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Continuation see inside of back cover.
A New *Troglohyphantes* from Bulgarian Caves (Araneae, Linyphiidae)

by

Ch. DELTSHEV*

Drensky (1931) reported 5 species of the genus *Troglohyphantes* inhabiting Bulgarian caves. Kratochvil and Miller (1938) and Deltshev (1972) established that two of these species belong to the genus *Centromerus* and the rest to *Leptothyphantes*. From research in the cave “Suchata” near the town of Velingrad, 16 and 4? *Troglohyphantes* were found. This provided an opportunity for a more profound study which resulted in the establishment of a new species, which I call *Troglohyphantes drenskii* in honour of the well known Bulgarian arachnologist Dr. P. Drensky.

**Troglohyphantes drenskii** n.sp.

*Description of male*

Total length – 2.47 mm. Cephalothorax, length – 1.09 mm, wide 1.01 mm, pale yellow with head areal slightly elevated.

Eyes (fig. 1) very small almost reduced, without any black strip. Clypeus, height – 0.24 mm, concave.

Chelicerae, length – 0.54, wide – 0.40 mm, armed with 3 teeth on outer row and 3 denticles on inner row.

Sternum, length – 0.67 mm, wide 0.67 mm.

Abdomen, length – 1.46 mm, grey.

* Zoological Institute, Bulg. Acad. of Sci., Boul. Rusky 1, Sofia.
Legs, yellowish, long and thin. Femora I with 1 dorsal and 1 prolateral spine on apical half. Femora II-IV with 1 dorsal spine. Tibiae I–II with 1 prolateral, 1 retrolateral and 1 dorsal spine on apical half, and 1 dorsal spine in the middle. Tibiae III-IV only with 2 dorsal spines. Metatarsi I-III with 1 dorsal spine.

Measurements (in mm) of legs:

<table>
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<th>Leg</th>
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Fig. 2. *Troglohyphantes drenskii* n.sp. Left ♂ palp, external view.
Troglohyphantes drenskii n.sp. Left δ palp, internal view.

Fig. 3. Troglohyphantes drenskii n.sp. Left δ palp, internal view.

Palpus fig. 2, 3, 4. Tibia spherical. Cymbium very similar to that of T. salax, with characteristic transverse groove on the dorsal side. Paracymbium forked. Lamella characteristically smaller than embolus and the great part covered by other parts of bulbus. Embolus (fig. 5) large and semicircular, cut on the top, like T. salax.
Fig. 4. *Troglohyphantes drenskii* n.sp. Left ♂ palp, dorsal view.

Fig. 5. *Troglohyphantes drenskii* n.sp Embolus.
**Description of female**

Total length — 2.93 mm. Cephalothorax, length — 1.28 mm, wide 1.09 mm, pale-yellow.

Eyes, very small without any black strip, anterior medians almost reduced.

Clypeus, height — 0.24 mm, concave.

Chelicerae (fig. 6), length — 0.64 mm, wide — 0.27 mm with 3 well developed teeth on outer row. Inner row with 5 denticles.

Sternum, length — 0.67 mm, wide — 0.67 mm.

Abdomen, length — 1.64 mm.

Legs: Femora I with 1 dorsal and 1 prolateral spine on apical half. Femora I—IV with 1 dorsal spine. Tibiae I—II with 1 prolateral, 1 retrolateral and 1 dorsal spine on apical half and 1 dorsal spine in the middle. Tibiae II—IV only with 2 dorsal spines. Metatarsi I—III with 1 dorsal spine.
Measurements (in mm) of legs:

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<th>Leg</th>
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Palpus: Fe – 0.54 mm, Pt – 0.18 mm Tb – 0.27 mm, Tr – 0.64 mm. Epigyne (fig. 7,8). Lamina basalis elevated above outer range of the body, heart-shaped, very rounded. Very similar to *T. salax*, *T. orpheus* and *T. pademontanus*.

**DISCUSSION**

*Troglohyphantes drenskii* n. sp. belongs to the group of *T. orpheus* and is related to *T. salax* and *T. pademontanus*.

Material and locality:
“Suchata pesta” cave near the town Velingrad (district of Pazardžik), 1♂ holotype, 4 ♀♀ paratypes, 6.IV.1972, 4 ♀♀ paratypes, 3.VI.1963. The type-material is preserved in collections of the Zoological Institute—BAN, Sofia.

![Fig. 7. *Troglohyphantes drenskii* n.sp. Epigyne ventral view.](image-url)
Fig. 8. *Troglohyphantes drenskii* n.sp. Epigyne, lateral view.

**SUMMARY**

A new species *Troglohyphantes drenskii* is described, which was collected in the cave “Suchata pestera” near Velingrad, Bulgaria. *Troglohyphantes drenskii* n.sp. belongs to the group of *T. orpheus* and is related to *T. salax* and *T. pademontanus*.

**LITERATURE**


Ragni delle Filippine. I. Un nuovo Althepus cavernicolo dell’Isola di Mindanao (Araneae, Ochyroceratidae)

di

Paolo Marcello BRIGNOLI*

Tra il numeroso materiale del Museo di Copenaghen da poco affidatomi in studio dal Dr. S.L. Tuxen e dal Dr. B. Petersen, che vivamente ringrazio, erano anche due Ochyroceratidae raccolti in una grotta di Mindanao nel corso della missione della Noona Dan. Com’era logico attendersi, visto che delle intere Filippine erano note solo due altre specie di questa famiglia, Psiloderces egeria Simon 1892 della grotta di Calapnitan e Theotima microphthalma (Simon) 1892 della grotta di Antipolo (ambedue di Luzon), la specie raccolta dalla missione danese era nuova.

**ALTHEPUS Noonadanae N.SP.**


**DESCRIZIONE** – ♀: colore di fondo del prosoma gialliccio; di bruno violaceo sono colorati il clipeo (specie il margine anteriore e la parte centrale) e la regione oculare come pure il centro del prosoma, con una banda che giunge al margine posteriore ed i margini laterali del prosoma (queste ultime zone colorate non confluiscono però in nessun punto con quelle del clipeo o della zona centrale). Sei occhi nella tipica disposizione; mediani appena più grandi dei laterali (7:6); occhi mediani accostati tra loro, come pure i laterali; intervallo MA-LA pari alla metà del diametro dei LA. Labium nettamente articolato con lo sterno e più lungo che largo, v.fig. 5: gnatocoxe, v.fig.5. Sterno cordiforme, bruno violaceo salvo una zona chiara a forma di “T” rovesciata (holotypus) o di trapezio rovesciato (paratypus; N.B.: margine posteriore sempre scuro); mancano tubercoli pronunciati. Cheliceri, v.fig. 4. Palpi, v.fig. 1, piuttosto sottili ed allungati. Zampe annulate di bruno (specie le tibie); tarsi e metà prossimali dei femori giallucchi. Opistosoma ovale appuntito; colore di fondo bianchiccio, assai irregolarmente macchiato di bruno-violaceo, sui lati macchie confluenti in strisce parallele; sotto scuro più uniformemente. Vulva, v.fig. 7. Filiere e colulo, v.fig. 2. d ignoto.

* Istituto di Zoologia dell’Università di Roma – Viale dell’Università 32: 00100-ROMA
DIMENSIONI (in mm, leggermente approssimate) – ♀ holotypus : prosoma lungo 1,07, largo 0,92; opistosoma 2,37. Lunghezza totale : 3,44.

<table>
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<th>Zampe</th>
<th>Femori</th>
<th>Patelle</th>
<th>Tibie</th>
<th>Metatarsi</th>
<th>Tarsi</th>
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DERIVATIO NOMINIS: il nome di questa specie deriva da quello della nave su cui è stata effettuata la crociera durante la quale essa è stata raccolta.


1. Margine inferiore dei cheliceri privo di denti .............. *A. stellatus* (Simon)
   - Margine inferiore dei cheliceri con denti ......................... 2
2. Margine superiore dei cheliceri con 3 denti ................. 3
   - Margine superiore dei cheliceri con più di 3 denti ............ 4
3. 3 denti ben distinti ........................................ *A.incognitus* Brignoli
   - 2 dei 3 denti corrispondono alle punte della lamella trasparente mediale. ...
   ................................................................. *A.noonadanae* n. sp
4. Margine superiore dei cheliceri con 5 denti .................. *A.mulcatus* Brignoli
   - Margine superiore dei cheliceri con 4 denti ................. 5
5. Zampa I attorno a 26 mm di lunghezza ..................... *A.pictus* Thorell
   - Zampa I attorno a 5 mm di lunghezza ........ *A.machadoi* Brignoli

Rispetto alle tre specie da me recentemente descritte (Brignoli, 1973a, 1973b) la nuova specie è anche distinguibile in base alle forma dei genitali delle ♀ (ignoti in *A.pictus* e *A. stellatus*).

Parlare di affinità è del tutto prematuro, visto che certamente sono ancora assai numerose le specie da descrivere di questo genere del SE asiatico; basti quindi aver sottolineato i caratteri differenziali. Questi stessi caratteri sono infatti del tutto insufficienti per giudicare con quale delle specie già note *A.noonadanae* presenti reali affinità.

La nuova specie presenta ben poco di peculiare dal punto di vista morfologico; è provvista di polmoni, come sembra la norma negli Ochyroceratidae di maggiori dimensioni; normali sono gli organi liriformi (v.fig. 6) come pure labium e gnatocoxe. Il palpo è piuttosto allungato e può ricordare quello di *Psiloderces egeria*; interessante è che gli stigmi tracheali posteriori sono esternamente pressoché
Althepus noonadanae n.sp. – Fig. 1: palpo della ⊘; fig. 2: filiere e colulo; fig. 3: tubuli annessi alla vulva; fig. 4: chelicero; fig. 5: labium e gnatoce (asimmetria dovuta al preparato); fig. 6: stigma polmonare destro ed organi liriformi (da sotto; fig. 7: vulva.
separati (sono però comunicanti internamente). Da una della lamella ripiegate che circondano le spermate che si dipartivano dei singolari tubuli, di ignoto significato (v.fig. 3).

Con l’occasione debbo far notare che è assai verosimile che i generi *Althepus* Thorell, *Merizocera* Fage e *Psiloderces* Simon debbano essere ridefiniti, sulla base di caratteri più validi (genitali); sfortunatamente di molte specie i♂ sono ancora ignoti e mancano descrizioni dei genitali femminili.

Questa specie è la quinta della famiglia trovata in una grotta del SE asiatico; a parte infatti *Psiloderces egeriae* e *Theotima microphthalma*, *Althepus pictus* fu anche citato delle Farm Caves in Birmania e *Psiloderces crinitus* Fage 1929 è stato descritto delle Batu Caves in Maleasia. A proposito di quest’ultima specie, è da notare che, in base al ♂ scoperto da Bristowe (1952), la sua posizione generica non è più del tutto chiara; il palpo del ♂ infatti, ricorda assai quello di *Merizocera cruciata* (Simon), come illustrato da Fage (1912).

*Althepus noonadanae* n.sp. non presenta alcun adattamento alla vita cavernicola; è quindi al più solo un troglofilo, di un gruppo però ormai da considerare tipico delle grotte tropicali, forse l’equivalente dei Leptonetidae delle grotte temperate.

Sfortunatamente la fauna delle grotte delle Filippine, che deve essere di estremo interesse, a giudicare dai pochi dati esistenti (ricordo solo la “migale” cieca *Accola caeca* Simon ed i Blattoidei cavernicolì del genere *Nocticola* Bolivar), è ancora pressoché sconosciuta.

**RIASSUNTO**

Viene descritto *Althepus noonadanae* n.sp. (♀; ♂ ignoto; loc. typ.: grotta di Latuan, distretto di Curuan, Mindanao, Filippine); distinguibile dalle altre specie note per la morfologia dei cheliceri e dei genitali della ♀. Per il momento è impossibile avvicinare questa specie a nessuna di quelle già note. Viene proposta una chiave per le ♀ di *Althepus*.

**SUMMARY**

*Althepus noonadanae* n.sp. is described (♀; ♂ unknown; loc. typ.: Latuan Cave, Curuan district, Mindanao, Philippines); it can be distinguished from the other known species by the morphology of the chelicerae and of the ♀ genitalia. It is not related to any of the very few described species. A key for the ♀ *Althepus* is given.

**BIBLIOGRAFIA**


Redescription of *Centromerus bulgarianus* (Drensky 1931) and *Centromerus lakatnikensis* (Drensky 1931), (Araneae, Linyphiidae)

by

Ch. DELTSHEV*

Drensky (1931) described two new species, *Troglohyphantes bulgarianus* and *Troglohyphantes lakatnikensis* from Bulgarian caves. Later Kratochvil and Miller (1938) revised the description of these species and established that the two species belong to the genus *Centromerus*. The original description is very superficial and the drawings done inexactl. That is why I consider it necessary to redescribe these species, having had an opportunity to use the type material.

I would like to acknowledge my gratitude to Dr. Hubert of Paris for sending comparative material and to Dr. Saaristo of Turku, who made a comparison of types of *Centromerus bulgarianus* and *C. europeus*.

**Centromerus bulgarianus** (Drensky, 1931)

*Troglohyphantes bulgarianus*, Drensky 1931, pp. 2, 25-26, 48-47, fig. 5, a-i; *Troglohyphantes balcanica* Drensky 1931 pp. 2, 41 (nomen nudum); *Centromerus bulgarianus* (Drensky 1931), Kratochvil and Miller (1938), pp. 1-7, fig. 2, a-e.

Description of male

Total length — 1.64 mm. Cephalothorax, length — 0.64, wide — 0.54 mm, pale-yellow, convexed.

Eyes completely absent. Clypeus, height — 0.09 mm, slightly concave.

Chelicerae length — 0.32 mm, wide — 0.12 mm, armed with 3 well developed teeth on outer row and 3-4 denticles on inner row.

Sternum, length — 0.36 mm, wide 0.36 mm.

Abdomen, length — 0.82 mm, grey.

Legs, yellowish short, covered proportionally with short fine spines. Femora I with 1 prolateral spine on apical half. Tibiae I–IV with 2 dorsal spines. Metatarsi I–II with small dorsal spine.

Measurements (in mm) of legs:

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<th>Fe</th>
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* Zoological Institute Bulg. Acad. of Sci., Boul. Rusky 1, Sofia.
Palpus fig. 1, 2. Tibia and patella each with a stout spine. Paracimbiun large, with serrated inner margin. Lamella characteristic small. Basal apophysa forked, like *C. europaeus*.

*Description of female*

Total length – 1.74 mm. Cephalothorax, length – 0.73 mm, wide – 0.54 mm, pale-yellow.

Eyes completely absent. Clypeus, height – 0.09 mm.

Chelicerae (fig. 3), length – 0.27 mm, wide – 0.18, armed with 2 teeth on outer row and 3-4 denticles on inner row.

Sternum, length 0.36 mm, wide 0.36 mm.

Abdomen, length – 1.00 mm.

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Fig. 1. *Centromerus bulgarianus* (Dr.). Left ♂ palp, external view.
REDESCRIPTION OF TWO CENTROMERUS

Legs: Femora I with a prolateral spine on apical half. Tibiae I–IV with 2 dorsal spines. Metatarsi I–II with small dorsal spine.

Measurements (in mm) of legs.

<table>
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<th>Leg</th>
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Palpus: Fe - 0.27 mm, Pt - 0.18 mm, Ta - 0.27 mm. Epigyne (fig. 4) similar to those of C. europaeus and C. subcaecus.
Fig. 3. *Centromerus bulgarianus* (Dr.), Right $\delta$ palp, posterior view.

Fig. 4. *Centromerus bulgarianus* (Dr.). Epigyne.
REDESCRIPTION OF TWO CENTROMERUS

DISCUSSION

*Centromerus bulgarianus* is related to *C. europaeus* and *C. subcaecus* but the three species are readily separated because:

1. There are differences in structure of the basal apophysis.
2. There are a few differences in the structure of the epigyne.
   
   The epigyne of *C. bulgarianus* is bigger than *C. europaeus* (Saaristo in lit. 5.IV. 1972).
3. *C. bulgarianus* is the largest of the three species.

Material and locality.

"Suchata pester" cave near the village Lakatnik (district of Sofia), 1 ♂ lectotype and 3♀ paralectotype (leg. P. Drensky); "Sokolskata peštera" near the village of Lutatgik (district of Vraca) 1♀, 6.II.1967 (leg. P. Beron); "Beljara" cave near the town of Vraca 1♀, 5.X.1968 (leg. P. Beron).

*Centromerus lakatnikensis* (Drensky 1931)

*Troglohyphantes lakatnikensis*, Drensky 1931, pp. 2, 5, 23-25, 46-47, fig. 4, a-d; *Centromerus lakatnikensis* (Drensky 1931), Kratochvil and Miller (1938), pp. 2-3, 6-7.

*Description of male.*

Total length – 1.92 mm. Cephalothorax, length – 0.91, wide – 0.73 mm, pale-yellow.

Fig. 5. *Centromerus lakatnikensis* (Dr.). Eyes (♂ from in front).

Eyes (fig. 5), well developed, surrounded by a black strip. Posterior row, 0.25 mm long, median eyes ca one diam. apart and one diam. from laterals. Anterior row, 0.18 mm long, medians very small and almost approached, ca one diam. from laterals. Clypeus concave, height – 0.09 mm.

Chelicerae, length – 0.36 mm, wide at the base – 0.18 mm, armed with 3 well developed teeth. Posterior row with 3-4 denticles.

Sternum, length – 0.54 mm, wide – 0.49 mm.

Abdomen, length – 1.01 mm, grey.

Legs, yellowish. Femora I with 1 retrolateral spine on apical half. Tibiae I–III with 2 dorsal spines. Tibia IV with 1 dorsal spine.
Fig. 6 *Centromerus lakatnikensis* (Dr.). Right ♂ chelicera.

Measurements (in mm) of legs:

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<th>Leg</th>
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<td>0.18</td>
<td>0.49</td>
<td>0.45</td>
<td>0.34</td>
<td>2.02</td>
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<tr>
<td>IV</td>
<td>0.82</td>
<td>0.21</td>
<td>0.69</td>
<td>0.45</td>
<td>0.40</td>
<td>2.57</td>
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</table>
Fig. 7. Centromerus lekatnikensis (Dr.). Right palp, external view.

Palpus (fig. 7,8). Tibia and patella each with a stout spine. Paracimbium is large, toothed along its inner margin. Bulbus similar to those of C. albidus and C. serratus.

Description of female

Total length – 2.16 mm. Cephalothorax, length – 0.72 mm, wide – 0.57 mm. Eyes, well developed, surrounded by a black strip. Posterior row, 0.23 mm long, median eyes ca one diam. apart and ca one diam. from laterals. Anterior row, 0.17 mm long, median eyes very small and almost approached, ca. one diam. from laterals. Clypeus, height – 0.05 mm.
Chelicerae, length – 0.32 mm, wide 0.14 mm, armed with 3 well developed teeth. Posterior row with 3–4 denticles.
Sternum, length – 0.57 mm, wide – 0.55 mm.
Abdomen, length – 1.40 mm, grey.
Legs: Femora I with 1 retrolateral spine on apical half. Tibiae I-III with 2 dorsal spines. Tibia IV with 1 dorsal spine.
Epigyne presented on fig. 9. Vulva presented on fig. 10. The epigyne is very similar to those of Calbidus and C. quercicola.
Fig. 9. Centromerus lakatnikensis (Dr.). Epigyne.

Fig. 10. Centromerus lakatnikensis (Dr.). Vulva.
Centromerus lakatnikensis is related to C. albidus, but C. albidus is smaller and there are a few differences in the structure of the epigyne.

Material and locality.

“Suchata peštera” near the village of Lakatnik (district of Sofia), 1♀ lectotype, 3♂♂ paralectotype, 23. III. 1930 (leg. P. Drensky); 2♂♂, 5.XI. 1970 (leg. Ch. Deltshev); “Radjova lama” pot near the village of Millanovo (district of Sofia), 2♂♂, 3. XII. 1961 (leg. P. Beron).

By examining type-material of Centromerus lakatnikensis, it was established, that the species is very related to C. albidus, described by Simon 1929. The comparative material from C. albidus, which was sent to me, was very insufficient (1♀) and that did not give me a ground to synonymised C. lakatnikensis.

In the meantime while the article was in press, Dr. Moritz (to whom I had sent material from C. lakatnikensis) established (in litt.) that the two species are identical.

SUMMARY

The type specimens (lectotypes) of Centromerus bulgarianus and C. lakatnikensis, preserved in the collection of the Zoological Institut – BAN, Sofia, are redescribed. The redescription is necessary, because the original description is superficial and the drawings are inexact. Moreover, the male of C. lakatnikensis was unknown.

RÉSUMÉ

Les exemplaires du type (lectotypes) de Centromerus bulgarianus et C. lakatnikensis, conservés dans la collection de l’Institut Zoologique – BAN, Sofia sont décrits de nouveau. La nouvelle description originale est indispensable parce que la description originale est très superficielle et les figures ne sont pas précises. De plus, le mâle de C. lakatnikensis était inconnu.

LITERATURE

A New Cavernicolous Species of the Pseudoscorpion
Genus Roncus L. Koch, 1873 (Neobisiidae, Pseudoscorpionidae) from the Balkan Peninsula

by

Božidar P.M. ĆURČIĆ *

The range of the pseudoscorpion subgenus Parablothrus Beier 1928 (from the genus Roncus L. Koch 1873) extends over the northern Mediterranean, covering a vast zone from Catalonia on the west as far as Thrace on the east. The northern limit of distribution of these false scorpions is situated within the Dolomites and the Alps of Carinthia; the most southern locations of the subgenus were registered on the island of Crete.

Eight species of Parablothrus are known to inhabit the Balkan Peninsula which represents an important distribution centre of the subgenus (Beier 1963, Helversen 1969); of them, six were found in the Dinaric Karst. The caves of Carniola are thus populated by R. (P.) stussineri (Simon) 1881, and R. (P.) anophthalmus (Ellingsen) 1910, R. (P.) cavernicola Beier 1928 and R. (P.) vulcanius Beier 1939 are known from Herzegovina. The last species was also collected on some Dalmatian islands. Both Adriatic and Ionian islands are inhabited by two other members of Parablothrus, namely R. (P.) insularis Beier 1939 (which was found on the isle of Brač) and R. (P.) corcyraeus Beier 1963, the latter living on Corfu.

Except for the Dinaric elements of Parablothrus, the Balkan representatives of the subgenus have not been sufficiently studied. In spite of this, one may assume that the differentiation of cave living species of Roncus took place both east and north of the peninsula. Namely, both Hadži (1937) and Helversen (1969) verified the presence of Parablothrus in these regions and also established two new species of the subgenus. One of them, R. (P.) parablothroides Hadži 1937, was found in Macedonia, Bulgaria and Turkey (Thrace), the other: R. (P.) peramae Helversen 1969, is restricted to a single cave in Epirus.

In 1972 I had the opportunity to obtain a number of false scorpions from some Serbian caves. One of the samples was thus collected in a cave which is situated on the western slopes of Mt. Stara Planina (= Mt. Balkan). From the taxonomic point of view, the pseudoscorpions from this location are the first representatives of Parablothrus to be found in Serbia. These specimens belong to a species which clearly differs from all parablothroid elements, and appears to be new to science.

Roncus pljakici, new species

Derivatio nominis — This species is dedicated to Professor Milika Pljakic (Institute of Zoology, Faculty of Science, University of Belgrade) who, in a series of papers, has made an outstanding contribution to our knowledge of the Balkan endemic fauna in general and of the Serbian cave living animals in particular.

Type locality — The cave ‘Pecina u selu Vrelo’ on Mt. Stara Planina, 20 km E of Pirot and 19 km N of Dimitrovgrad, East Serbia; August 11, 1972 (one male, one female) and August 12, 1972 (one female); air temperature: 11°C. Specimens of R. (P.) pljakici were collected under stones, in total darkness.

Hydrogeologically, the complex corridor system of the cave ‘Pecina u selu Vrelo’ came into existence by the action of a subterranean watercourse in the source region of the river Visočica. This complex has already lost its permanent hydrographic function due to the process of intense karstification of the region.

ADULT

Cephalothorax — The carapace is considerably longer than broad. The epistomal process is well-developed, consisting of a broad triangular elevation. Neither eyes nor eyespots are developed (Figs. 1a & 2a). The cephalothorax carries a variable number of chaetae, 22 in the male and 23-24 in the female.

Abdomen — Tergite I normally carries six chaetae but thereafter there is a gradual increase in the number of chaetae borne on the succeeding tergites with a maximum of 11 chaetae from tergite VI onwards (6-7-10-9-10-9-11-9-9 in the male, and 6-8-9-10-11-11-10-10 and 6-7-10-10-11-11-10-11 in the female, respectively). In the male sternite II carries a cluster of 15 chaetae, thinning out anteriorly; in the female sternite II carries fewer chaetae (7-9). Sternite III of the male carries 12 chaetae; in the female this sternite possesses 10 chaetae. Normally thirteen chaetae are carried on sternites V-IX but this is subject to some variation (12-15).

Chelicerae — The spinneret is represented by a low convex hyaline tubercle. The movable and fixed fingers of the chelicera carry 8-12 teeth and 10-14 teeth respectively. Seven chaetae occur on the chelicera (Figs. 1b & 2b), only one of these on the movable finger. The serrula interior possesses 29-31 blades.

Pedipalps — The movable finger of the chela carries 68-77 teeth in both male and females and 76-79 teeth on the fixed finger (Figs. 1f & 2e-g). The most distal pointed teeth on the movable finger give way to teeth with rounded tops and these are gradually replaced proximally by shorter flattened teeth. On the fixed finger the

Fig. 1. Roncus (Parablothrus) pljakici sp. n., male. (a) carapace and abdomen — (b) chelicera — (c) flagellum — (d) pedipalp — (e) teeth of the chela — (f) chela. Scale in mm.
first few teeth are pointed, slightly asymmetrical, and then there is a gradual transition to the square topped teeth of the proximal region. The granulations already noticed on the anterolateral surface of the femur also occur on the palm of the chela.

Legs — Coxa I carries 6-8 chaetae, coxa II 6-7, coxa III 5, and coxa IV 6-7 chaetae.

The chitin is reticulated throughout. In life, specimens are delicate in appearance, with almost transparant legs. Cheliceræ with reddish-brown fingers; reddish-yellow carapace and tergites.

Material — Holotype, male; allotype, female; and paratype, female.

Dimensions in mm — Tab. 1 and 2.

RELATIONS BETWEEN *R. (P.) PLJAKICI* AND OTHER MEMBERS OF THE SUBGENUS

Of the Balkan pseudoscorpions of the subgenus *Parablothrus*, *R. (P.) pljakici* is allied to two other members of the subgenus, namely *R. (P.) parablothroides* and *R. (P.) anophthalmus*. They share the following characters: chaetotaxy of the chelicerae, simple teeth on the fixed finger of the chela, surface irregularities on the palm of the chela, form of the femur of the pedipalps, and some morphometric ratios.

The new species appears to be closest to *R. (P.) parablothroides*, but differs in the presence of 29-31 blades on the serrula interior (against 22-25 in *parablothroides*), in the absence of eyes (*parablothroides* possesses two small eyes), and in having the posterolateral surface of the femur of the pedipalps smooth (in *parablothroides*, this surface carries one or two tubercles). The two species also differ in number and arrangement of the teeth on the chelae, carapacal chaetotaxy, numerous morphometric ratios, and in form of the tibia of the pedipalps.

The new pseudoscorpion is easily distinguished from *R. (P.) anophthalmus* by the larger triangular epistome, the absence of a lamella on the movable finger of the chelicera, and the presence of granulations on the femur of the pedipalps. Furthermore, the two species differ clearly in such details as the form of the tibia and the femur of the pedipalps, dorsal abdominal chaetotaxy, and some morphometric ratios.

It seems probable that *R. (P.) pljakici* represents an endemic species of Balkan pseudoscorpions which appears to be specialized to the cavernicolous way of living. The analogies of this and other species of the subgenus point to the similar phenomena which occur in other genera of false scorpions (Čurčić 1972). In all these cases, a close relationship among the species inhabiting East Serbia, Macedo-

Fig. 2. *Roncus (Parablothrus) pljakici* sp. n., female. (a) carapace — (b) chelicera — (c) flagellum — (d) pedipalp — (e) teeth of the chela — (f) teeth of the chela — (g) chela — (h) leg II — (i) leg IV. Scale in mm.
Table 1. Range in measurements (mm) of various structures of *Roncus (Parablothrus) pijakici* sp. n. together with selected ratios.

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body</strong></td>
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<td></td>
</tr>
<tr>
<td>1. length</td>
<td>2.87</td>
<td>3.235 - 3.515</td>
</tr>
<tr>
<td><strong>Cephalothorax</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. length</td>
<td>0.89</td>
<td>1.015 - 1.035</td>
</tr>
<tr>
<td>3. anterior breadth</td>
<td>0.58</td>
<td>0.65 - 0.70</td>
</tr>
<tr>
<td>4. maximum breadth</td>
<td>0.75</td>
<td>0.76 - 0.82</td>
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<tr>
<td>5. ratio 2/4</td>
<td>1.19</td>
<td>1.24 - 1.36</td>
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<tr>
<td>6. posterior breadth</td>
<td>0.64</td>
<td>0.72 - 0.77</td>
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<tr>
<td>7. ratio 3/6</td>
<td>0.91</td>
<td>0.90 - 0.91</td>
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<tr>
<td><strong>Abdomen</strong></td>
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<td></td>
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<tr>
<td>8. length</td>
<td>1.98</td>
<td>2.20 - 2.50</td>
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<tr>
<td>9. maximum breadth</td>
<td>1.01</td>
<td>0.99 - 1.27</td>
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<td><strong>Chelicerae</strong></td>
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<td>11. breadth</td>
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<tr>
<td>12. height (thickness)</td>
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<td>0.23 - 0.24</td>
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<tr>
<td>13. length of movable finger</td>
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<td>0.40 - 0.43</td>
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<td>14. ratio 10/13</td>
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<td>1.44 - 1.50</td>
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<td><strong>Pedipalps</strong></td>
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<tr>
<td>15. length (with coxa)</td>
<td>5.295</td>
<td>5.525 - 5.755</td>
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<tr>
<td>16. length (without coxa)</td>
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<td>4.925 - 5.09</td>
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<tr>
<td>17. ratio 15/1</td>
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<td>1.64 - 1.71</td>
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<tr>
<td>18. length of coxa</td>
<td>0.58</td>
<td>0.60 - 0.665</td>
</tr>
<tr>
<td>19. length of trochanter</td>
<td>0.65</td>
<td>0.665 - 0.70</td>
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<td>20. breadth of trochanter</td>
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<td>0.26</td>
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<td>21. length of femur</td>
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<td>1.20 - 1.21</td>
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<td>0.14</td>
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<tr>
<td>23. maximal breadth of femur</td>
<td>0.25</td>
<td>0.26 - 0.27</td>
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<td>24. ratio 21/23</td>
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<td>4.44 - 4.65</td>
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<td>25. length of tibia</td>
<td>0.96</td>
<td>1.00 - 1.06</td>
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<td>26. breadth of tibia</td>
<td>0.35</td>
<td>0.38 - 0.39</td>
</tr>
<tr>
<td>27. ratio 25/26</td>
<td>2.74</td>
<td>2.63 - 2.72</td>
</tr>
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<td>28. length of chela</td>
<td>1.96</td>
<td>2.05 - 2.13</td>
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<td>29. breadth of palm of chela</td>
<td>0.46</td>
<td>0.50 - 0.51</td>
</tr>
<tr>
<td>30. ratio 28/29</td>
<td>4.26</td>
<td>4.02 - 4.26</td>
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<td>31. length of palm of chela</td>
<td>0.89</td>
<td>0.95 - 0.98</td>
</tr>
<tr>
<td>32. ratio 31/29</td>
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<td>1.86 - 1.96</td>
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<tr>
<td>33. length of fixed finger</td>
<td>1.07</td>
<td>1.10 - 1.15</td>
</tr>
<tr>
<td>34. ratio 33/31</td>
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<td>1.16 - 1.17</td>
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<tr>
<td>35. distance from the base of movable finger to B</td>
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<td>0.15</td>
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<td>36. distance from B to SB</td>
<td>0.21</td>
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<td>37. distance from SB to ST</td>
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<td>38. distance from ST to T</td>
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<tr>
<td>39. distance from T to the tip of movable finger</td>
<td>0.315</td>
<td>0.28 - 0.34</td>
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</table>
Table 2. Range in measurements (mm) of various structures of *Roncus (Para-blothrus) pljakici* sp. n. together with selected ratios.

<table>
<thead>
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<th>Leg II</th>
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<th>male</th>
<th>female</th>
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<tr>
<td>1. total length</td>
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<td>2.55 - 2.67</td>
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<tr>
<td>2. coxa length</td>
<td>0.33</td>
<td>0.33 - 0.34</td>
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<tr>
<td>3. coxa breadth</td>
<td>0.22</td>
<td>0.23</td>
<td></td>
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<tr>
<td>4. trochanter length</td>
<td>0.22</td>
<td>0.24 - 0.25</td>
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<tr>
<td>5. trochanter breadth</td>
<td>0.16</td>
<td>0.17</td>
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<tr>
<td>6. femur I length</td>
<td>0.52</td>
<td>0.55 - 0.56</td>
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<tr>
<td>7. femur I breadth</td>
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<td>0.15 - 0.17</td>
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<td>8. ratio 6/7</td>
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<td>3.29 - 3.67</td>
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<td>9. femur II length</td>
<td>0.32</td>
<td>0.34 - 0.37</td>
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<td>10. femur II breadth</td>
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<td>0.13 - 0.14</td>
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<td>12. tibia length</td>
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<td>18. tarsus II (tarsus) length</td>
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<td>19. tarsus II (tarsus) breadth</td>
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<th>Leg IV</th>
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<td>21. total length</td>
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<td>3.45 - 3.62</td>
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<tr>
<td>22. coxa length</td>
<td>0.445</td>
<td>0.45 - 0.46</td>
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<tr>
<td>23. coxa breadth</td>
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<td>0.22 - 0.23</td>
<td></td>
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<td>24. trochanter length</td>
<td>0.40</td>
<td>0.42 - 0.46</td>
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<td>25. trochanter breadth</td>
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<td>0.16</td>
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<td>26. femur length</td>
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<td>27. femur breadth</td>
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<td>0.25 - 0.27</td>
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<td>28. ratio 26/27</td>
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<tr>
<td>29. tibia length</td>
<td>0.84</td>
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<tr>
<td>30. tibia breadth</td>
<td>0.12</td>
<td>0.14 - 0.15</td>
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<tr>
<td>31. ratio 29/30</td>
<td>7.00</td>
<td>6.00 - 6.71</td>
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<tr>
<td>32. tarsus I (metatarsus) length</td>
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<td>0.27 - 0.28</td>
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<tr>
<td>33. tarsus I (metatarsus) breadth</td>
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<td>0.11</td>
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<tr>
<td>34. ratio 32/33</td>
<td>2.90</td>
<td>2.45 - 2.545</td>
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<td>0.47 - 0.51</td>
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<td>36. tarsus II (tarsus) breadth</td>
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<td>0.10</td>
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<tr>
<td>37. ratio 35/36</td>
<td>4.80</td>
<td>4.70 - 5.10</td>
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</table>

nia and Herzegovina, was noticed. It is possible, therefore, that the three regions constitute the autchthonous areas of the original populations of the analysed groups of species, out of which new species came into existence.
Roncus (Parablothrus) pljakici, a new species of cave living pseudoscorpions, is described from the cave 'Pečina u selu Vrelo' on Mt. Stara Planina, East Serbia. The problem of its taxonomic position in the subgenus is discussed. The new species is the first representative of Parablothrus to be found in Serbia.

It seems possible that R. (P.) pljakici represents an endemic species, specialized for a cavernicolous way of living. The analogies of this and other species of the subgenus point to some similar phenomena which occur in other genera of Balkan false scorpions (Čurčić 1972). In all these cases, a close relationship among the species inhabiting East Serbia, Macedonia and Herzegovina was noticed. It is probable, therefore, that the three regions represent the autochthonous areas of the original populations of the analysed groups of species, out of which new species came into existence.

Résumé
La grotte 'Pečina u selu Vrelo' dans la montagne Stara Planina en Serbie orientale est habité par un Pseudoscorpion cavernicole du genre Roncus (Parablothrus); il diffère nettement des autres membres du sous-genre Parablothrus et appartient à une nouvelle espèce: R. (P.) pljakici. En même temps, ce Pseudoscorpion est le premier représentant, tandis que sa localité-type est le premier lieu de trouvaille des Roncus cavernicoles en Serbie.

Il est probable que R. (P.) pljakici représente une espèce endémique, adaptée à la vie cavernicole. Les analogies entre cette espèce et les autres espèces du même sous-genre nous conduisent à des constatations identiques à celles faites chez des espèces d'autres genres des Pseudoscorpions (Čurčić 1972): à savoir que dans tous ces cas, on a constaté la parenté entre les espèces habitant les régions de la Serbie orientale, de la Macédoine et de l'Herzégovine. Conformément à cela, il est possible que ces régions représentent des aires autochtones des populations ancestrales des groupes analysés, dont les nouvelles espèces tirent leur origine.

References
Sur un nouvel Amphipode souterrain de Bulgarie
Niphargus kochianus melticensis n. ssp.

par

Dan DANCAU* et Stoitze ANDREEV**

Les Niphargides de Bulgarie sont, en général, connus grâce aux travaux publiés par L. Fage (1926), St.et G. Karaman (1959), et St. Andreev (1966). Jusqu'à présent on a mentionné ou décrit un petit nombre d'espèces et sous-espèces (7), la plupart étant des endémiques.

Pendant une excursion d'études que nous avons effectuée au mois d'Octobre 1970, dans la région de Loveč nous avons recolté dans un puits du village Sokolovo, de nombreux exemplaires de Niphargus kochianus, espèce qui n'avait pas été identifiée en Bulgarie. A notre avis il s'agit d'une nouvelle sous-espèce que nous nommerons Niphargus kochianus melticensis*** n. ssp.

Cette sous-espèce, dont la taille des adultes atteint seulement 3 mm est caractérisée par les particularités morphologiques suivantes: maxille I avec le lobe interne pourvu d'un seul poil et le lobe externe garni distalement de 7 épines masticatrices, dont 6 unidentées et la 7-ème, l'épine interne, pourvue de 5-6 petites dents; gnathopodes à carpes beaucoup plus longs que les propodes; dactyles de tous les péréiopodes avec des griffes très longues par rapport à leurs socles; péréiopodes V-VII ayant le lobe distal de l'angle postérieur proéminent et arrondi; telson, plus long que large divisé jusqu'à la base et portant sur chaque lobe, au milieu du bord externe, une épine et deux longues soies aristées.

Nous présentons ici la description de cette nouvelle sous-espèce.

Niphargus kochianus melticensis n. ssp.

Holotype: une femelle de 2,6 mm, avec des oostégites bien développés et pourvus de longues soies sur leurs bords libres, récoltée le 3-XI-1970, dans un puits du village Sokolovo (district Loveč). Les 8 préparations microscopiques de l'holotype se trouvent dans la collection de l'Institut Zoologique et Musée de Sofia, enregistrées sous le numéro 15.

Paratypes: 50 exemplaires mâles, femelles et juvéniles récoltés dans le même puits que l'holotype, ainsi que dans 2 autres puits voisins (le 26-X et 3-X – 1970). Les

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paratypes se trouvent dans la même collection que l’holotype ainsi que dans la collection de l’Institut de Spéologie ‘Emil G. Racovitza’ de Bucarest (15 exemplaires).

DESCRIPTION DE L’HOLOTYPE

Antenne I dépassant la moitié du corps; les articles du pédoncule décroissent en longueur depuis la base; le flagelle principal composé de 17 articles. Les bâtonnets hyalins sont égaux ou un peu plus courts que les articles correspondants. Flagelle accessoire un peu plus long que les deux premiers articles du flagelle principal; l’article basal trois fois plus long que le suivant.

Antenne II à flagelle de 6 articles.

Mandibules (fig. 1, C-E): Le bord tranchant et la lame accessoire différents chez les deux mandibules. Entre le bord tranchant et le processus molaire, il y a une rangée de 7 épines. Le deuxième article du palpe a 3 soies au bord interne et le dernier article a 12 soies sur le bord interne, deux soies sur la face interne et une soie sur la face externe.

Maxilles I (fig. 1, B): lobe interne allongé et pourvu d’une seule soie distale. Lobe externe garni distalement de 7 épines masticatrices, dont 6 unidentées et la 7-ème, l’épine interne, pourvue de 5-6 petites dents. Palpe sur le second article ayant 4 soies distales, insérées sous-apicalement. Sur le même article du côté interne, il y a un poil et sur le bord externe quelques très fines soies.

Maxillipède (fig. 1, A): lobe interne un peu plus court que le premier article du palpe et portant 2 dents et une épine distalement et 3 épines sous-apicalement du côté interne. Lobe externe atteignant 2/3 du deuxième article du palpe.

Gnathopodes I et II (fig. 2, A-D; fig. III, K-L): carpe beaucoup plus long que le propode, spécialement pour la deuxième paire de gnathopodes; les dactyles portant une seule soie. Chez les deux paires de gnathopodes, dans l’angle palmaire, il y a 2 épines, dont l’une plus courte. Le bord interne du propode est pourvu de deux groupes de soies chez le premier gnathopode et de trois groupes chez le deuxième gnathopode. L’article ischial et méral des gnathopodes I et l’article ischial des gnathopodes II pourvu chacun d’une callosité à leurs bords sternaux.

Plaques coxales (fig. 2, A-B; fig. 3, A-E): I-III plus hautes que larges, IV a même largeur que hauteur, avec le bord postérieur concave.

Péréiopodes (fig. 3, C-J): de longueurs différentes ($P_3$: 1,20 mm; $P_4$: 1,90 mm; $P_5$: 1,44 mm; $P_6$: 1,98 mm; $P_7$: 2,01 mm).

L’article basal des trois derniers péréiopodes est plus long que large, avec le lobe distal de l’angle postérieur proéminent et arrondi. Les dactyles de tout les
Fig. 1. A – H: Niphargus kochianus melticensis n. ssp. Holotype. A – maxillipède; B – maxille 1; C – mandibule; D – E – bord tranchant et lame accessoire – droit et gauche.
Fig. 2. A – D: *Niphargus kochianus melticensis* n. ssp. Holotype. A – gnathopode 1; B – gnathopode 2; C – gnathopode 1; D – gnathopode 2.
péréiopodes ont des griffes très longues par rapport à leurs socles. Ainsi les griffes des dactyles de P₃ et P₄ sont 1,5 plus longues que leurs socles et chez les P₅-P₇, les griffes sont plus ou moins de la même longueur que leurs socles.

Les plaques épinérales (fig. 4, D): II et III ont leurs angles inféro-postérieurs aigus; les deux dernières sont armées d'une seule épine.

Pléopodes: avec 2 crochets par rétinacule.

Uropodes I et II (fig. 4, E, F): ayant des branches subégales, élancées.

Uropodes III (fig. 4, A): indifférenciés. Le pédoncule est deux fois plus long que la rame interne. Branche externe à premier article 4 fois plus long que le deuxième. Deuxième article de l'urosome armé de 2 épines subégales.

Telson (fig. 4, B, C): plus long que large, profondément échançré presque jusqu'à la

![Fig. 4. A – F: Niphargus kochianus melticensis n. ssp. Holotype. A – uropode 1; B – telson; C – telson; D – plaques épinérales; E – uropode 1; F – uropode 2.](image-url)
NIPHARGUS KOCHIANUS MELTICENSIS N. SSP.

base. Chaque lobe présentant trois épines distales et un petit poil aristé; au milieu des bords externes une épine et deux longues soies aristaes; bords internes dépourvus d'épines.

**OBSERVATIONS SUR LES PARATYPES**

Les exemplaires examinés présentent, en général, les caractères morphologiques que nous avons mentionnés pour l'holotype. Nous n'avons pas observé des différences importantes en ce qui concerne les caractères morphologiques des exemplaires mâles et femelles de la même taille. Quelques petites différences quantitatives existent toutefois entre les exemplaires de taille différente, marquées par le nombre des articles pour les flagelles des deux antennes et par la chétotaxie des appendices.

Parmi les 50 paratypes (mâles, femelles et juvéniles) ayant une taille qui varie 1,1 à 3 mm nous avons identifié une femelle de 2,4 mm ayant un seul œuf dans le marsupium.

**AFFINITÉS ET DIFFÉRENCES**


**ÉCOLOGIE**

Les puits que nous avons prospectés dans le village Sokolovo ont une profondeur de 8 à 24 m. et un diamètre de 0,80 à 1 m. Les récoltes ont été effectuées avec le filet phréatobiologique Cvetkow.

À part *Niphargus kochianus melticensis* n. ssp. nous avons trouvé dans ces puits les Amphipodes *Niphargus ablaskiri gueorguievi* St. et G. Karaman, mentionnés seulement des grottes, et *Bogidiella* sp. ainsi que des Isopodes *Microparasellidae* (*Microcharon* sp.).

**RÉSUMÉ**

La note présente la description d'une nouvelle sous-espèce, premier représentant du groupe de *Niphargus kochianus* en Bulgarie.

La nouvelle sous-espèce se rapproche de *N. k. tamanini* Ruffo, *N. k. petrosani* Dobr. et Manolache, *N. k. labacensis* Sket, *N. k. minor* Sket, par la maxille I ayant
un seul poil sur le lobe interne et une seule épine pectinée du lobe externe. Mais elle
diffère nettement de toutes les sous-espèces, par les griffes des dactyles très longues
par rapport à leurs socles, ainsi que par la forme et la chétotaxie du telson.

ZUSAMMENFASSUNG

In dieser Mitteilung wird eine neue Unterart beschrieben, die als erster Vertreter der
Gruppe *Niphargus kochianus* in Bulgarien auftritt.

Die neue Unterart steht *N. k. tamanini* Ruffo, *N. k. petrosani* Dobr., Man., *N. k.
*labacensis* Sket, *N. k. minor* Sket nahe nach Maxilla I und einem einzigen Börstchen
auf dem inneren Lappen und einem einzigen Kammdorn auf dem äußeren Lappen.
Sie unterschiedet sich aber deutlich von allen Unterarten nach ihren Daktillennägeln — sehr lang im Vergleich zu ihrer Basis sowie nach der Form und Chetotaxie
des Telsons.

BIBLIOGRAPHIE

Cluj, T. III, 2.
Univ. Bologna, X.
RUFFO, S., 1953. Studi sui Crostacei Anfipodi XXXVIII. Nuovi Niphargus (Amphipoda
Gammaridae) della Venezia Tridentina, Rev. del Mus. di Stor. Nat. della Venezia
Tridentina, Ann. XXX, fasc. II.
SKET, B., 1956. Einige neue Formen der Malacostraca (Crust.) aus Jugoslawien, Bulletin
Scientifique, T. 3, No 3.
SCHELLENBERG, A., 1933. Höhlenflokhkrebe des Adelsberger Grottensystems nebst Bemer-
kung über Niphargus kochianus, Mitt. über Höhlen- und Karstforsch.
102.
SCHELLENBERG, A., 1936. Subterrane Amphipoden Badens, nebst einem neuen Niphargus
XLIX Contribution to the Knowledge of the Amphipoda. 
On Three Niphargus Species (Fam. Gammaridae) from the Balkans 

by 

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INTRODUCTION 

The genus *Niphargus* is presented in the Balkans by a large number of species. There are more than 100 species and subspecies of this genus now known. 

Recently was discovered the first member of the *Niphargus carpathicus*-group in Yugoslavia, *N. deelemani* G. Kar. 1973 from the cave Držina pecina near Pirot (eastern Serbia). 

A second species of this group, *N. adbiptus*, n. sp., has been collected in the Ravanica cave in Serbia. 

S. Karaman described in 1943 *Niphargus stygius ravanicanus* from the same cave (Ravanica). As he confused two species in his description of *N. st. ravanicanus* (*N. st. ravanicanus* + *N. adbiptus*), below is a short diagnosis of *N. st. ravanicanus* based on the holotype. 

*Niphargus valacnicus* (Dobr. Man. 1933) known from Central Europe, Yugoslavia, Hungary and Rumania, now is known from Bulgaria also (Devnja). 

*Niphargus stygius ravanicanus* S. Karaman 1943

fig. 1


S. Karaman described this species from the cave Ravanica in Serbia, based on one adult female of 12 mm collected by dr. M. Radovanović and on 4 juvenile specimens collected by čr. S. Stanković. 

After reexamination of this material, I concluded that only the female belongs to this species, and that 4 juvenile specimens belong to another species, *N. adbiptus*, n. sp. described now from the same cave. 

A short diagnosis of *N. stygius ravanicanus* is as follows: Body-length of single female 12 mm. Antenna 1 shorter than half of the body-length, its principal flagellum 20-articulate, articles with one short aesthetasc each. 

Antenna 2 shorter, medially setose, its flagellum 10-articulate (see fig. 14 of S. Kar. 1943). 

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Maxilla 1: inner lobe with 2-3 distal short setae, outer lobe with 7 spines provided with one lateral tooth each (only inner spine bears 4 lateral teeth), palp with 6 distal setae (see fig. 18 of S. Kar. 1943). Maxilliped: inner lobe with 2 distal spines. Mandible: third palpar article provided with 20 D-setae and 4 long E-setae at margin, 3 groups of 1-2 B-setae on inner surface and one A-group of setae on outer surface (fig. 1, 1).

Coxae 1-4 nearly quadrate (figs. 1, 2-5). Gnathopod 1: article 6 very slightly longer than broad, with 5 groups of setae at posterior margin, palm somewhat inclined, dactyl with several setae at superior margin (see fig. 19 of S. Kar. 1943).

Gnathopod 2: article 6 slightly broader than long, with 7 groups of setae at posterior margin, palm slightly inclined, dactyl with several setae at superior margin (see fig. 20 of S. Kar. 1943).

Fig. 1. Niphargus stygius ravanicanus, S. Kar., Ravanica cave, female 12 mm, (holotype): 1= palp of maxilliped, inner face; 2= coxa 1; 3= coxa 2; 4= pereopod 3; 5= coxa 4; 6= dactyl of pereopod 3; 7= pereopod 7; 8= telson; 9= dactyl of pereopod 7.
Pereopods 3-4 similar, articles with longer setae at posterior margin, dactyl medially strong, with the nail slightly shorter than the remaining part of dactyl itself (figs. 1, 4,6).

Pereopods 5-7 relatively short, also stygius-like, dactyls medially strong, with one spine at inner margin, nail nearly 65 percent as long as the remaining part of dactyl itself. Article 2 more or less ovoid, its distoposterior lobe marked (figs. 1, 7,9).

Pleopods with 2 retinacula each. Epimere 1-3 with obtuse distoposterior corner (see fig. 27 of S. Kar. 1943).

Uropods 1-2: peduncle lacking distal protrusion, inner ramus somewhat longer than outer one, both with marginal and distal spines.

Uropod 3: inner ramus scale-like, outer ramus 2-articulate, second article nearly 50 percent as long as the first one (see fig. 26 of S. Kar. 1943).

Telson broader than long, stygius-like, nearly 60 percent incised, with 3 distal and several marginal spine on each lobe, no spines on dorsal surface (fig 1, 8). The pair of a short plumose setae appears in the middle of the telson length.

Gills on thoracic segment 2 slender (fig. 1, 3), on thoracic segment 3-4 ovoid (figs. 1, 4,5).

Material examined. The preparate of a single ovig. female of 12 mm from Ravanica cave, 193° (leg. M. Radovanović).

Holotype: female, 12 mm from Ravanica-cave. It is deposited in my collection in Titograd.

Remarks and Affinity. The single female of ssp. ravanicanus belong to stygius group, based on the shape of telson, of pereopods 3-7, of gnathopods 1-2, uropods 1-3, epimere etc.

*N. st. ravanicanus* differs from *N. stygius stygius* by the shape of gnathopods, telson etc.

Since this group of *Niphargus stygius* must be revised, I retain the ssp. ravanicanus as before, with one subspecies of *N. stygius* (Schiodte), but the precise position of this subspecies must be studied together with all other species of this group.

All figures are described from the preparate of holotype, which may have a slight deformation of single appendages in this specimen.

*Niphargus adibiptus* n. sp.

figs. II-IV


Description of the male. Body-length 9 mm. Lateral cephalic lobes rounded, body smooth, urosomite 1 with one dorsolateral seta, urosomite 2 with one dorsolateral spine on each side.

Antenna 1 long, the proportion body: antenna 1 is 9:7; principal flagellum
Fig. II. *Niphargus adbiptus*, n. sp., Ravanica cave, male 9 mm: 1, 2= gnathopod 1; 3, 4= gnathopod 2; 5, 6= pereopod 3; 7= coxa 4; 8= pereopod 5; 9= pereopod 6; 10, 11= pereopod 7; 12= urosome with uropods.
25-articulate, each article with one short aesthetasc, accessory flagellum 2-articulate, antennal gland cone short.

Antenna 2 much shorter than antenna 1, its flagellum 8-articulate. Maxille 1: inner lobe with one distal seta, outer lobe with 7 spines bearing usually only lateral tooth each (only 1-2 median spines bear 2 lateral teeth and inner spine bears 4-6 lateral teeth); palp biarticulate, with 8 distal setae (fig. III, 1). Inner lobe of maxilliped with 4 distal spines. Mandible: third palpar article with 18 marginal D-setae and 5 long E-setae, on outer surface appears one tuft of A-setae, on inner surface 3 tufts of 1-2 B-setae (fig. IV, 5).

Coxa 1 broader than long, coxae 2-4 nearly as long as broad, all provided with distal setae (figs. II, 1, 3, 5, 7). Coxae 5-7 progressively shorter (figs. II, 8-10).

Gnathopod 1: article 6 slightly longer than broad, with 6 tufts of setae at posterior margin, palm inclined to the middle of the length of article 6, with one corner spine. Dactyl with slender nail provided with one median seta at superior margin (figs. II, 1, 2).

Gnathopod 2: it is broader than gnathopod 1, article 6 as long as broad, with less inclined palm. Posterior margin of article 6 with 7 tufts of setae, dactyl with one median seta at superior margin (figs. II, 3, 4).

Pereopods 3-4 similar, with relatively slender articles, articles 4 and 6 are subequal in length, dactyl slender, with long nail nearly as long as the remaining part of dactyl itself. The articulation of the nail is visible (figs. II, 5, 6).

Pereopod 5: article 2 dilated posteriorly, but lacking distoposterior lobe, articles 3-6 slender, provided with spines at both margins (fig. II, 8).

Pereopods 6-7 similar in shape and spinulation, only article 2 is slightly longer; posterior part of article 2 dilated, its distoposterior lobe not produced. Dactyl very slender, 40 percent of the article 6 length, nail much shorter than the remaining part of dactyl (figs. II, 9, 10). The dactyls of pereopods 3-7 are progressively longer towards posterior, but their nail is progressively shorter towards posterior pereopod (figs. II, 6, 11).

Pleopods with numerous retinacula: pleopod I with 6-7 retinacula, pleopods 2-3 with 8 retinacula each.

Epimere 1-3 with subrounded distoposterior portion (corner), epimere 2-3 with several subdistal spines (fig. III, 2).

Uropod 1: peduncle longer than rami, lacking distal protrusion, rami slightly flattened dorsoventrally. Outer ramus very slightly longer than inner one, both rami with several lateral and distal spines (fig. II, 12). Uropod 2: inner ramus longer than outer one, both with lateral and distal spines (fig. II, 12).

Uropod 3: long and slender (fig. III, 3), inner ramus scale-like, provided with 2 distal spines; outer ramus biarticulate, second article nearly as long as the first one.

Telson longer than broad, with numerous long spines at distal and lateral margin. One spine appears on distal surface of each lobe (fig. III, 4). The pair of the plumose setae appears in the middle of telson length.

Gills on thoracic segment 2 long and halfmoon-like, gills on thoracic segments 3-6 more or less ovoid (figs. II, 3, 7-9).

The female. She is similar to the male (the length of antenna 1, shape of
Fig. III. *Niphargus adbiptus*, n. sp., Ravanica cave, male 9 mm: 1= maxilla 1; 2= epimere; 3= uropod 3; 4= telson.
female, 9 mm: 5= gnathopod 1; 6= gnathopod 2; 7= dactyl of pereopod 3; 8, 9= pereopod 7; 10= telson of ovig. female, 7 mm; 11= telson, female 11 mm.
ON THREE NIPHARGUS FROM THE BALKAN

epimere, urosomites, dactyls of pereopods, uropods 1-2). Article 6 of gnathopods 1-2 like to that of the males (adult specimens of 7 mm), or slightly broader (adult specimens of 9 mm) (figs. III, 5, 6), coxae 1-4 like those of the males (figs. IV, 1-4). Pleopod 1 with 6 retinacula, pleopods 2-3 with 7 retinacula each. Pereopod 7 slightly broader than that of the male (figs. III, 8, 9).

Uropod 3: long and slender, second article of outer ramus nearly 40 percent of the length of the first one (fig. IV, 14). Telson longer than broad, with 3 distal spines and one lateral spine on each lobe. Telson of ovig. female of 7 mm has absence of lateral spine. The pair of a short plumose setae appears less than half of telson length (figs. III, 10, 11). Oostegys broad. Gills like those of the males.

Variability. The spinulation of telson, the position of the pair of plumose setae on telson (males: females?), as well as the shape of article 6 of gnathopods 1-2 by the females in connection to the body-size (probably with the maturity of the specimens) are variable.

The shape of epimere, length of antenna 1, high number of retinacula, the shape of dactyl of gnathopods 1-2 and pereopods are constant.

Material examined. Ravanica cave, 195?, single adult male (leg. T. Petkovski et C. Bogoevski); Ravanica, 195?, several females (leg. T. Petkovski et C. Bogoevski); Ravanica-cave, 1933, 4 juvenile specimens (leg. S. Stankovic) (preparates).

Type locality: Ravanica-cave, Serbia.

Holotype: male of 9 mm from Ravanica cave; it is deposited in my collection in Titograd.

Remarks and Affinity. It seems that the specimens of the first and second sample (male and females) belong to the same new species, N. adbiptus. Slightly doubtful is the shape of telson, especially the position of the pair of plumose setae on outer margin of telson lobes. As the differences are very small, I think the females of the second sample belong to the same new species with the single male from Ravanica, N. adbiptus.


From Serbia is known one other member of carpathicus group, N. deelemani G. Kar. 1973, described from Drzina pecina-cave near Pirot. N. adbiptus differs from N. deelemani by rounded epimere 1-3 (by deelemani obtuse), by more inclined palm of article 6 on gnathopod 1, by more slender gills on second thoracal segment, by more slender dactyl of pereopods 3-7, by less number of setae on inner lobe of the first maxilla, by the shape of uropods 1-3 and telson, by higher number of retinacula (by deeleman only 3-4), longer antenna 1 etc.
Niphargus valachicus (Dobr. Manolache 1933)

fig. IV


Material examined. Devnja, 12 July, 1942 (Bulgaria), single male of 9.3 mm, accompanied by Gammarus sp.

Distribution. Yugoslavia (S. Karaman 1934, 1950), Rumania (Dobr., Manolache, 1933; Dobr. Man., Carausu 1955), Hungary (Dudich 1941), Czechoslovakia (Straškraba 1972), Bulgaria (present paper).

Remarks and Affinity. Our male was a non adult specimen, but it manifests all the characteristics of N. val. valachicus (the shape of epimere, of pereopods, the protrusion on distal margin of uropod 1 peduncle, telson etc.).

The article 6 of gnathopods 1-2 is slightly narrower and dactyl of pereopods 3-7 provided with a smaller number of spines at inner margin than those of the adult specimens of N. valachicus, but this is due to the small body-size of our specimen.

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SUMMARY

Three Niphargus species from the Balkans are studied. Niphargus adbiptus, n. sp. is described from Ravanica cave in Serbia. Niphargus stygius ravanicanus S. Kar. 1943 from the same cave (Ravanica) is redescribed. N. valachicus Dobr. Man. 1933, is newly recorded from Bulgaria (Devnja).

RÉSUMÉ

Etude de trois espèces de Niphargus de la région des Balkans. N. adbiptus n. sp. est complètement décrit et figuré de la grotte du Ravanica (Serbie), il a de grandes affinités avec N. carpathicus Dobr. Man. 1939, mais il en diffère par certains caractères importants. N. stygius ravanicanus S. Kar. 1943 de la même grotte (Ravanica) est redécrit. Niphargus valachicus Dobr. Man. 1933 est signalé pour la première fois de Bulgarie (Devnja).
Fig. IV. *Niphargus adhbitus*, n. sp., Ravanica cave, female 9 mm: 1-4= coxae 1-4; 5= third palmar article of maxilliped, inner face; 14= uropod 3; *Niphargus valachicus* Dobr. Man., Devnja, male 9.3 mm: 6, 7= gnathopod 1; 8= gnathopod 2; 9= dactyl of pereopod 6; 10= article 2 of pereopod 7; 11= telson; 12= epimere; 13= distal protrusion of uropod 1 peduncle.
REFERENCES


Trichoniscidae della grotta di su Mannau, Sardegna Sud-Occidentale
(Crustacea, Isopoda)

Roberto ARGANO*

Sulle pendici del monte Linas, a N-W di Cagliari, in Sardegna, si apre un gran numero di vastissime cavità note da sempre per le preziosissime concrezioni e per i reperti archeologici che hanno fornito. Dal punto di vista biologico c'è una disproporzione tra la vastità e varietà degli ambienti sotterranei e la relativa scarsità di informazioni.

La grotta di su Mannau 97 SA/CA (cfr. Fureddu, 1964), presso Fluminimaggiore, si apre a 210 m s.l.m., una ventina di metri sopra al Rio omonimo (Zuffa, 1967) e, a tutt'oggi, è stata esplorata per uno sviluppo complessivo di 4050 mt, compresi i collegamenti sotterranei con cavità ritenute in precedenza indipendenti (Puddu, in litteris). Le esplorazioni sembra siano cominciate intorno al 1930, ma presero una veste scientifica solo dal 1963, con le esplorazioni del G.S. Piemontese del CAI-Uget di Torino in collaborazione con speleologi sardi, e successivamente di speleologi dell'Iglesiente, di Bologna e, recentemente, dello Speleo Club di Cagliari. E' appunto da quest'ultima gruppo di speleologi che sono state effettuate raccolte faunistiche nella grotta, condotte in particolare da Sergio Puddu. E' a lui infatti che debo l'invio di due campionature di Trichoniscidae effettuate nel corso di due diverse esplorazioni.

Si tratta dei primi dati biologici di un certo interesse raccolti nella grotta (cfr. Brignoli, in stampa). Ma è prevedibile che il fitto reticolo diaclasico, in calcare cambrico, in cui si imposta il complesso di gallerie, saloni e fessurazioni della grotta, con tutta la varietà d'ambienti che offre (cfr. Grimandi, 1968), riservi, a ulteriori indagini, sorprese notevoli in questo campo.

Le conoscenze sui Trichoniscidae della Sardegna sono relativamente scarse. Ne sono una prova queste occasionali campionature di Su Mannau che hanno permesso di conoscere tre nuove specie appartenenti a due generi, oltre che nuovi, assolutamente inattesi per la Sardegna. Un quadro completo delle conoscenze sul l'argomento verrà dato al termine di ricerche attualmente in corso.

Nella presente nota viene data la descrizione delle tre specie rinvenute nella grotta di Su Mannau con un cenno alle implicazioni sistematiche e biogeografiche che la loro scoperta comporta.

L'olotipo ♂ e un paratipo ♀ di ciascuna delle specie descritte viene conservato presso il Museo di Storia Naturale di Verona, il resto dei paratipi presso l'Istituto di Zoologia dell'Università di Roma.

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MATERIALE ESAMINATO: 2 ♂ e 3 ♀ raccolti il 31.III.1968 da S. Puddu a 300 m circa dall'ingresso, in un grande salone del ramo sinistro alla base di una larga stalagmite. Resti di carte lasciati da precedenti visitatori della grotta hanno permesso il riunirsi di diversi esemplari della stessa specie in un'unico punto.

DIAGNOSI: un Catalauniscus di medie dimensioni (5,3 mm) in cui il lobo terminale dell'esopodite del pleopode I del ♂ porta una forte incisione a coda di rondine sul lato esterno.

DESCRIZIONE. Dimensioni del ♂: lunghezza 5,3 mm; larghezza massima del pereion 2,1 mm; larghezza massima del pleon 1,0 mm. Occhi e pigmento completamente assenti.

Tegumento fortemente tubercolato. I tubercoli, formati da una larga setola centrale, molto corta, circondata da diverse serie concentriche di scaglie, sono disposti in serie trasversali sul cephalon e sul pereion.


Le parti boccali non presentano caratteristiche degne di rilievo. Mandibola sinistra con tre penicillae, mandibola destra con una. Il settimo paio di pereiopodi del ♂ non presenta nessuna differenziazione sessuale.

Endopodite del pleopode I del ♂ triangolare, tre volte circa più lungo che largo, si assottiglia fortemente all'estremità distale su cui è inserita una lunga setola provvista di barbule. Il lobo terminale dell'esopodite porta una forte incisione a coda di rondine.

Apolisi genitale a margini paralleli mucronata all'apice.

L'esopodite del pleopode II del ♂ è molto grande arrivando fino alla metà del secondo articolo dell'endopodite. Quest'ultimo, biarticolato, presenta il secondo articolo, lungo poco più della metà del I, troncato distalmente e con una doppia punta terminale.

AFFINITÀ. C. hirundinella n.sp. presenta affinità con la specie spagnola C. espanoi Vandel alla quale somiglia, oltre che per le dimensioni, per la forma dell'esos e dell'endopodite del secondo pleopode e per l'endopodite del pleopode I del ♂.

DERIVATIO NOMINIS. L'incisione dell'esopodite del pleopode I del ♂ è carattere diagnostico, ha una vaga forma a coda di rondine; di qui il nome della specie.
Tav. 1. *Catalauniscus hirundinella* n.sp.: 1, pleopode II ♂; 2, mandibola sinistra; 3, antenna; 4,5,6 endopodite, esopodite e apofisi genitale del pleopode I ♂; 7, antennula; 8, mandibola destra; 9, telson.
CATALAUNISCUS PUDDUI N.SP.


DIAGNOSI: Un Catalauniscus di piccole dimensioni (4 mm) in cui il lobo terminale dell’esopodite del pleopode I del ♂ è molto prominente e arrotondato sul lato esterno. L’apofisi genitale è larga, conformata a spatola, nettamente troncata all’apice. L’endopodite del pleopode II del ♂ termina con un lungo filamento.

DESCRIZIONE. Dimensioni del ♂: lunghezza 4 mm (la ♀ può raggiungere i 6 mm di lunghezza); larghezza massima del pereion 1,4 mm; larghezza massima del pleon 0,8 mm.

Occhi e pigmento completamente assenti.

Tegumenti lisci. Il cephalon e il pereion portano piccolissime setole sottili, visibili solo con un buon ingrandimento, disposte approssimativamente in serie trasversali.

Il primo e il terzo articolo dell’antennula sono lunghi il doppio del secondo. Il terzo articolo, due volte più lungo che largo, porta terminalmente sei bastoncelli sensori.


Apofisi genitale, a forma di larga spatola troncata all’estremità, con mucrone terminale in posizione mediana.

L’esopodite del pleopode II del ♂ è particolarmente grande e arriva fin quasi all’estremità del secondo articolo dell’endopodite della stessa appendice, escludendo il lungo filamento terminale caratteristico dell’endopodite stesso.

AFFINITÀ Catalauniscus puddui n.sp. presenta una serie di caratteri comuni con una delle due specie spagnole note: somiglia infatti a C.bolivari (Arcangeli), oltre che per le dimensioni, per la forma generale dell’eso e dell’endopodite del pleopode I del ♂ e in parte per la forma dell’endopodite del pleopode II. Il fatto che manchi di forti granulazioni sui tegumenti ha importanza relativa esistendo per questo carattere una certa variabilità da una popolazione all’altra, almeno per la specie C. espanoli Vandel (Vandel, 1953). L’apofisi genitale ha invece una vaga rassomiglianza con quella di C. espanoli.
Tav. 2. Catalauniscus puddui n.sp.: 1, endopodite ed esopodite del pleopode I ♂; 2, antennula; 3, apofisi genitale; 4, perciopode VII; 5, pleopode II ♂; 6, endite della maxillula; 7, mandibola destra; 8, mandibola sinistra.
DERIVATIO NOMINIS. La specie è dedicata all’amico Sergio Puddu, che ha raccolto le tre specie di Su Mannau, e al cui entusiasmo costante ed efficiente la biospeleologia della Sardegna deve un gran numero di interessanti scoperte recenti.

SCOTONISCUS JANAS N.SP..

MATERIALE ESAMINATO: 1 ♂, privo di antenne, pereiopodi e uropodi, e 2 ♀ raccolti da S. Puddu il 3.VIII.1970 assieme a Catalauniscus puddui.

DIAGNOSI: Uno Scotoniscus di piccole dimensioni (3,1 mm) con l’estremità dell’endopodite del pleopode II del ♂ terminante semplicemente con una punta leggermente ricurva e con una lunga setola provvista di barbule.

DESCRIZIONE. Dimensioni del ♂: lunghezza 3,1 mm; larghezza massima del pereion 1,2 mm; larghezza massima del pleon 0,6 mm.

Occhi e pigmento completamente assenti.

Tegumento con granulazioni appena percettibili sulla porzione anteriore dei tergiti.

Il terzo ed ultimo articolo dell’antennula, più stretto e allungato dei primi due, porta due estetaschi bastoncellari.

Mandibola destra con tre penicillae, sinistra con due. Lamina esterna della prima mascella con una serie di dieci denti semi-circolari inseriti sul bordo anteriore obliquo; lamina interna terminante con una forte setola tozza conica coperta di setole sottili e due altre setole corte coniche subapicali interne.

L’esopodite del pleopode I del ♂ si presenta subquadrandolare, fortemente arrotondato agli angoli esterni. L’angolo interno posteriore si prolunga in un lobo allungato piegato verso l’esterno che porta terminalmente una lunga setola con barbule. Altre due lunghe setole con barbule si trovano, internamente, alla base del lobo. Endopodite subrettangolare, due volte più lungo che largo con una forte e lunga setola con barbule sull’angolo posteriore interno e l’angolo posteriore esterno prolungato in un lobo.

Esopodite del secondo pleopode del ♂ subquadrandolare con angolo posteriore esterno arrotondato e provvisto di una serie di corte setole sottili. Il primo segmento dell’endopodite è lungo quanto l’esopodite. Il secondo segmento, lungo circa il doppio del primo, si assottiglia distalmente terminando con una corta punta ricurva verso l’esterno e una lunga setola sottile.

AFFINITÀ. La posizione geografica della stazione di questa seconda specie di Scotoniscus (tutte le altre entità dello stesso genere, considerate sottospecie della stessa unica specie S. macromelos Racovitza, sono descritte per le grotte delle regioni centrali dei Pirenei settentrionali) impone delle considerazioni a livello sistematico. Va sottolineato che si dispone di un unico maschio, per di più mutilato, per quanto tutte le appendici che portano caratteri distintivi siano assolutamente intatte. Va comunque considerato che eventuali nuovi dati sulla variabilità
Tav. 3. *Scotoniscus janus* n.sp.: 1, antennula; 2,3, mandibola destra e sinistra; 4, pleopode II ♂; 5, pleopode I ♂; 6,7 maxillula, lamina esterna ed interna; 8, telson; 9, massili pede.
potrebbero portare ad un’analisi diversa. 


Accettando questo punto di vista la nuova specie si inserirebbe sotto il profilo sistematico proprio tra T. daviï e S.m. malarodensis acuendo le affinità tra i due generi, tanto che ci si può porre la questione se attribuirla all’uno, considerando la presenza di tre setole sugli esopoditi dei pleopodi I del δ come particolarmente eccezionale (nei casi analogi osservati in Trichonisoides la terza setola era presente solo su uno degli endopoditi dei pleopodi I degli individui anomali), o all’altro, considerando la terminazione dell’endopodite del pleopode II del δ come un eccezionale grado di semplificazione, cioè una fase primitiva, se vogliamo, più vicina alla situazione del genere Trichonisoides di quanto non sia Scototniscus m. malarodensis.

Il fatto che questa appendice abbia un significato funzionale diverso nei due generi, di apposizione in Scototniscus e di intromissione in Trichonisoides ha le sue eccezioni sia nell’uno (T.fouresi) che nell’altro genere (S.m. malarodensis).

In conclusione, considerando la nuova specie come appartenente al genere Scototniscus, (per la morfologia del pleopode I del δ), e accettando il quadro evolutivo proposto da Vandel, S.janas viene ad essere la specie del genere più affine al Trichonisoides, in particolare alle specie del gruppo pirenaico, e viene a trovarsi alla prima fase differenziazione filogenetica del genere Scototniscus.

Derivatio nominis: domus de janas, case selle fate, è il nome che si dà attualmente a quelle piccole cavità artificiali scavate con grande cura nelle rocce dai protosardi per custodirvi i defunti.

CONSIDERAZIONI GENERALI

La geonemia del genere Caralallniscus era limitata alla regione catalana, tra la valle del Llobregat, a nord, e quella dell’Ebro a sud (Vandel, 1953). Lo stesso nome dato al genere da Vandel lascia intuire l’opinione dell’Autore che si trattasse di un fenomeno endemico, cioè che nella differenziazione filogenetica dei generi Catalauniscus, Nesiotoniscus e Balkanonicus dal ceppo Speleonethes (o forma vicina) (Vandel 1953, 1960) la storia del primo genere fosse limitata ad una regione ristretta. L’esistenza in Sardegna di due specie di questo genere che, per la loro morfologia, ripetono curiosamente la stessa identica situazione che in Spagna (sono infatti sorprendenti le forti rassomiglianze hirundinella-espanoli e puddui-bolivari) riapre naturalmente la questione, o meglio avvalora l’affermazione di Vandel che si
tratti di un genere *tyrrhénien*, ma suggerisce cautela per altre conclusioni in attesa di dati che potrebbero chiarire in maniera del tutto imprevedibile i rapporti tra i generi suelencati.

Un discorso analogo si può fare per la nuova specie di *Scotoniscus*. Al momento, sia che si considerino affinità con *Trichoniscoides* (meno impegnative dato il vasto areale del genere) o con *Scotoniscus* (considerato anche questo un fenomeno endemico del versante nord dei Pirenei centrali) si ripropone solo un’affinità tra la storia faunistica dell’isola e quella dei Pirenei. Si può dire che, pur rispettando il quadro della meccanica di differenziazione suggerito da Vandel (1952), il fenomeno ha interessato un’area più vasta di quella supposta precedentemente ed è da rivedere l’idea che tale differenziazione abbia avuto origine nei Pirenei. *S. janas* risulta infatti essere la forma più primitiva del gruppo.

RÉSUMÉ

Description de trois nouvelles espèces anophtalmes et dépigmentées de *Trichoniscidae* capturées à la grotte de Su Mannau en Sardaigne. Deux d’entre-elles appartiennent au genre *Catalauniscus* Vandel: *Catalauniscus hirundinella* n.sp. qui présente quelques affinités avec l’espèce espagnole *C. espanoli* Vandel et *Catalauniscus puddui* n.sp. qui se rapproche également d’une forme ibérique, *C. bolivari* Arcangeli. La troisième (*Scotoniscus janas* n.sp.) fait partie du genre endémique *Scotoniscus* Racovitza, monospecifique jusqu’à ce jour et représenté par une série de sous-espèces des Pirénéens septentrionales; toutes très proches de la forme spécifique *S. macromelos* Racovitza.

La découverte de ces trois nouvelles espèces apportent des arguments supplémentaires à la thèse d’une origine tyrrhénienne de ces lignées de *Trichoniscidae*.

SUMMARY

Description of three eyeless and apigmented new species of *Trichoniscidae* which have been found in Su Mannau cave in Sardinia. Two of them belong to the genus *Catalauniscus* Vandel: *Catalauniscus hirundinella* n.sp. offering few relationships with the spanish species *C. espanoli* Vandel, and *Catalauniscus puddui* n.sp. which has also similar features to an iberian form, *C. bolivari* Arcangeli. The third (*Scotoniscus janas* n.sp.) belongs to the endemic genus *Scotoniscus* Racovitza, until now monospecific and represented by a series of subspecies from the Northern Pyrenees, all nearly related to the specific form *S. macromelos* Racovitza.

The discovery of those three new species brings forward additional arguments to the thesis of a Tyrrhenian origin of these taxa of *Trichoniscidae*. 
BIBLIOGRAFIA

BRIGNOLI P.M., in stampa – Catalogo dei ragni cavernicoli italiani.


Description du mâle de *Mexistenassellus parzefalli*
(Crustacea Isopoda Asellota cavernicole du Mexique)
et observations sur cette espèce

Guy MAGNIEZ*

GÉNÉRALITÉS

Dans cette même revue, j’ai eu l’occasion de décrire, en 1972, les femelles de deux espèces nouvelles de *Stenasellidae* (*Mexistenassellus parzefalli* et *M. wilkensi*). Ces Crustacés avaient été capturés dans les collections d’eau de la Cueva del Huizache (située près de Micos, à 27 km au N-W de Ciudad-Valles, état de San-Luis Potosi, Mexique), par les Docteurs Parzefall et Wilkens, de l’Université de Hambourg. Le lot ne comprenait que 2 ♀ de *M. parzefalli* et 1 ♀ de *M. wilkensi*, mais il était nécessaire de signaler l’existence de ces Sténasellides, cette famille d’Asellotes souterrains n’étant connue dans le Nouveau-Monde que depuis fort peu de temps (Cole et Minckley 1972). Au début de 1973, le Dr. Horst Wilkens, que je remercie très vivement de sa confiance, m’a fait parvenir un lot plus important d’Isopodes aquatiques de même provenance. La composition de ce lot est la suivante:


2. 1 ♀ adulte de 15,5 mm de *Mexistenassellus wilkensi*. Il importera d’effectuer de nouvelles prospections dans les eaux de la grotte, pour découvrir le mâle de cette magnifique espèce.

3. 26 *Mexistenassellus parzefalli* adultes et subadultes, soient:
   - 5 ♀ de 13,2; 12,5; 11,2; 7,7 et 7,5 mm,
   - 3 ♀ immatures de 8,8; 8,0 et 7,7 mm,
   - 14 ♀ adultes au repos génital (oostégites rudimentaires), de 14,0; 13,9; 13,1; 13,0; 12,5; 12,4; 11,2; 11,1; 11,0; 9,9; 9,4; 9,2; 7,9 et 7,7 mm,
   - 4 ♀ à marsupium vide (oostégites fonctionnels), de 14,0; 13,0; 13,0 et 12,5 mm.

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Il est donc désormais possible:
a. De décrire le δ de l’espèce et en particulier d’étudier l’aspect des pleopodes I et II δ, dont l’intérêt, chez les Asellotes, est considérable (à ce jour, sur les 4 espèces de Stenusellidae du Nouveau-Monde, seul le δ de la forme-type Mexistenasellus coahuila Cole et Minckley avait été capturé),
b. De compléter la description de l’espèce, les fouets de l’antennule et de l’antenne du type étant absents,
c. D’observer les caractères sexuels temporaires de la δ en intermue de reproduction (modifications du maxillipède en particulier).

DESCRIPTION DU δ DE MEXISTENASELLUS PARZEFALLI

1. Corps: Tête, péréion et pleon ont très sensiblement le même aspect chez la δ et aucun dimorphisme sexuel notable ne les atteint. Nous retrouvons, en particulier, le grand développement des régions pleurales des péréionites, qui va de pair avec une réduction et l’ankylose des coxopodites des péréiopodes (Magniez 1972, p. 21, fig. 1J). La même particularité existe, je le rappelle, chez des espèces de l’Ancien Monde, comme Stenasellus gjorgjevici de Serbie, Johannella purpurea d’Algérie ou Parastenasellus chappuisi d’Afrique occidentale. Ce n’est donc pas un caractère à valeur générale, puisque les autres Mexistenasellus (M. coahuila et M. wilkensi) possèdent au contraire, des péréionites à pleurons étroits, laissant apparaître l’expansion épimérale d’un coxopodite bien développé. La taille du δ de M. parzefalli serait, en moyenne, très légèrement inférieure à celle de la δ, ce qui est normal.

2. Appendices céphaliques: Les antennules atteignent 2,7 mm sur un δ de 12,5 mm. Le fouet comporte 14 articles, dont les 7 distaux portent chacun une grande lame olfactive hyaline de 160 microns de longueur (fig. 1A). La hampe de l’antenne atteint 3 mm pour le même individu et son troisième article porte le même

PLANCHE 1:

A – Mexistenasellus parzefalli δ de 12,5 mm: extrémité d’une antennule; e = 100 microns.
B – M. P. δ de 11,2 mm: maxillipède gauche, face sternale; b = basipodite; c = coxopodite; e = 400 microns.
C – M. p. δ de 13 mm au repos génital: le coxopodite (c) du maxillipède porte un petit lobe charnu interne (1) et un autre externe (2); e = 400 microns. Les soies polymorphes du basipodite et les soies lisses de l’endopodite ont été volontairement omises sur ce schéma, ayant été représentées antérieurement (Magniez 1972).
D – M. p. δ à marsupium de 13 mm: maxillipède droit, face sternale; les deux lobes (1) et (2) se sont temporairement transformés en deux grandes lamelles ovaérales, à aspect d’oostégites. Seule la pièce interne (1) existe chez Stenasellus virei et les autres formes européennes; e = 400 microns.
E – F – Maxillipède de la δ ovigère (E) et du δ (F) de Caecosphaeroma burgundum Dollfus, d’après Husson et Daum (1954), montrant la similitude des caractères sexuels temporaires δ du maxillipède chez le Sténasellide mexicain et le Sphéromien cavernicole européen.
G – Une des soies sensorielles ramifiées de la marge tergale du basipodite des péréiopodes II-VII de Mexistenasellus parzefalli; e = 200 microns.
minuscule exopodite unisetigère que la ♀. Le fouet de l’antenne atteint 8 mm. Il est très grêle et fragile. Il comporte 80-90 articles. Mandibules, maxillules et maxilles identiques à celles de la ♀.

3. **Le maxillipède** est typiquement celui d’un Sténasellide, sans épipodite. Celui de la ♀, subissant des transformations spectaculaires lors de l’intermue de reproduction, est étudié plus loin.

4. **Péréiopodes**: Les péréiopodes II à VII sont très semblables à ceux de la ♀. La marge tergale de leur basipodite porte une rangée de très longues soies sensorielles de 200-300 microns (fig. 1G), dont le nombre croît de P2 à P4. Les péréiopodes I restent courts et non locomoteurs, comme chez la ♀, mais montrent un notable dimorphisme sexuel: leur propodite est nettement plus massif. Sa marge sternale est mieux armée. Les 5 tiges ensiformes proximales ne sont pas crénelées, comme pour la ♀; mais elles sont suivies d’une série de 11-12 lames acérées contiguës, inclinées en direction proximale (fig. 2H), alors que leur emplacement est, chez la ♀, occupé par de simples écaillées peignées (Magniez 1972, fig. 1G). L’ongle du dactylopodite est doublé d’une épine sous-unguëale sternale, comme pour la ♀.

5. **Papilles génitales**: Elles s’insèrent dans l’angle interne du coxopodite du péréiopode VII correspondant, comme c’est la règle chez les Sténasellides. Elles sont très longues et grêles. Elles s’appliquent distalement l’une contre l’autre, dans le plan médian, juste en avant des pleopodes I. Leur extrémité se termine en biseau et peut se coapler avec l’orifice afféré de l’organe copulateur situé du même côté, lorsque le pleopode II se rabat vers l’avant.

6. **Pleopodes**: Pleopodes I avec protopodite massif, subquadragulaire et sans rétinacule. Son exopodite étroit et allongé, avec 12-14 tiges lisses sur la marge distale (fig. 2J). Ces appendices ressemblent plutôt à ceux des Stenaseilidae africains qu’à ceux de Stenasselius virei. Les pleopodes II sont longs. Au repos, ils sont portés contre la face sternale des opercules, mais le pleopode I correspondant, trop court, ne protège pas entièrement l’endopodite du pleopode II, ce qui rappelle le cas du genre congolais Metastenasselus (Magniez 1966). Protopodite allongé, une fois et demie plus long que large. Exopodite court, biarticulé, son article distal portant

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**PLANCHE 2:**

H – *Mexistentellus parzeziali* ♀ de 12,5 mm: péréiopode I droit, face tergale. Le propodite est plus renflé que celui de la ♀. La série de lames quasi-jointives qui suit les 5 tiges ensiformes proximales de la marge sternale du propodite n’existent pas chez la ♀ (cf. Magniez 1972, p. 21, fig. 1G); e = 200 microns.

J – *M. p.* ♀ de 13,2 mm: pleopode I gauche, face sternale; e = 400 microns.

K – *M. p.* ♀ de 13,2 mm: pleopode II gauche, face sternale. L’orifice proximal ou afféré de l’organe copulateur (O.P.) est signalé par une flèche; e = 400 microns.

L – Moitié distale du second article de l’endopodite (organe copulateur) du pleopode précédent. Les longues soies (300 microns environ), s’insèrent sur un mamelon interne de la paroi du canal. Elles existent, quoique moins développées, chez d’autres Sténasel-rides, comme *Stenasselius breuili* Racovitza; e = 200 microns.
quelques soies, les proximales lisses, les distales plumeuses (fig. 2K). Endopodite biarticulé (ce qui distingue les *Stenasellidae* des *Asellidae*). Son article proximal court. Article distal (organe copulateur) très long et falciforme. Il semble constitué d’une pièce foliacée (en forme de feuille de Saule, par exemple), qui se serait repliée longuement autour de sa nervure. Les deux bords viennent s’affronter du côté interne, mais sans se souder. Dans la partie proximale, ils restent écartés, ménageant un infundibulum où la papille génitale peut s’engager (fig. 2K; O. P. = orifice proximal ou affèrent). Dans la partie distale, ils ménagent un orifice terminal ou effèrent. L’article forme ainsi un conduit imparfait, ouvert à ses deux extrémités et restant fendu selon sa génératrice interne. Dans la portion distale de ce canal existe une protubérance interne, sur laquelle sont insérées de très longues soies (15 à 20 au plus), légèrement ramifiées distalement. Elles peuvent atteindre 300 microns de long et forment un long pinceau qui accroît considérablement la longueur de l’organe copulateur (fig. 2L). Un tel dispositif, dont le rôle doit être de faciliter la conduction des spermatozoïdes vers les voies génitales de la ♀, existe chez d’autres Sténasellides, (*StenaseUllus breuili* Racovitza, 1924, d’Espagne, par exemple), mais nulle part avec un tel développement. A lui seul, ce caractère suffit à caractériser l’espèce. Chez *Mexistenasellus coahuila*, qui est de taille bien plus réduite, la protubérance interne distale de l’organe copulateur existe également, mais glabre.

Le pleopode II de *M. parzefalli* ♂ est donc celui d’un *StenaseUllus* typique. Son endopodite biarticulé est toutefois caractérisé par une nette réduction en longueur du premier article, compensée par le développement inhabituel du second. Une telle tendance évolutive existe aussi dans les genres africains *Metastenasellus* et *Parastenasellus* plutôt que chez *StenaseUllus*. Ce pleopode II ♂ est nettement différent de celui de *M. coahuila*, espèce-type du genre américain, bien que l’organe copulateur, largement ouvert latéralement dans les deux cas, soit d’aspect primitif. Il sera intéressant de connaître le pleopode II ♂ des deux autres espèces de *MexistenaUllus*, dont la ♀ est seule connue, pour effectuer des comparaisons plus poussées.

Les pleopodes III, IV et V sont pratiquement identiques à ceux de la ♀. Les uropodes possèdent le même aspect exceptionnel, par suite d’un développement en longueur du protopodite aussi important que celui des deux rames, ce qui distingue *M. parzefalli* de tous les autres Sténasellides connus.

**OBSERVATIONS COMPLÉMENTAIRES SUR L’ESPÈCE**

1. Un rapide examen d’un individu détérioré a montré que l’espèce possède une seule paire de caecums entériques, comme les Sténasellides de l’Ancien Monde. Ceci distinguerait donc les *StenaseUllus* des *Asellidae* qui, eux, semblent toujours munis de 2 paires de caecums.

2. *Sur la taille de puberté*: Les 5 ♂ du lot ont tous atteint la conformation définitive de leurs pleopodes I et II. Les plus petits (7,5 et 7,7 mm), sont donc déjà des adultes. Parmi les ♀, au contraire, 3, mesurant 7,7 à 8,8 mm, sont encore dépour-
vues d’oostégitaires. Il semble que ces organes apparaissent pour une taille comprise entre 8 et 9 mm, chez *M. parzefalli*. Ceci confirme les observations réalisées sur *Stenascellus virei* et les formes voisines: l’aspect adulte n’est atteint, chez les ♀, que pour une taille déjà élevée, qui dépasse la moitié de la taille maximale de l’espèce. La période de vie juvénile est donc certainement très longue.

3. Caractères sexuels temporaires de la femelle:
Les oostégitaires fonctionnels, portés par les ♀ adultes, en intermues de repos génital, sont très comparables à ceux des autres Sténasellides, c’est-à-dire relativement longs.

Dans le lot ♀, se trouvent 4 grands individus à marsupium vide, qui avaient vraisemblablement libéré leur portée au moment de la capture. Les oostégitaires fonctionnels qui forment la poche incubatrice (portés à la base des péréiopodes I-IV) sont semblables à ceux des autres Sténaselles, mais, c’est sur les maxillipèdes qu’une observation intéressante a pu être faite:

4. Les oostégitaires du maxillipède de la femelle gestante:
On sait que le maxillipède des *Asellidae* est muni d’un grand épipodite subquadran-gulaire induré et muni de soies marginales. Cette production coxopodiale est permanente et identique chez les ♂ et les ♀. Le maxillipède des *Stenascellidae* est totalement dépourvu de cette formation et rappelle plutôt celui de certains Cirolanides, des Sphéromiens ou des *Microcerberidae*. La constance de ce caractère a été utilisée pour la diagnose différentielle des deux familles d’*Aselloidea: Asellidae* et *Stenascellidae*.

Chez les Asellides, le maxillipède de la ♀ adulte porte, en plus, un petit lobe coxopodial interne qui, lors de la mue parturiente, se développe en une palette sétigère (Wasserstrudelapparat ou Putzapparat des auteurs allemands), cf. Gravier 1931, p. 345 et Balesdent 1964, p. 52. Chez les Sténasellides, le maxillipède de la ♀ adulte porte également ce petit lobe interne, muni d’un muscle moteur. Mais, lors de la mue parturiente, il se développe en une grande lamelle glabre, de même aspect que les oostégitaires des péréiopodes I-IV (Racovitza 1924, p. 84).

Chez la ♀ gestante de *M. parzefalli*, il se développe sur le maxillipède, lors de la mue parturiente, non pas une, mais deux lamelles à aspect d’oostégitaire (fig. 2D). La première (1) interne, occupant la position de l’oostégité maxillipédién de *St. virei*; la seconde, externe, occupant la position de l’épipodite permanent des Asellides. Chez la ♀ de *M. parzefalli*, au repos génital, ces deux formations sont représentées par deux minuscules lobes, situés de part et d’autre du coxopodite du maxillipède (fig. 1C). Le maxillipède du ♂ en est totalement privé. De telles doubles formations temporaires sont déjà connues sur le maxillipède des ♀ gestantes de certains Isopodes Cirolanides et surtout de Sphéromiens cavernicoles, tels que *Caecosphaeroma burgundum* Dollfus. Elles ont été décrites et interprétées par Husson et Daum (1954). Il sera intéressant, lorsque les captures le permettront, de vérifier si ce curieux caractère sexuel temporaire du maxillipède de *M. parzefalli* ♀ se retrouve dans les autres espèces du genre américain ou chez d’autres formes tropicales de la famille. Ceci permettrait de savoir si sa signification est d’ordre systé-
matique ou plus simplement physiologique. Dans ce dernier cas, le grand développement des formations temporaires du maxillipède chez la ♀ gestante pourrait être lié à la nécessité d'assurer aux embryons un renouvellement très intense de l'eau du marsupium, les eaux souterraines tropicales se trouvant à une température élevée et étant particulièrement pauvres en oxygène.

RÉSUMÉ

Description du ♂ du Sténasellide cavernicole mexicain: Mexistenasellus parzefalli Magniez, 1972, provenant de la grotte Huizache, état de San-Luis Potosi, Mexique.

Chez les ♀ à poche incubatrice, le coxopodite du maxillipède porte deux expansions provisoires, à aspect d'oostégite, tandis que chez les ♂ des Sténasellides européens, on ne trouve que la lamelle interne. Ce caractère sexuel temporaire de la ♀ est connu chez d'autres Isopodes, en particulier le cavernicole Caecosphaeroma burgundum Dollfus.

SUMMARY

Description of the ♂ of the mexican cavernicolous Stenasellid Mexistenasellus parzefalli Magniez, 1972, from Huizache Cave, San-Luis Potosi State, Mexico.

In the ♀ with a brood pouch, the coxopodit of the maxilliped contains two provisional, oostegit-like plates, whereas the ovigerous ♂ of european Stenasellids have only the inner one.

This temporary sexual ♀ character is known in other Isopods, such as the cavernicolous Caecosphaeroma burgundum Dollfus.

BIBLIOGRAPHIE


Temperature Preference Responses of Some Aquatic, Cave-adapted Crustaceans from Central Texas and Northeastern México*

by

William R. ELLIOTT** and Robert W. MITCHELL***

INTRODUCTION

The purpose of this study was to determine the preference responses of five species of aquatic, cave-adapted crustaceans in a temperature gradient. We studied two species of gammarid amphipods, *Stygonectes hadenoecus* Holsinger and *S. russelli* Holsinger, and three species of isopods, an asellid, *Asellus reddelli* Steeves, and two cirolanids, *Cirolanides texensis* Benedict and *Specirolana bolivari* (Rioja). The first four species are from Texas, the last from Tamaulipas, México. The specific objectives of the study were to compare the temperature preference responses of these five species with those reported for other troglobites, and to speculate on the significance of the presence or lack of temperature discrimination in aquatic troglobites.

Relatively few studies on temperature-related behavior of cavernicoles have been done. Szymczkowsky (1953) reported an activity optimum of 6°-8°C for the troglophile spider, *Meta menardi*, but no preference data were gathered.

Edwards (1971) studied the temperature and relative humidity preferences of *Cryptocellus pelaezi*, a troglophile ricinuleid (Arachnida) from México. He found that this species preferred temperatures of 23.5°-28°C, corresponding closely to the temperature of Cueva de la Florida from which the specimens were collected.

Two studies have dealt with the temperature preferences of terrestrial troglobites. Mitchell (1971) reported that *Rhadine subterranea*, a carabid beetle from Central Texas, prefers temperatures cooler than its habitat in summer and prefers cave temperature (20°C) in winter. Mitchell suggested that this seasonal change of temperature preference serves to restrict the beetles to the cave except during that time when their chances for survival on the surface would seem best. Bull and Mitchell (1972) found that two troglobite millipedes from Central Texas, *Cambala specobia* and *Speodesmus bicornourus*, prefer temperatures between 15° and 26.5°C. However, *C. specobia* is more selective of relative humidities at or approaching saturation and of temperatures closely corresponding to that of caves which it inhabits than is *S. bicornourus* which is less tolerant of elevated

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temperatures and reduced relative humidities. Bull and Mitchell suggested that *S. bicornourus* is an older troglobite than *C. speobia* because it is less responsive and less tolerant to environmental variations and has a distribution which indicates that its surface ancestor colonized caves much earlier than that of *C. speobia*.

Thinès (1958, 1969) observed the behavior of *Caecobarbus geertsi*, a troglobite cyprinid fish, in a natural temperature-light gradient inside the entrance of Kavuaya Cave in the Congo. Temperature preference behavior was not evident until night, when the forty-three individuals (twenty-nine young and fourteen adults) remained 5 to 7.5 m inside the entrance at a temperature of 21.8°-22.8°C. During the day, the young were distributed throughout the light gradient, but the adults apparently responded to the light and remained in the interior of the cave.

Two laboratory studies have dealt with temperature preferences of aquatic troglobites. Mitchell (in press) found that the Central Texas cave planarian, *Sphallopiana zeschi*, from Zesch Ranch Cave, Mason County, has a temperature preferendum of 17°-24°C in a gradient of 15°-30°C, but that it is not very efficient at sensing and avoiding the extremes of the gradient, which are lethal to it. This planarian inhabits water of 21°-21.5°C. Mitchell concluded that *S. zeschi* is a more recent troglobite than *S. percoeca* (a northern and eastern troglobite in the United States, studied by Buchanan, 1936) because it can withstand moderate exposure to light, exhibits negative phototaxis and rheotaxis, rights itself rapidly, and has a well-defined temperature preferendum. In contrast, *S. percoeca* is intolerant to sunlight, displays no oriented movements when exposed to light or moving water, and takes longer to right itself. These characters can probably be ascribed to its greater degree of cave-adaptation. Unfortunately, the temperature preference responses of *S. percoeca* are unknown.

Johnson (1967) investigated four closely related populations of blind characin fishes, genus *Astyanax*, and their surface ancestor, *A. mexicanus*, from México. He reported a preferendum of 23°-30°C for all the populations he studied. These cave fishes inhabit waters of 21°-25.5°C.

Thus, all of the troglobite species mentioned above appear to have fairly well-defined temperature preferenda. The results for the aquatic species would seem to refute the hypothesis of Mitchell (1971) that troglobites which are imprisoned within caves should lose their ability to respond to variations in temperature, light, and relative humidity because of the relative constancy of the cave environment. Mitchell stated, “I would offer this hypothesis as appropriate only for those troglobites which are physically imprisoned in their subterranean habitats. Such troglobites would be primarily those aquatic species living in subterranean water systems which lack navigable connections with epigeal waters.” This hypothesis would apply to cave-dwelling *Astyanax* and *S. zeschi* because of the nature of the caves they inhabit. Regarding troglobites which are not imprisoned, he further stated, “I could, then, propose as a second general hypothesis that terrestrial troglobites and some aquatic ones possess a complex of behavioral responses which operate to restrict them in their cave environment.”
TEMPERATURE PREFERENCES OF CAVE CRUSTACEANS

HABITATS OF THE SPECIES STUDIED

We only studied aquatic populations which are effectively imprisoned in their respective cave habitats. To demonstrate the isolation of these populations from the epigeum, the cave habitats are described below.

Zesch Ranch Cave is located about 5 km southwest of Mason, Mason County, Texas. This small cave (about 12 x 18 m and about 9 m deep) is the only known locality for *Sphalloplilna zesi* Mitchell (1968) and one of fifteen known localities for *Stygonectes russeli* (Holsinger, 1966, 1967). The cave has a small pool at its west and deepest end, which has no direct connection to the epigeum, but which fluctuates in size and depth depending on the dryness of the surrounding area (Mitchell, in press). The cave has a pit entrance of sufficient depth (5 m) to imprison the aquatic fauna within the subterranean habitat.

Two collections of *S. russeli* were made in August and November, 1970. Water temperature varied from 21°-21.5°C. The pool has no direct communication with larger bodies of water and apparently is filled by the rise of lower-lying groundwater (Mitchell, in press).

*Stygonectes russeli* is placed in the *balconis* species group by Holsinger (1966, 1967) who thinks it is possible that this species is actually a group of very similar sibling species descended from a common, spring-dwelling ancestor which became extinct in Texas during the Pleistocene.

The Devil's Sinkhole is a deep pit-cave located 11 km east-northeast of Rocksprings, Edwards County, Texas. It is the only known locality for *Stygonectes hadenoecus* and one of thirteen recorded localities for *Cirolanides texensis* (Fig. 1) (Holsinger, 1966, 1967; Reddell, 1965, 1970). A new locality for

![Fig. 1. The distribution of *Cirolanides texensis* in Central Texas. A new record from Twin Pits Cave, Bexar County, is shown.](image-url)
C. texensis, Twin Pits Cave, Bexar Country, is shown in Fig. 1. The large pit entrance of Devil’s Sinkhole has a vertical drop of 42 m to the top of a large talus mound. The talus slopes steeply to two lake rooms which are situated between its periphery and the dome-shaped ceiling, 95 m below the surface. No other entrances to the cave are known (Reddell and Smith, 1965). Aquatic animals are truly imprisoned within this cave.

Two collections of *S. hadenoecus* and *C. texensis* were made in October, 1970, and January, 1971. *Stygonectes hadenoecus* was found only in the smaller of the lakes. This lake is floored with guano from an overhanging colony of Mexican freetail bat, *Tadarida brasiliensis mexicana*. *Stygonectes hadenoecus* is seasonally abundant in both lakes (Reddell, 1970), presumably because of the declining abundance of bats and fresh guano during winter. *Cirolanides texensis* was abundant in the larger lake but rare in the smaller lake in both October and January; at times it is abundant in the small lake. The larger lake is much deeper and probably communicates with the regional groundwater. Divers have reached depths of 12 to 24 m (Reddell and Smith, 1965). Both lakes varied from 18°C in October to 17°C in January.

*Stygonectes hadenoecus* was tentatively placed in its own species group by Holsinger (1966, 1967) who was undecided as to whether it was an ancient offshoot of the *flagellatus* group or a member of a distinct lineage. The former is unlikely because caves far from the Balcones Fault Zone (such as Devil’s Sinkhole) were available for colonization later than Fault Zone caves, and the *flagellatus* species are strictly Fault Zone cave-dwellers, indicating an early colonization time for their ancestor(s). Also, as Holsinger emphasized, geological discontinuities between Edwards County and the Fault Zone preclude dispersal of subterranean, aquatic animals between the two areas. The wide distribution of *C. texensis* (Fig. 1) argues for a relatively recent colonization by its ancestor (Mitchell and Reddell, 1971).

Jack’s Joint is located in Travis County about 40 km northwest of Austin. This small fissure-cave contains two amphipods, *Stygonectes bifurcatus* and *S. russelli* (Reddell, 1970) as well as an unrecorded population of the asellid isopod, *Asellus reddelli* Steeves, which we studied. The cave is about 43 m long and is almost horizontal. The floor gradually ascends stepwise by means of rimstone pools at the back. When first visited in September, 1970, water was flowing from the entrance of the cave and over a 3 m high drop about 2 m outside the entrance. Apparently the water flows only when heavy rains have seeped through joints in the approximately 10 m of overburden. The isopods were found about 30 m from the entrance in a relatively quiet, shallow pool. Specimens were collected on the first trip and again in February, 1971. In February no water was flowing from the cave, and the pool was 19°C. The September temperature was not taken but was probably lower than 19°C due to cool weather conditions.

This species is known from only four other Fault Zone caves (Reddell, 1970). In effect, the Jack’s Joint population is isolated even when the water flows because of the precipice outside the entrance. Those animals which might be washed out would not be able to return and would be lost to the gene pool. There would seem
to be little advantage for members of this population to have a well-developed
temperature sense restricting them to the cave. The temperature of the water would
not change appreciably in the short distance it flows between the entrance and “the
point of no return”. This isopod may be limited to the cave by means of positive
rheotaxy or negative phototaxy.

Grutas de Quintero is a large cave located about 2 km south of the town of
Quintero and about 11 km southwest of Ciudad Mante, Tamaulipas, México. It is
the type locality of *Speocirolana bolivari*, a large cirolanid isopod which we used in
this study. This species is known from two other localities in the Sierra Madre
Oriental (J. Reddell, pers. comm.). The cave also contains *Speocirolana pelaezi*, a
common cave species throughout the Sierra de El Abra in San Luis Potosí and
Tamaulipas. Although these two species cohabit pools in the cave, they may readily
be distinguished from each other: *S. bolivari* has much longer antennae, a more
truncated telson, and is usually more translucent and elongated.

This cave has about 1200 m of explored passage, half of which has been
surveyed (Russell and Raines, 1967). *Speocirolana bolivari* was collected from two
pools, 240 m and 285 m from the entrance, in January, March, and May, 1971. In
March, the temperature of the first, smaller pool was 23°C and the larger pool was
25°C. We do not know what temperature fluctuations the water undergoes, but we
have previously recorded 24°C in one of the pools. The cave does not take surface
waters through its entrance but is a wet-weather resurgence for subterranean waters
which drain from the cavernous Sierra de El Abra immediately to the West.

MATERIALS AND METHODS

The temperature gradient apparatus used in this study was essentially that
described and illustrated in Bull and Mitchell (1972). Basically, it was an open
aluminum channel, housed in an insulated case in which a temperature gradient
could be established with electric strip heaters, a recirculating water-ethylene glycol
solution, and much associated equipment. Fitting precisely into this channel was a
Plexiglas insert 1200 mm long, 119 mm wide, and 60 mm deep (internal dimen-
sions). The bottom of the insert was covered with about 3 mm of black obsidian
gravel. Thirteen thermistor sensors were positioned at 10 cm intervals along the
center of the insert; with their tips touching the gravel. These thermistor sensors
served to delineate the insert into twelve areas such that the low and high
temperatures for each area could be read on a multi-channel transistorized thermo-
meter.

A gradient of 15°-30°C was used for all five species studied; *S. hadenoecus*
was also tested in a gradient of 10°-30°C. All species were tested in dechlorinated
tapwater. The four Texas species were tested in 15 mm deep water. *Speocirolana
bolivari*, being a larger animal, was tested in 20 mm deep water to insure that all
individuals were completely immersed.

The same insert was used for the control runs. Some control data were gathered
by allowing the entire apparatus to equilibrate with ambient temperature (20°C) in
a temperature control room. Other control data were gathered with the insert fitted into a separate wooden box with a 1.5 mm thick aluminum bottom beneath which were attached two electric heating belts equal in length to the insert. The heating belts were controlled by an Athenia Model 51 proportional temperature controller actuated by a thermistor sensor located in the center of the insert. This permitted the desired control temperature to be established independently of ambient temperature.

It is more accurate to describe the gradient established in the water as a temperature-oxygen gradient. Oxygen tensions at the ends of the gradient were determined by the Alsterberg modification of the Winkler method (Am. Public Health Assoc., 1960). Water was extracted with a syringe from the bottom of the insert. At 10°C the oxygen tension was about 7.5 ppm, at 15°C it was about 7 ppm, and at 30°C it was about 5 ppm. No attempt was made to eliminate this oxygen gradient because one would expect different oxygen tensions at different water temperatures under natural conditions.

Specimens were collected with small dip nets or by hand and were transported to the laboratory in polyethylene containers filled with water from their respective habitats. These containers were placed in polystyrene foam coolers to minimize sharp temperature changes en route. The Texas species were kept at 20°C in the laboratory as was the January collection of S. bolivari. We later suspected that the latter species may have acclimated to this temperature, which is 3-5°C cooler than its natural habitat. For this reason, the March and May collections of S. bolivari were kept at 24°C in a heated aquarium. All species were kept in darkness and infrequently fed pieces of crickets.

Before and after each experimental and control replicate the temperature at each thermistor sensor was recorded. Usually the temperature at each sensor varied no more than ±0.5°C in the experimental conditions. With S. bolivari the temperatures in the middle range of the gradient were occasionally upset as much as ±1.0°C by the end of the experimental replicate.

Forty-eight individuals of each species were tested in both gradient and control situations. In both experimental and control runs the animals were randomly introduced (with the use of a random numbers table) into the insert by area, facing the sides rather than the ends. The purpose of this was to avoid any positional or directional bias. The laboratory lights were then turned off, leaving the room in total darkness. After five minutes the number of animals in each area was counted by flashlight and recorded. Their positions were recorded every five minutes for two hours, yielding twenty-four observation periods for each replicate.

The two cirolanid species were each run in four replicates of twelve individuals. The other three species were run in six replicates of eight individuals each. Thus, for each species, there were 1152 observations made in both experimental and control situations. Stigongenes hadenoecus was run again in a gradient of 10°-30°C because its responses in the 15°-30°C gradient were difficult to interpret. The first experiment on S. bolivari was done with forty-eight individuals which had been kept at 20°C in the laboratory. Forty-eight other individuals, which were kept at 24°C, were used for the control run at 24°C and for a second experiment.
Experimental and control data for each species were compared by $2 \times 12$ contingency table analysis to determine whether they were significantly different. A computerized linear regression analysis (Sokal and Rohlf, 1969) was applied to each set of experimental and control data to determine if there was significant association of numbers of observations with areas of the gradient and if there were significant deviations of the data from a linear regression line. In three experiments in which the data did not fit a linear regression, a computerized stepwise polynomial regression analysis (Dixon, 1971) was employed to determine what degree of polynomial regression equation best fit the data. Fourth-degree polynomial equations were computed for each of the three experiments although we found that a quartic equation fit only one of the data sets the best and quadratic and cubic equations fit the other two the best.

RESULTS

The results of the experimental and control runs are presented as histograms (Figs. 2-6). In each histogram the ordinate represents the twelve areas of the insert and the temperature at each thermistor sensor (averaged over all the replicates). The abscissa represents the total number of observations recorded for each area.

Fig. 2 presents the results of the two experimental runs and the control results for *Stygonectes hadenoecus*. Inspection of the graph for Experiment 1 (15°-30°C) seems to indicate a preference for the cool end of the gradient and roughly increasing avoidance of warmer temperatures. One might conclude from this graph alone that this species prefers temperatures of 15°-20.5°C (76% of total observations), perhaps being strongest between 15° and 16.5°C (38% of total). This interpretation does not take into account the possibly large “end effect” which is evident in the control results. End effect, or edge effect, is the tendency for animals to concentrate at the boundaries on their enclosure, and the control data measure it. We also tested this species in a 10°-30°C gradient (Experiment 2) to determine if the apparent preference in Experiment 1 was consistent. Inspection of the graph for Experiment 2 indicates that this species does not prefer temperatures of 15°-20.5°C, and that it has no well-defined temperature preferendum. It is probable that the large number of observations for area 1 in Experiment 1 was the result of end effect. It is probable that the lack of end effect in area 1 of Experiment 2 was the result of a slight avoidance of the cold end. Both experiments show that this species markedly avoids temperatures above 24°C.

Contingency table analysis (Table 1) showed that each of the experimental data sets were different from the control data and from each other (P<.001). Linear regression analysis of the Experiment 1 data showed a significant linear relationship between areas of the gradient (independent variable) and numbers of observations (dependent variable) (P<.01). The y values (dependent variable) did not deviate significantly from the regression line (P>.05). Linear regression analysis of the Experiment 2 data showed no significant association of x and y values (P>.05) and there were no significant deviations from the linear regression line (P>.05). In the
### Table 1. 2 x 12 Contingency table analyses of experimental-control and experimental-experimental data

<table>
<thead>
<tr>
<th>Area of gradient chamber</th>
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<td><strong>S. hadenoecus</strong></td>
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<td>88</td>
<td>75</td>
<td>94</td>
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The table below shows the temperature preferences of cave crustaceans, specifically *S. bolivari*. The data from two experiments and a control group are presented in a 15°-30°C gradient.

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<td>(\chi^2 / 11 \text{ d.f.} = 55.78, P &lt; 0.001)</td>
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<td>(\chi^2 / 11 \text{ d.f.} = 79.45, P &lt; 0.001)</td>
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The control, x and y values were not significantly associated (P>0.05) but there were significant deviations (P<0.01), indicating curvilinearity, as can be seen from the graph. The conflicting results from the regression analyses on the two experiments indicate to us that *S. hadenoecus* behaves erratically in a temperature gradient and has no discernible thermal preferendum. It does, though, appear to avoid temperatures above 24°C.

Fig. 3 presents the experimental and control results for *Stygonectes russelli*. This species has no apparent thermal preferendum in a 15°-30°C gradient.

Contingency table analysis (Table 1) showed a significant difference between the experimental and control data (P<0.001). However, linear regression analysis showed there was no significant association of x and y values in either the experiment or control (P>0.05). The y values in the experiment did not deviate significantly from the regression line (P>0.05), but the y values in the control did (P<0.01). It may appear from the graph for the experiment that this species exhibited some response to temperatures of 18.5°-21.5°C. However, this small peak is only 30% of the total number of observations and does not demonstrate a temperature preference response. During the experiment, we made 55 observations on 41 different occasions of an animal or several animals clinging to the thermistor sensor at the cold end. There is a little doubt that in many instances these were the same animals from one observation period to the next. In one experimental replicate, there was at least one
Fig. 2. Experimental and control results for *Stygonectes hadenoecus*. 
animal clinging to the sensor at the cold end for 20 consecutive observations. This may have been the same individual each time. These animals were probably "cold-trapped", or lethargic and immobile from the cold. Cold-trapping in this species would lend support to the idea that this species is rather insensitive to temperature differences.

Fig. 4 presents the experimental and control results for *Asellus reddelli*. This species had no apparent thermal preferendum in a 15°C-30°C gradient.

Contingency table analysis (Table 1) of the experimental and control data showed a significant difference between the two (P<.001). Linear regression analysis showed no significant association of x and y values in either the experimental or control data (P>.05) and no significant deviations in the experimental data (P>.05). The y values for the control deviated significantly (P<.05). *Asellus reddelli* may avoid temperatures above 25.5°C slightly, but has no other perceivable temperature response.

Fig. 5 presents the results of the two experiments and the control for *Speotrirolana bolivari*. Experiment 1 was done on animals which had been kept in the laboratory at 20°C and Experiment 2 with animals kept at 24°C.
Contingency table analysis (Table 1) showed no significant difference between the two experiments (P>0.05). Both experiments were significantly different from the control (P<0.001). Thus, it appears that this species did not acclimate its temperature preference to lower temperatures (20°C) in the laboratory. However, inspection of the graph for Experiment 1 reveals a slight peak of occurrences in area 5, between 19° and 19.5°C. It is possible that a few individuals acclimated to laboratory temperature and lingered in this area. However, this is only conjecture.

Linear regression analysis for *S. bolivari* showed no significant association of x and y values for either of the experiments or for the control (P>0.05). However, all three had significant deviations (P<0.01). Stepwise polynomial regression analysis to degree four was applied to both sets of experimental data. A quadratic polynomial regression was found to have the best fit for the Experiment 1 data which showed significant curvilinearity (P<0.025). The equation described 63% of the variation. For the Experiment 2 data, a cubic polynomial regression was found to have the best fit and showed significant curvilinearity (P<0.005). The equation described 84% of the variation. Thus, it appears that this species has a rather weak but discernible temperature preferendum, about 20°-30°C (58% of occurrences in Experiment 1,
Fig. 5. Experimental and control results for Speocirulana boliviari.
63% in Experiment 2). In both experiments the greatest number of observations occurred in area 11 at 25.5°-27°C. This species seems to prefer its own cave temperature, roughly, yet its preference is weak enough to allow some end effect and possibly some mild cold-trapping. Slight avoidance of the warm end in both experiments indicates some degree of temperature selectivity also.

Fig. 6 shows the experimental and control results for *Cirolanides texensis*. As can be seen, this species has an obvious temperature preferendum of about 20°-30°C (88% of total observations). The greatest number of observations in a single area occurred between 22.5° and 23.5°C (23% of total). This species prefers temperatures 2 to 12°C warmer than the highest temperature recorded in its habitat (18°C).

![Graph](image-url) Fig. 6. Experimental and control results for *Cirolanides texensis*. 
Contingency table analysis (Table I) indicated a significant difference between the experiment and control (P < .001). Linear regression analyses of the experimental and control data showed a significant association of x and y values in the experiment (P < .01), none in the control (P > .05), and significant deviations for both (P < .01 for experiment, P < .05 for control). Stepwise polynomial regression analysis of the experimental data resulted in a quartic equation of very close fit (98% of variation explained). The data were highly significantly curvilinear (P < .001). Almost 68% of the variation was described by the linear term alone, reflecting the sharpness of the curve’s peak. There can be little doubt that this species has a very well-defined temperature preferendum.

DISCUSSION

Of the five species studied, three have no discernible, or at best, very weak temperature preferenda, one has a weak preferendum, and one has a strong, well-defined preferendum. The three species with no discernible preferenda probably responded somewhat to both extremes of the gradient. This is borne out by the fact that their responses were linear whereas the control data were curvilinear, and the fact that the experiments were significantly different from the controls. The differences may have resulted from avoidance responses, cold-trapping, responses to the oxygen gradient, or a combination of these phenomena.

There is a possibility that some of the species had temperature responses which were obscured by their responses to the oxygen gradient. If this were so, it would only show that their temperature responses were relatively weak. It appears that the temperature response of C. texensis was very strong because it is difficult to imagine why this species would prefer the oxygen-poorer end of the gradient. It might be objected that the large end effect at the cold end in Experiment 1 on S. hadenoecus, and in both experiments on S. bolivari, was enhanced by a response to the oxygen gradient. However, Experiment 2 on S. hadenoecus demonstrated no preference for the colder, oxygen-richer end of the gradient. The end effect at the cold end in both experiments on S. bolivari was not as large as in the control, which presumably had no oxygen gradient.

The avoidance of two extremes demarcates a preferendum, but such a demarcation was possible only for the two cirolanid species. Even though S. hadenoecus and A. reddelli had few occurrences in the warm end and relatively great numbers of occurrences in the cold end, these are not necessarily best explained as taxes. These may have only been kineses (cold-trapping in the cold end, and a rise in body temperature, metabolic rate, and locomotor rate in the warm end). Although these species may have responded to the extremes of such gradients as 10°-30°C or 15°-30°C, these extremes probably never occur in the caves they inhabit. Therefore, their responses to such extremes are unimportant to them in their natural habitats.

Two general explanations for the results of this study may be suggested. First, assuming that each of the species is isolated in a subterranean habitat, the
temperature fluctuations of each habitat may be more important than the degree of
cave-adaptation in determining the extent to which each species exhibits a
temperature preferendum. If these species are imprinted with a temperature sense,
the caves having the greatest temperature fluctuations may then have the aquatic
species with the least temperature specificity. However, this would not explain why
the Devil’s Sinkhole contains a species with a narrow preferendum (C. texensis) and
another with no discernible preferendum (S.hadenoecus). Also, the water tempera-
ture in Zesch Ranch Cave varies little, yet this cave is inhabited by S. russelli, which
has no discernible preferendum, and Sphalloplana zeschi, which has a well-defined
preferendum.

Mitchell’s (1971) hypothesis seems to better explain the behavior of these
species. The three species with no discernible preferenda have probably lost their
abilities to perceive and respond to spatial differences in temperature because
temperature is relatively constant in their habitats. The loss of thermoreceptors and
temperature-related behavioral traits would be analogous to the loss of eyes and
pigment, structures which are non-adaptive in cave animals. We could hypothesize
that species which have only entered the early stages of troglobitism, even though
imprisoned in the hypogaeum, may retain their temperature preference responses.
This would apply to both “recent” species and those which are older but which
have undergone slow rates of adaptation.

The explanation for the pronounced temperature preferendum of C.texensis
may lie in its geographic origin and ancestry. The Cirolaninae are predominantly
marine, all but one of the North American freshwater species being cave-dwellers.
Of the eleven North American cavernicole species, nine are from tropical or
semi-tropical areas. Cave cirolanids are commonly referred to as “marine relicts”
because their distributions are easily explained, in some cases, as a result of direct
colonization of subterranean waters by marine ancestors. Bolivar y Pieltain (1950),
Vandel (1964), and Bowman (1964) have discussed the origins of cave cirolanids.
Vandel said, “Les Cirolanides hypogés sont si voisins des formes marines que l'on ne
saurait douter qu'ils en dérivent directement. Mais ont-ils passé par un stade épiégé et
dulçaquiique? C'est ce à quoi nous ne saurions répondre actuellement.” However,
Mitchell and Reddell (1971) said, “C. texensis, like the stygonectid amphipods, as
suggested by Holsinger (1967), was probably derived from its marine stock through
the intermediacy of a freshwater ancestor, since marine waters receded from
Central Texas prior to the time of cave accessibility and never encroached upon the
area subsequently.” Bowman (1964) discussed the possibility of Antrolana lira
having been derived from a freshwater ancestor, but was undecided as to whether
this was an adequate explanation of the species’ distribution (it is known only from
one cave in Virginia). In view of the temperature preferendum of C.texensis, and
the species’ wide distribution in Central Texas, we suggest that this species had a
rather recent freshwater ancestor. We also suggest that its ancestor was of southern
derivation since the species prefers temperatures more characteristic of tropical
waters than temperate waters. Colonization may have occurred in Recent times
during the warming trend following the last glaciation.

Speocirolana bolivari is probably the descendant of a marine species which
TEMPERATURE PREFERENCES OF CAVE CRUSTACEANS

directly colonized caves along the front of the Sierra de El Abra, part of a massive Cretaceous platform. Uplift of the Sierra de El Abra occurred in early Tertiary times and was accompanied by recession of the sea from the area (Mitchell, 1969). Caves may have been available for colonization as early as Cretaceous times (Mitchell, Russell, and Elliott, in press). Thus, this species may have been a cave-dweller for a long period of time, yet it still retains a temperature preferendum. This may be the result of a slow rate of cave-adaptation. Mitchell (1969) has hypothesized that the rate of cave-adaptation in the tropics may be slower than in temperate or highland areas. Energy economization, being at a premium in caves of low food input, may accelerate the selective loss of non-adaptive, energy consuming structures and traits. Tropical and semi-tropical areas, with their relatively greater food abundance both on the surface and in caves, may have cave species which evolve troglobite features at a slower rate than temperate or highland cave species.

In conclusion, it would seem that a very constant temperature, through time, may not be necessary for truly imprisoned troglobites to eventually lose their responses to spatial temperature differences. We refer to aquatic troglobites which would have access to neither the epigeum nor deeper groundwater. If a cave were so formed that the water in it were shallow, and all of it underwent the same temperature fluctuations, there would still be no advantage in being able to sense and respond to temperature changes. An example of this would be Jack’s Joint. Asellus reddelli is imprisoned in this cave by the drop outside the entrance and probably has no access to lower-lying groundwater because of the way the cave floor rises toward the back. Water which comes indirectly from the surface may undergo temperature fluctuations depending on the weather. Since the cave is small, the water flowing through it would probably be of a uniform temperature throughout, and temperature changes would be fairly uniform throughout the cave. The aquatic fauna would have no “choice” as far as temperature is concerned. It is likely that similar situations exist elsewhere, such as springs and interstitial habitats, so that one might expect a loss of temperature selectivity for animals imprisoned in those habitats.

ACKNOWLEDGEMENTS

The authors wish to thank Mr. Clarence Whitworth and Mr. Kurt Zesch for allowing us to work in their caves (the Devil’s Sinkhole and Zesch Ranch Cave) and Mr. Greg Passmore and Mr. Glenn Darilek for new locality data and specimens of Cirolanides texensis. We are indebted to Dr. Laurence Fleming for identifying the specimens of Asellus reddelli, and to Dr. William Atchley, Mr. Mel Brownfield, Dr. Walter Conley, Mr. Jerry Cooke, Mr. Ronnie Fieseler, Mr. James Reddell, Mr. William Russell, Mr. Jon Vinson, and Mrs. Suzanne Wiley for their assistance.
The temperature preference responses of five species of troglobite crustaceans were studied in a 15°C-30°C gradient. *Stygonecetes hadenoecus*, *S. russelli*, and *Asellus reddelli* had no discernible temperature preferenda. *Speocirolana bolivari* had a weak preference for 20°C-30°C. *Cirolanides texensis* had a pronounced preference for 20°C-30°C, temperatures much warmer than that of its habitat. The lack of temperature preferenda in three species agrees with the hypothesis that imprisoned troglobites tend to lose responses to those environmental variables which are constant in caves. *S. bolivari* may retain its temperature selectivity because of a slow rate of cave-adaptation. It is hypothesized that *C. texensis* is recently descended from a tropical, epigean, freshwater ancestor.

**RESUME**

Le préférendum de température de cinq espèces troglobies de Crustacés a été étudié dans un intervalle compris entre 15° et 30°. *Stygonecetes hadenoecus*, *S. russelli* et *Asellus reddelli* ne présentent aucun préférendum de température notable. *Speocirolana bolivari* montre une légère préférence pour les températures de 20° à 30°. *Cirolanides texensis* possède un préférendum très marqué pour des températures comprises entre 20° et 30°, températures plus élevées que celles de ses habitats.

L’absence de préférendum de température chez trois espèces est en accord avec l’hypothèse selon laquelle les troglobies confinées tendent à perdre toute réaction à des variations des conditions du milieu qui sont constantes dans les grottes. Il semble que *S. bolivari* conserve sa sensibilité aux variations de température par suite d’un faible taux d’adaptation au milieu cavernicole. On peut admettre que les réactions de *C. texensis* signifient que cette espèce est issue récemment d’un ancêtre épiégé des eaux douces tropicales.

**REFERENCES**


TEMPERATURE PREFERENCES OF CAVE CRUSTACEANS


BOOKS RECEIVED


A general survey of species has shown that Tricladida Paludicola are abundant in the European fauna. Species from both the Planariidae and Dendrocoelidae families are present. The two families from this suborder are differentiated by the arrangement of their pharyngeal muscle fibers. In the internal part of the pharynx, the circular and longitudinal muscle layers are distinct from one another in the first family and are intermingled in the second one. The general anatomy of the copulatory apparatus and the morphology of its main components make possible the separation and classification of the genera. For most of them, the penis structure is the distinctive feature of the species.

I. – In Europe, seven genera of Planariidae are to be found; they include: *Dugesia*, *Plagnolia*, *Crenobia*, *Planaria*, *Polycelis*, *Phagocata*, *Atrioplanaria*. Only three of them are found in subterranean waters exclusively: *Plagnolia*, *Phagocata* (*Fonticola*) and *Atrioplanaria*.

The epigeous species are widely distributed and are common in most European rivers, springs and ponds, they include: *D. gonocephala*, *D. lugubris-polychroa*, *C. alpina* and *C. montenigrina*.

An American form, *D. tigrina*, has been introduced into Europe and becomes more widely spread every year. In contrast, two species of *Phagocata* are restricted to Lake Ohrid and are to be considered as strictly endemic forms. As a whole and with a few exceptions (*Phagocata vitta* and *P. albissima*) hypogeous Planariidae are more narrowly distributed than the epigeous one. However as far as the genera are concerned, *Atrioplanaria* is to be considered as widely distributed in Europe, but occurring in disconnected areas; it also occurs in Mediterranean islands. The species *A. notadena* is restricted to the region between La Tour-du-Pin and Strasbourg. *Plagnolia vandeli* is to be found in subterranean waters in the vicinity of the Ariège and the higher Garonne basins.

*Dugesia absoloni* on the one hand and *Polycelis benazzii* on the other hand are the only hypogeous species of these two cosmopolitan and widespread genera; but each of them has been collected only from a single cave.

Quantitative and qualitative results have shown that the Planariidae family is poorly distributed among the hypogeous aquatic fauna. Only fifteen species have been recorded as exclusive dwellers of subterranean waters.

Particular attention has been given to sexual reproduction. This seems to be the most common reproductive process among the species collected. In fact most of the hypogeous triclads are found sexually mature and belong to the Dendrocoelidae which display a very reduced power of regeneration.
Very few differences are noted in the genital apparatus of hypogeous and epigeous species. In hypogeous forms the ovaries produce a reduced number of large-sized cells. Copulation occurs frequently and lasts several hours contrasting with that of epigeous forms in which it lasts a few minutes only. Mating may occur repeatedly and frequently between two individuals, at any time of year.

Breeding and egg-laying were observed. Cocoons are ellipsoidal or spherical according to species, slightly pigmented and lacking a peduncle. Breeding period is different among hypogeous species. Some (such as *A. delamarei*) follow a seasonal cycle and egg-laying takes place from February to March, others may lay eggs at any time of the year.

Even though the course of embryonic development is the same for all triclads, it is important to note that it is much slower for hypogeous species. Two to six months are needed for full development of hypogeous forms, whereas only two to six weeks are necessary for epigeous species.

The number of youngs hatching from every cocoon is low (always less than eight); their length ranges between 0.7 and 4.5 mm.

Growth is slow. Two years are necessary to attain full size in *D. chattoni* and six months for *P. (Fonticola) vitta*.

Longevity is greater in hypogeous species than in epigeous species.

In low-permeability sediments, such as those found under certain rivers and the water tables, there are numerous biotopes favorable to hypogeous triclads. A year-around study of the populations of the Nert River yielded much data on the biotopes and biocenoses and the role of different factors influencing the establishment of an interstitial fauna. Three species of Planaridae, two genera of Gastropoda and 26 species of Crustacea have been collected in the Nert underflow. Some of these forms were already known as dwellers of the water tables associated with the river system (*Niphargus*, Copepoda), while others which were considered as very rare and restricted to the cave water (*Plagnolia, Stenaselella*) were collected in great number for the first time, because of the very efficient method used by the author.

The species which live in these water tables are often swept out of their biotopes by intermittent outflowing springs.

The study of high-permeability sediments has been restricted to the karstic system. In the caves of the upper, filtration area, some triclads can be captured occasionally, but they are restricted to the point where the water passes into the cave (Riusec, Plagnol de la Plagne, Montalibet and Betharram stations). These planarians are not very numerous and most of them are immature. They are thought to be transient specimens which have been displaced from their original biotope through the karstic system.

In contrast to this, cave rivers are suitable for the establishment of normal tricladd populations which include all stages in the life cycle (except cocoons). This was demonstrated by the study of the Goueil-di-Her cave. The cave river, the siphons and the pools of the main gallery have been prospected and the conditions of life of the triclads in running waters, in surface-layer sediments and deep interstitial lacunar systems have been described. It is in alluvial sedimentary biotopes only that normal populations can be maintained; 87% of the *Plagnolia* specimens collected
were found in these biotopes. By moving into the deeper layers of the sediments they can escape being displaced by the current during the flood season. In fact no hypogeous triclad~; can be found by filtering the water flowing out from this karstic system.


This bibliography, 158 pages in length and containing 2206 titles, is the result of searching over 200 cave and non-cave publications on a world wide basis. The editor has been selective and has omitted trip reports unless they add materially to the cave description. Great Britain predominates with 656 titles closely followed by the Americas with 422 titles clearly showing the sources of most of today's speleological literature.


_Bungonia Caves_ is an account of the history, exploration and scientific investigation of the caves located in the Bungonia Preserve, 130 miles southwest of Sydney, N.S.W., Australia. Within the several square mile area of the preserve, 121 caves and shafts have been located to date. These range from small crawlways, through larger caves such as Fossil Cave (430 ft. deep; 5300 ft. long) to the famed Efflux. The latter is only 70 feet long but has probably had more manhours spent in its excavation than any other cave of similar length.

The Bungonia caves are formed in Silurian limestone on the edge of the Bungonia Gorge 1200 feet deep, which bisects the area and which is one of the most remarkable limestone gorges of the world. As a whole the Bungonia caves tend to be more vertically developed than is common amongst the cave areas of the Eastern Highlands of mainland Australia. With few exceptions they are entered from the bottoms or lower sides of the closed depressions of the Bungonia plateau. Most descend in sharp drops either directly from the surface or not far below it. Adytum Pitch in Blowfly Cave has the longest straight drop of any cave on the Australian mainland – 155 feet. The famed Efflux is a perennial spring 650 feet below the rim of the gorge which serves as drainage for several of the larger caves. Entry at the Efflux should provide access to many of the lower passages in the Bungonia cave system. Since 1955 Benjamin S. Nurse has been directing the exploration of the Efflux which to date has resulted in the excavation of 400 tons of material in an attempt to negotiate a sump blocking access to known passages. The chapter devoted to this attempt, although accurate in detail, does not give due credit to the extraordinary human effort expended in blasting, digging and exploring the Efflux.
The beauty and integrity of Bungonia are currently being threatened by the development of limestone quarries at Marulan South on the northern side of the Bungonia Gorge. Already a scar is visible along the edge of gorge near the quarry while rubble and tailings have formed a talus slope spreading down toward the bottom of the gorge. G.J. Middleton has contributed a chapter that can be utilized as a good case history of the efforts of a regional speleological group in coping with the apathy of public officials and environmental disregard of quarry owners; in this case the Metropolitan Portland Cement Company. The “Battle for Bungonia” is far from over. The combination of a classic karst landscape, deep gorge, many caves with a distinctive fauna, and an area rich in early history make it imperative that the Bungonia Preserve remain intact.

The fauna of the caves is outlined in a chapter by Glennis Wellings (invertebrates), Elery Hamilton-Smith (bats) and Christopher Sonter (birds of the Bungonia region). A chapter by Joyce L. Whaite on the flora of the area includes a vegetational map of value to anyone interested in the ecological relationship of the cave fauna itself. The raison d'être of the whole volume are the descriptions and maps of all 121 caves, including a three page fold out of Fossil cave. This amounts to 45 pages of cave maps in addition to a 19” X 27” area map included in a pocket on the back end paper which is a composite surface and underground plan of the area. The maps are complemented by 55 photographs, comprising 24 plates, eight of which are in full, albeit sometimes hazy, color.

The maps, descriptions, photographs and text represent a truly joint effort of the Sydney Speleological Society. Thirty-five members of the SSS, plus a dozen or so members of four other neighboring speleological groups have contributed to the volume. To coordinate this complex an effort and still produce a volume that demonstrates continuity, few internal contradictions, and a high degree of readability without sacrificing scientific accuracy bespeaks intense effort on the part of the editorial committee. This care for production has extended to the printing and binding. Even though printed by offset lithography and letterpress the diagrams, maps and text are reproduced with exceptional clarity. The front end paper map plus all plates remain an integral part of the volume. Would that all speleological society volumes could be so well produced!

A comprehensive bibliography and index, plus reprints of a dozen inaccessible historical papers, complete Bungonia Caves. Aside from its thoroughness, this book is a first in other respects – the longest volume (seventeen chapters) yet published about an Australian cave system; the first hard back volume published by an Australian speleological society; and the first to have maps of every cave within the area described.
ABSTRACTS


In samples collected in the Postojna-Planina system, 35 true Chironomid species were identified, plus five species that could not be accurately determined due to paucity of collected specimens. The total amount of sampled specimens shows clearly a peak curve with a maximum density of population between 1 April and 15 May. This coincides with the first water — air thermal equilibrium. The most abundant species is Parametriocnemus stylatus, being widespread throughout the entire subterranean system, forming the chief part of the Chironomid population and with the most outstanding swarming activity.


More than eighty mineral species are known which have formed as the result of secondary chemical reactions in solutional limestone caves. The minerals are frequently the transitional and end products of carbonate wall rock — organic residue — ground water reactions. In some cases bacteria may play a critical role in the mineralization process. The ultimate source of heavy metallic ions is usually from sulfide minerals weathering in the overlying strata, and brought into the cave environment by circulating ground waters. Hydrothermal ground waters may bring concentrations of metallic ions from below.


Springs in karst areas may be difficult to detect. Because springs have less diurnal and annual variation of temperature than does surface water, temperature differences between such springs and other water should be detectable by remote infrared thermal sensing. A drainage basin in western Alberta, Canada, contains three large lakes which drain underground, and two of these had not been traced previously to known springs. In an attempt to locate air venting from a large known but inaccessible cave system, by using infrared line scanning from a light aircraft, a large spring discharging cold water into a lake was discovered. This probably is the outlet for untraced waters, and had not been known previously because its flow varied seasonally and was masked by the lake.

An outline of the basic principles and assumptions and some of the practical difficulties and limitations of the carbon-14 dating method is followed by a brief mention of some examples of its application to dating of material from caves. The relative stability for dating of the various materials and remains commonly found in caves is briefly discussed and some recommendations are given for collection of samples.


A model of competition for aquatic cave invertebrates in the southern Appalachians of the United States in which competition affects washout rate in the cave stream is presented. The model accounts for the two major generalizations about microdistributions of cave isopods and amphipods in the Appalachians: species distribution is uncertain and only one species is found in a habitat patch. The model also predicts the amount of habitat overlap various species pairs have. Experiments to verify the model were conducted in artificial streams.


The variation in form in stalagmitic and stalactitic structures is a function of physical and chemical conditions prevailing at the time of formation. Therefore it should be possible to deduce the paleo-climatic factors from the form of the structures. A theory is proposed based on an assumption concerning the morphology of the structures. It appears that the variety of forms can be derived from a small number of changes in physical and chemical parameters. Such parameters include gravity, the composition of the calcareous solution and the passage of carbon dioxide between water and air. A model is suggested in which the dependency of the growth rate and the cross-section of the structures can be deduced from the carbon dioxide concentration and the availability of the calcareous solution.


The Cave Basalt, a high-alumina pahoehoe flow containing numerous lava tubes, originated at the southeast flank of Mount St. Helens, southwestern Washington, and flowed down a stream valley incided in older pyroclastic flow deposits. In situ charcoal samples from two localities with lava tubes yield $^{14}C$ dates of 1,860 ± 250 years B.P. and 1,925 ± 95 years B.P. Detailed survey of 9,125 m of lava tubes, correlated with surface geologic mapping, yields several geomorphic relations of
basalt flows. Most of the lava tubes apparently formed between shear planes in laminar lava flow, although some tube sections show evidence that the roof formed by accretion of spattered lava in turbulent flow. Partial collapse of tube interiors reveals: (1) The wall separating the tube interior form the preflow country rock may be thinner than 25 cm. (2) Lava flows can erode the surface over which they flow. (3) Collapse of the tube interior can occur immediately after the tube has been drained of molten lava and before the walls cool completely. (4) Lava tubes may represent the thickest part of the lava flow, occupying topographic lows (stream channels). (5) Tubes can be modified extensively through accretion and erosion of later lava flows.


The earth is probably unique in the solar system in having an atmosphere of free water. Mars, the diameter of which is about half that of earth, has at the present time only a sparse atmosphere; and the Moon, with a diameter of only a quarter, has no atmosphere. It is therefore unlikely that sea caves or limestone solution caves, which are dependent on free water for their formation, exist on the Moon or on Mars unless their atmospheres were very different in the past. There is nevertheless evidence of extensive volcanicity and fracturing on both bodies, so that volcanic lava caves and tectonic caves are to be expected. The sinuous rilles of the Moon, which can be seen to be discontinuous in places, are thought by many scientists to be collapsed lava tubes. Since most lunar processes ceased long ago many such cave entrances are likely to be blocked by detrital material called regolith. By contrast, volcanism has occurred on the Martian surface during relatively recent times so that some openings there may be relatively fresh.


A summary of morphological, ecological, biogeographical and taxonomic studies indicates that Proasellus cavaticus should be split into four distinct species: P. cavaticus, which is limited to subterranean waters in karst massifs and certain resurgences; P. walteri, which is found typically in an interstitial habitat of the Rhône and Saône hydrographic basins; P. valdenis, which is limited to a strictly cavernicolous habitat in the karst terrain of the Jura and Alps; and P. strouhali, which is found in phreatic seeps and springs of the Danube basin. These four species plus P. franciscoli and P. synaselloides constitute the cavaticus group. A detailed description of P. cavaticus is followed by the differential diagnosis of the other species.

Examples of fully domesticated common beans (*Phaseolus vulgaris*) and lima beans (*Phaseolus lunatus*) were recovered from deposits in Guitarrero Cave in the Callejón de Huaylas, Ancash, Peru. Carbon-14 dates for stratum II, in which the earliest beans were found, range from 7680 - 280 to 10,000 ± 300 years before the present.


Climate exerts a universal dominant influence on ecology, but processes of karstification have an equally high ecological influence in carbonate rock regions. Development of karst features depends greatly on the degree to which water containing carbon dioxide has been able to move on and through carbonate rocks and remove some of the rock in solution. Distinctive features of many karst terranes include scarcity of soils, scarcity of surface streams, and rugged topography; less distinctive are the highly permeable and cavernous rocks, especially at the shallow depths. This high permeability gives rise to many practical problems; including (1) scarcity and poor predictability of groundwater supplies, (2) scarcity of surface streams, (3) instability of the ground, (4) leakage of surface reservoirs, and (5) an unreliable waste-disposal system. Natural karst processes in some carbonate rock regions have caused a greater restriction in the development of the biota than man can ever be suspected of causing.


The description of a fresh-water hydroid *Velkovrhia enigmatica*, n. g., n. sp., from the Cave of Planina in Slovenia, Yugoslavia. This genus possesses the characteristics of the family Bougainvilliidae plus some characteristics of the Haleciidae. The periderm does not produce a hydrotheca but a gonotheca around the primitive styloid. The animal lives in colonies, its growth is sympodial and it possesses a creeping stolon.


The skull of a juvenile baboon is described from a cave near Leba, Angola, where it occurred in a pink breccia of presumed Pleistocene age. The specimen is assigned to the genus *Parapapio* but remains indeterminate as to species and sex. The skull shows a depression fracture which seems to have been inflicted by the blow of a blunt object, most likely that of a weapon wielded by an australopithecine. The
caves of Leba are roughly the same age, the same limestone cave facies, and the same broad climatic region as the South African caves which abound in australopithecine remains. The Leba caves are thus a promising place to look for fossil baboons and also for fossil hominids. The Leba caves contain evidence for the former existence of *Australopithecus*.


Descriptions are provided and affinities discussed for three new species of *Pachychitra* Chamberlin (*P. grandis* n. sp., *P. Mexicana* n. sp., *P. similis* n. sp.), and one each of *Paravachonium* Beier (*P. superbun* n. sp.), *Leucochya* Chamberlin (*L. magnifica* n. sp.), and *Mexobisium* n.g., with type-species *M. paradoxum* n. sp. The status of the families Vachoniidae and Gymnobisiidae is clarified.


Three new species are described from caves in Mexico and Guatemala; *Aphrastochthonius parvus, A. verapasanus*, and *A. russelli*. This genus had previously been known only from one cave in Alabama, southern United States.


A description of a cave in crystalline limestone around the northwestern part of Lake Torneträsk (Sweden) and analysis of height distribution of the profiles.


A summary of collections in caves of the states of Chiapas, Guerrero and Veracruz. Although the terrestrial troglobite fauna is less well-developed than in more northern Mexico, there are still many troglobites of great systematic and zoogeographic interest. These include the blind scorpion, *Typhlochactas reddelli*; the troglobitic isopod *Typhlotricholigionoides aquaticus* from Cueva del Ojo de Agua Grande, Veracruz; the only blind crayfish described from Mexico, *Procamburus rodriguezi* and the blind crab *Potamocarcinus (Typhlossiluoplusiothelhpsa) mocinoi*. 

Subterranean fauna and subterranean water protection problems in karst areas. The protection of cave animals is important above all for scientific reasons. They are not put in jeopardy by intensive collecting but they are endangered by artificial elements which are encroaching on their environment. In effect, protection of cave fauna is to a large extent in accordance with the immediate interests of protection of all the inhabitants of the karstic areas; *i.e.*, the necessity to prevent pollution of waters in karst regions.


Presently submerged Bahaman stalagmites from Ben’s Hole on the western end of Grand Bahama Island can be used to date Pleistocene low sea level stands. Good precision was obtained using both $^{14}$C and $^{23}$OTh–$^{23}$U methods. The respective dates obtained were 21,900 ± 600 and 22,000 ± 350 YBP.


An attempt is made to analyse the planimetric morphometry of humid tropical karst in eight districts of east New Guinea. The geology, process environments and morphology of sample localities provide a background for judging the morphometric results. The morphometry section includes information on procedure, spatial dispersion and association analysis, and terrain differentiation; it concludes with a growth model for polygonal karst. Closed depressions completely pit the landscapes and, when limited on the basis of their topographic divides, form a cellular network termed polygonal karst. These cells tend more towards pentagons than hexagons. The streamsinks associated with the depressions have dispersion patterns that tend toward uniformity. This probably comes about through competition. Each polygonal cell is a solution depression that drains centripetally to an internal streamsink, and some striking morphometric similarities to “normal” drainage basins are observed.
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