States - Florida, Louisiana).

Specimens examined. USA: FLORIDA: Alachua County: From cypress swamp beside Rt. 307 between Orange Heights and Windsor 2♂♂ (slides) on 27 April 1958 by R.D. Mitchell. Manatee County: From backwater slough in Myakka River beside Wauchula Road 2.9 km north of Rt. 70, 1♀ (GAW) on 26 April 1992 (IMS). Martin County: From pool in stream beside Rt. 609 near Indiantown 1♀ (GAW) on 11 February 1976 (IMS). Polk County: From backwater pools in stream beside Lake Arbuckle Road near County Park at Lake Arbuckle 6♂♂, 6♀♀ (slides) + 33♂♂, 21♀♀ (GAW) on 25 April 1992 (IMS). LOUISIANA: Jefferson Davis Parish: From flooded rice field 2♂♂, 2♀♀ (slides) + 1♂, 3♀♀ (GAW) in summer of 1984 by M.F. Vidrine.

Remarks. Male adults of *Centrolimnesia bondi* differ from those of other species of the genus in that the tarsus of legs III is clavate but only slightly shorter than the tibia, attains its greatest height at the level of the base of the claw socket, and has the setae in a row on the distolateral surface all relatively thick and similar in shape.

ACKNOWLEDGMENTS

We thank Roger D. Mitchell and Malcolm F. Vidrine for supplying specimens of *Centrolimnesia bondi* from Florida and Louisiana, respectively, and Lynn Hill of CLBRR for preparing many of the slide-mounted specimens referred to in this paper.

LITERATURE CITED

- BARR, D.W. 1973. *Methods for the collection, preservation, and study of water mites (Acari: Parasitengona)*. Life Sciences Miscellaneous Publication, Royal Ontario Museum. 28 p.
- BESCH, W.K. 1963. Südandine Limnesiiden. *Acarologia* 5: 259-265.
- COOK, D.R. 1974. Water mite genera and subgenera. *Mem. Am. Entomol. Inst.* 21: 860 pp.
- COOK, D.R. 1980. Studies on Neotropical Water Mites. *Mem. Am. Entomol. Inst.* 31: 645 pp.
- COOK, D.R. 1981. Amsterdam expeditions to the West Indian Islands, Report 11. New hyporheic water mites from Haiti. *Bijdr. Dierkd.* 51: 135-144.
- FERNÁNDEZ, H.R. 1987. Ácaros intersticiales del noroeste Argentino II. Los generos *Protolimnesia* Lundblad y *Diamphidaxona* Cook (Acari: Hydrachnellae). *Neotropica* 33: 139-146.
- LUNDBLAD, O. 1924. Über einige Hydracarininen aus den peruanischen Anden. *Göteborg. K. Vetensk. Vitterhets-samh. Handl. (Ser. 4)* 27: 1-25.
- LUNDBLAD, O. 1927. Zur Kenntnis der Hydracarininenfauna der Mount Elgongebirgs im britischen Ostafrika. *Arch. Hydrobiol.* 18: 361-441.
- LUNDBLAD, O. 1930. Südamerikanische Hydracarininen. Zugleich Revision einiger von E. Daday aus Paraguay beschriebenen Arten. *Zool. Bidr. Upps.* 13: 1-86.
- LUNDBLAD, O. 1935. Über einige Hydracarininen aus Haiti. *Ar. Zool.* 28A: 1-30.
- LUNDBLAD, O. 1938. Neue Wassermilben aus Paraguay. *Zool. Anz.* 122: 7-19.
- LUNDBLAD, O. 1941. Die Hydracarininenfauna Südbrasilien und Paraguays. Erster Teil. *K. Svenska Vetensk. Handl. (Serien 3)* 19: 1-183.
- LUNDBLAD, O. 1953. Die Hydracarininenfauna von Columba. *Ark. Zool. (Serien 2)* 5: 435-585.
- SMITH, I.M. & D.R. Cook. 1991. Water mites. In: J. Thorp & A. Covich (eds); *Ecology and classification of North American freshwater invertebrates*. Academic Press, San Diego, CA. pp. 523-592.
- VIETS, K.H. 1938. Brasilianische Wassermilben. V. *Zoologischer Anzeiger* 121: 21-24.
- VIETS, K.H. 1954a. Süßwassermilben (Hydrachnellae, Acari) aus Südamerika. *Arch. Hydrobiol.* 49: 1-224.
- VIETS, K.H. 1954b. Wassermilben aus dem Amazongebiet (Hydrachnellae, Acari). *Rev. Suisse Hydrol* 16: 78-247.
- VIETS, K.O. 1976. Über einige Wassermilben von St. Vincent, West-Indien (Acari, Hydrachnellae). *Entomol. Scand.* 7: 76-78.
- VIETS, K.O. 1987. Die Milben des Süßwassers (Hydrachnellae und Halacaridae [part.], Acari). 2. Katalog. *Sonderb. Naturwiss. Ver. in Hambg.* 8: 1012 pp.
- WALTER, C.W. 1919. Hydracarininen aus den peruanischen Anden und aus Brasilien. *Rev. Suisse Zool.* 27: 19-59.