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ON SOME NEW HIGH ALTITUDE, CAVE, AND ENDEMIC PSEUDOSCORPIONS (PSEUDOSCORPIONES, ARACHNIDA) FROM CROATIA AND MONTENEGRO

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Five new species of endemic and relict pseudoscorpions are described from caves in Croatia: *Neobisium chaimweizmanni* n. sp., and Montenegro, respectively: *Neobisium davidbengurioni* n. sp., *N. marcchagalli* n. sp., *N. goldameirae* n. sp. and *N. mendelssohni* n. sp. Their diagnostic characters are presented and analysed. The biogeographic, evolutionary and phylogenetic evidence of this species complex is briefly discussed.

KEY WORDS: Pseudoscorpions, *Neobisium*, cave fauna, evolution, biogeography, phylogeny, Croatia, Montenegro.

INTRODUCTION

Nowhere else in the Mediterranean region is the relief of the land more complicated than in the Balkan Peninsula. In fact, two mountain branches of the great Alpine Orogeny run round the Peninsula: the arc of the Carpathians and Balkan mountains in the north, and the Dinarids in the west and south (Aubouin, 1963). The western part of the Peninsula is dominated by the folds of the Dinarids which run NW to SE parallel and along the Adriatic and Ionian coasts, from the Eastern Alps in the north, to Greece and Crete, where they turn to the east, past the Aegean Cyclades and Sporades islands joining the Taurid chain in Asia Minor. They form the great southern branch of the Alpine Orogeny, which borders, on the east and north, the main part of the Peninsula. Together they constitute a large tectonic unity. The mountains are in close, parallel ranges occupying the western parts of Slovenia, Croatia, the whole of Bosnia and Herzegovina, Montenegro and Albania, western Serbia, western Republic of Macedonia and Greece. Some of the summits rise higher than 2,500 m (Cvijić, 1924, 1926; Ćurčić, 1988).

In the Dinaric Karst, all karstic phenomena are present; the development of the karst has been almost unlimited in the horizontal direction at the surface as well as in the vertical direction. The limestone series are folded and traversed by fissures, allowing erosion. The most instructive examples of the high karst are both in the Dinarids sensu stricto and Hellenids (Gavrilović, 1974).

The Dinaric region is not a single unit in hydrographic sense. Deep river valleys running down to the Adriatic Sea traverse land, dividing it into several subregions which are hydrographically independant from each other: the Carso Triestino, the Karst of Carniola and the karstic plateau of Lika; the karst of the Dalmatian mountains exemplified by Mts. Kozjak, Mosor and Biokovo with a pronounced underground relief; and the Holokarst between the valley of the river Neretva, Lake Skadar and the Adriatic Sea (in Herzegovina and Montenegro; e. g. Mt. Durmitor). Even a drop of water would not remain on the surface; all water sinks through various subterranean passages and drains subsequently towards the Neretva, the valleys of rivers Zeta and Morača, and Lake Skadar (Cvijić, 1924, 1926; Ćirić, 1960; Gavrilović, 1974; Ćurčić, 1988).

The terrestrial cave-dwellers (including pseudoscorpions) are usually the descendants of a tropical epigean fauna living in Eurasia and North America at the beginning of the Tertiary. The tropical fauna has subsequently disappeared from these regions. The species changed, were destroyed or emigrated towards the modern tropics. Only in deep soil and in caves have some species survived. Simultaneous karstification provided a wide variety of niches underground, resulting in a huge refuge for originally non-hypogean species. Additionally, a strict adaptation to life in deep soil (or euedaphism) developed as an adaptive response of originally humicolous pseudoscorpions to survival in either Mediterranean or boreal climates.

This study includes both descriptions, diagnoses and brief accounts on the evolution and paleozoogeography of five endemic and relict cave species of the family Neobisiidae; two of these, ***Neobisium chaimweizmanni*** n. sp. and ***Neobisium marcchagalli*** n. sp. inhabit caves on Mt. Mosor (Dalmatia) and at the edge of the Nikšić Polje (Montenegro), respectively. The remaining three species, all new to science: ***Neobisium davidbengurioni*** n. sp., ***Neobisium goldameirae*** n. sp. and ***Neobisium mendelssohni*** n. sp. are found in caves on Mt. Durmitor (Montenegro). Here are the results of a thorough analysis of the new taxa studied.

SURVEY OF NEW DINARIC PSEUDOSCORPIONS

Most investigators (Vandel, 1964; Vitali-Di Castri, 1973; Gavrilović, 1974; Ćurčić, 1988) consider that favorable conditions for the colonization of karst by pseudoscorpions were achieved as early as the beginning of the Paleogene, when parts of the Dinaric system had become dry land. During this period, fluvial and other erosion removed much of the Mesosoic carbonate series under the conditions of a tropical humid climate. The long period of warm climate over a wide area was favorable for the formation of karst hydrography. The Glacial Period brought a humid and moderately cold climate which did not halt karstification, but only slowed its development. Only above the High Pleistocene nival border did the karst process temporarily stop (Cvijić, 1924, 1926; Hadži, 1941; Deeleman-Reinhold, 1978; Ćurčić, 1988). All phyletic lineages of cave pseudoscorpions show parallel development particularly in the loss of pigment, reduction of eyes and elongations of the appendages and other body structures; in particular, these are of considarable length and are characterized by the extreme slenderness.

The subterranean fauna of Dinaric false scorpions is extremely rich in species, most of which occur in very small areas, so that any search in a new region potentially provides a new set of species. The present material has been collected by the late G. Nonveiller, A. Vučković, A. Milosavljević, I. Karaman and M. Popović over a period from 1935 to 1996.

SYSTEMATIC PART

NEOBISIIDAE J. C. CHAMBERLIN

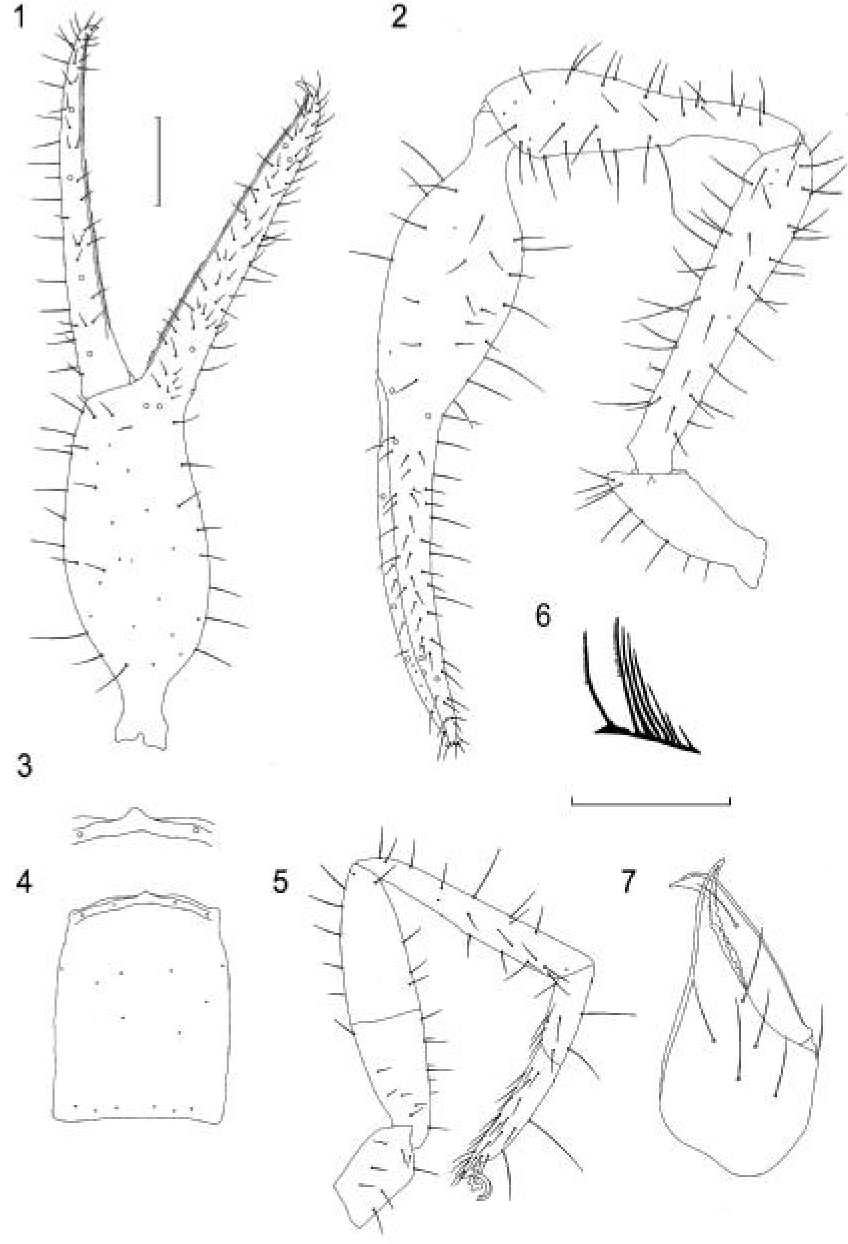
NEOBISIUM J. C. CHAMBERLIN

NEOBISIUM CHAIMWEIZMANNI B. P. M. ĆURČIĆ & R. N. DIMITRIJEVIĆ, NEW SPECIES
(Figs. 1-7)

Etymology. - After the name of a famous chemist and statesman, otherwise the first President of Isreal.

MATERIAL EXAMINED. Holotype **G**, CROATIA: Dalmatia, Mt. Mosor, Trojama Pit, 6. VIII. 1935, G. Nonveiller (IZUB 1400).

Description. - Carapace considerably longer than broad, epistome small and



Figs. 1-7. *Neobisium chaimweizmanni* n. sp. — Holotype male: 1 - pedipalpal chela; 2 - pedipalp; 3 - epistome; 4 - carapace; 5 - leg IV; 6 - flagellum; 7 - chelicera. Scale lines = 0.25 mm (Figs. 3, 6, 7) and = 0.50 mm (Figs. 1, 2, 4, 5).

tubercular (Figs. 3, 4). The mid-region of the anterior carapacal margin is slightly concave. Neither eyes nor eye spots are present; 'ocular' protuberances (lateral to the ocular setae) and preocular microsetae absent. Carapacal setal formula: 4 + 6 + 2 + 6 = 18 (male). Carapace sligthly reticulate throughout.

Tergal setation: 6-7-8-9-8-9-7-8-8-9. Male genital area: sternite II with 11 median and posterior setae, sternite III with 8 anterior and 10 posterior setae and 3 suprastigmatic setae on either side; sternite IV with 8 posterior setae and 2 or 3 suprastigmal microsetae along each of the stigma. Sternites V-X with 8-11-11-9-9-8 posterior setae. Female genital area: unknown. Twelfth abdominal segment with two pairs of small setae. Pleural membranes granulostriate.

Galea is a low hyaline convexity. Fixed cheliceral finger with six, movable finger with a single seta (Fig. 7). Galeal seta is inserted slightly proximal to the level of the large tooth on the movable finger. Fixed cheliceral finger with 9 or 11 small and irregularly shaped teeth, mobable cheliceral finger with 4 small distal and rounded denticles, one large tooth and a row of 5 or 7 triangular and close-set teeth which diminish from distal to proximal. Flagellum eight-bladed; only two distal blades are pinnate along their anterior margins (Fig. 6). Other blades smooth and acuminate and diminish in size from distal to proximal.

Apex of pedipalpal coxa (manducatory process) with 5 long setae. Trochanter with 3 or 4 minute interior tubercles. Pedipalpal articles smooth and slender (Figs. 1, 2); femur and tibia dilated distally; chelal palm ovate, chelal fingers elongated, slightly bent inwards. Pedipalpal femur with a minute anterior and lateral tubercle. Fixed chelal finger with 116 teeth: distally, these are subtriangular, somewhat pointed, but proximally they are close-set, narrower and lower. A number of most basal teeth are square-topped. Movable chelal finger with 101 small teeth; these are pointed, triangular, but proximal to the trichobothrium t the teeth become close-set and rounded. The teeth of the movable finger do not reach the level of the trichobothrium b. Chelal fingers longer than chelal palm. Pedipalpal femur slightly longer than chelal fingers.

Disposition of trichobothria: eb, esb, ib and isb on the finger base; it, est, ist and it in the proximal finger part. Setae b and sb in the basal, and st and t in the distal finger part. Distance sb-st is longer than either t-st or b-sb. Distance b-sb only slightly longer than t-st.

Anterior and median rim of coxa I with a protuberance carrying few small chitinous points. Trochanteral foramen small and transparent apically. Articles of leg IV attenuated (Fig. 5). Tibia IV with one long sensitive seta, basitarsus IV and telotarsus IV each with a single sensitive seta.

Subterminal tarsal setae furcate, each branch with few spinules. Morphometric ratios and linear measurements are presented in Table 1.

Diagnosis.- The species *N. chaimweizmanni* n. sp. is easily distinguished from *N. dalmatinum dalmatinum* Beier, 1939 (from different caves on Mt. Mosor, Dalmatia), in many important respects, such as the pedipalpal femur length (2.13 mm vs. 1.41-1.52 mm) and breadth (0.37 mm vs. 0.25-0.26 mm), pedipalpal tibia length (1.78 mm vs. 1.17-1.29 mm), pedipalpal chelal palm length (1.70 mm vs. 1.10-1.18 mm) and pedipalpal chelal finger length (2.10 mm vs. 1.48-1.63 mm), as well as in tergal and sternal setation, tergal dentition, disposition of trichobothria, as well as in the form of pedipalpal articles. From *N. dalmatinum aberrans* Beier, 1939 (inhabiting a single cave on Mt. Mosor, Dalmatia), the new species differs in the tergal setation, in the pedipalpal tibia (5.59-5.84 vs. 3.60), chelal palm (1.44-1.60 vs. 2.20) and in the pedipalpal chelal length/breadth ratio (6.685-7.05 vs. 4.60). Additionally, *N. chaimweizmanni* n. sp. is also separated from *N. dalmatinum* aberrans by the length of the pedipalpal femur (2.29-2.63 mm vs. 1.49 mm), by the pedipalpal tibial length (1.90-2.22 mm vs. 1.22 mm), by the pedipalpal chelal finger length (2.17-2.56 mm vs. 1.43 mm), as well as by the trichobothriotaxy and form of carapace and pedipalpal and pedal articles.

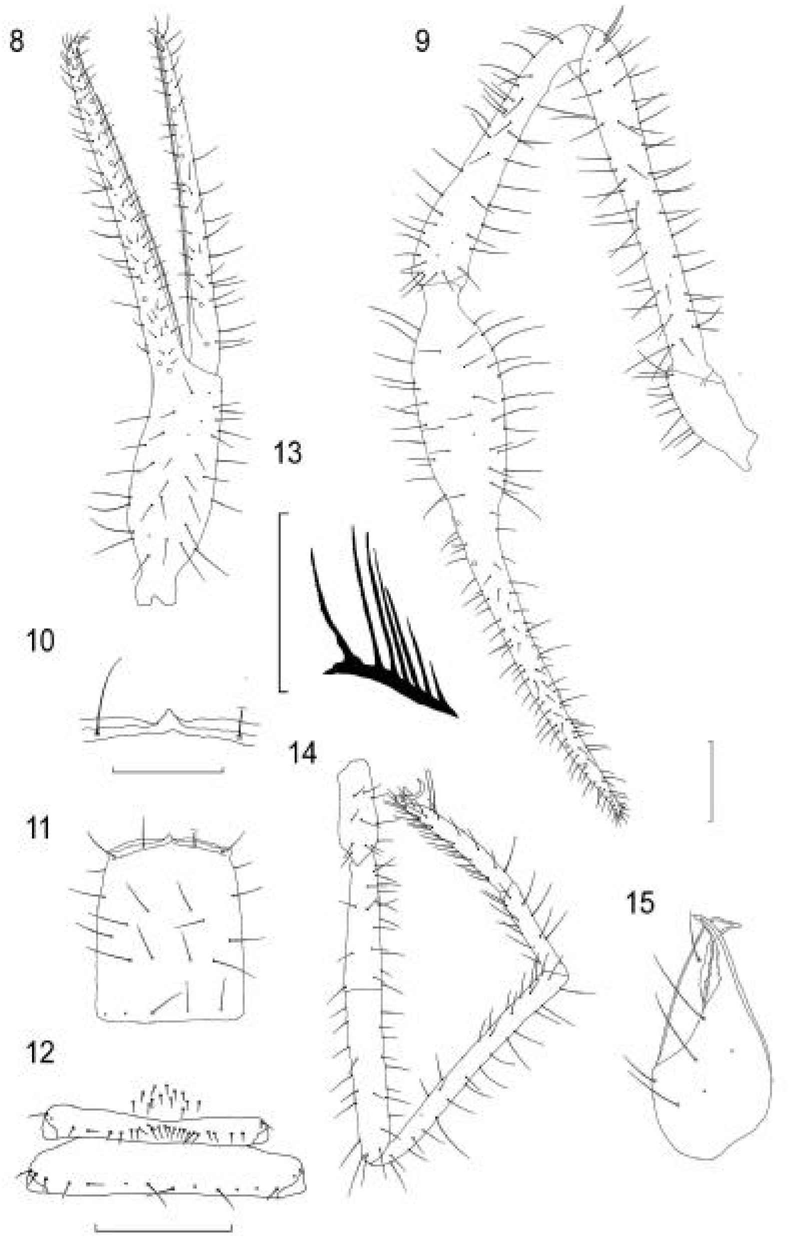
Distribution. - Croatia (central Dalmatia); probably a Tertiary form endemic to the western parts of the Dinaric Karst and, therefore, to the Balkan Peninsula.

NEOBISIUM DAVIDBENGURIONI B. P. M. ĆURČIĆ & R. N. DIMITRIJEVIĆ, NEW SPECIES (Fig. 8-23)

Etymology. - After the name of a noted politician and publicist, David Ben-Gurion, otherwise the first Prime Minister of Israel.

MATERIAL EXAMINED. Holotype **G**, SERBIA AND MONTENEGRO: Montenegro, Mt. Durmitor, Vjetrena Brda, Jama u Vjetrenim Brdima Pit, 23. vii. 1991, A. Vučković (IZUB 1401). Allotype **E**, SERBIA AND MONTENEGRO: Montenegro, Mt. Durmitor, Zeleni Vir, Zelenovirska Pećina Cave, 7. viii. 1992, A. Milosavljević (IZUB 1402).

Description. - Carapace longer than broad (Figs. 11, 19), epistome small and triangular (Figs. 10, 18). Eyes/eye spots absent. A single mesoseta is borne anterior to the place where each anterior eye would be developed. Setal carapacal formulae: 4 + 6 + 6 + 5 = 21 (female) and 4 + 7 + 6 + 5 = 22 setae (male). In fact, the normal formula is probably: 4 + 6 + 6 + 6 = 22. Carapace reticulate.



Figs. 8-15. *Neobisium davidbengurioni* n. sp. — Holotype female: 8 - pedipalpal chela; 9 - pedipalp; 10 - epistome; 11 - carapace; 12 - female genital area; 13 - flagellum; 14 - leg IV; 15 - chelicera. Scale lines = 0.25 mm (Figs. 10, 13, 15) and 0.50 mm (Figs. 8, 9, 11, 12, 14).

Abdominal tergites with 7-6-6-6-7-7-7-7-7-7 setae (female) and with 6-6-6-5-7-7-7-7-7-7 (male). Female genital area (Fig. 12): sternite II with 13 small median and posterior setae; sternite III with 23 posterior setae and with 2 or 3 suprastigmal small setae on either side; sternites V-X with 14-12-14-14-14-14 setae. Male genital area (Fig. 20): sternite II with 23 anterior and median setae, sternite III with 19 anterior and 21 posterior setae and 2 or 3 suprastigmatic microsetae on either side. Sternite IV with 11 posterior setae and 2 or 3 small setae along each stigma. Sternites V-X with 11-12-14-11-11-10 setae. Twelfth abdominal segment with two pairs of small setae. Pleural membranes granulostriate.

Galea of a low, but prominent, hyaline convexity. Fixed cheliceral finger with 14 or 15 small teeth of irregular form and size medially; the teeth are slightly interspaced but they gradually become contiguous and smaller both to distal and proximal sides. Movable cheliceral finger with 6 or 7 small distal irregularly shaped teeth, one large and rounded tooth, and a row of 5 teeth which eventually become lamellar (Figs. 15, 23). Flagellum of seven (female) or eight blades (male); only two distal blades are pinnate anteriorly; other blades are smooth and acuminate (Figs. 13, 22). The most proximal flagellar blade is the smallest.

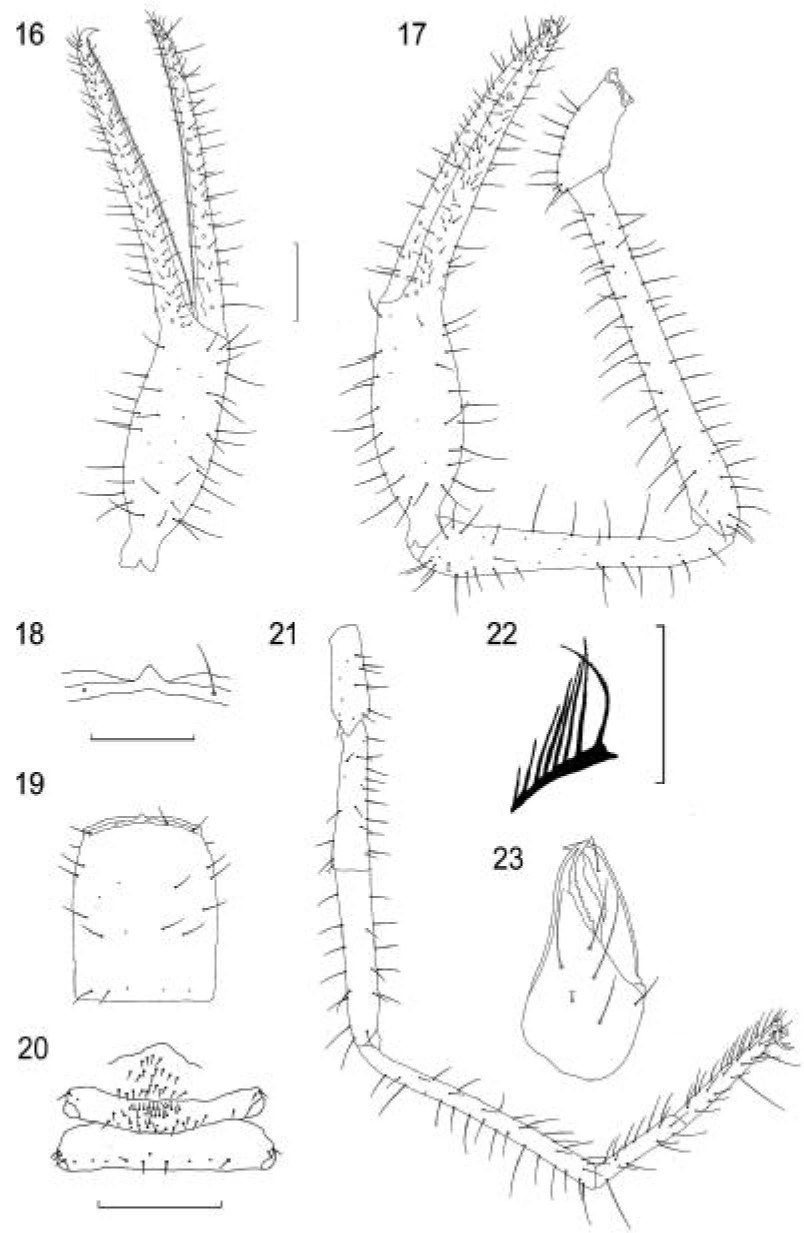
Manducatory process (apex of pedipalpal coxa) with 5 long setae. Trochanter with a small and low tubercle. Pedipalpal articles smooth (Figs. 9, 17), femur and tibia dilated distally. Pedipalpal femur with a small anterior and lateral tubercle, chelal palm slenderly ovate (dorsal view) or with almost parallel sides (lateral view), chelal fingers attenuated (Figs. 8, 16). Fixed chelal finger with 123 (female) and 124 small teeth (male); these teeth are subtriangular but gradually these become lower, smaller and close-set, reaching the level of the trichobothrium ib. Movable chelal finger with 117 (female) or 115 small and close-set teeth (male); distally, these are pointed, subtriangular and retroconical. From the level of t backwards, they are gradually replaced by lower, rounded or square-topped teeth which end before the level of the trichobothrium b.

Trichobothriotaxy: eb, esb, ib and isb on the finger base, it, et and est on the finger top, ist closer to est than to ib. Setae b and sb in proximal, t and st in distal finger half. Distance sb-st three (female) or 1.5 times as long as b-sb (male) and more than twice as long as t-st. Chelal fingers considerably longer than chelal palm. Pedipalpal femur longer than chelal fingers (Table 1).

Anterior and medium rim of coxa I with a small protuberance carrying numerous chitinous points. All leg IV articles almost parallel-sided (Figs. 14, 21). Tibia IV with one (female) or two (male), basitarsus IV with three (female) and two (male), and telotarsus with two sensitive setae. Subterminal tarsal setae furcate, each branch with few spinules.

Table I
Linear measurements (in mm) and morphometric ratios in *Neobisium chaimweizmanni* n. sp. from Croatia, and in *N. davidbengurioni* n. sp., and *N. marcchagalli* from Montenegro. Abbreviations: M = male, F = female.

Character	*Neobisium chaimweizmanni*	*Neobisium davidbengurioni*		*Neobisium marcchagalli*	
	M	M	F	M	F
Body					
Length (1)	3.35	4.22	4.20	3.73	4.29
Cephalothorax					
Length (2)	1.26	1.23	1.12	1.00	1.08
Breadth (2a)	1.05	0.94	0.93	0.79	0.855
Abdomen					
Length	2.09	2.985	3.08	2.72	3.21
Chelicerae					
Length (3)	0.87	0.77	0.75	0.65	0.74
Breadth (4)	0.41	0.37	0.37	0.36	0.37
Length of movable finger (5)	0.55	0.49	0.50	0.50	0.52
Ratio 3/5	1.58	1.57	1.50	1.30	1.42
Ratio 3/4	2.12	2.08	2.03	1.805	2.00
Pedipalps					
Length with coxa (6)	9.79	10.085	9.25	8.725	8.855
Ratio 6/1	2.92	2.39	2.20	2.34	2.06
Length of coxa	1.05	0.94	0.95	0.88	0.93
Length of trochanter	1.03	0.845	0.79	0.79	0.77
Length of femur (7)	2.13	2.58	2.17	1.98	2.03
Breadth of femur (8)	0.37	0.28	0.28	0.29	0.305
Ratio 7/8	5.76	9.21	7.75	6.83	6.655
Ratio 7/2	1.69	2.10	1.94	1.98	1.88
Length of patella (tibia) (9)	1.78	2.06	1.81	1.57	1.61
Breadth of patella (tibia) (10)	0.46	0.305	0.34	0.35	0.35
Ratio 9/10	3.87	6.75	5.32	4.485	4.60
Length of chela (11)	3.80	3.66	3.535	3.505	3.515
Breadth of chela(12)	0.73	0.54	0.56	0.57	0.65
Ratio 11/12	5.205	6.78	6.31	6.15	5.41
Length of chelal palm (13)	1.70	1.61	1.47	1.46	1.51
Ratio 13/12	2.33	2.98	2.625	2.56	2.48
Length of chelal finger (14)	2.10	2.05	2.07	2.05	2.00
Ratio 14/13	1.235	1.27	1.41	1.40	1.32
Leg IV					
Total length	6.035	6.82	6.55	6.165	6.325
Length of coxa	0.73	0.61	0.62	0.60	0.585
Length of trochanter (15)	0.63	0.70	0.65	0.64	0.63
Breadth of trochanter (16)	0.305	0.21	0.23	0.23	0.23
Ratio 15/16	2.065	3.33	2.83	2.78	2.74
Length of femur + patella (17)	1.70	2.10	1.98	1.905	2.00
Breadth of femur + patella (18)	0.39	0.22	0.22	0.275	0.31
Ratio 17/18	4.36	9.545	9.00	6.93	6.45
Length of tibia (19)	1.59	1.77	1.70	1.54	1.59
Breadth of tibia (20)	0.22	0.13	0.13	0.17	0.17
Ratio 19/20	7.23	13.615	13.08	9.06	9.35
Length of metatarsus (21)	0.57	0.71	0.68	0.61	0.62
Breadth of metatarsus (22)	0.17	0.11	0.12	0.12	0.13
Ratio 21/22	3.35	6.36	5.67	5.08	4.77
Length of tarsus (23)	0.815	0.93	0.92	0.87	0.90
Breadth of tarsus (24)	0.15	0.10	0.11	0.13	0.15
Ratio 23/24	5.43	9.30	8.36	6.69	6.00
TS ratio - tibia IV	0.43	0.21	0.30	0.32	0.32
TS ratio - metatarsus IV	0.14	0.16	0.13	0.17	0.17
TS ratio - tarsus IV	0.44	0.49	0.455	0.435	0.40



Figs. 16-23. *Neobisium davidbengurioni* n. sp. — Allotype male: 16 - pedipalpal chela; 17 - pedipalp; 18 - epistome; 19 - carapace; 20 - male genital area; 21 - leg IV; 22 - flagellum; 23 - chelicera. Scale lines = 0.25 mm (Figs. 18, 22, 23) and 0.50 mm (Figs. 16, 17, 19-21).

All morphometric ratios and linear measurements are presented in Table 1.

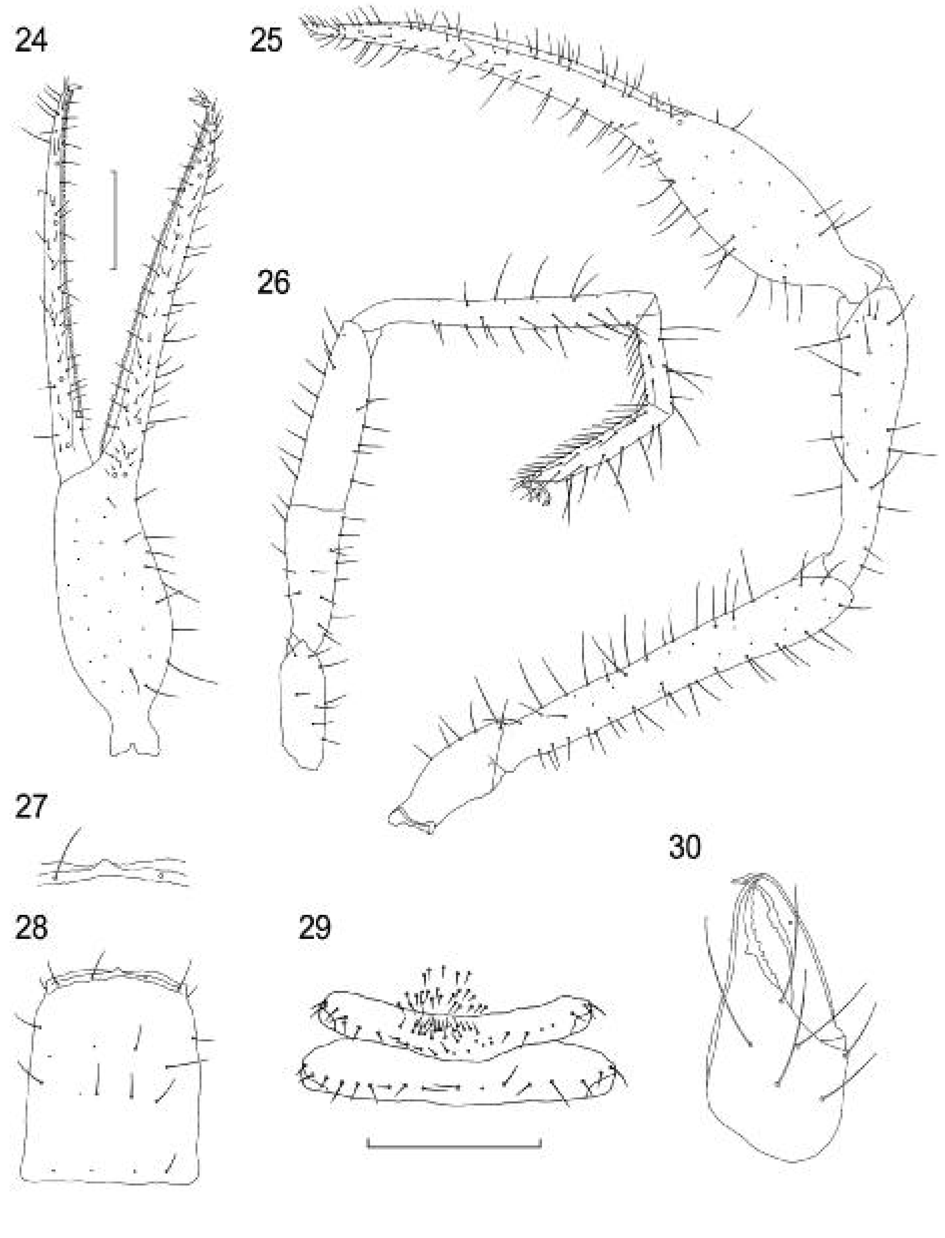
Diagnosis. - From its phenetically close congener, ***Neobisium umbratile*** Beier, 1939, from some caves in Montenegro, the new species differs in the form of the epistome (wide vs. triangular), in the presence/absence of the pedipalpal trochanteral tubercle (absent vs. present), in the pedipalpal femur length/breadth ratio (7.00 vs. 7.75-9.21), in the pedipalpal tibia (4.30 vs. 5.32-6.75), chelal palm (2.20 vs. 2.625-2.98) and in the pedipalpal chelal length/breadth ratio (5.50 vs. 6.31-6.78). The new pseudoscorpion is also distinct from ***N. umbratile*** in the length of pedipalpal femur (2.17-2.58 mm vs. 2.10 mm), tibia (1.81-2.06 mm vs. 1.70 mm) and chelal finger (2.05-2.07 mm vs. 2.35 mm), as well as in the form of pedipalpal articles, trichobothriotaxy, chelal dentition, and in the presence/absence of eye spots (absent vs. present). Furthermore, ***N. davidbengurioni*** n. sp. differs from ***N. temniskovae*** Ćurčić, 2002 from a cave in Montenegro by the form of the epistome (triangular vs. tubercular), in the carapacal setal formula (22 vs. 20 setae), setation of tergites I-X (7-6-6-6-7-7-7-7-7-7 vs. 4-7-6-6-6-7-7-10-10-10), in the number of teeth on the movable chelal finger (115-117 vs. 108), in the disposition of trichobothria, in the pedipalpal patella (5.32-6.75 vs. 4.92), pedipalpal chela and pedipalpal chelal finger to chelal palm length/breadth ratio (1.27-1.41 vs. 1.49), as well as in the form of pedipalpal and pedal articles, different morphometric ratios and linear measurements.

Distribution. - This new species is a cave-dweller, inhabiting the subterranean environment (caves and pits) on Mt. Durmitor, northern Montenegro. Its origin is probably related to the influences of the great Alpine Orogeny, the suitable numerous paleoclimatic events, the evolution of the process of karstification, as well as to the subsequent development of numerous habitats and niches underground. It probably represents a Paleogene relict, the distribution of which is restricted to the Dinaric Highlands, or to the Mt. Durmitor Plateau.

NEOBISIUM MARCCHAGALLI B. P. M. ĆURČIĆ & S. B. ĆURČIĆ, NEW SPECIES
(Figs. 24-38)

Etymology. - After the name of Marc Chagall, a famous Russian-Jewish painter.

MATERIAL EXAMINED. Holotype **G**, SERBIA AND MONTENEGRO: Montenegro, Nikšić, Nikšićko Polje, Velja Peć Cave, 7. vii. 1996, I. Karaman (IZUB 1403). Allotype **E**, same data as holotype (IZUB 1404).



Figs. 24-30. *Neobisium marcchagalli* n. sp. — Holotype male: 24 - pedipalpal chela; 25 - pedipalp; 26 - leg IV; 27 - epistome; 28 - carapace; 29 - male genital area; 30 - chelicera. Scale lines = 0.25 mm (Figs. 27, 30) and = 0.50 mm (Figs. 24-26, 28, 29).

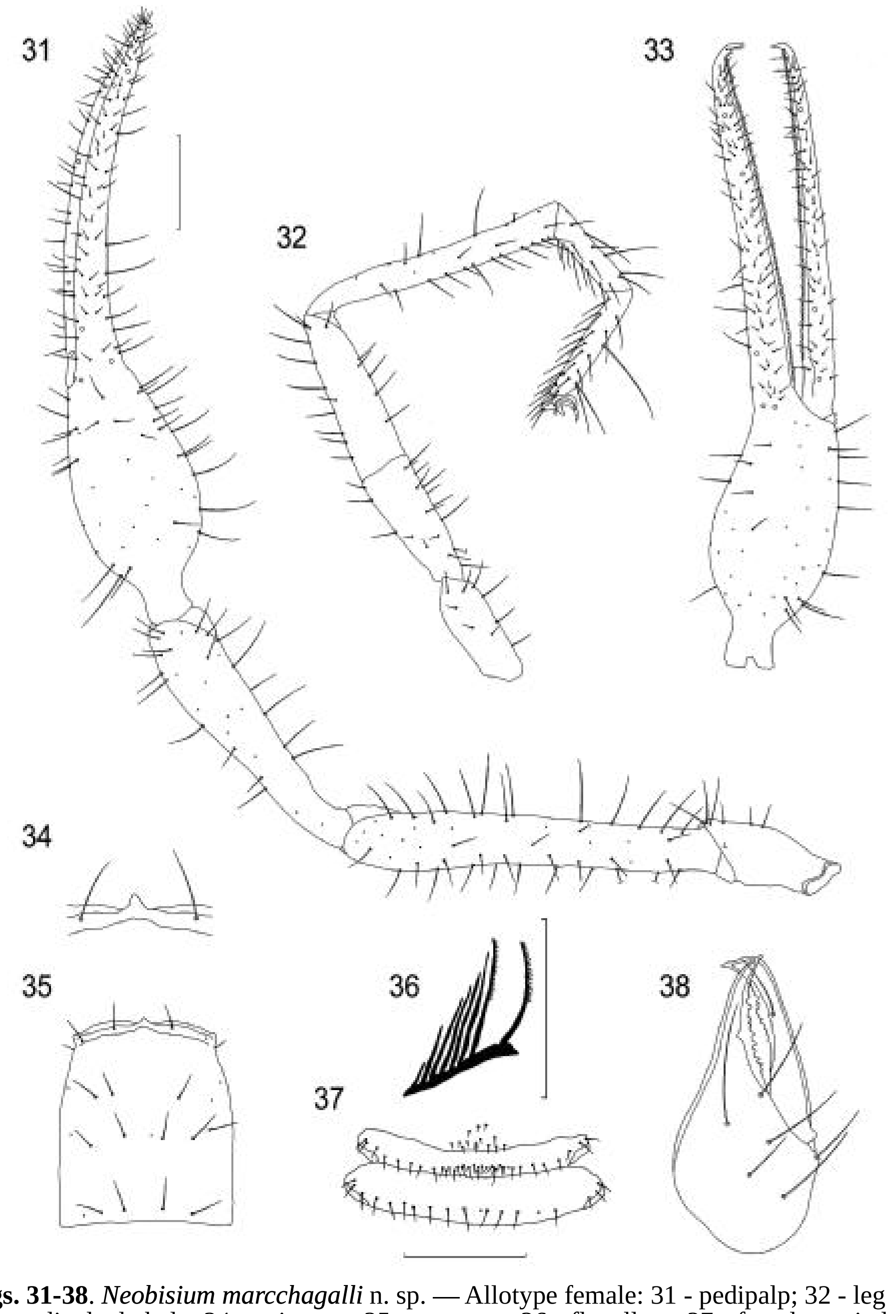
Description. - Carapace is longer than broad (Figs. 28, 35). Neither eyes nor eye spots are developed. Preocular microsetae present (one on each carapacal side). Epistome small, tubercular, or apically rounded (Figs. 27, 34). Setal carapacal formulae: 4 + 6 + 6 + 4 = 20 (holotype male) and 4 + 6 + 6 + 5 = 21 setae (allotype female). Carapace slightly reticulate throughout.

Abdominal tergites entire, uniseriate and smooth. Tergites I-X with 4-6-6-6-6-9-8-8-9-9 (holotype male), and 4-6-6-6-8-8-9-9-9-9 (allotype female). Male genital area (Fig. 29): sternite II with 24 small median and posterior setae; sternite III with 22 anterior and 16 posterior setae, sternite IV with 11 posterior setae. Sternite III with 1-3 suprastigmatic microsetae on either side, and sternite IV with 3 small setae along each stigma. Sternites V-X with 14-14-12-13-13-11 setae. Female genital area (Fig. 37): sternite II with 14 posterior and median setae, sternite III with 30, sternite IV with 13 setae, sternites III and IV each with 3 suprastigmatic small setae along each of the stigma. Sternites V-X: 11-11-11-8-8-10 setae. Twelfth abdominal segment with two pairs of small setae. Pleural membranes granulostriate.

Galea of a small elevation of the finger margin, more prominent in the allotype female. Cheliceral palm with six setae, movable chaliceral finger with a single seta. Fixed cheliceral finger with 14 (male) and 15-17 small teeth (female). The movable cheliceral finger carries some small distal teeth, one large trifid tooth, and a row of some slightly interspaced subtriangular and low teeth (Figs. 30, 38). Flagellum of 8 blades; only two distalmost blades are pinnate along their anterior margins. Other blades are smooth and acuminate, and the most proximal blade is the smallest.

Manducatory process (apex) of pedipalpal coxa with 5 long and acute setae. Pedipalpal trochanter with one or two small tubercles, pedipalpal femur with a minute anterior and lateral tubercle. Pedipalpal articles elongate and smooth (Figs. 25, 31). Chelal palm slenderly ovate (dorsal view). Pedipalpal femur and tibia elongated, widening distally. Chelal palm shorter than chelal fingers, tibia and femur. Fixed chelal finger with 104 (holotype male) and 107 (allotype female) small, contiguous and asymmetrically pointed teeth which reach the level of ib (Figs. 24, 33). Movable chelal finger bears 97 (holotype male) and 103 teeth (allotype female); only few distal teeth are asymmetrically pointed; basal to the level of t they become rounded and occupy the rest of the blade. The denticles on the movable finger do not reach the level of the trichobothrium b.

Trichobothriotaxy (both sexes): eb, esb, ib and isb close to the finger base; ist closer to the proximal than to the distal trichobothrial group. The distance sb-st less than twice as long as b-sb; t-st only slightly longer than or equal to b-sb.



Figs. 31-38. *Neobisium marcchagalli* n. sp. — Allotype female: 31 - pedipalp; 32 - leg IV; 33 - pedipalpal chela; 34 - epistome; 35 - carapace; 36 - flagellum; 37 - female genital area; 38 - chelicera. Scale lines = 0.25 mm (Figs. 34, 36, 38) and 0.50 mm (Figs. 31-33, 35, 37).

Leg IV: tibia IV with one long sensitive seta (and with further 3 shorter tactile setae), basitarsus with 1 longer (and 2 shorter) setae, and telotarsus with 1 long sensitive seta (Figs. 26, 32). Subterminal tarsal setae furcate, each branch with few spinules.

Morphometric ratios and linear measurements are presented in Table 1.

Diagnosis. - The cave species *Neobisium marcchagalli* n. sp. and *N. temniskovae* are well-distinguished in many important respects, such as the size of galea (present vs. almost absent), dentition of both fixed (104-107 vs. 116 teeth) and movable chelal fingers (97-103 vs. 108 teeth), length of tooth blade on the movable chelal finger (reaching the level of b vs. not reaching the level of b), setation of tibia IV (4 vs. 1 tactile seta), metatarsus IV (3 vs. one seta), as well as in many morphometric ratios: e. g. pedipalpal femur length/breadth ratio (6.655-6.83 vs. 8.649), pedipalpal tibia length /breadth ratio (4.485-4.60 vs. 4.92), pedipalpal chelal length/breadth ratio (5.41-6.15 vs. 6.42), as well as in many other morphometric ratios and linear measurements.

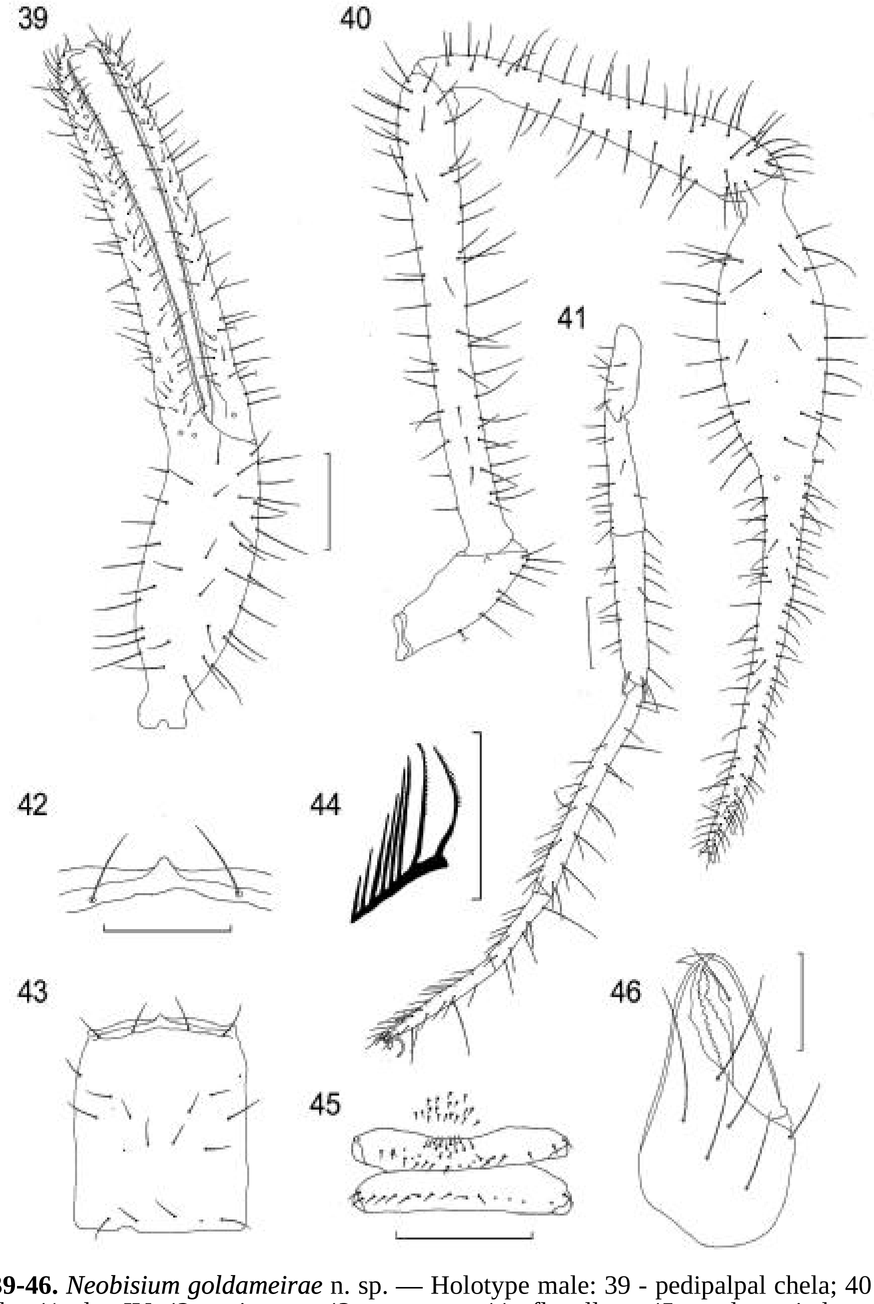
Distribution. - This is an endemo-relict cave inhabitant of the Nikšićko Polje in northwestern Montenegro. Its origin is to be sought among the proto-Balkan humicolous and detriticolous ancestors which had populated some humid and warm epigean habitats in the remote past of the dry land of the Peninsula.

NEOBISIUM GOLDAMEIRAE B. P. M. ĆURČIĆ & R. N. DIMITRIJEVIĆ, NEW SPECIES
(Figs. 39-60)

Etymology. - After the name of the Mother of Israel, Ms. Golda Meir, a noted Israeli politician and the former Prime Minister of the country.

MATERIAL EXAMINED. Holotype **G**, SERBIA AND MONTENEGRO: Montenegro, Mt. Durmitor, Grabovica, Arapova Pećina Cave, 16. viii. 1995, I. Karaman (IZUB 1405). Paratype tritonymph, same data as for holotype (IZUB 1406); paratype **G**, SERBIA AND MONTENEGRO: Montenegro, Mt. Durmitor, the Tara River Canyon, Pleće, Pećina u Pleću Cave (900 m a. s. l.), 2. vii.1990, M. Popović (IZUB 1407).

Description. - Carapace is longer than broad (Figs. 43, 50, 57). Neither eyes nor eye spots are developed. Preocular microsetae absent. Epistome small, triangular, or apically rounded and knob-like (Figs. 42, 49, 56). Setal carapacal formulae: 4 + 6 + 6 + 5 = 21 (holotype male), 4 + 6 + 6 + 6 = 22 (paratype male) and 4 + 6 + 6 + 5 = 21 (paratype tritonymph). Carapace slighly reticulate troughout.



Figs. 39-46. *Neobisium goldameirae* n. sp. — Holotype male: 39 - pedipalpal chela; 40 - pedipalp; 41 - leg IV; 42 - epistome; 43 - carapace; 44 - flagellum; 45 - male genital area; 46 - chelicera. Scale lines = 0.25 mm (Figs. 42, 44, 46) and 0.50 mm (Figs. 39-41, 43, 45).

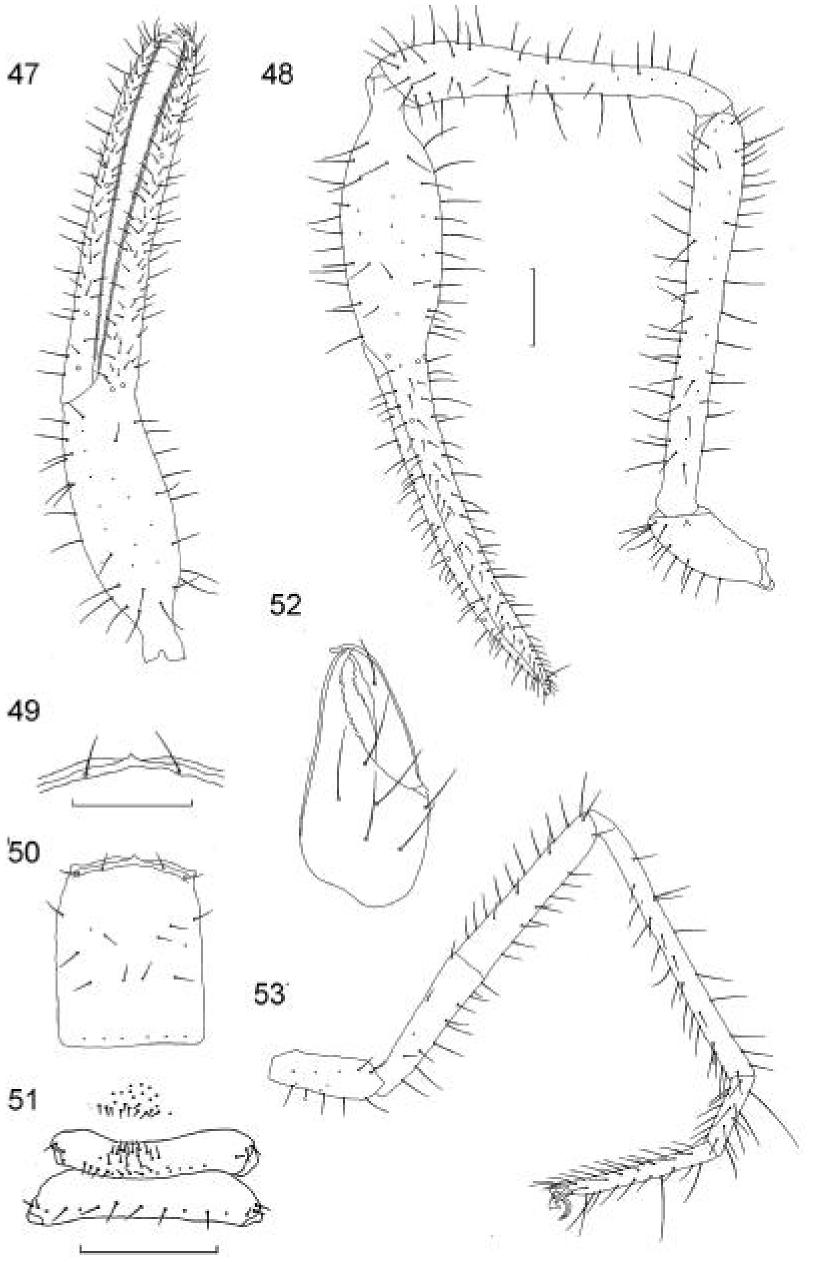
Abdominal tergites entire, uniseriate and smooth. Tergites I-X with 7-6-5-6-7-7-7-7-7-7 (holotype male), 6-6-6-8-7-8-6-9-9-8 (paratype male) and 6-6-6-7-8-9-9-9-9-7 (paratype tritonymph). Male genital area (Figs. 45, 51): sternite II with 19 (holotype male) and 24 (paratype male) median and posterior setae, sternite III with 14 or 16 anterior and 16 or 19 posterior setae, sternite IV with 10 or 12 posterior setae. Sternite III with 1 or 2 suprastigmatic microsetae on either side, and sternite IV with 2 or 3 small setae along each stigma. Sternites V-X with 10-13-11-11-11-9 (holotype male) and 14-15-14-13-11-10 setae (paratype male). Female genital area: unknown. Tritonymph: sternite II with 4, sternite III with 7, sternite IV with 9 setae, sternites III and IV each with 2 suprastigmatic small setae along each of the stigma. Sternites V-X: 13-14-14-15-12-10 setae. Twelfth abdominal segment with two pairs of small setae. Pleural membranes granulostriate.

Galea of an inconspicous elevation of the finger margin (males), more prominent in the tritonymph. Cheliceral palm with six setae, movable cheliceral finger with a single seta. Fixed cheliceral fingers with 13 (tritonymph) and 17 or 18 small teeth (males). The movable cheliceral finger carries some small distal teeth, one large trifid tooth, and a row of some slightly interspaced subtriangular and low teeth (Figs. 46, 52, 60). Flagellum of 7 (tritonymph) or 8 blades (males); only two distal blades are pinnate along their anterior margins (Figs. 44, 58). Other flagellar blades are smooth and acuminate, the most proximal blade being the smallest.

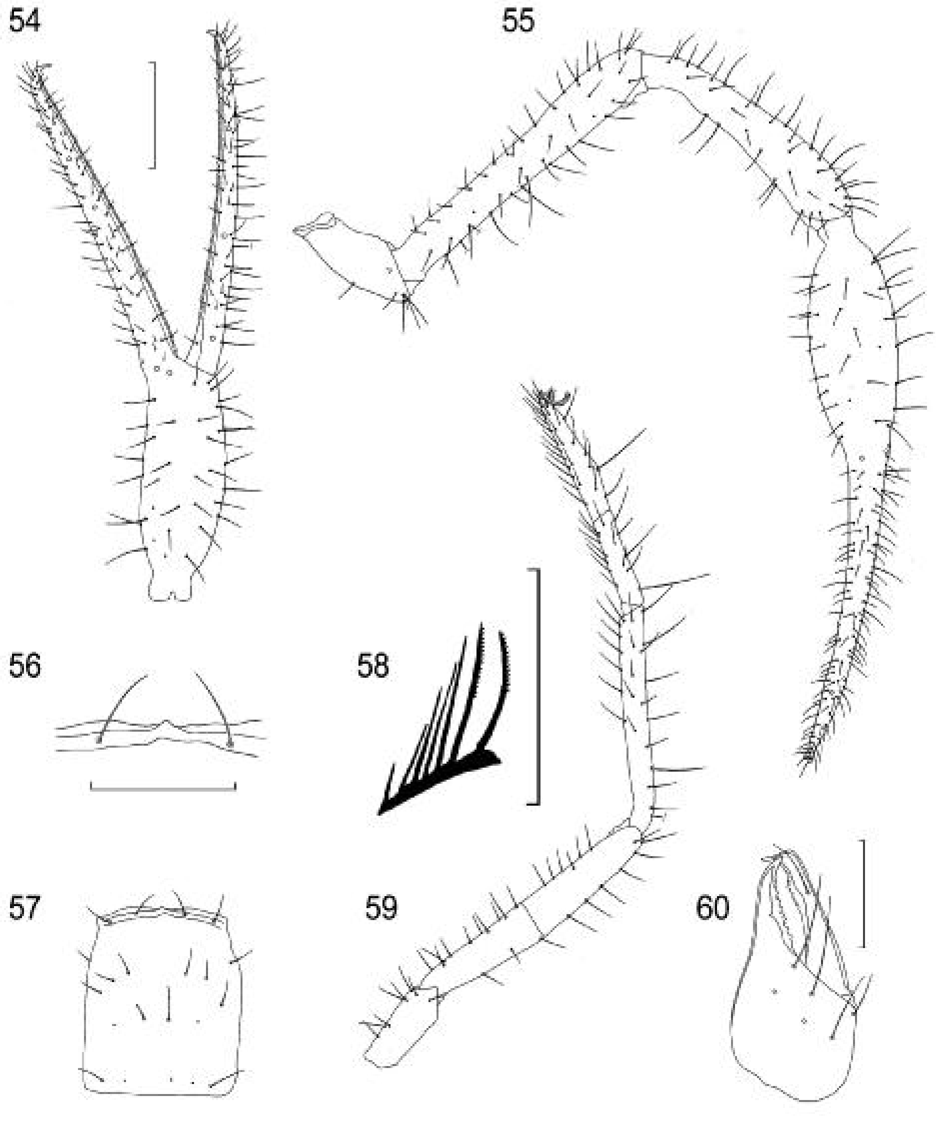
Manducatory process (apex) of pedipalpal coxa with 4 (tritonymph) or 5 long and acute setae (males). Pedipalpal trochanter with one or two small tubercles, pedipalpal femur with a minute anterior and lateral tubercle. Pedipalpal articles elongate and smooth (Figs. 40, 48, 55). Chelal palm ovate (dorsal view) or with almost parallel sides (lateral view). Pedipalpal femur and tibia elongated, widening distally. Chelal palm shorter than chelal fingers, tibia and femur. Fixed chelal finger with 114 (tritonymph) and 127-132 (males) small, contiguous and asymmetrically pointed teeth which reach the level of ib. Movable chelal finger bears 102 (tritonymph) and 123 or 124 teeth (males); only few distal teeth are asymmetrically pointed; basal to the level of t they become rounded and occupy the rest of the blade (Figs. 39, 47, 54). The denticles on the movable finger do not reach the level of the trichobothrium b.

Trichobothriotaxy (males): eb, esb, ib and isb close to the finger base; ist closer to the proximal than to the distal trichobothrial group. The distance sb-st twice as long as b-sb; t-st longer than b-sb.

Leg IV: tibia with one long sensitive seta (and with further 4 shorter tactile setae), basitarsus with 1 longer (and 2 shorter) setae, and telotarsus with 1 long sensitive seta (males) (Figs. 41, 53, 59). Subterminal tarsal setae furcate, each branch with few spinules.



Figs. 47-53. *Neobisium goldameirae* n. sp. — Paratype male: 47- pedipalpal chela; 48 - pedipalp; 49 - epistome; 50 - carapace; 51 - male genital area; 52 - chelicera; 53 - leg IV. Scale lines = 0.25 mm (Figs. 49, 52) and 0.50 mm (Figs. 47, 48, 50, 51, 53).



Figs. 54-60. *Neobisium goldameirae* n. sp. — Paratype tritonymph: 54 - pedipalpal chela; 55 - pedipalp; 56 - epistome; 57 - carapace; 58 - flagellum; 59 - leg IV; 60 - chelicera. Scale lines = 0.25 mm (Figs. 56, 58, 60) and 0.50 mm (Figs. 54, 55, 57, 59).

Table II
Linear measurements (in mm) and morphometric ratios in *Neobisium goldameirae* n. sp. and *N. mendelssohni* n. sp. from Montenegro. Abbreviations: M = male, F = female, T = tritonymph.

Character	*Neobisium goldameirae*		*Neobisium mendelssohni*	
	M	T	F	T
Body				
Length (1)	3.83-3.94	3.20	4.94	2.77
Cephalothorax				
Length (2)	1.11-1.20	0.90	1.30	0.76
Breadth (2a)	0.89-1.00	0.70	0.96	0.63
Abdomen				
Length	2.63-2.83	2.30	3.64	2.01
Chelicerae				
Length (3)	0.73-0.81	0.53	0.68	0.46
Breadth (4)	0.38-0.39	0.30	0.39	0.24
Length of movable finger (5)	0.45-0.51	0.38	0.49	0.285
Ratio 3/5	1.59-1.62	1.39	1.39	1.61
Ratio 3/4	1.92-2.08	1.77	1.74	1.92
Pedipalps				
Length with coxa (6)	9.625-10.97	6.83	7.975	4.64
Ratio 6/1	2.44-2.56	2.13	1.61	1.675
Length of coxa	0.97-1.00	0.71	0.93	0.56
Length of trochanter	0.855-0.96	0.63	0.805	0.48
Length of femur (7)	2.29-2.63	1.52	1.76	1.04
Breadth of femur (8)	0.275-0.33	0.23	0.315	0.20
Ratio 7/8	7.97-8.33	6.61	5.59	5.20
Ratio 7/2	2.06-2.19	1.69	1.35	1.37
Length of patella (tibia) (9)	1.90-2.22	1.29	1.41	0.79
Breadth of patella (tibia) (10)	0.34-0.38	0.25	0.37	0.22
Ratio 9/10	5.59-5.84	5.16	3.81	3.59
Length of chela (11)	3.61-4.16	2.68	3.07	1.77
Breadth of chela(12)	0.54-0.59	0.40	0.69	0.45
Ratio 11/12	6.685-7.05	6.70	4.45	3.93
Length of chelal palm (13)	1.44-1.60	1.06	1.43	0.72
Ratio 13/12	2.67-2.71	2.65	2.07	1.60
Length of chelal finger (14)	2.17-2.56	1.62	1.64	1.05
Ratio 14/13	1.51-1.60	1.53	1.15	1.46
Leg IV				
Total length	6.151-7.46	4.525	5.385	3.185
Length of coxa	0.60-0.71	0.46	0.66	0.39
Length of trochanter (15)	0.67-0.69	0.47	0.65	0.37
Breadth of trochanter (16)	0.22-0.25	0.18	0.24	0.15
Ratio 15/16	2.76-3.045	2.61	2.71	2.47
Length of femur + patella (17)	2.00-2.27	1.385	1.48	0.855
Breadth of femur + patella (18)	0.23-0.25	0.19	0.36	0.23
Ratio 17/18	8.695-9.08	7.23	4.11	3.72
Length of tibia (19)	1.61-2.03	1.12	1.355	0.69
Breadth of tibia (20)	0.14-0.15	0.12	0.18	0.13
Ratio 19/20	11.50-13.53	9.33	7.53	5.31
Length of metatarsus (21)	0.68-0.77	0.45	0.54	0.39
Breadth of metatarsus (22)	0.11-0.12	0.10	0.13	0.09
Ratio 21/22	6.18-6.42	4.50	4.15	4.33
Length of tarsus (23)	0.95-0.99	0.64	0.70	0.49
Breadth of tarsus (24)	0.11	0.10	0.10	0.09
Ratio 23/24	8.64-9.00	6.40	7.00	5.44
TS ratio - tibia IV	0.27-0.28	0.31	0.315	0.43
TS ratio - metatarsus IV	0.14-0.15	0.18	0.13	0.13
TS ratio - tarsus IV	0.38-0.42	0.33	0.49	0.43

Morphometric ratios and measurements are presented in Table 2.

Diagnosis. - From the phenetically close congener, *N. umbratile*, ***N. goldameirae*** n. sp. differs in many important respects: presence/absence of eye spots (present vs. absent), form of epistome (tubercular vs. triangular), presence/absence of pedipalpal trochanteral tubercle (absent vs. present), pedipalpal femur length/breadth ratio (7.00 vs. 7.97-8.33), pedipalpal femur (2.10 mm vs. 2.29-2.63 mm) and tibia length (1.70 mm vs. 1.90-2.22 mm). Additionally, the two species differ in the form of pedipalpal articles (more attenuated in ***N. goldameirae*** n. sp.), trichobothriotaxy, chelal dentition, as well as in many morphometric ratios and linear measurements of both pedipalpal and pedal structures.

Distribution. - This is an endemo-relict cave inhabitant of Mt. Durmitor in Montenegro. Its origin is to be sought among the proto-Balkan humicolous and detriticolous ancestors which had populated the Peninsula in the remote past.

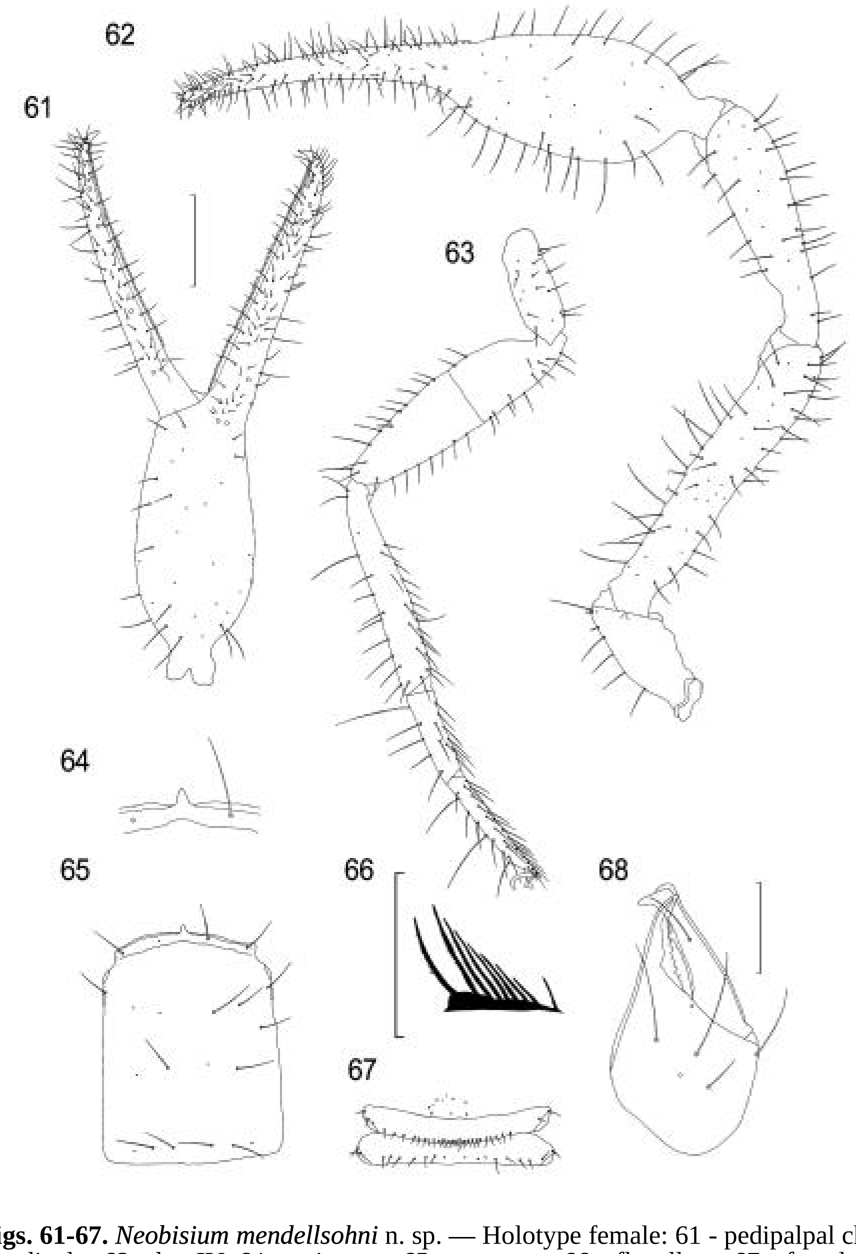
NEOBISIUM MENDELSSOHNI B. P. M. ĆURČIĆ & N. B. ĆURČIĆ, NEW SPECIES
(Figs. 61-75)

Etymology. - After Moses Mendelssohn, a great German-Jewish philosopher, otherwise the grandfather of the famous composer Jacob Ludwig Felix Mendelssohn-Bartholdy.

MATERIAL EXAMINED. Holotype **G**, SERBIA AND MONTENEGRO: Montenegro, Mt. Durmitor, Godijelji, 2. vii. 1991 (IZUB 1408). Paratype tritonymph, SERBIA AND MONTENEGRO: Montenegro, Mt. Durmitor, Pećina Gornja Ališnica Cave, 2. viii. 1992 (IZUB 1409).

Description. – Anterior carapacal margin slighly convex medially (Figs. 65, 73), with small subtriangular epistome (Figs. 64, 72). With two pairs of reduced and flattened eyes, posteriors considerably smaller than the anterior eyes. Setal carapacal formulae: 4 + 8 + 4 + 6 = 22 (tritonymph) and 4 + 6 + 5 + 6 = 21 setae (female). One or two small setae are carried in front of each anterior eye. Carapace reticulate.

Setation of abdominal tergites I-X: 6–8–8–8–9–9–10–10–9–9 (tritonymph) and 7–10–11–12–12–11–11–12–12–12 (female). Male genital area: unknown. Female genital area (Fig. 67): sternite II with ten setae, sternite III with 27 posterior setae and three microsetae on either side. Sternite IV with 14 posterior setae and three small setae along each stigma. Sternites V-X with 15–14–15–13–12–10 se-



Figs. 61-67. *Neobisium mendellsohni* n. sp. — Holotype female: 61 - pedipalpal chela; 62 - pedipalp; 63 - leg IV; 64 - epistome; 65 - carapace; 66 - flagellum; 67 - female genital area; 68 - chelicera. Scale lines = 0.25 mm (Figs. 64, 66, 68) and 0.50 mm (Figs. 61-63, 65, 67).

tae. Tritonymph: sternite II with 2 median setae, sternite III with 12 posterior setae and two small setae along each of the stigma, sternite IV with 10 posterior setae and two microsetae on either side. Sternites V-X with 11–12–11–9–9–8 setae. Twelfth abdominal segment with two pairs of small setae. Pleural membranes granulostriate.

Cheliceral spinneret well-developed. Fixed cheliceral finger with six acuminate setae, movable finger with a single long seta. Fixed cheliceral finger with 14 (tritonymph) and 17 small and interspaced teeth (female), triangular and square-topped, which diminish in size proximally and distally. On the movable finger 10 (tritonymph) or 12 teeth (in the form of a lamella; female) are present (Figs. 68, 75). Among them, a single median trifid big tooth is developed. Flagellum seven- (tritonymph) or eight-bladed (female) (Figs. 66, 74). Only two distal blades are pinnate or dentate anteriorly and the remaining smooth and acuminate blades diminish in size from distal to proximal. Galeal seta inserted basal to the level of the large tooth on the movable cheliceral finger.

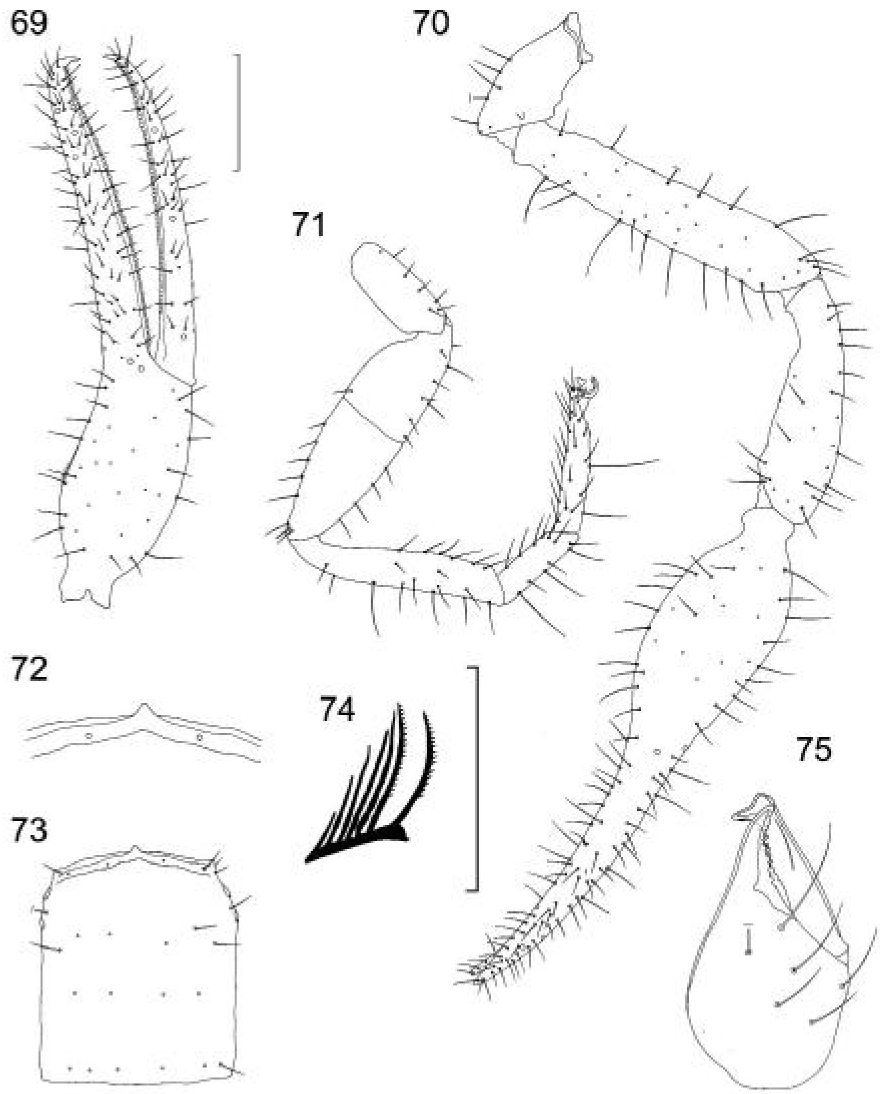
Manducatory process (apex) of pedipalpal coxa with 3 or 4 (tritonymph) and 5 long and acuminate setae (female). Pedipalpal articles smooth and attenuated (Figs. 62, 70). Pedipalpal trochanter with three (tritonymph) or one small interior tubercle (female). Femur with an anterior and lateral tubercle, which is barely visible. Both pedipalpal femur and tibia elongated. Pedipalpal femur as long as chelal fingers, but longer than carapace. Chelal palm subovate (dorsal view) or ellipsoid (lateral view). Chelal palm shorter than chelal fingers. Fixed chelal finger with 93 (tritonymph) and 96 (female) contiguous and asymmetrically pointed (retroconical) teeth, reaching the level of ib. Movable chelal finger bears 71 (tritonymph) or 79 teeth (female); only few distal teeth are asymmetrically pointed; basal to the trichobothrium t they become rounded and occupy the rest of the blade (Figs. 61, 69). The denticles on the movable finger do not reach the level of b.

Trichobothriotaxy: eb and esb on the base of the finger; ib, isb and ist in proximal finger half; ist closer to the proximal than to the basal group of trichobothria. Distance st-sb less than twice as long as b-sb, b-sb considerably longer than t-st.

Leg IV (Figs. 63, 71): femur and patella ovate and elongated; tibia with one long sensitive seta, basitarsus with one, and telotarsus with 2 long sensitive setae. Subterminal tarsal setae furcate, each branch with few spinules.

Morphometric ratios and linear measurements are presented in Table 2.

Diagnosis. – *N. mendelssohni* n. sp. is phenetically close to *N. marcchagalli* n. sp., both from caves in Montenegro. However, the former species has 4 eyespots



Figs. 68-75. *Neobisium mendellsohni* n. sp. — Paratype tritonymph: 69 - pedipalpal chela; 70 - pedipalp; 71 - leg IV; 72 - epistome; 73 - carapace; 74 - flagellum; 75 - chelicera. Scale lines = 0.25 mm (Figs. 72, 74, 75) and 0.50 mm (Figs. 69-71, 73).

(vs. none), less attenuated pedipalps (7.975 mm vs. 8.725-8.855 mm in *N. marcchagalli* n. sp.), considerably shorter pedipalpal femur (1.76 mm vs. 1.98-2.03 mm), tibia (1.41 mm vs. 1.57-1.61 mm), chela (3.07 mm vs. 3.505-3.515 mm), chelal fingers (1.64 mm vs. 2.48-2.56 mm), leg IV (5.385 mm vs. 6.165-6.325 mm), etc. Additionally, the two species also differ in the setation of tergites I (6 or 7 vs. 4 setae) and II-IV (8-12 vs. 6), dentition of the fixed chelal finger (96 vs. 104-107 teeth), as well as in a number of different morphometric ratios and linear measurements (Tables 1, 2) as well as in the form and structure of pedipalpal and pedal articles.

Distribution. – This species is probably troglophilic, since it inhabits both soil, leaf-litter, and caves. The presence of reduced eyes and cave habitus points to its active colonization of different underground habitats. It probably represents a Neogene form, whose members still inhabit epigean environment. It is presently distributed in the Mt. Durmitor Highlands in northern Montenegro, and represents both a Montenegrine and Balkan endemo-relict arachnid species of the Tertiary origin.

* * *

There exist clear distinctions between all new pseudoscorpion species studied from Montenegro. These differences have been presented in the descriptions and diagnoses of the new taxa, as well as in Figs. 1-75 and in Tables 1 and 2.

DISCUSSION AND CONCLUSIONS

Study of the evolution of the autochthonous species studied leads us to reconsider the origin and history of cave-living pseudoscorpions of the Dinaric Karst. Usually, such concepts were one-sided and concerned only with the age of species. Efforts were made especially to establish whether different endemic species are relicts, or to elucidate their origin, age, and the way in which they have survived. In his works on Mediterranean pseudoscorpions, Ćurčić (1974, 1986, 1988) concluded that the Tertiary (and some pre-Tertiary) pseudoscorpions have survived there almost intact.

It follows that pseudoscorpions lived on the floors of the ancient tropical and subtropical forests, which existed before the origin of caves in the areas studied. But, the present cave pseudoscorpions must have gone through a long evolutionary history, which resulted in the actual composition of this fauna. During that time certain species disappeared, other evolved at different geological times and many species underwent evolution underground, giving birth to new autochthones.

The composition of the old thermophilous fauna of pseudoscorpions was not uniform and regional differences no doubt existed. With the Ice Age, its distribution changed. Many species disappeared in Central and North Europe, Siberia and North America, mostly pushed south, into refuges, where climatic and other changes were less infavorable. This process must have been complicated and can not be explained only by climatic changes. It must have taken place with an uneven intensity in various parts of the northern hemisphere and must have extended over different groups of organisms. The disappearance of different pseudoscorpion species and genera was least intense in the shelters where the fauna was able to maintain itself. We recognize three main shelter zones: the Mediterranean, East Asia and North America. It is certainly in the first that are most relicts from the Tertiary epigean fauna (Kosswig and Battalgil, 1943; Guéorguiev, 1977; Ćurčić, 1986, 1988).

It is pertinent to note that the faunal exchange between Dinaric caves has been very limited, especially in the advanced phases of karstic evolution. This is due to their geographical position and to the adaptation of their inhabitants to the specific life conditions. However, these conditions have certainly changed during cave existence, but not in a manner to have provoked the disappearance of the majority of relicts. In addition, such changes have favored the divergent differentiation of cave pseudoscorpions.

It is now generally recognized that fundamental elements of the European fauna are of Angaran origin. Europe has indeed been apropriately described as a sort of zoogeographical appendage of Asia. However, contrary to this opinion of Mani (1968), Europe does not lack a proper distribution center for its fauna. In spite of the fact that the immediate relatives of the pseudoscorpion genera and species occur in Asia, it is actually the Balkan Peninsula that might be considered as one of the most important global centres of an extraordinary faunal (including pseudoscorpion) diversity, or the center of revitalisation of the whole European fauna after a rapid climatic subversion at the end of the Miocene (Hsü, 1972; Kober, 1952).

This study of new cave pseudoscorpions inhabiting the Dinaric Karst (Dalmatia and Montenegro) has offered further proofs of their great age and different origin. These species and genera represent the last vestiges of an old fauna, which found their shelter in the underground domain of the Balkan Peninsula and the adjoining regions.

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О НЕКИМ ВИСОКОПЛАНИНСКИМ, ПЕЋИНСКИМ И ЕНДЕМИЧНИМ ПСЕУДОСКОРПИЈАМА (PSEUDOSCORPIONES: ARACHNIDA) ИЗ ХРВАТСКЕ И ЦРНЕ ГОРЕ

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Пет за науку нових врста ендемичних и реликтних псеудоскорпија је дијагностификовано на бази узорака из пећина у Храватској (*Neobisium chaimweizmanni* n. sp.) и Црној Гори (*Neobisium davidbengurioni* n. sp., *N. marcchagalli* n. sp., *N. goldameirae* n. sp. и *N. mendelssohni* n. sp.). У овој студији су изнета и оригинална схватања о биогеографским, еволуционим и филогенетским особеностима наведеног комплекса врста.

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