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**THE FAMILY PSEUDOGARYPIDAE (PSEUDOSCORPIONIDA)  
IN NORTH AMERICA WITH COMMENTS ON  
THE GENUS *NEOPSEUDOGARYPUS* MORRIS FROM TASMANIA**

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**ABSTRACT**

The North American genus *Cerogarypus* Jacot is synonymized under the similarly distributed genus *Pseudogarypus* Ellingsen, together with a redescription of *Pseudogarypus* and a brief diagnosis of the Tasmanian genus *Neopseudogarypus* Morris. *Cerogarypus agassizi* Jacot is synonymized under *Pseudogarypus bicornis* (Banks). *Pseudogarypus banksi* Jacot, *P. bicornis* and *P. hesperus* Chamberlin are redescribed from type series and numerous new specimens; extensive distributional data are given. A new species, *P. spelaeus*, from Samwell Cave, California, is described.

**INTRODUCTION**

This paper, one of a series resulting from studies of pseudoscorpions collected in Oregon, reports on the species of the family Pseudogarypidae Chamberlin from North America. Although pseudogarypids seem to be distributed widely in the United States, relatively few specimens have been reported and several species have not been adequately described by modern standards. Not only are original diagnoses unfortunately brief, but in some cases descriptive terms are inadequately defined, type specimens are limited in number, and certain of these are in poor condition. This situation has discouraged workers from making specific determinations, resulting in a lack of knowledge concerning interspecific and intraspecific variation. In fact, it has become increasingly apparent that all species must be re-evaluated before further specimens can be identified correctly. For example, Nelson (1975) reported that neither he nor Muchmore were able to find "reliable criteria to establish the Michigan specimens as a new or existing species" (p. 283).

A large number of pseudogarypid specimens from various localities in North America have accumulated over the years in the Muchmore and authors' collections. Recently Benedict and Malcolm collected pseudogarypids from over 35 localities in Oregon which

appeared to fall into three series: one clearly identifiable as *Pseudogarypus hesperus* Chamberlin, one resembling *P. bicornis* (Banks) and the other series apparently differing from either species. In addition, three different series have been recovered from caves or fissures in California and Arizona (Muchmore, pers. comm.). Due to the complex systematic problems, these specimens could not be assigned to species with any degree of confidence. In an attempt to resolve these problems, the authors have examined over 200 specimens, including the types of all extant species of the family. This paper reports the results of this study and presents a clarification of the systematic affinities of the genera within the family Pseudogarypidae; a redescription of the genus *Pseudogarypus*; redescrptions and numerous new records for *P. bicornis*, *P. hesperus*, and *P. banksi* Jacot; and the description of *P. spelaeus*, new species, from Samwell Cave, California. In an attempt to clarify structural terms and relationships each species is extensively illustrated. Comparable structures are drawn to the same scale in all figures.

#### Family PSEUDOGARYPIDAE Chamberlin

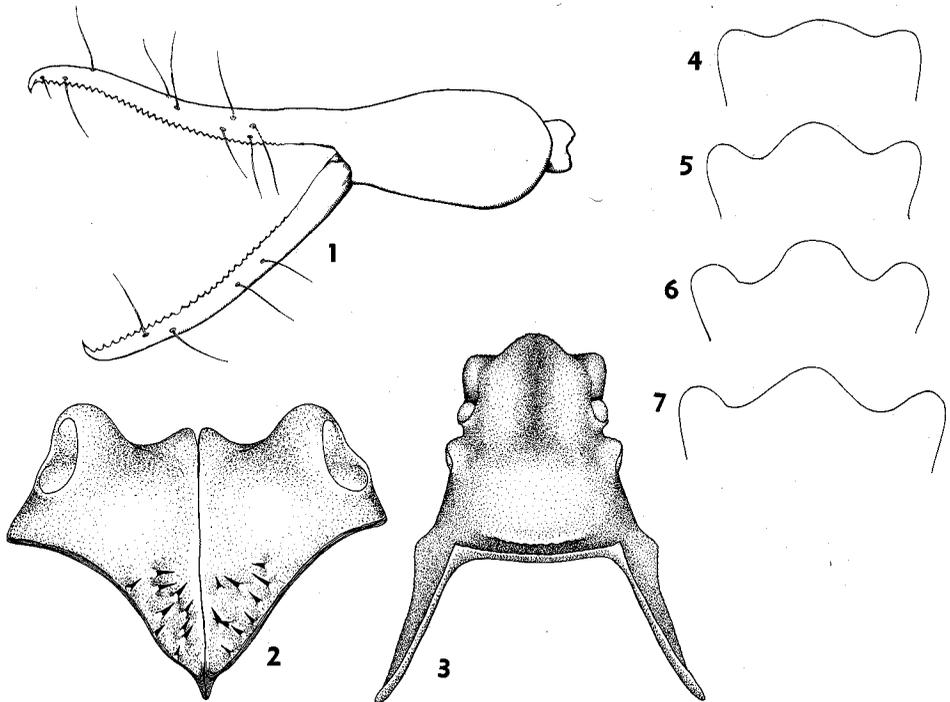
Pseudogarypinae Chamberlin 1923:161.

Pseudogarypidae Chamberlin 1931:230; Morris 1947:43; Hoff 1956:2.

The family Pseudogarypidae traditionally has been considered to consist of the genus *Pseudogarypus* Ellingsen with three extant species and three fossil species, and the monotypic genera *Cerogarypus* Jacot and *Neopseudogarypus* Morris.

Ellingsen in 1909 recognized that specimens from Yellowstone National Park, Wyoming, previously described by Banks (1895) as *Garypus bicornis*, did not conform to the generic definition of *Garypus* Koch. Therefore, he erected the genus *Pseudogarypus* for the Wyoming specimens, and for a single pseudoscorpion collected at Shasta Springs, California, which he determined as the same species. Chamberlin (1923) described *P. bicornis* in detail, not from Banks' type series but from a single specimen collected at Bear Lake, Utah, which he considered to be conspecific. In 1931, Chamberlin described *P. hesperus* from two female pseudoscorpions collected at Puyallup, Washington. He differentiated this new species from the earlier Utah specimen of "*P. bicornis*" on the basis that, among other characteristics, it exhibited well developed "pseudocoxal spines" on coxae I. Jacot (1938) described the species *P. banksi* from New Hampshire specimens. These also possessed well-developed spines on coxae I. In the same paper, Jacot created the taxon *Cerogarypus agassizi* for Chamberlin's Utah specimen of "*P. bicornis*" because it exhibited "no spines on mesal end of pedal coxae I, and no sclerotized roof over posterior eye" (p. 301). Hoff (1946) upon re-examination of Banks' type specimens of *P. bicornis* (the genotype of *Pseudogarypus*) confirmed the presence of "pseudospines" on the first coxae just as Jacot had implied and gave support to the idea that there were two North American genera of pseudogarypid pseudoscorpions: *Pseudogarypus* and *Cerogarypus*. At about this time, Morris (1947) added the genus *Neopseudogarypus* from Tasmania. He distinguished this genus on the presence of three rows of "chitinised plates" in the pleural membrane. Thus for the past 30 years three genera have been assigned to the family. While the history of these taxa appears relatively straightforward, great confusion exists as to the terminology used by certain authors and to the systematic affinities within the family.

The genus *Cerogarypus* Jacot presents special problems since it is known only from one specimen which is in poor condition. The exoskeleton appears very thin, eroded and stretched as a result of KOH treatment. Careful examination of the male holotype under phase optics reveals that exceedingly minute basal fragments of pseudospines are still present on the first coxae suggesting that the major portions of the spines were broken off during specimen preparation. The fragility of the pseudospines is readily apparent, e.g., the holotype of *P. hesperus* has only one remaining unbroken spine while the rest are stubs of varying lengths. A further area of confusion results from Jacot's statement that *Cerogarypus* has "no sclerotized roof over posterior eyes" (p. 301). This phrase is puzzling. It is true that the specimen lacks both pigmentation and sclerotization of the dorsal portion of the posterior eye tubercle. Again, this may reflect an artifact of specimen preparation. However, specimens of *Pseudogarypus* do exhibit a continuum of variation from a total lack of pigmentation and sclerotization to dark pigmentation and heavy sclerotization in this area. One specimen is heavily pigmented and sclerotized above one posterior eye and not above the other. This character can be most easily viewed under a stereoscope where it appears in some specimens as light-colored and shiny. Therefore, this study shows that the genera *Pseudogarypus* and *Cerogarypus* cannot be discriminated on the basis of Jacot's criteria. Examination of the types of *C. agassizi* and *P. bicornis*, as well as numerous specimens of *Pseudogarypus* from various localities, reveals no other essential differences between the two genera; thus the authors conclude that *Cerogarypus* Jacot is a junior synonym of *Pseudogarypus* Ellingsen.



Figs. 1-3.—*Neopseudogarypus scutellatus* Morris, drawn from female: 1, external aspect of chela; 2, coxae I showing details of pseudospines; 3, carapace.

Figs. 4-7.—*Pseudogarypus* Ellingsen, comparison of anterior margins of female carapace, drawn to same scale: 4, *P. banksi* Jacot; 5, *P. hesperus* Chamberlin; 6, *P. bicornis* (Banks); 7, *P. spelaeus*, new species, allotype.



Figs. 8-10.—*Pseudogarypus banksi* Jacot, scanning electron micrographs: 8, dorsal view of body (50X); 9, coxal area showing pseudospines on coxae I (250X); 10, chelal fingers showing teeth (250X).

Fig. 11.—*Pseudogarypus bicornis* (Banks) tip of fixed chelal finger showing teeth (250X).

Figs. 12-13.—*Pseudogarypus hesperus* Chamberlin: 12, lateral view of carapace showing eyes (56X); 13, dorsal view of carapace showing fingers of chelicerae (100X).

When Morris (1947) erected the genus *Neopseudogarypus* for certain Tasmanian specimens, he described the pleural membrane of *N. scutellatus* as raised into three folds with "a row of chitinised plates" (p. 45) in each fold. At that time he revised the diagnosis of the family "to include forms in which 'abdominal pleural plates are either absent or present'" (p. 43). The authors and Muchmore (pers. comm.) have observed somewhat similar sclerites in some specimens of *Pseudogarypus*, especially males. These sclerites, when present, are weakly-developed and not as uniformly shaped nor as definite as those of *Neopseudogarypus*. The sclerotization may be so poorly developed on some specimens of *Pseudogarypus* that it is nearly impossible to discern unless the pleural membrane is mounted flat. Many females lack these structures entirely.

The discovery of pleural plates in *Pseudogarypus* raises the question as to whether or not it and *Neopseudogarypus* are synonymous. Although there are no longer any distinguishing criteria as defined by Morris (1947), specimens from North America and Tasmania do differ in the arrangement of pseudospines on coxae I, in the form of the abdominal sclerites, the shape of carapace, and in the shape of the chelal fingers. In addition, North American pseudogarypids, though divisible into several species, resemble each other much more than they do Tasmanian pseudogarypids. The authors, therefore, recognize both *Pseudogarypus* Ellingsen and *Neopseudogarypus* Morris as distinct genera.

Pseudogarypids may be recognized by feaelloid facies (Chamberlin 1931), no specialized articulation between cephalothorax and abdomen, carapace with pleural alae or processes, abdomen with or without pleural sclerites, coxae I with pseudospines, and pedipalps of normal prehensile form. Tactile setae of movable chelal finger subequally distributed in a linear row on distal two-thirds of finger. Tactile setae of fixed finger roughly distributed as follows: IST and EST forming a medially located pair distinctly separated from more basally grouped IB, EB, ISB, and ESB and distally placed IT and ET; IT about one-fifth length of finger from tip; ET about one-half that distance from tip. Absolute placement of individual setae varies within a given species.

A comprehensive study of *Neopseudogarypus* based upon large series of specimens is necessary before it can be fully characterized. However, the following couplet will separate non-fossil specimens of the presently recognized genera of Pseudogarypidae.

Fixed finger of chela strongly recurved (Fig. 1); several pseudospines arise from posterior margin of coxae I (Fig. 2); carapace with distinct, well-developed posterior suture and posterior margin elevated into high ridge (Fig. 3); pleural plates strongly developed in both males and females; from Tasmania . . . *Neopseudogarypus* Morris  
 Fixed finger of chela relatively straight (Figs. 15, 23, 28, 30); all pseudospines arise at least one spine's length from posterior margin of coxae I (Figs. 20, 22, 25, 31); carapace with weak posterior suture and posterior margin weakly elevated (Figs. 18, 19); pleural plates lacking or weakly developed in some specimens and relatively well-developed in others; from North America . . . . . *Pseudogarypus* Ellingsen

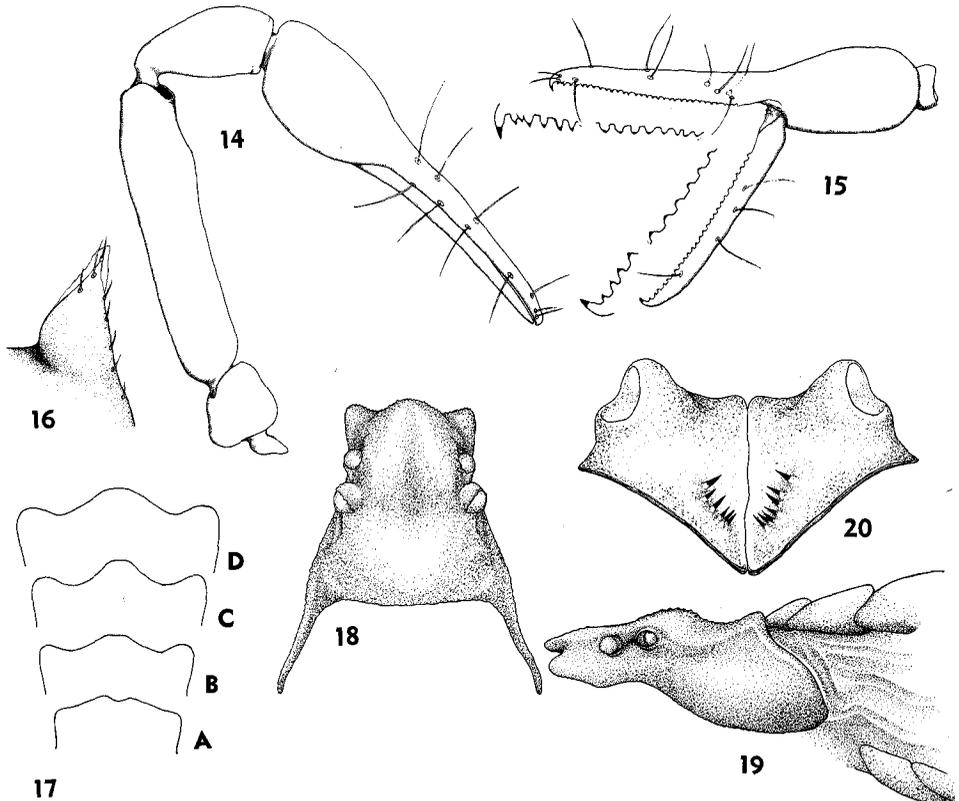
#### Genus *PSEUDOGARYPUS* Ellingsen

*Pseudogarypus* Ellingsen 1909:217 (type species, *Garypus bicornis* Banks); Banks 1911:637; Chamberlin 1923:146, 161, 1931:321; Jacot 1938:301; Hoff 1961:442.  
*Cerogarypus* Jacot 1938:301 (type species, *Cerogarypus agassizi*). NEW SYNONYMY.

**Diagnosis.**—As described in key to genera.

**Description.**—Exhibits typical fealoid facies (Chamberlin 1923, 1931). Derm of entire animal heavily rugose-tessellate making minute simple vestitural setae barely discernible. Known range of palpal chelal length (including pedicel) 1.1-2.0 mm; body length (exclusive of chelicerae) of male 2.2-3.2 mm, of female 2.3-3.4 mm.

Carapace (Figs. 12, 13) very irregular in outline and conformation. Anterior margin from dorsal view appearing sinuate with more or less prominent notch or indentation on each side of bluntly rounded median anterior protuberance (Figs. 4-7). Lateral carapacial aspects strongly sclerotized, extending ventrad nearly to coxal area, thus markedly reducing pleural area, and extending caudad to about middle of coxae III as very distinctive, extremely prominent, concave or "spoon-shaped" projections or "lateral alae." Carapace, exclusive of lateral alae, subtriangular and 1-1.25 times longer than posterior breadth. Cucular furrow a broad, shallow, central depression which becomes obsolete anteriorly, extending forward from convex hillock or elevated median disc of pars thoracica. A so-called "antero-lateral protuberance" or "horn," a characteristically prominent, conical projection, arises beneath eye tubercle and extends forward almost even with anterior carapacial margin on both sides of median protuberance. Moderate to well-developed anterior eyes weakly tuberculate and located 2-2.5 ocular diameters from



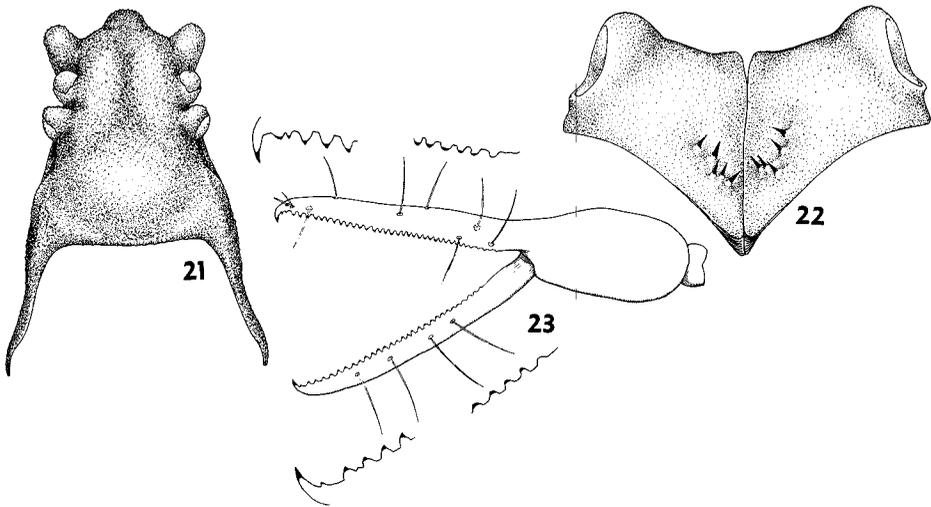
Figs. 14-20.—*Pseudogarypus banksi* Jacot: 14, dorsal aspect of palp of female (cotype MCZ-315); 15, external aspect of chela of male showing details of teeth; 16, apex of maxilla; 17, comparative development of anterior carapacial margin: a—protonymph, b—deutonymph, c—tritonymph, d—adult male; 18, dorsal view of carapace; 19, lateral view of carapace; 20, coxae I showing details of pseudospines.

anterior margin of "horn." Slightly flatter posterior eyes arising from very prominent, well-sclerotized lateral tubercles which face more or less posteriorly. Eyes in most specimens separated about one ocular diameter as measured from corneal margin of each eye.

Illustrations of general form of coxal area by Chamberlin (1936, Pl. F; 1931, fig. 63) here augmented by scan electron micograph (Fig. 9). In addition to the usual apical, marginal and discal setae, a series of 5-7 setae (Fig. 16) is located on median border of maxilla which intergrades with apical setae (included in apical setal number in chaetotaxal formulae). Each coxa I with group of elongate pseudospines, separated from posterior margin of coxa by at least one spine length (Figs. 20, 22, 25, 31).

Obovate abdomen (Figs. 8, 32) broadest at segment 6, with 10 visible tergites dorsally, each bearing numerous, inconspicuous, minute setae. Sclerotic shield formed by fused 11th tergite and sternite (Chamberlin 1931, figs. 63, 64) surrounding 12th or anal segment. Scuta of tergites 1-8 and sternites 5-10 divided. Lateral margins of the broad tergites project beyond the narrower sternites producing shield-like dorsum. Well-sclerotized pair of apodemes on anterior margins of sternites 4 and 5. Tessellated pleural membranes with 3 prominent, longitudinal, sinuate furrows which extend entire length of abdomen (Fig. 19). Well-developed pleurite bearing internal apodeme, characteristic of pseudogarypids, at anterior end of ventral furrow. Males may bear longitudinal series of additional slightly sclerotic, or frequently only pigmented, "plates" in all 3 furrows; females lack these supplemental structures. External genitalia of both sexes with no apparent unique features. Internal and external male genital structures of *P. bicornis* (Chamberlin 1931, fig. 51) apparently characteristic of genus. Setal distribution on sternites 3 and 4 of both sexes, as illustrated by Jacot (1938:302), appears representative of the genus.

Chelicerae (Chamberlin 1923, Pl. F; 1931, fig. 14) very small, largely hidden from dorsal view by carapace (fig. 13). Proximal portion of hand smooth, lightly sclerotized; distal portion well-sclerotized, deeply pigmented, tessellated, with 8-12 simple setae. Flagellum of 2 slender, curved, simple setae, typical of family. Movable finger with typical subapical lobe, small and conspicuously pigmented; anterior medial margin of



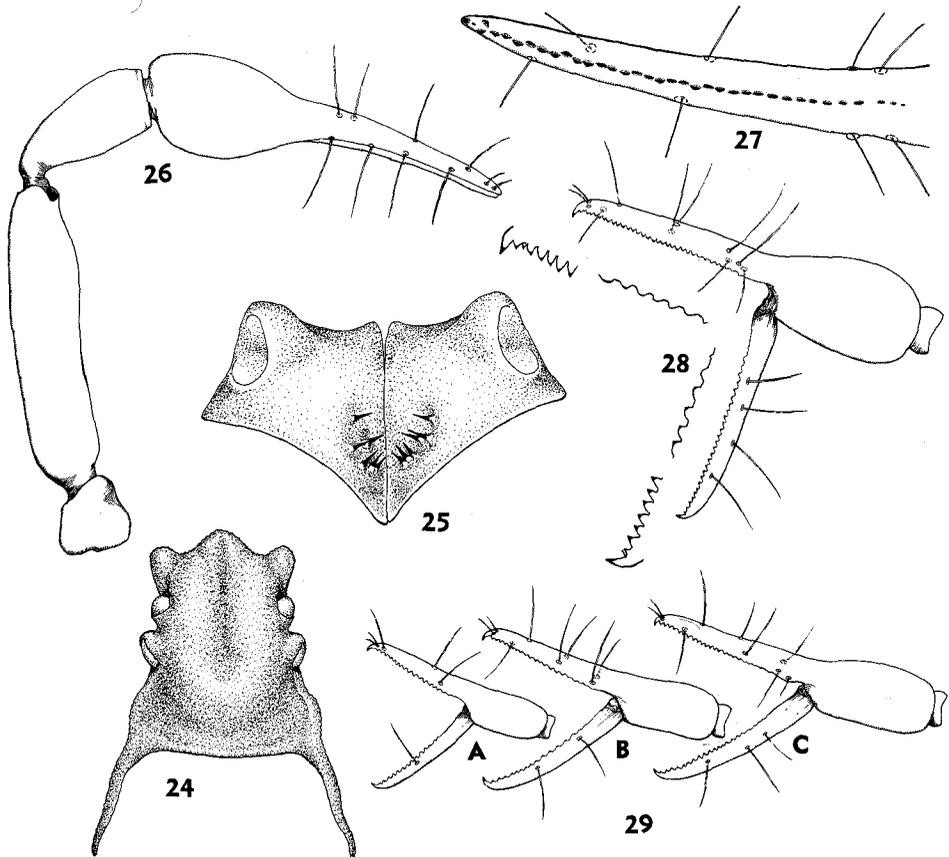
Figs. 21-23.—*Pseudogarypus bicornis* (Banks): 21, carapace; 22, coxae I showing details of pseudospines; 23, external aspect of chela of male showing details of teeth (cotype WM-621.01001).

finger with 1-2 very small to obsolete "microdenticles" or serrulations; serrula exterior fused along entire length to movable finger with sharply differentiated acute terminal tooth or blade directed at an anterior angle from remaining 15-16 blades. Fixed finger, characteristic of family, lacking all teeth except terminal or apical one; serrula interior a broad plate-like sheet of fused blades.

Pedipalps (Chamberlin 1923, Pl. V; Hoff 1926, fig. 5) long, slender and typical of family; fingers of chela relatively straight. Marginal teeth somewhat staggered instead of aligned in straight row (Fig. 27), erroneously appearing heterodentate in some orientations. One or 2 internal accessory teeth near tooth 1 of each finger. Chelal chaetotaxy typical of family (Figs. 15, 23, 28, 29, 30).

Legs illustrated by Chamberlin (1923, figs. 1, 8; fig. 63) typical of family.

**Remarks.**—In this genus, many of the characteristics traditionally employed for discrimination of species cannot be used in identifying individual specimens due to the degree of both inter- and intra-specific variability. For example, the position and number of tactile setae on the chelal fingers are too inconstant to be useful as identifying characteristics. In both *P. banksi* and *P. hesperus*, ST tends to be closer to SB, while in *P.*



Figs. 24-29.—*Pseudogarypus hesperus* Chamberlin: 24, carapace; 25, coxae I showing details of pseudospines (paratype JC-708.01001); 26, dorsal aspect of palp of female; 27, fixed finger of chela from ventral view showing tooth arrangement and tactile setae; 28, external aspect of chela of female showing details of teeth; 29, comparative development of chela: a—protonymph, b—deutonymph, c—tritonymph.

*bicornis* and *P. spelaeus* ST tends to be closer to T. The exceptions to this pattern are evident in the arrangement observed in 46 otherwise typical males of *P. bicornis*: ST in one male is 0.24 of the distance from T to SB; in 42 males it is between 0.30 and 0.47 of the distance; and in three, it is 0.50 to 0.56 of the distance. Further, two males and one female of *P. bicornis* and one male of *P. hesperus* with genitalia typical of adults have only three setae on the movable finger. The arrangement and number of pseudospines provide other examples of variability. The pseudospines in *P. banksi* tend to be in a line while in other species they are in a scattered cluster. Although mean spine number per coxa is slightly greater in both *P. spelaeus* and *P. banksi* than in the other two species, ranges overlap. When all specimens studied were arranged according to the depth of the notches on the anterior carapacial margin, it became apparent that with certain exceptions, the notches were progressively deeper in the following sequence of species: *P. banksi*, *P. hesperus*, *P. bicornis*, and *P. spelaeus* (Figs. 4-7). Further, whereas the femoral length is nearly equal in *P. hesperus* and *P. banksi*, the chela tends to be slightly longer in *P. banksi*. Although these species are variable, they do appear to be "good" morphological species, and are separable by the combination of characters in the following key:

Key to Adults of the North American Species of *Pseudogarypus*

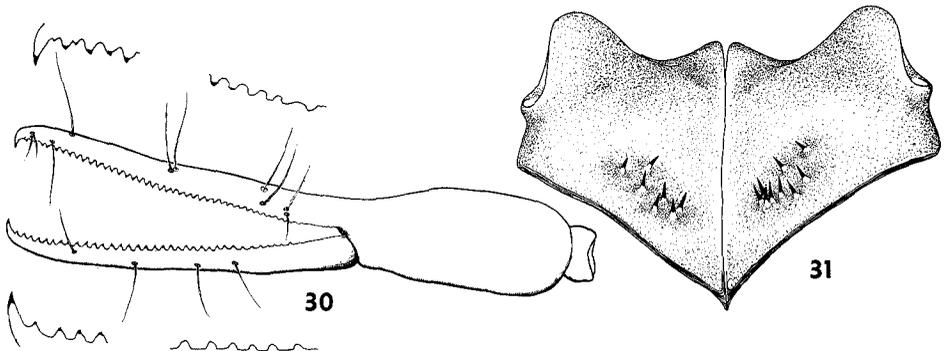
1. Chelal length (including pedicel) less than 1.70 mm . . . . . 2  
 Chelal length (including pedicel) of male 1.87-1.90 mm, of female 1.99 mm; palpal femur length of male 1.65 mm, of female 1.73 mm; cavernicolous, Samwell Cave, California . . . . . *P. spelaeus*, new species
  
2. Palpal femur length of male less than 1.0 mm, of female less than 1.05 mm; anterior margin of carapace with shallow notch between antero-lateral and median protuberances (Figs. 4, 5) . . . . . 3  
 Palpal femur length of male 1.02-1.28 mm, of female 1.07-1.33 mm; chelal length of male 1.27-1.51 mm, of female 1.31-1.61 mm; anterior margin of carapace with relatively deep notch between antero-lateral and median protuberances (Fig. 6); chelal fingers with widely-spaced teeth; epigean, widely-distributed in western United States . . . . . *P. bicornis* (Banks)
  
3. Teeth in distal half of chelal fixed finger definitely separated (Fig. 15), not appearing contiguous; chelal length of male (including pedicel) 1.19-1.29 mm, of female 1.20-1.31 mm; palpal femur length of male 0.90-0.98 mm, of female 0.96-1.02 mm; epigean, from the United States and Canada . . . . . *P. banksi* Jacot  
 Teeth in distal half of chelal fixed finger appearing contiguous in male and only very slightly spaced in female (Fig. 28); chelal length (including pedicel) of male 1.07-1.18 mm, of female 1.09-1.24 mm; palpal femur length of male 0.85-0.97 mm, of female 0.91-1.03 mm; epigean, from the Pacific Northwest of the United States . . . . . *P. hesperus* Chamberlin

Even though *P. hesperus* and *P. banksi* share a number of traits in common they appear to be geographically isolated. On the other hand, *P. bicornis* and *P. hesperus*, markedly different in their expressions of several characters, are sympatric in Oregon, and even may have been collected together from under the same rock. *P. spelaeus*, most similar to the epigean species *P. bicornis*, apparently exhibits a certain degree of cavern-

icolous adaptation. *P. spelaeus* (Table 6) is much larger than the other three species, *P. bicornis* (Table 3) is next in size, while *P. banksi* (Table 2) and *P. hesperus* (Table 5) are generally smaller. The chelal teeth of both *P. bicornis* and *P. spelaeus* are widely spaced, those of *P. banksi* moderately spaced, while the teeth of *P. hesperus* are contiguous on the distal half of the fixed finger, especially of the male.

Table 1.—Appendicular morphometric ratios of adult *Pseudogarypus* Ellingsen (abbreviations: B-breadth, D-depth, L-length).

	<i>P. banksi</i> Jacot		<i>P. hesperus</i> Chamberlin	
	♂ ♂ (n=14)	♀ ♀ (n=13)	♂ ♂ (n=14)	♀ ♀ (n=15)
<b>Pedipalp</b>				
Trochanter L/B	1.3-1.5	1.2-1.7	1.4-1.6	1.4-1.6
Femur L/B	4.6-5.0	4.3-5.0	4.3-4.8	4.4-4.9
Tibia L/B	2.5-2.9	2.4-2.7	2.4-2.8	2.5-2.7
Chela (with pedicel) L/B	4.2-4.7	4.0-4.4	4.1-4.5	3.8-4.2
Chela (with pedicel) L/D	4.6-5.1	4.4-4.8	4.4-4.8	4.3-4.9
Movable finger L/Hand L	1.5-1.7	1.5-1.7	1.4-1.8	1.4-1.7
Hand L/D	1.6-1.8	1.4-1.8	1.5-1.7	1.5-1.7
Chela L/Femur L	1.21-1.32	1.24-1.35	1.18-1.26	1.16-1.23
<b>Leg I</b>				
Basifemur L/D	2.8-3.4	2.8-3.1	2.9-3.3	2.8-3.2
Telofemur L/D	2.6-3.0	2.4-2.9	2.6-3.2	2.7-3.0
Tibia L/D	2.8-3.1	2.9-3.2	3.1-3.7	2.8-3.3
Tarsus L/D	6.6-7.2	6.6-7.7	6.1-7.7	6.1-7.2
<b>Leg IV</b>				
Basifemur L/D	2.2-2.6	2.1-2.5	2.3-2.8	2.7-2.9
Telofemur L/D	3.2-3.5	3.0-3.5	2.7-3.4	2.7-3.2
Tibia L/D	4.9-5.6	5.0-5.8	5.2-6.1	5.3-6.5
Tarsus L/D	8.4-9.7	8.3-9.8	9.1-10.2	9.2-9.9



Figs. 30-31.—*Pseudogarypus spelaeus*, new species: 30, external aspect of chela of male showing details of teeth (holotype DM-407.01001); 31, coxae I showing details of pseudospines (paratype DM-405.01001).

Table 2.—Appendicular morphometric ratios of adult *Pseudogarypus* Ellingsen (abbreviations: B-breadth, D-depth, L-length, ?-indeterminable).

<i>P. bicornis</i>	<i>P. bicornis</i> (Banks)		<i>P. spelaeus</i> , n. sp.	
	♂ ♂ (n=52)	♀ ♀ (n=30)	♂ ♂ (n=2)	♀ (n=1)
Pedipalp				
Trochanter L/B	1.3-1.6	1.4-1.6	1.6,1.6	1.6
Femur L/B	4.7-6.2	5.1-6.0	7.3,6.5	7.0
Tibia L/B	2.5-3.0	2.5-3.3	3.0,3.5	3.6
Chela (with pedicel) L/B	4.2-5.5	4.1-5.0	5.4,5.4	5.4
Chela (with pedicel) L/D	4.6-5.7	4.4-5.4	5.9,5.8	5.9
Movable finger L/Hand L	1.5-1.8	1.4-1.7	1.7,1.6	1.7
Hand L/D	1.6-2.1	1.6-2.0	2.2,2.2	2.1
Chela L/Femur L	1.12-1.28	1.16-1.26	1.09,1.13	1.14
Leg I				
Basifemur L/D	2.8-3.6	3.0-3.6	4.2, ?	4.7
Telofofemur L/D	2.6-3.2	2.6-3.4	3.5,3.8	4.1
Tibia L/D	3.1-3.8	3.1-3.8	4.2,4.2	4.6
Tarsus L/D	7.0-8.7	7.1-8.8	10.5,11.4	11.7
Leg IV				
Basifemur L/D	2.3-2.9	2.3-3.3	3.0,3.2	3.1
Telofofemur L/D	2.7-3.6	2.8-3.6	4.0,4.4	4.2
Tibia L/D	5.9-6.6	5.7-7.2	8.6,8.4	8.7
Tarsus L/D	10.0-12.3	10.0-11.7	13.5,13.9	14.2

Table 3.—Measurements (in mm) of *Pseudogarypus banksi* Jacot adults (abbreviations: B-breadth, D-depth, L-length).

	♂ ♂ (n=14)	♀ ♀ (n=13)
Body L	2.27-2.40	2.34-2.55
Abdominal B	1.37-1.67	1.54-1.65
Carapace L	0.54-0.60	0.55-0.64
Ocular B	0.32-0.34	0.33-0.36
Posterior B	0.44±-0.54±	0.55±
Ant. eye diam.	0.062-0.068	0.062-0.074
Post. eye diam.	0.062-0.080	0.068-0.086
Chelicera L/B	0.23-0.24/0.13-0.14	0.23-0.26/0.14-0.15
Pedipalps		
Trochanter L/B	0.28-0.32/0.21-0.22	0.33/0.22-0.23
Femur L/B	0.90-0.98/0.19-0.21	0.96-1.02/0.20-0.22
Tibia L/B	0.48-0.54/0.19-0.20	0.48-0.55/0.20-0.21
Chela (inc. pedicel) L	1.19-1.29	1.20-1.31
Chela B	0.26-0.29	0.29-0.31
Chela D	0.23-0.26	0.27-0.28
Hand L	0.41-0.48	0.44-0.46
Movable finger L	0.69-0.76	0.76-0.79
Leg I		
Basifemur L/D	0.30-0.33/0.10-0.11	0.33-0.35/0.11-0.12
Telofofemur L/D	0.30-0.32/0.10-0.12	0.31-0.34/0.11-0.13
Tibia L/D	0.25-0.29/0.08-0.09	0.27-0.30/0.08-0.10
Tarsus L/D	0.44-0.46/0.06-0.07	0.45-0.49/0.06-0.07
Leg IV		
Basifemur L/D	0.25-0.28/0.10-0.12	0.26-0.30/0.11-0.12
Telofofemur L/D	0.39-0.43/0.12-0.13	0.42-0.48/0.13-0.14
Tibia L/D	0.45-0.50/0.08-0.09	0.48-0.52/0.08-0.10
Tarsus L/D	0.56-0.63/0.06-0.08	0.58-0.67/0.06-0.07

*Pseudogarypus banksi* Jacot

Figures 4, 8-10, 14-20

*Pseudogarypus banksi* Jacot 1938:302; Hoff 1958:18.*Pseudogarypus hesperus*: Manley 1969:7, 12 (misidentification, Michigan records).*Pseudogarypus* sp: Nelson 1975:283 (Michigan records).

To the present time, the only published record of *P. banksi* is the type collection described by Jacot from New Hampshire. Our examination of several large series of specimens of the described species of *Pseudogarypus* from North America reveals that the Michigan specimens, reported as *P. hesperus* by Fenstermacher (1959) in his unpublished masters thesis and by Manley (1969), are rightfully assignable to *P. banksi*, not only from geographical, but also from morphological evidence. The two species, although similar in general size and conformation, can be distinguished by the characters in the key. The following redescription of *P. banksi*, including all nymphal stages, is based upon examination of the type series and more than 40 specimens from the eastern United States and Canada.

**Diagnosis.**—Body length of male 2.27-2.40 mm, of female 2.34-2.55 mm; palpal femur length of male 0.90-0.98 mm, of female 0.96-1.02 mm. Epigean species with moderately spaced marginal teeth on distal half of chela.

**Description.**—Measurements in Table 2.

**ADULTS.** Carapace (Fig. 18) only slightly longer than posterior breadth; notch between anterolateral and median protuberances relatively shallow (Figs. 4, 17d). Coxal area illustrated in Figs. 9, 20; each coxa I bears a somewhat linear array of 5 to 6 pseudospines (average about 7 for male, 6 for female). Abdomen broadly obovate (Fig. 8), only slightly longer than broad. Appendages typical of epigean species (morphometric ratios Table 1), pedipalp of male illustrated by Nelson (1975), of female (Fig. 14); chelal chaetotaxy and dentition illustrated in Fig. 15; fixed finger with a graded series of moderately spaced, retrorse, triangular marginal teeth (male 27-33, female 28-34) which are distally elongate, gradually becoming lower and broader basally; movable finger with entire series similar in general shape but lower and broader, very widely spaced basally (male with 24-27, female with 23-29 teeth).

**TRITONYMPH.** Similar to adult except as noted. Slightly paler and smaller; derm slightly less sclerotized. Anterior carapacial margin illustrated in Fig. 17c. Coxal chaetotaxy (WM-1146.01006) 6-3-9:0-0-3-PS:0-2-5:0-1-7:0-1-7, each coxa I with 4-7 pseudospines. Chaetotaxy of chela typical of species and nymphal stage; teeth of both fingers similar in shape to adult but more widely separated, fixed finger with 24-27, movable finger with 19-24 marginal teeth.

**DEUTONYMPH.** Similar to adult except as noted. Paler and smaller; derm definitely tessellated but much less sclerotized. Anterior carapacial margin illustrated in Fig. 17b. Coxal chaetotaxy (WM-1146.01007) 5-2-3:0-1-3-PS:0-2-3:0-2-3:0-1-3, each coxa I with 4-6 pseudospines. Chaetotaxy of chela typical of species and nymphal stage; teeth of both fingers similar in shape to adult but more widely spaced, fixed finger with 20-21, movable finger with 17-19 marginal teeth.

**PROTONYMPH.** Similar to adult except as noted. Much paler and smaller; derm definitely tessellated but weakly sclerotized. Anterior carapacial margin only slightly notched; median protuberance barely developed, two-parted (Fig. 17a); anterior eye tubercles lacking, posterior eye tubercles very weakly developed. Coxal chaetotaxy

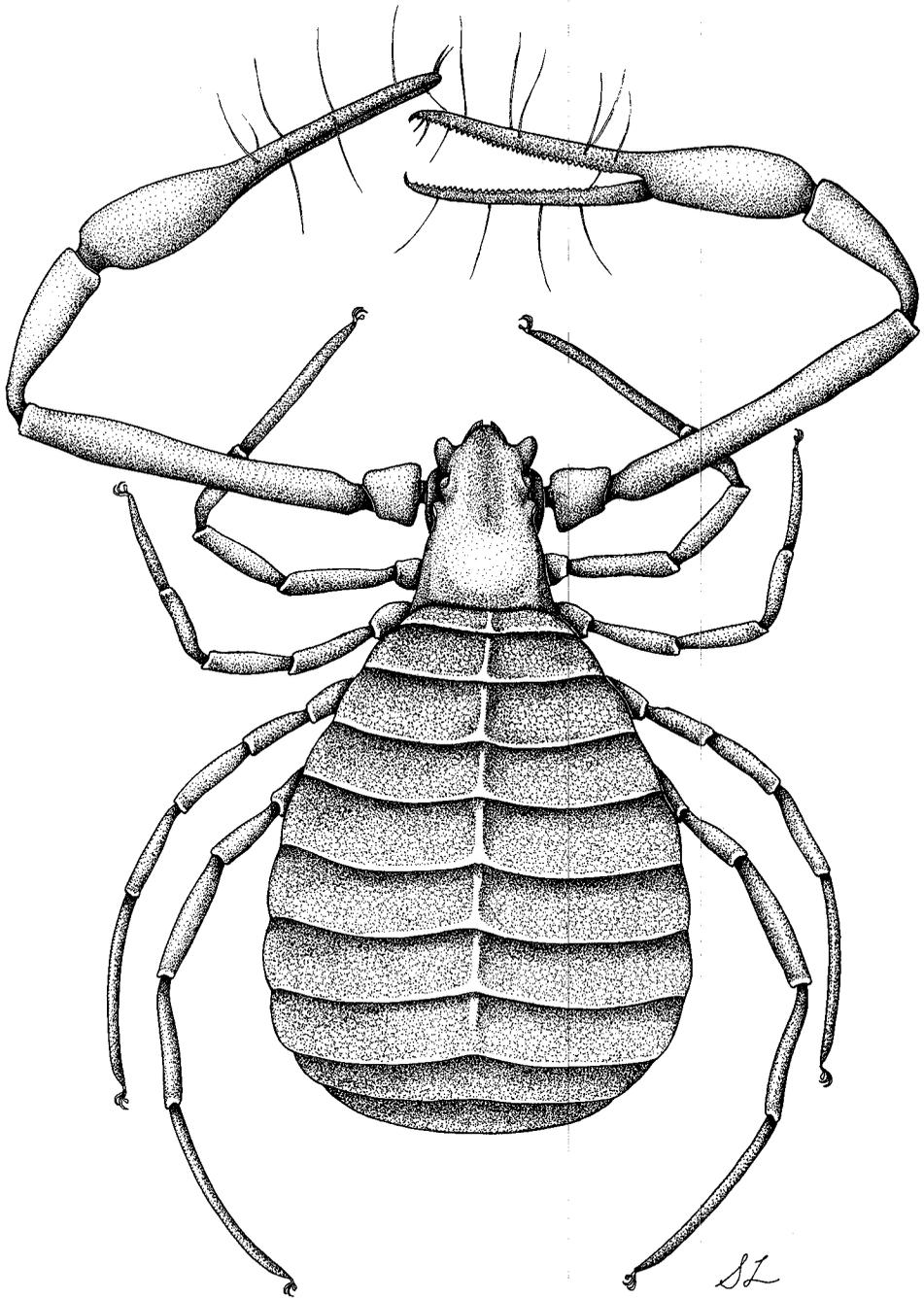


Fig. 32.—*Pseudogarypus spelaeus*, new species: dorsal view (holotype male).

(WM-1146.01001) 2-0-2:0-0-1-PS:0-0-1:0-0-1:0-0-1, median marginal series lacking, each coxa I with 3-5 pseudospines. Chaetotaxy of chela typical of species and nymphal stage; teeth of both fingers similar in shape to adult but very widely spaced, fixed finger with 14-19, movable finger with 11-16 marginal teeth.

**Remarks.**—In his reference to the carapace of *P. bicornis*, Jacot (1938:302) states that the “horns are deeply separated from the central lobe, so that there projects between them a rounded lobe but at a lower level. From the center of the lower lobes there springs a short but conspicuous bristle which extends forward to [the] level of the horns and central lobe.” We have searched in vain for this lower “rounded lobe” and its “conspicuous bristle.” In our opinion, Jacot must have been describing the chelicera since from a dorsal view of a mounted specimen of *Pseudogarypus* with attached chelicerae (Fig. 13), these diminutive structures appear as rounded lobes and the galea as conspicuous bristles. Additionally, Jacot illustrates the tip of a chelal finger showing a number of accessory teeth in addition to the marginal teeth (1938, fig. C). All of the chelae examined bear a single accessory tooth located near the first marginal tooth. Jacot may have seen and illustrated the bases of a series of small broken setae.

**Distribution.**—The known range of *Pseudogarypus banksi* apparently extends from Michigan eastward to the New England states and northward into southern Canada. Despite extensive collections by Hoff (1949) this species has not been recovered from Illinois. The present disjunct pattern of distribution will likely be eliminated when

Table 4.—Measurements (in mm) of *Pseudogarypus banksi* Jacot nymphs (abbreviations: B—breadth, D—depth, L—length).

	Tritonymph (n=7)	Deutonymph (n=3)	Protonymph (n=6)
Body L	1.64-1.86	1.48-1.65	1.08-1.23
Abdominal B	1.08-1.25	0.98-1.04±	0.69-0.79
Carapace L	0.46-0.51	0.39-0.43	0.30-0.35
Ocular B	0.30-0.32	0.28-0.30	0.25-0.28
Posterior B	0.44±-0.48±	0.41±-0.44±	0.40±
Ant. eye diam.	0.049-0.058	0.043-0.049	0.040-0.046
Post. eye diam.	0.062-0.065	0.037-0.043	0.037-0.046
Chelicera L/B	0.20-0.22/0.12-0.13	0.18-1.20/0.11	0.16-1.18/0.09-0.11
Pedipalps			
Trochanter L/B	0.26-0.28/0.16-0.19	0.21-0.23/0.14-0.16	0.15-0.21/0.11-0.13
Femur L/B	0.70-0.78/0.15-0.17	0.59-0.63/0.13-0.16	0.42-0.49/0.11-0.12
Tibia L/B	0.39-0.43/0.16-0.17	0.33-0.35/0.14-0.15	0.25-0.29/0.11-0.13
Chela (inc. pedicel) L	0.93-1.04	0.83-0.89	0.66-0.70
Chela B	0.20-0.22	0.18-0.19	0.13-0.16
Chela D	0.18-0.21	0.17-0.18	0.13-0.15
Hand L	0.33-0.40	0.30-0.33	0.21-0.26
Movable finger L	0.56-0.62	0.50-0.54	0.39-0.42
Leg I			
Basifemur L/D	0.23-0.27/0.09-0.10	0.21-0.23/0.08-0.09	0.16-0.18/0.06-0.07
Telofofemur L/D	0.23-0.28/0.09-0.10	0.19-0.21/0.08-0.09	0.13-0.16/0.07-0.08
Tibia L/D	0.21-0.23/0.07-0.08	0.17-0.18/0.07-0.08	0.13-0.14/0.06-0.07
Tarsus L/D	0.33-0.38/0.06-0.07	0.28-0.32/0.06-0.07	0.23-0.24/0.05-0.06
Leg IV			
Basifemur L/D	0.21-0.22/0.09-0.11	0.15-0.17/0.08-0.09	0.12-0.14/0.07-0.08
Telofofemur L/D	0.31-0.35/0.10-0.12	0.26-0.28/0.09-0.10	0.19-0.22/0.08-0.09
Tibia L/D	0.30-0.40/0.07-0.08	0.28-0.31/0.07-0.08	0.20-0.24/0.06-0.07
Tarsus L/D	0.45-0.51/0.06-0.07	0.36-0.41/0.0600.07	0.30-0.32/0.05-0.06

Muchmore (pers. comm.) publishes additional records and habitat data for *P. banksi* collected from numerous localities in the eastern United States.

Specimens examined.—CANADA: *Quebec*; Gatineau Park, Harrington Lake, 20 June 1954 (R. McCondochie), 2 females (WBM). UNITED STATES: *Michigan*; Chippewa Co., T46N, R6W, s31, 26 August 1969 (S. O. Nelson, Jr.), 3 males, 1 female (WBM); *New Hampshire*; Grafton Co., Pierce Bridge, 29 August (year unknown) (A. P. Jacot), 1 male, 4 females, 3 nymphs (MCZ), 0.9 mi W of Gale River, 25 June 1967 (W. B. Muchmore), 2 males, 2 females, 6 nymphs (WBM); *New York*; Albany Co., Rensselaerville, E. M. Huyck Preserve, 3 September 1955 (W. B. Muchmore), 6 males, 5 females, 9 nymphs (WBM), 10 September 1955 (W. B. Muchmore), 2 males, 1 female (WBM), 27 August 1966 (W. B. Muchmore), 2 males (WBM); *Essex Co.*, Wilmington Notch, 1 July 1967 (W. B. Muchmore), 1 male (WBM), about 5 mi SW of Wilmington, 1 July 1967 (W. B. Muchmore), 1 female, 1 nymph (WBM); *Hamilton Co.*, 1.5 mi NW of Long Lake, 1 July 1967 (W. B. Muchmore), 1 female (WBM).

*Pseudogarypus bicornis* (Banks)

Figures 6, 11, 21-23

*Garypus bicornis* Banks 1895:8.

*Pseudogarypus bicornis*: Ellingsen 1909:217; Banks 1911:637; Chamberlin 1923:162 (22 figs.), 1931:232; Beier 1932:57; Jacot 1938:301; Hoff 1946:198, 1961:443.

*Cerogarypus agassizi* Jacot 1938:301; Hoff 1958:18. NEW SYNONYMY.

Table 5.—Measurements (in mm) of *Pseudogarypus bicornis* (Banks) adults (abbreviations: B—breadth, D—depth, L—length).

	♂ ♂ (n=52)	♀ ♀ (n=30)
Body L	2.23-2.96	2.61-3.25
Abdominal B	1.44-1.77	1.64-1.97
Carapace L	0.57-0.68	0.59-0.74
Ocular B	0.33-0.39	0.34-0.39
Posterior B	0.40±-0.55±	0.51±-0.57±
Ant. eye diam.	0.062-0.086	0.074-0.089
Post. eye diam.	0.062-0.086	0.068-0.089
Chelicera L/B	0.24-0.27/0.13-0.15	0.23-0.29/0.13-0.16
Pedipalps		
Trochanter L/B	0.31-0.36/0.21-0.25	0.33-0.40/0.21-0.26
Femur L/B	1.02-1.28/0.18-0.22	1.07-1.33/0.19-0.23
Tibia L/B	0.50-0.63/0.18-0.22	0.52-0.72/0.19-0.23
Chela (inc. pedicel) L	1.27-1.51	1.31-1.61
Chela B	0.26-0.34	0.28-0.39
Chela D	0.24-0.31	0.26-0.36
Hand L	0.43-0.58	0.47-0.63
Movable finger L	0.74-0.89	0.79-0.94
Leg I		
Basifemur L/D	0.32-0.42/0.10-0.14	0.37-0.43/0.11-0.13
Telo-femur L/D	0.31-0.38/0.09-0.13	0.33-0.40/0.11-0.14
Tibia L/D	0.28-0.33/0.08-0.10	0.29-0.36/0.08-0.11
Tarsus L/D	0.45-0.57/0.06-0.07	0.47-0.56/0.06-0.08
Leg IV		
Basifemur L/D	0.27-0.34/0.10-0.15	0.29-0.37/0.10-0.14
Telo-femur L/D	0.40-0.51/0.12-0.18	0.44-0.55/0.13-0.18
Tibia L/D	0.50-0.60/0.08-0.13	0.53-0.67/0.08-0.11
Tarsus L/D	0.61-0.75/0.06-0.07	0.60-0.80/0.06-0.07

As noted previously, Chamberlin as early as 1923 described *P. bicornis* in detail from a single non-type male. Hoff (1946) restudied the type series of *P. bicornis*, designated a lectotype (male, USNM 4191) and published a detailed description of a male and a tritonymph. In 1961, he supplemented this description with measurements of a single male collected in Colorado. Since *P. bicornis* has been known only from three or four males and a tritonymph, and since there has been so much confusion as to which specimens rightfully belong to this species, it is appropriate to provide a full description of all stages and give data relative to intraspecific variation.

**Diagnosis.**—Body length of male 2.23-2.96 mm, of female 2.61-3.25 mm; palpal femur length of male 1.02-1.28 mm, of female 1.07-1.33 mm; epigean species with widely spaced marginal teeth on chela.

**Description.**—Measurements in Tables 5-7.

ADULTS. Carapace (Fig. 21) only slightly longer than posterior breadth; notch between anterolateral and median protuberances relatively deep (Fig. 6). Each coxa I bears a cluster (Fig. 22) of 4-7 scattered pseudospines (average about 5). Abdomen broadly obovate, only slightly longer than broad. Appendages typical of epigean species (morphometric ratios Table 2), pedipalp of male illustrated by Hoff (1946, fig. 5); chelal chaetotaxy and dentition illustrated in Figs. 11, 23; fixed finger with a graded series of widely spaced, elongate marginal teeth (male 32-43, female 34-42) which are distally elongate, gradually becoming lower, broader and more widely spaced basally (tooth shape

Table 6.—Measurements (in mm) of *Pseudogarypus bicornis* (Banks) nymphs (abbreviations: B—breadth, D—depth, L—length).

	Tritonymphs (n=7)	Deutonymphs (n=3)	Protonymphs (n=6)
Body L	205-2.27	1.48-1.84	1.24-1.43
Abdominal B	1.14-1.53	1.18-1.28	0.80-0.93
Carapace L	0.51-0.57	0.46-0.48	0.31-0.35
Ocular B	0.33-0.35	0.28-0.33	0.26-0.27
Posterior B	0.44±0.51±	0.47±0.49±	0.38±0.44±
Ant. eye diam.	0.056-0.068	0.043-0.056	0.037-0.043
Post. eye diam.	0.062-0.074	0.040-0.056	0.030-0.043
Chelicera L/B	0.21-0.23/0.12-0.16	0.18-0.19/0.11-0.12	0.16-0.18/0.09-0.10
Pedipalps			
Trochanter L/B	0.28-0.31/0.19-0.21	0.24-0.27/0.13-0.15	0.20-0.21/0.11-0.13
Femur L/B	0.85-0.93/0.17-0.20	0.68-0.78/0.14-0.16	0.52-0.59/0.11-0.12
Tibia L/B	0.39-0.47/0.16-0.18	0.35-0.39/0.14-0.16	0.27-0.31/0.12-0.13
Chela (inc. pedicel) L	1.11-1.19	0.91-1.03	0.75-0.86
Chela B	0.21-0.25	0.18-0.19	0.16-0.17
Chela D	0.21-0.24	0.17-0.19	0.15-0.16
Hand L	0.42-0.43	0.31-0.37	0.25-0.29
Movable finger L	0.65-0.69	0.55-0.62	0.46-0.52
Leg I			
Basifemur L/D	0.29-0.30/0.09-0.10	0.20-0.24/0.07-0.08	0.17-0.19/0.06-0.07
Telfemur L/D	0.26-0.29/0.09-0.11	0.20-0.22/0.08-0.09	0.15-0.17/0.07-0.08
Tibia L/D	0.22-0.26/0.07-0.09	0.16-0.18/0.06-0.07	0.14-0.16/0.06-0.07
Tarsus L/D	0.39-0.41/0.05-0.07	0.31-0.32/0.05-0.06	0.25-0.28/0.05-0.06
Leg IV			
Basifemur L/D	0.20-0.25/0.09-0.10	0.17-0.18/0.08-0.09	0.11-0.15/0.07-0.08
Telfemur L/D	0.33-0.37/0.12-0.13	0.27-0.29/0.09-0.10	0.21-0.25/0.08-0.09
Tibia L/D	0.40-0.45/0.08-0.09	0.32-0.33/0.06-0.07	0.24-0.27/0.06-0.07
Tarsus L/D	0.51-0.59/0.05-0.07	0.43-0.44/0.05-0.06	0.35-0.37/0.05-0.06

varies from specimen to specimen from retrorse triangular to nearly parallel-sided); movable finger with entire series similar in general shape but lower, broader, and very widely spaced basally (male 27-36, female 27-34 teeth).

TRITONYMPH. Similar to adult except as noted. Slightly paler and smaller; derm slightly less sclerotized. Coxal chaetotaxy 6-3-7:0-0-6-PS:0-1-6:0-1-6:0-1-6, each coxa I with 4-5 pseudospines. Chaetotaxy of chela typical of species and nymphal stage. Teeth of both fingers similar in shape to adult but more widely spaced in certain specimens, fixed finger with 26-34, movable finger with 24-28 marginal teeth.

DEUTONYMPH. Similar to adult except as noted. Paler and smaller; derm definitely tessellated but much less sclerotized. Coxal chaetotaxy 5-1-6:0-0-3-PS:0-1-3:0-1-3:0-2-3, each coxa I with 3 pseudospines. Chaetotaxy of chela typical of species and nymphal stage. Teeth of both fingers similar in shape to adult but more widely spaced in certain specimens, fixed finger with 24-27, movable finger with 22-25 marginal teeth.

PROTONYMPH. Similar to adult except as noted. Much paler and smaller; derm definitely tessellated but weakly sclerotized. Anterior carapacial margin much less deeply notched; median protuberance barely developed and two-parted; anterior eye tubercles lacking, posterior eye tubercles weakly developed and much less sclerotized. Coxal chaetotaxy 2-0-2:0-1-1-PS:0-1-0:0-0-1:0-0-1, median marginal series lacking, each coxa I with 2-3 pseudospines. Chaetotaxy of chela typical of species and nymphal stage. Teeth

Table 7.—Measurements (in mm) of *Pseudogarypus biconis* (Banks) adults bearing only three tactile setae on chelal movable finger (abbreviations: B-breadth, D-depth, L-length, ?-indeterminable. "Atypical" measurements followed by an asterisk).

	♂ ♂		♀
	Cotype	JC-1317.02003	EB-1363.01001
Body L	2.22*	2.56	212*
Abdominal B	±1.28*	?	1.25*
Carapace L	0.57	0.66	0.60
Ocular B	0.32*	0.34	0.39
Posterior B	±0.53	0.51±	0.51±
Ant. eye diam.	0.056*	0.077	0.074
Post. eye diam.	0.049*	0.074	0.080
Chelicera L/B	?/?	0.24/0.13	0.24/0.13
Pedipalps			
Trochanter L/B	?/0.18*	?/?	0.33/0.21
Femur L/B	0.86*/0.17*	1.08/0.20	0.98*/0.21
Tibia L/B	0.44*/0.17*	0.51/0.20	0.49*/0.18*
Chela (inc. pedicel) L	1.12*	1.30	1.28*
Chela B	0.24*	0.29	?
Chela D	0.21*	0.27	0.24*
Hand L	0.39*	0.48	0.48
Movable finger L	0.69*	0.75	0.76*
Leg I			
Basifemur L/D	0.31*/0.09*	0.37/0.11	0.28*/0.10*
Telfemur L/D	0.27*/0.09	0.34/0.12	0.29*/0.11
Tibia L/D	0.24*/0.07*	0.29/0.10	0.22*/0.08
Tarsus L/D	0.43*/0.06	0.49/0.07	0.39*/0.07
Leg IV			
Basifemur L/D	0.24*/0.09*	0.29/0.11	0.23*/0.10
Telfemur L/D	0.34*/0.11*	0.43/0.13	0.37*/0.12*
Tibia L/D	0.48*/0.07*	0.54/0.13	0.43*/0.09
Tarsus L/D	0.53*/0.06	0.68/0.06	0.57*/0.07

of both fingers similar in shape to adult but very widely separated, fixed finger with 19-24, movable finger with 17-21 marginal teeth.

**Remarks.**—It should be emphasized that the species in the genus *Pseudogarypus* appear to be highly variable and, therefore, the description of a new species from one or two specimens must be approached with great caution. Initially the authors considered the possibility that the Oregon specimens of *P. bicornis* might be two species due to size and slight differences in the shape of the chelal teeth. When specimens from approximately 50 localities in seven states were examined and measured it became obvious that intermediates existed for every character and that no group of specimens possessed the same cluster of traits. It is true that in certain localities there are local populations with limited variation in one or two characters; e.g., Utah and Wyoming specimens are at the lower limits of the size range while San Benito County, California, and certain Oregon specimens are at the upper limits. However, when all of the specimens are taken together they form a continuum of variation leading to the conclusion that they are assignable to a single species. From studies based on large series of specimens (Benedict and Malcolm 1970, 1977; Chamberlin 1952), like this one of *P. bicornis*, it has become increasingly evident that intraspecific variation in some pseudoscorpion species is greater than had been thought in earlier years.

Three specimens of this species which possess typical adult genitalia bear only three tactile setae on the chelal movable finger. These specimens also tend to be smaller in a

Table 8.—Measurements (in mm) of *Pseudogarypus hesperus* Chamberlin adults (abbreviations: B-breadth, D-depth, L-length).

	♂ ♂ (n=14)	♀ ♀ (n=15)
Body L	2.32-2.66	2.40-2.85
Abdominal B	1.44-1.73	1.63-1.92
Carapace L	0.47-0.57	0.54-0.63
Ocular B	0.32-0.33	0.33-0.38
Posterior B	0.47±-0.57±	0.58±-0.57±
Ant. eye diam.	0.062-0.074	0.062-0.074
Post. eye diam.	0.068-0.086	0.074-0.093
Chelicera L/B	0.22-0.25/0.12-0.14	0.24-0.27/0.14-0.15
Pedipalps		
Trochanter L/B	0.30-0.33/0.20-0.22	0.33-0.35/0.21-0.24
Femur L/B	0.85-0.97/0.19-0.22	0.91-1.03/0.20-0.24
Tibia L/B	0.49-0.57/0.19-0.21	0.52-0.56/0.20-0.23
Chela (inc. pedicel) L	1.07-1.18	1.09-1.24
Chela B	0.26-0.28	0.26-0.31
Chela D	0.23-0.26	0.24-0.29
Hand L	0.39-0.47	0.44-0.45
Movable finger L	0.62-0.69	0.64-0.74
Leg I		
Basifemur L/D	0.31-0.35/0.10-0.11	0.31-0.35/0.12-0.13
Telfemur L/D	0.30-0.34/0.10-0.12	0.32-0.34/0.11-0.12
Tibia L/D	0.26-0.30/0.07-0.09	0.27-0.31/0.09-0.10
Tarsus L/D	0.40-0.48/0.06-0.07	0.42-0.49/0.06-0.07
Leg IV		
Basifemur L/D	0.27-0.32/0.10-0.11	0.30-0.33/0.11-0.12
Telfemur L/D	0.40-0.44/0.12-0.15	0.41-0.47/0.14-0.16
Tibia L/D	0.46-0.53/0.08-0.10	0.61-0.68/0.08-0.10
Tarsus L/D	0.56-0.65/0.06-0.07	0.59-0.69/0.06-0.07

number of measurements (Table 7). It is possible that these specimens may be neotenic adults, but neoteny in pseudoscorpions has not been clearly established, and, therefore, we feel it to be unwise to include the morphometric data of these specimens in Table 5 with the adults bearing the typical four setae on the movable finger.

Examination reveals no significant differences between male co-types of *P. bicornis* and the male holotype of *C. agassizi*. The existence of pseudospines on coxae I and the degree of sclerotization over the posterior eyes have already been discussed. Subtle differences, such as chelal tooth number and the slight size variation, follow the common range of continuous intraspecific variation exhibited by the extensive series of specimens of *P. bicornis* examined. In our opinion, therefore, the species are synonymous.

**Habitats.**—This species has been collected in the foothills and mountains at elevations from 300 to 3050 m and appears to inhabit most available surfaces including leaf litter, moss, bark and hollows of both living and dead trees and stumps, rock crevices and a "swallow's nest."

**Specimens examined.**—UNITED STATES: *Wyoming*; Yellowstone National Park, Specimen Ridge, 12 August 1891 (H. G. Hubbard and Swartz), 3 males, 4 nymphs (syntypes USNM, MCZ). Muchmore (pers. comm.) prepared slides of MCZ syntypes which are the types we examined. *Arizona*; Coconino Co., 15 mi N of Flagstaff, 16 August 1968 (R. H. Russell), 2 females (WBM); *California*; Los Angeles Co., 13.4 mi W of Big Pines, 8 September 1957 (unknown), 2 males, 2 females (WBM); San Benito Co., Pinnacles National Monument, 3 July 1958 (W. Gertsch and V. Roth), 2 males (WBM); *Colorado*; El Paso Co., North Cheyenne Canyon, 27 June 1962 (W. B. Muchmore), 3 males, 2 females (WBM), 29 June 1962 (W. B. Muchmore), 1 male (WBM); Park Co., 2 mi N of Fairplay, 29 August 1961 (W. Gertsch and W. Ivie), 1 female (WBM); *Idaho*; Bear Lake Co., Fish Haven, Bear Lake, 18 August 1923 (B. C. Cain), 1 female, 1 nymph (JCC); Blaine Co., 8-9 mi W of Ketchum (1890 m), 31 August 1941 (J. C. Chamberlin and D. E. Fox), 2 males, 2 females (JCC), 19 mi N of Ketchum (2075 m), 25 August 1941 (J. C. Chamberlin and R. L. Piemeisel), 2 males, 2 females (JCC); Franklin Co., Cub River Canyon, 26 June 1971 (G. F. Knowlton and Cazier), 1 male (WBM); *Oregon*; Douglas Co., 11 mi NE of Idleyld Park (335 m), 2 April 1972 (E. M. Benedict), 2 males, 6 nymphs (EMB), 65 mi E of Roseburg (1280 m), 22 June 1972 (E. M. Benedict), 1 nymph (EMB), 65 mi E of Roseburg (1770 m), 22 June 1972 (E. M. Benedict), 4 males, 1 female, 13 nymphs (EMB), 64 mi E of Roseburg (1280 m), 22 June 1972 (E. M. Benedict), 1 nymph (EMB), 9 mi S, 15 mi E of Steamboat (855 m), 21 October 1972 (E. M. Benedict), 1 male (EMB); 9 mi S, 14 mi E of Steamboat (945 m), 21 October 1972 (E. M. Benedict), 1 nymph (EMB), 12 mi E, 3 mi N of Tiller (520 m), 11 November 1972 (E. M. Benedict), 1 nymph (EMB), 2 mi E of Canyonville (305 m), 13 September 1973 (E. M. Benedict), 1 male (EMB), 8 mi S, 4 mi E of Tiller (795 m), 13 September 1973 (E. M. Benedict), 2 males, 1 female, 11 nymphs (EMB); Harney Co., 2 mi E of Frenchglen (1280 m), 19 March 1972 (E. M. Benedict), 1 male, 3 nymphs (EMB), 11 July 1972 (E. M. Benedict), 1 nymph (EMB), 18 March 1973 (E. M. Benedict), 1 nymph (EMB), 1 March 1974 (E. M. Benedict), 1 female (EMB), Blitzen Crossing on Steens Mt. (1525 m), 15 July 1971 (E. M. Benedict), 1 female (DRM), 31 July 1971 (E. M. Benedict and D. R. Malcolm), 1 male, 1 female (DRM), Big Indian Canyon on Steens Mt. (1675 m), 6 August 1971 (E. M. Benedict), 4 males, 1 female, 1 nymph (DRM), 25 July 1972 (E. M. Benedict), 1 male (EMB); Jackson Co., 9 mi S, 2 mi W of Ashland (2075 m), 17 September 1972 (E. M. Benedict), 1 nymph (EMB), 6 mi S, 12 mi W of Ashland (1465 m), 17 September 1972 (E. M. Benedict), 4 nymphs (EMB), 7 mi S, 13 mi E of Ashland (1495 m), 15 October 1972 (E. M. Benedict), 1 nymph (EMB), 7 mi S, 12 mi E of Ashland (1465 m), 15 October 1972 (E. M. Benedict), 1 male, 1 female (EMB), 4 mi S, 11 mi E of Ashland (1465 m), 15 October 1972 (E. M. Benedict), 1 female (EMB); Jefferson Co., Santiam Pass (1370 m), 3 September 1941 (J. C. Chamberlin), 2 males, 1 female (JCC), Ochoco Divide, 14 mi N, 23 mi E of Prineville (1525 m), 19 June 1972 (E. M. Benedict), 1 male, 1 female (EMB); Josephine Co., 4 mi NW of Oregon Cave National Monument (915 m), 10 August 1973 (E. M. Benedict), 1 nymph (EMB); Klamath Co., 12 mi N, 2 mi E of Lake of the Woods Resort (1770 m), 25 August 1972 (E. M. Benedict), 1 nymph, 0.5 mi N of Lake of the Woods Resort (1525 m), 14 October 1972 (E. M. Benedict), 2 nymphs (EMB); Lane Co., 2 mi N, 7 mi E of McKenzie Bridge (550 m), 28 February 1972 (E. M. Benedict), 1 male, 1 nymph (EMB), 13 mi S of Oakridge (550 m), 4 March 1972 (E. M. Benedict), 1 male (EMB), 5 mi E of McKenzie Bridge (520 m), 31 August 1973 (E. M. Benedict), 2 males (EMB); Linn Co., 5 mi E of McKenzie Bridge (610 m), 28 February 1972 (E. M. Benedict), 3

males, 2 females, 4 nymphs (EMB), 34 mi E of Sweet Home (975 m), 1 September 1973 (E. M. Benedict), 2 males, 2 females (EMB), 6 mi S of Crawfordsville (365 m), 15 September 1973 (E. M. Benedict), 1 nymph (EMB): *Utah*; Cedar Canyon, 8 June 1934 (W. Ivie), 1 male (JCC), Hughes Canyon, 20 May 1934 (W. Ivie), 1 nymph (JCC), Cache Co., Logan Canyon, 1 May 1959 (G. F. Knowlton), 1 male 1 nymph (WBM), 3 November 1963 (G. F. Knowlton), 1 male, 1 female, 1 nymph (WBM), 15 April 1970 (G. F. Knowlton), 1 female (WBM), 23 April 1970 (G. F. Knowlton), 1 male (WBM), 23 June 1970 (G. F. Knowlton), 2 males, 2 nymphs (WBM), 25 June 1970 (G. F. Knowlton), 1 male (WBM), 29 June 1970 (G. F. Knowlton), 1 male (WBM), Fork Canyon, 25 April 1959 (G. F. Knowlton), 2 nymphs (JCC); Rich Co., 7 mi W of Woodruff, 22 July 1970 (G. F. Knowlton and Whitworth), 1 male (WBM); Salt Lake Co., Salt Lake City, no date (R. V. Chamberlin), 1 female (JCC), Mill Creek Canyon, 21 August 1941 (J. C. Chamberlin), 2 males, 2 females, 1 nymph (JCC); San Pete Co., Maple Canyon, 20 August 1924 R. V. Chamberlin, 1 male, 1 female (JCC), 18 June 1970 (G. F. Knowlton and Judd), 1 male (WBM); Sevier Co., Clear Creek, Raft Mts., 4 September 1932 (R. V. Chamberlin and W. Ivie), 1 female, 1 nymph (JCC); Utah Co., Timpanogos Park, American Forks Canyon, 19 August 1941 (J. C. Chamberlin and W. Ivie), 2 males, 2 females (JCC); *Washington*; Adams Co., Othello, 4 February 1963 (R. Harwood), 1 male (WBM).

*Pseudogarypus hesperus* Chamberlin

Figs. 5, 12-13, 24-29

*Pseudogarypus hesperus* Chamberlin 1931:232; Beier 1932:239; Jacot 1938:301; Hoff 1958:18; *nec* Manley 1969:7, 12 (misidentification).

Table 9.—Measurements (in mm) of *Pseudogarypus hesperus* Chamberlin nymphs (abbreviations: B—breadth, D—depth, L—length; ?—indeterminable).

	Tritonymph (n=1)	Deutonymphs (n=4)	Protonymph (n=1)
Body L	1.72	1.30-1.64	1.65
Abdominal B	1.16	0.81-1.06	0.80
Carapace L	0.47	0.39-0.41	0.30±
Ocular B	0.32	0.28-0.29	0.28
Posterior B	0.44±	0.40±-0.47±	0.37±
Ant. eye diam.	0.056	0.043-0.056	0.028
Post. eye diam.	0.062	0.043-0.046	0.037
Chelicera L/B	?	?	0.13±/0.09±
Pedipalps			
Trochanter L/B	0.26/0.17	0.22-0.23/0.13-0.15	0.18/0.12
Femur L/B	0.73/0.18	0.54-0.59/0.13-0.14	0.43/0.11
Tibia L/B	0.41/0.17	0.32-0.34/0.14-0.18	0.24±/0.11±
Chela (inc. pedicel) L	0.98	0.74-0.82	0.64±
Chela B	0.25	0.18	?
Chela D	0.20	0.15-0.16	0.13
Hand L	0.37	0.27-0.31	0.22
Movable finger L	0.56	0.44-0.49	0.38
Leg I			
Basifemur L/D	0.25/0.09	0.18-0.20/0.07-0.08	?/0.06
Telo-femur L/D	0.33/0.12	0.17-0.21/0.07-0.08	0.14/0.06
Tibia L/D	0.21/0.07	0.15-0.17/0.16	0.12/0.05
Tarsus L/D	0.36/0.07	0.25-0.31/0.05-0.06	0.24/0.04
Leg IV			
Basifemur L/D	0.23/0.09	0.13±/0.07±	0.14±/0.06±
Telo-femur L/D	0.33/0.12	0.24-0.29/0.09-0.10	0.20/0.07
Tibia L/D	0.39/0.09	0.26-0.30/0.06-0.08	0.19/0.06
Tarsus L/D	0.47/0.07	0.36-0.40/0.05-0.06	0.29/0.05

The only valid prior record of *Pseudogarypus hesperus* is the type collection from Washington reported by Chamberlin (1931) in his extremely brief diagnosis. Although Fenstermacher (1959) in his master's thesis and Manley (1969) identified Michigan pseudogarypid specimens as *P. hesperus*, Nelson (1975:283) could find no "reliable criteria to establish the Michigan specimens as a new or existing species." Our examination of types of *P. hesperus* and more than 50 specimens from a number of localities in Oregon reveals that the Michigan specimens (Fenstermacher 1959; Manley 1969; Nelson 1975) are not the same and should be assigned, instead, to the eastern *P. banksi*, as discussed under that species. The two species can be separated by the characters in the key. Since *P. hesperus* has been known only from two females, it seems most useful to give detailed descriptions of all stages so that the range of intraspecific variation may become known.

**Diagnosis.**—Body length of male 2.32-2.66 mm, of female 2.40-2.85 mm; palpal femur length of male 0.85-0.97 mm, of female 0.93-1.03 mm; epigeal species; chela with retrorse triangular, very closely spaced distal teeth which appear contiguous.

**Description.**—Measurements in Tables 8 and 9.

**ADULTS.** Of typical generic facies (Chamberlin 1931, fig. 63) except as noted. Carapace (Figs. 12, 13, 24) only slightly longer than posterior breadth; notch between anterolateral and median protuberance relatively shallow (Figs. 5, 24). Coxal area illustrated by Chamberlin (1931 figs. 20, 21); each coxa I (Fig. 25) bears a cluster of 4-7 scattered pseudospines (average about 5 for each sex). Abdomen broadly obovate and

Table 10.—Measurements (in mm) of type specimens of *Pseudogarypus spelaeus*, new species (abbreviations: B-breadth, D-depth, L-length, ?-indeterminable).

	♂ Holotype	♂ Paratype	♀ Allotype
Body L	3.20	?	3.37
Abdominal B	1.77	?	2.02
Carapace L	0.77	?	0.77
Ocular B	0.39	0.41	0.43
Posterior B	0.56	?	0.60
Ant. eye diam.	0.068	0.078	0.078
Post. eye diam.	0.088	0.088	0.088
Chelicera L/B	?	?	0.34/0.17
Pedipalps			
Trochanter L/B	0.43/0.28	0.44/0.28	0.45/0.28
Femur L/B	1.68/0.23	1.64/0.25	1.73/0.25
Tibia L/B	0.85/0.28	0.84/0.25	0.90/0.25
Chela (inc. pedicel) L	1.80	1.87	1.98
Chela B	0.33	0.35	0.37
Chela D	0.31	0.32	0.34
Hand L	0.67	0.69	0.71
Movable finger L	1.12	1.13	1.21
Leg I			
Basifemur L/D	0.54/0.13	?/0.13	0.60/0.13
Telfemur L/D	0.48/0.14	0.49/0.13	0.56/0.14
Tibia L/D	0.41/0.10	0.41/0.10	0.45/0.10
Tarsus L/D	0.66/0.06	0.72/0.06	0.75/0.06
Leg IV			
Basifemur L/D	0.41/0.14	0.44/0.14	0.43/0.14
Telfemur L/D	0.61/0.15	0.65/0.15	0.66/0.16
Tibia L/D	0.77/0.09	0.79/0.09	0.86/0.10
Tarsus L/D	0.94/0.07	0.96/0.07	0.98/0.07

slightly longer than broad. Appendages typical of epigeal species, palp illustrated in Fig. 26 (morphometric ratios Table 1); chelal chaetotaxy and dentition illustrated in Figs. 27-28 (Chamberlin 1931 fig. 38), fixed finger with a graded series of markedly retrorse triangular marginal teeth (male 25-35, female 32-36), distally contiguous and elongate, gradually becoming lower, broader and more widely spaced basally; teeth of movable finger similar in general shape but lower, broader and slightly more separated distally, basally very widely spaced, as much as a tooth's width apart (male 25-30, female 26-30 teeth).

**TRITONYMPH.** Based only on EB-1432.01001. Similar to adult except as noted. Slightly paler and smaller; derm only slightly less sclerotized. Coxal chaetotaxy 2-3-9-4:0-1-3-PS:0-2-4:0-1-6:0-1-6, each coxa I with 5-6 pseudospines. Chaetotaxy of chela (Fig. 29c) typical of species and nymphal stage. Teeth of both fingers similar to adult in shape but very slightly spaced distally, fixed finger with 28 marginal teeth, movable finger with 23 teeth.

**DEUTONYMPH.** Similar to adult except as noted. Paler and smaller; derm definitely reticulate to reticulate-spinose but less sclerotized. Coxal chaetotaxy 2-2-3-2:0-1-2-PS:0-1-2:0-1-2:0-1-3, each coxa I with 3 pseudospines. Chaetotaxy of chela (Fig. 29b) typical of species and nymphal stage. Teeth of both fingers similar in shape to adult but slightly spaced, fixed finger with 21-26 marginal teeth, movable finger with 19-22 marginal teeth.

**PROTONYMPH.** Similar to adult except as noted. Much paler and smaller; derm definitely reticulate to reticulate-spinose but weakly sclerotized. Coxal chaetotaxy 1-1-1-2:0-0-1-PS:0-0-1:0-0-1:0-0-1, each coxa I with 2 pseudospines. Chaetotaxy of chela (Fig. 29a) typical of species and nymphal stage. Teeth of both fingers similar in shape to adult but more widely spaced, fixed finger with 19 spaced marginal teeth, movable finger with 15 well-spaced teeth.

**Remarks.**—One specimen, which exhibits typical male genitalia, has only three tactile setae on the chelal movable finger. Although most palpal dimensions of this specimen fall within the range of *P. hesperus* males, its body is less well-sclerotized and smaller. In fact, the specimen appears immature when compared to the other male from the same collection. Therefore, it seems inadvisable to include the measurements of this "immature male" in Table 8. Measurements not conforming are body length 2.14 mm; abdominal breadth 1.34 mm; chelal breadth 0.24 mm.

**Distribution.** The known range of *Pseudogarypus hesperus* extends south from Pierce County, Washington, nearly to the California border and eastward to Umatilla County, Oregon.

**Habitat.**—This species has been collected most frequently from very flakey and well rotted bark still attached to very large and old living conifers. We attempted to recover it from near the type locality at Puyallup, Washington, but the area has few remaining old-growth trees. Despite more than 30 bark samples from stumps, 5 to 8 feet in diameter, and from older "seed" trees, no new Washington specimens were recovered by Berlese extraction. All but two Oregon specimens came from bark of Douglas and Pacific silver firs, western and mountain hemlock, Englemann spruce and western red cedar. One specimen was recovered from beneath a rock and another captured alive in a spider web inside an outhouse in a forest camp. No specimens have been recorded from coniferous litter.

**Specimens examined.**—UNITED STATES: *Washington*; Pierce Co., Puyallup, 8 August 1928 (W. W. Baker), 2 females (holotype, paratype JCC); *Oregon*; Clackamas Co., 15 mi S, 6 mi W of Government Camp (1070 m), 26 May 1972 (E. M. Benedict), 1 male, 3 nymphs (EMB), 15 mi S, 1 mi W of

Government Camp (1005 m), 26 May 1972 (E. M. Benedict), 6 males, 6 females, 3 nymphs (EMB), 4 mi N, 6 mi E of Zig Zag (1035 m), 2 September 1972 (E. M. Benedict), 1 nymph (EMB); Jackson Co., Summit of Mt. Ashland (2285 m), 16 September 1972 (E. M. Benedict), 2 males, 2 females (EMB); Jefferson Co., Santiam Pass, 9 mi W, 3 mi S of Camp Sherman (1370 m), 3 September 1941 (J. C. Chamberlin), 1 male (JCC); Lane Co., 9 mi S, 21 mi E of Oakridge (1495 m), 24 June 1972 (E. M. Benedict), 3 males, 1 female, 3 nymphs (EMB), 20 mi S, 14 mi E of Oakridge (1525 m), 16 August 1973 (E. M. Benedict), 3 males, 2 females, 6 nymphs (EMB), 16 mi N, 8 mi E of Oakridge (1525 m), 30 August 1973 (E. M. Benedict), 1 nymph (EMB); Lincoln Co., Saddleback Mt., 1 mi S, 10 mi E of Lincoln City, 15 May 1937 (J. A. MacNab), 1 female (JCC); Linn Co., Santiam Pass, 2 mi N, 31 mi E of Sweet Home (1465 m), 24 June 1972 (E. M. Benedict), 1 male, 1 female (EMB), 1 mi N, 28 mi E of Sweet Home (1190 m), 24 June 1972 (E. M. Benedict), 1 female, 1 nymph (EMB), 13 mi N, 23 mi E of Sweet Home (580 m), 29 April 1972 (E. M. Benedict), 1 nymph (EMB), 12 mi N, 28 mi E of Sweet Home (1220 m), 17 September 1973 (E. M. Benedict), 2 females, 2 nymphs (EMB); Polk Co., 8 mi E of Valsetz (670 m), 11 June 1973 (E. M. Benedict), 3 males, 1 female, 3 nymphs (EMB); Umatilla Co., Woodward Camp, 33 mi N of La Grande (1540 m), 7 August 1972 (J. J. Kirk), 1 female (EMB).

*Pseudogarypus spelaeus* new species

Figures 7, 30-32

**Type records.**—United States: California; Shasta Co., about 20 mi NE of Redding, Samwell Cave (442 m), 11 June 1959 (R. E. Graham), holotype male, DM-407.01001, (AMNH), 30 June 1959 (R. E. Graham), allotype female, DM-406.01001, (AMNH), 22 June 1959 (R. E. Graham), paratype male, DM-405.01001 (DRM).

**Etymology.**—The specific name, derived from the Greek word, *spelaeion*, for “cave” is given in recognition of the first species of the family Pseudogarypidae known to exhibit cavernicolous tendencies.

**Distribution.**—The species is known only from Samwell Cave, California, a “Pleistocene bone cave,” with a mapped length of 275 m and a vertical depth of 250 m in Permian McCloud limestone (Halliday 1962).

**Diagnosis.**—Body length of male 3.20 mm, of female 3.36 mm; palpal femur of male 1.64-1.65 mm, of female 1.73 mm; attenuate, cavernicolous species; chela with widely spaced teeth.

**Description.**—Measurements in Table 10.

**ADULTS.** Carapace (Fig. 32) about 1.4 times longer than posterior breadth; notch between anterolateral and median protuberances relatively deep; corneas of eyes slightly flatter than epigeal species. Each coxa I (Fig. 31) bears a scattered cluster of 4-9 pseudospines (average about 7.5 for male). Abdomen (Fig. 32) obovate, about 1.3 times as long as broad. Appendages attenuate (morphometric ratios Table 2); chelal chaetotaxy and dentition illustrated in Fig. 30; fixed finger with graded series of widely spaced elongate teeth (males with 44-47; female 41), moderately triangular retrorse distally, gradually becoming lower, broader, less retrorse and rounder basally; movable finger with broad retrorse triangular teeth distally, broader and higher medially, and lower, rounder and less retrorse basally (male with 36-40; female 36).

**NYMPHAL STAGES.** Not represented in collection.

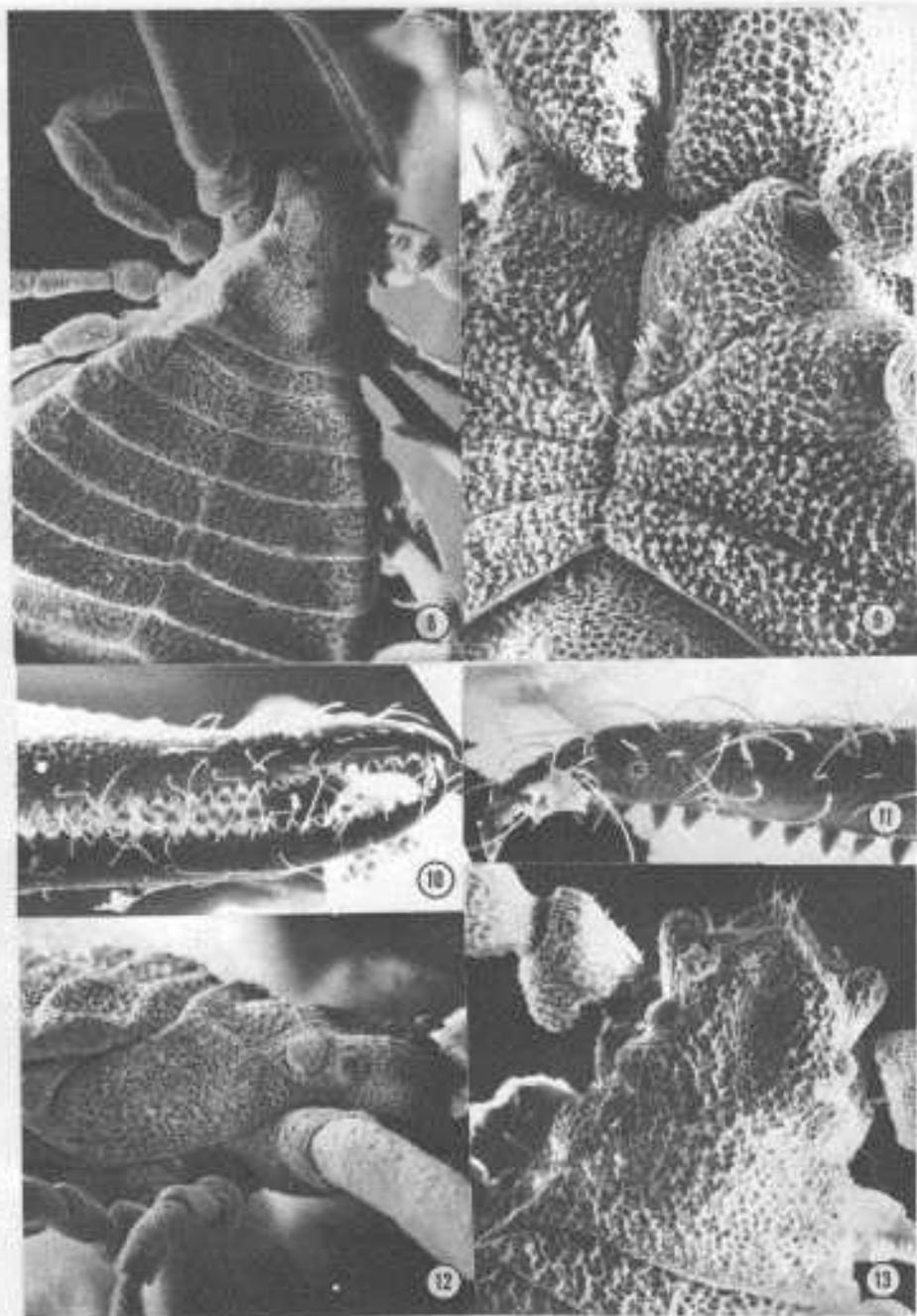
**Remarks.**—*Pseudogarypus spelaeus* exhibits a degree of cavernicolous modification in the somewhat reduced eyes, giantism, and attenuation of appendages, especially of the palpal femur.

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Figs. 8-10.—*Pseudogarypus banki* Jacot, scanning electron micrographs: 8, dorsal view of body (50X); 9, coxal area showing pseudospines on coxae I (250X); 10, chelal fingers showing teeth (250X).

Fig. 11.—*Pseudogarypus bicornis* (Banks) tip of fixed chelal finger showing teeth (250X).

Figs. 12-13.—*Pseudogarypus hesperus* Chamberlin: 12, lateral view of carapace showing eyes (56X); 13, dorsal view of carapace showing fingers of chelloerae (100X).