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Two new cave-dwelling species of the false scorpion genus *Pseudoblothrus* Beier, 1931 (Arachnida: Pseudoscorpiones: Syarinidae) from the Crimean Peninsula

Два новых вида пещерных ложных скорпионов рода *Pseudoblothrus* Beier, 1931 (Arachnida: Pseudoscorpiones: Syarinidae) с Крымского полуострова

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KEY WORDS: Pseudoscorpion, new species, taxonomy, phylogeny, cave, speciation.

КЛЮЧЕВЫЕ СЛОВА: Pseudoscorpion, новый вид, таксономия, филогения, пещера, видообразование.

ABSTRACT. We provide a description of two new false scorpions species of the genus *Pseudoblothrus* Beier, 1931, *P. arcanus* sp.n. and *P. golovatchi* sp.n., from the caves of south-western Crimean Mountains. The species are morphologically similar, but differ in the presence of four eye spots, present in *P. arcanus* sp.n. and absent in *P. golovatchi* sp.n. The results of the phylogenetic analysis of the new species, including data for the third Crimean species *P. roszkovskii* (Redikorzev, 1918), are given. They show the differences between all Crimean species of the genus *Pseudoblothrus*. We discuss the reconstruction of a possible speciation scenario for the modern range of the genus *Pseudoblothrus* in Crimea. Most likely it is associated with certain features of regional historical geology and the results of paleoclimatic events that could affect speciation.

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РЕЗЮМЕ. Описывается два новых вида ложных скорпионов рода *Pseudoblothrus* Beier, 1931, *P. arcanus* sp.n. и *P. golovatchi* sp.n., из пещер, расположенных в юго-западной части Горного Крыма. Описываемые новые виды морфологически сходны, но отличаются наличием четырех глазных пятен у *P. arcanus* sp.n. и их отсутствием у *P. golovatchi* sp.n. Приведены результаты филогенетического анализа двух новых видов, в том числе с учетом данных по третьему крымскому виду *P. roszkovskii* (Redikorzev, 1918). Результаты филогении показывают достоверные различия между всеми крымскими видами рода *Pseudoblothrus*. Приводится реконструкция возможного сценария видообразования в пределах современного ареала рода *Pseudoblothrus* в Крыму, что скорее всего коренится с определенными особенностями региональной исторической геологии и последствиями палеоклиматических событий, которые в конечном итоге могли повлиять на процессы видообразования.

Introduction

Pseudoblothrus Beier, 1931 is a relict Euro-Mediterranean and Macaronesian false scorpions genus of the mostly tropical family Syarinidae Chamberlin, 1930, which is widespread in the caves of the Azores, Portugal, in the Italian, French, and Swiss Alps caves, and in the caves of the Crimean Mountains [Kolesnikov, Turbanov, 2018]. Such a sporadic, strictly subterranean distribution strongly suggests a relict status of the genus [Beier, 1970].

Our earlier morphological and molecular-genetic studies [Kolesnikov, Turbanov, 2018] allowed us to perform taxonomical and nomenclatural analyses. *P. ljovuschkini* Krumpál, 1984 and *Obisium tauricum* Lebedev, 1927, described earlier from the Crimean caves [Lebedev, 1927; Krumpál, 1984], were subjectively synonymized under *P. roszkovskii* (Redikorzev, 1918). Moreover, it was shown that the erroneous name

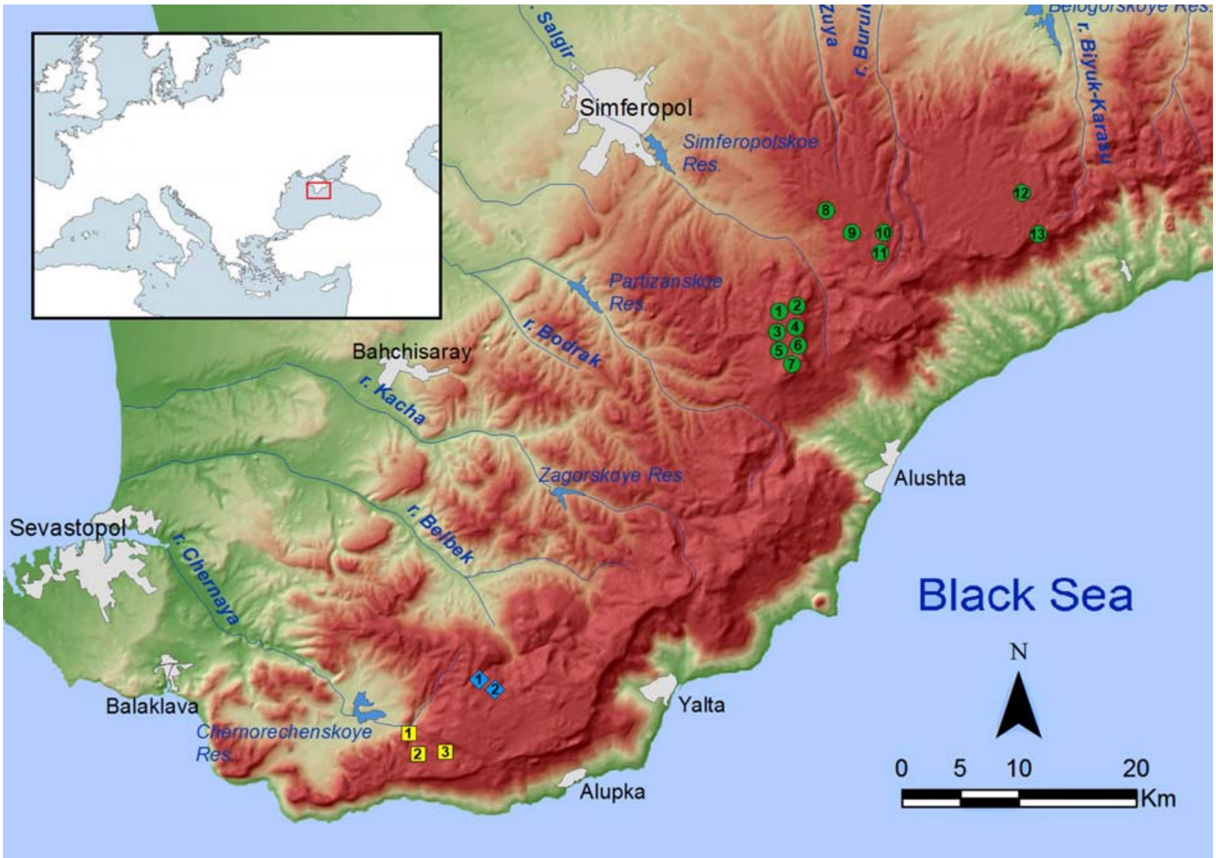

Fig. 1. Map of collection sites (caves) for the three species of the genus *Pseudoblothrus* in the Crimean Mountains: *P. arcanus* sp.n. (yellow square): 1 — Skelskaya; 2 — Kuznetsova; 3 — Kristalnaya. *P. golovatchi* sp.n. (blue diamond):1 — Villyaburunskaya; 2 — Kuban. *P. roszkovskii* (green circle): 1 — Suuk-Koba; 2 — Emine-Bair-Khosar; 3 — Emine-Bair-Koba; 4 — Triokhetazhnaya; 5 — Oziornaya; 6 — Paskhalnaya; 7 — Alushtinskaya; 8 — Kizil-Koba; 9 — Proval II; 10 — Partizanskaya; 11 — Vostotshny Potok; 12 — Egiz-Tinakh II; 13 — Tuakskaya.

Рис. 1. Карта мест сбора (пещеры) для трех видов рода *Pseudoblothrus* в Горном Крыму: *P. arcanus* sp.n. (желтый квадрат): 1 — Скельская; 2 — Кузнецова; 3 — Кристальная. *P. golovatchi* sp.n. (голубой ромб): 1 — Виллябурунская; 2 — Кубань. *P. roszkovskii* (зеленый круг): 1 — Суук-Коба; 2 — Эмине-Баир-Хосар; 3 — Эмине-Баир-Коба; 4 — Трехэтажная; 5 — Озерная; 6 — Пасхальная; 7 — Алуштинская; 8 — Кизил-Коба; 9 — Провал II; 10 — Партизанская; 11 — Восточный Поток; 12 — Эгиз-Тинах II; 13 — Туакская.

'*Obisium touricum* Lebedinsky, 1904', noted by Beier [1932b] and considered a *nomen nudum* in the latest global catalogue of Pseudoscorpiones [Harvey, 2013], was in fact proposed by Lebedev [1927], whereas nothing similar to that name is mentioned in the Lebedinsky's [1904] paper.

In addition, Lebedev [1914] mentioned the presence of *Obisium abeillei* Simon, 1872 in the Skelskaya Cave, the Ai-Petri Karst Massif, in south-western Crimea. This species now belongs to the genus *Neobisium* (*Blothrus*) Schiödte, 1847 [Beier, 1932a]. According to Pliginsky [1927], the reference to *O. abeillei* from the Skelskaya Cave should be considered as *Ideoblothrus roszkovskii* Redikorzev, 1918 (today, *Pseudoblothrus roszkovskii*, see Beier [1931]). However, our preliminary studies in the Skelskaya Cave allowed us to discover a new species of the genus *Pseudoblothrus*, which we described as troglobiont false scorpions of the family Syarinidae [Turbanov, Kolesnikov, 2015; Turbanov *et al*., 2016].

Further biospeleological research within the Ai-Petri Karst Massif allowed us to find false scorpions from the genus *Pseudoblothrus* in a number of other caves, and their detailed morphological and molecular-genetic study has showed that there are two new species, described here.

Material and methods

SAMPLING AND REPOSITORIES. We collected a total of 38 specimens from five caves in the Ai-Petri Karst Massif in the south-western Crimean Mountains: Kuban, Villyaburunskaya, Skelskaya, Kuznetsova (= Koryta), and Kristalnaya (= Maksimovitcha) caves (Figs 3A, C). We describe here two new species of the genus *Pseudoblothrus* based on the collected specimens. Moreover, we provide new data on the presence of *Pseudoblothrus roszkovskii* in a cave of the Dolgorukovsky Karst Massif. The map of the distribution of all three Crimean false scorpion species of the genus *Pseudoblothrus* is shown in Fig. 1.

Table 1. A list of the material, sampling sites and accession numbers of the COI mtDNA gene sequences included in this study. References are given for the sequences obtained from GenBank (NCBI).
Таблица 1. Список материалов, мест отбора проб и номеров доступа последовательностей генов мтДНК COI, включенных в это исследование. Ссылки даны для последовательности из GenBank (NCBI).

Species	**Locality**	**GenBank (NCBI) acc. no.**	**Reference**
Pseudoblothrus golovatchi sp.n.	Ai-Petri Karst Massif, Kuban Cave	MK423838	This study
Pseudoblothrus golovatchi sp.n.	Ai-Petri Karst Massif, Kuban Cave	MK423839	This study
Pseudoblothrus golovatchi sp.n.	Ai-Petri Karst Massif, Kuban Cave	MK423840	This study
Pseudoblothrus golovatchi sp.n.	Ai-Petri Karst Massif, Villyaburunskaya Cave	MK423841	This study
Pseudoblothrus golovatchi sp.n.	Ai-Petri Karst Massif, Villyaburunskaya Cave	MK423842	This study
Pseudoblothrus golovatchi sp.n.	Ai-Petri Karst Massif, Villyaburunskaya Cave	MK423843	This study
Pseudoblothrus arcanus sp.n.	Ai-Petri Karst Massif, Skelskaya Cave	MK423844	This study
Pseudoblothrus arcanus sp.n.	Ai-Petri Karst Massif, Skelskaya Cave	MK423845	This study
Pseudoblothrus arcanus sp.n.	Ai-Petri Karst Massif, Kuznetsova Cave	MK423846	This study
Pseudoblothrus arcanus sp.n.	Ai-Petri Karst Massif, Kuznetsova Cave	MK423847	This study
Pseudoblothrus arcanus sp.n.	Ai-Petri Karst Massif, Kristalnaya Cave	MK423848	This study
Pseudoblothrus roszkovskii	Caves of Tshatyr-Dagh, Dolgorukovsky and Karabi karst massifs, Crimean Peninsula	KY640598–KY640610	Kolesnikov & Turbanov [2018]
Chitrella cala DNA103116	USA	EU559551	Murienne *et al*. [2008]
Syarinus sp. DNA103120	Canada	EU559550	Murienne *et al*. [2008]

For sampling we used Barber traps [Barber, 1931]. All studied material was collected by the second author and Dr. Alexander G. Koval (All-Russian Institute of Plant Protection (FSBSI VIZR), Saint Petersburg, Russia).

The type material is deposited in the Zoological Museum of Moscow University (ZMMU), Zoological Institute of the Russian Academy of Sciences, Saint Petersburg (ZISP), Institute of Systematics and Ecology of Animals, the Siberian Branch of the Russian Academy of Sciences, Novosibirsk (ISEA), and the private collections of V. Kolesnikov (VK) and I. Turbanov (IT).

MORPHOLOGICAL CHARACTERS AND TERMINOLOGY. All pseudoscorpions taken were fixed with 96 % ethyl alcohol. For morphological studies using light microscopy, they were cleaned in pure lactic acid and temporarily mounted on microscopic slides. Some specimens were dissected for more detailed study of the chelicerae, pedipalps and legs I and IV. All drawings were made from microscope preparations using an RA-4 drawing tube attached to a Biomed 6 variant 3 microscope. After study, each sample, together with dissected body parts, was returned to the tube containing 96% ethanol.

The measurements are given in millimetres (mm) and were taken with an ocular micrometer using the reference points proposed by Chamberlin [1931]. All measurements and proportions are presented either as length/width ratios (carapace, chelicera and pedipalp) or as length/depth ratios (legs).

The terminology used is that of Chamberlin [1931], with amendments proposed by Harvey [1992], Harvey & Edward [2007] and Judson [2007a, 2017]. Inclusion of the pedicel in measurement data of the chela is indicated by a plus sign (e.g. hand$^+$) and its exclusion by a minus sign (e.g. hand$^-$) [Judson, 2007b].

PHYLOGENETIC ANALYSIS OF MOLECULAR DATA. New COI mtDNA sequences were used for phylogenetic analysis for two new species of the genus *Pseudoblothrus* from Crimean caves and for *P. roszkovskii* [Kolesnikov, Turbanov, 2018], collected earlier. All relevant information available in GenBank (NCBI) concerning the family Syarinidae Chamberlin, 1930 (Table 1) was also used.

Total DNA was extracted from one leg IV fixed in vivo in 96% ethanol. The total cellular DNA was isolated using an innuPREP DNA Micro Kit (AnalitikJena, Germany). For

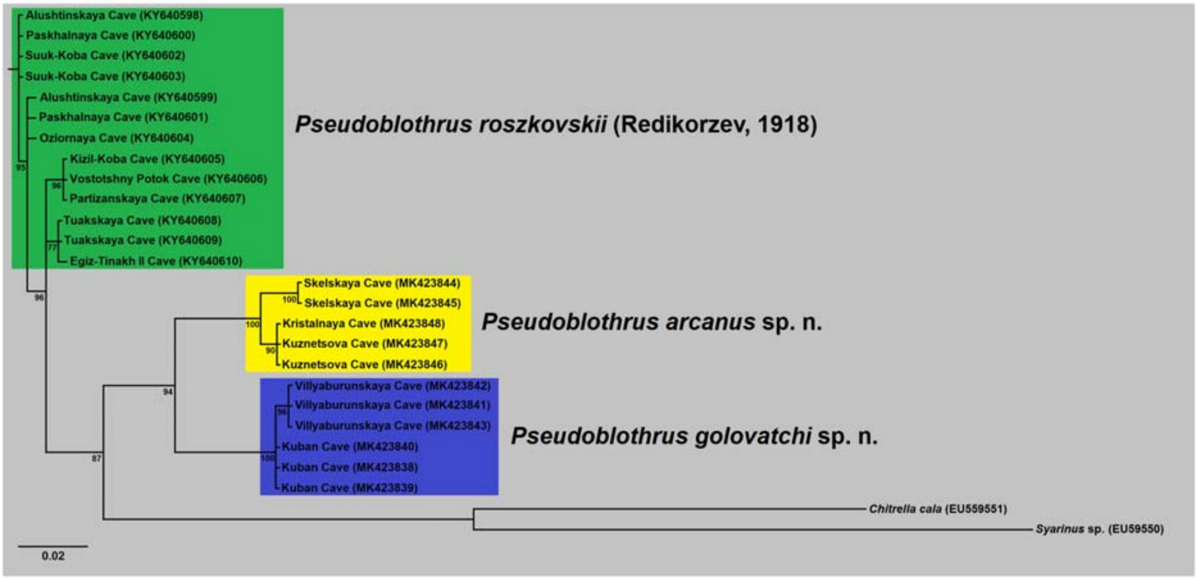

Fig. 2. Phylogeny of the three species of the genus *Pseudoblothrus* in the Crimean Mountains, based on the analysis of COI mtDNA gene sequences using the Bayesian analysis (BA) with the GTR + *Γ* + I evolutionary model for Maximum-Likelihood (ML), using Kimura-2-parameter (K2P) model; bootstrap support for branch nodes shown for 1,000 replications.

Рис. 2. Филогения трех видов рода *Pseudoblothrus* обитающих в Горном Крыму, основанная на анализе последовательностей генов мтДНК COI методом байесовского анализа (BA), с использованием эволюционной модели GTR + *Γ* + I для максимального правдоподобия (ML) и параметрической модели Kimura-2 (K2P); бутстреп поддержка на узлах ветвления для 1000 репликаций.

an analysis of genetic variation, a fragment of the COI mtDNA locus was used. The study was conducted utilizing a full-length mtDNA fragment obtained through amplification with HCO2198 and LCO1490 primers [Folmer *et al*., 1994].

Polymerase chain reaction (PCR) was performed in a 'Tercik' thermocycler, 'DNA Technology' production (Moscow, Russia), using a specially selected temperature range: initial denudation at 94 °C for 2 min; annealing at 95 °C for 2 min, at 59 °C for 45 sec, at 72 °C for 1.5 min (38 cycles), and final elongation at 72 °C for 7 min. A 'PCR Core' kit, 'Isogene Lab.' production (Moscow, Russia) was used for amplification. The reaction mixture 20 µl in volume contained 5 µl of total DNA, 10 µl of PCR diluent and 2.5 µl of each primer. Synthesis of the full-length fragment was performed at an annealing temperature of the primer at 59 °C for 45 sec. The amplification products were partitioned by electrophoresis in 2% agarose gel in 1õ TBE and visualized with ethidium bromide. The PCR products obtained were sequenced in the forward and reverse directions by the 'Eurogen' Company (Moscow, Russia). Obtained sequences were aligned with the help of BioEdit Version 5.0.9 software. The obtained gene fragments of COI mtDNA, 601 bp in length, were used in the phylogenetic analysis. The best evolutionary substitution model was determined using MEGA Version 7.0. Phylogenetic analysis was performed using MrBayes Version 3.2.7a for Bayesian analysis (BA) using GTR + *Γ* + I evolutionary model for Maximum-Likelihood (ML), using Kimura-2-parameter (K2P) model. Bayesian analysis was carried out by sampling one tree every 1,000 replications over 5,000,000 generations. The divergence of pairwise genetic distances (*p*-distances) was calculated using the Kimura-2-parameter (K2P) model in MEGA Version 7.0.

Results

PHYLOGENETIC ANALYSES OF GENUS *PSEUDOBLOTHRUS* FROM CRIMEAN CAVES. A total of 26 nucleotide sequences were used to assess species and intraspecific variation, 11 of them were obtained from the two new species (six from *P. golovatchi* sp.n., five from *P. arcanus* sp.n.), and 13 sequences were obtained from *P. roszkovskii*, collected earlier [Kolesnikov, Turbanov, 2018]. *Chitrella cala* (Chamberlin, 1930) and *Syarinus* sp. [Murienne *et al*., 2008] were chosen as outgroups, representing the closest species in the family Syarinidae available in GenBank (NCBI). The results are shown in a phylogenetic tree (Fig. 2).

Analysis of pairwise sequence divergences (*p*-distances) average values of partial COI mtDNA (Table 2) reveals that the interspecific difference is 5.8% between *P. golovatchi* sp.n. and *P. arcanus* sp.n., 6.3% between *P. roszkovskii* and *P. golovatchi* sp.n., and 6.5% between *P. roszkovskii* and *P. arcanus* sp.n. Such genetic distances indicate allied species within one genus [Kartavtsev, Lee, 2006; Harrison *et al*., 2014; Harms, 2018; Ohira *et al*., 2018; etc.].

Analysis of pairwise sequence divergence (*p*-distances) of partial COI mtDNA for intraspecific variation (Table 3) reveals that population differences within the species range from 0 to 0.3% for *P. golovatchi* sp.n., and from 0 to 1.5% for *P. arcanus* sp.n. Moreover, due to the increase of analyzed data, more de-

Table 2. Estimates of the average value of pairwise sequence divergence (*p*-distances) of partial COI mtDNA gene (below diagonal) and standard errors (above diagonal) between three species of the cave-dwelling false scorpion genus *Pseudoblothrus* Beier, 1931 in the Crimean Peninsula, as well as outgroup taxa, *Chitrella cala* and *Syarinus* sp.

Таблица 2. Оценка среднего значения расхождения попарных последовательностей (*p*-distances) частичного гена мтДНК COI (нижняя диагональ) и стандартных ошибок (верхняя диагональ) между тремя видами пещерных ложных скорпионов рода *Pseudoblothrus* Beier, 1931 г. с Крымского полуострова, а также, с таксонами внешней группы, *Chitrella cala* и *Syarinus* sp.

	P. roszkovskii	*P. golovatchi* sp.n.	*P. arcanus* sp.n.	*Chitrella cala*	*Syarinus* sp.
P. roszkovskii	–	0.009	0.009	0.016	0.016
P. golovatchi sp.n.	0.063	–	0.009	0.016	0.016
P. arcanus sp.n.	0.065	0.058	–	0.016	0.017
Chitrella cala	0.184	0.191	0.190	–	0.016
Syarinus sp.	0.194	0.214	0.211	0.198	–

Table 3. Estimates of the pairwise sequence divergence (*p*-distances) of partial COI mtDNA gene and standard errors (the numerator of the fraction indicates the average value and the minimum-maximum value of the denominator) for intraspecific variation within three species of the cave-dwelling false scorpion genus *Pseudoblothrus* Beier, 1931 in the Crimean Peninsula.

Таблица 3. Оценка расхождения попарных последовательностей (*p*-distances) частичного гена мтДНК COI и стандартные ошибки (в числителе среднее значение, в знаменателе минимально-максимальное значение) для внутривидовой изменчивости в пределах трех видов пещерных ложных скорпионов рода *Pseudoblothrus* Beier, 1931 с Крымского полуострова.

	p-distances	Standard error (S.E.)
P. roszkovskii	0.007 / 0.000–0.012	0.002 / 0.000–0.004
P. golovatchi sp.n.	0.002 / 0.000–0.003	0.001 / 0.000–0.003
P. arcanus sp.n.	0.009 / 0.000–0.015	0.003 / 0.000–0.005

tailed data were obtained for population distances for *P. roszkovskii* (with range from 0 to 1.2%). Such small interspecific genetic distances show only a population level of difference [Kartavtsev, Lee, 2006; Harrison *et al.*, 2014; Harms, 2018; Ohira *et al.*, 2018; etc.].

Taxonomic part

***Pseudoblothrus* Beier, 1931**

Pseudoblothrus Beier, 1931: 21; Beier, 1932a: 135; Beier, 1963: 227–228; Harvey, 1991: 428.

Type species. *Ideoblothrus roszkovskii* Redikorzev, 1918, by original designation.

Pseudoblothrus golovatchi **sp.n.**

Figs 3D, 4–7.

HOLOTYPE 1 ♂ (ZMUM TI-55), Crimea, Ai-Petri Karst Massif, Bolshoy Babulghan Area, Kuban Cave, 16.7.2017, leg. I.S. Turbanov.

PARATYPES: 3 ♂♂, 3 ♀♀, 1 tritonymph (ZMUM TI-56), 1 ♂, 1 ♀ (IT), 1 ♂ (VK), same cave and date, together with holotype; 1 ♂, 1 tritonymph (ISEA Ps. 001.0020), same cave, traps, 4.5.2013–7.5.2015, leg. I.S. Turbanov; 2 ♂♂, 2 ♀♀, 1 tritonymph (ZISP 1433), Crimea, Ai-Petri Karst Massif, Maly Babulghan Area, Villyaburunskaya Cave, traps, 16.4.2002–19.7.2004, leg. A.G. Koval; 2 ♂♂ (ZISP 1434), same cave, traps, 12.5.2008–12.9.2010, leg. A.G. Koval; 2 ♀♀ (ZISP 1435), same cave, traps, 12.9.2010–1.5.2012, leg. A.G. Koval; 1 ♂, 5 ♀♀ (ZMUM TI-57), 2 ♂♂, 2 ♀♀ (ISEA Ps. 001.0021), 2 ♀♀ (IT), 1 ♂ (VK), same cave, 16.7.2017, leg. I.S. Turbanov.

DISTRIBUTION. Known from the type locality so far.

NAME. Named after Dr. Sergey I. Golovatch (Moscow), an expert in millipedes, who contributed to many of the authors' scientific studies.

DIAGNOSIS (ADULTS). A subterranean *Pseudoblothrus* from the Crimea that differs from other species of the genus in the following combination of characters: no eyes or eye-spots; carapace with six setae in anterior row and 4 in posterior row; ♂ with ventral glands on sternite VI (2–3 patches of glandular areas and 7–15 ventral gland setae); sternites III and IV with 4 stigmatal setae on each side, respectively; pedipalp smooth (hand and base of fingers with uniform, rounded granulation; base of hand and chelal pedicel reticulated); chela long, hand expanded at base and gradually narrowing distally, with nonparallel edges in dorsal views — paraxial edge of visibly convex; *ist* placed close to *est*; length of pedipalpal femur, 1.10–1.29 mm (5.50–6.40 times as long as broad), of patella, 0.92–1.08 mm (3.68–4.95×), of chela with pedicel, 1.90–2.12 mm (4.76–5.30×); fixed and movable chelal fingers with 89–96 and 85–90 teeth, respectively.

DESCRIPTION OF ADULTS (♂♀). Troglomorphic habitus (Fig. 3D). Carapace, pedipalps and tergites I–II reddish brown, tergites II–XI pale brown. Opisthosoma and legs pale.

Carapace (Fig. 4A) longer than broad (Table 4), with two transverse furrows, without eyes or eye spots. Anterior margin without epistome, slightly curved forward, base of cheliceral tectum (λ) bent at an obtuse angle. Tegument covered with a weak meshwork of elongated rectangular cells. Setae thin, arranged in five main rows, chaetotaxy 6:4:4:4 (4–5 — ♂♀ paratype):4 (total setae 22–23). Three pairs of lyrifissures: two pairs between rows 1 and 2 and one pair between rows 4 and 5, respectively. Numerous minute pores all over carapace.

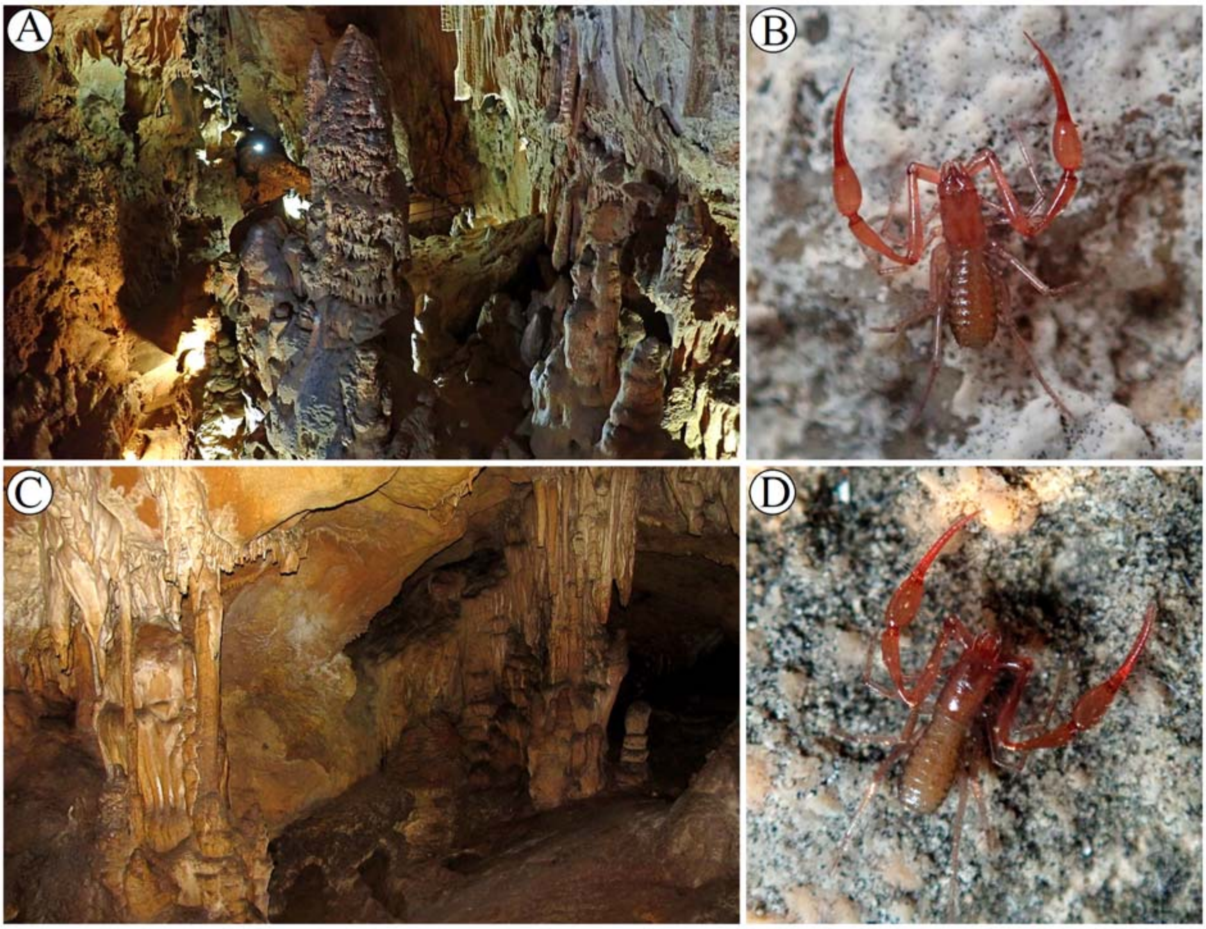

Fig. 3. Live specimens of two new species of the genus *Pseudoblothrus* in the Crimean Mountains in their natural habitat (caves): Skelskaya Cave (A) and live ♂ *P. arcanus* sp.n. (B) from the same cave; Villyaburunskaya Cave (C) and live ♂ *P. golovatchi* sp.n. (D) from the same cave. Photos by I.S. Turbanov.

Рис. 3. Живые экземпляры двух новых видов рода *Pseudoblothrus* обитающих в Горном Крыму в их естественной среде обитания (пещеры): пещера Скельская (A) и ♂ *P. arcanus* sp.n. (B) из той же пещеры; пещера Виллябурунская (C) и ♂ *P. golovatchi* sp.n. (D) из той же пещеры. Фото И.С. Турбанова.

Coxae (Fig. 4B). Manducatory process triangular and acuminate, with two setae. Pedipalpal coxa covered with a fine mesh sculpturing, with several tiny pores, 6–7 (7–11 — ♂♀ paratype) setae (those of manducatory process setae not included). Leg coxae smooth, setae I: 6 (6–7 — ♂ paratype, 6–8 — ♀ paratype); II: 7–8 (6–9 — ♂ paratype, 6–8 — ♀ paratype); III: 5 (4–5 — ♂♀ paratype); IV: 7–9 (8–10 — ♂ paratype, 8–11 — ♀ paratype).

Opisthosoma (Fig. 4C, D, F, H). Pleural membrane longitudinally striate (Fig. 4D). Tergites undivided, smooth. Chaetotaxy of tergites I–XI: 4 (4–5 — ♂ paratype):4 (4–6 — ♂ ♀ paratype):6:7 (6–7 — ♂ paratype):7 (8–9 — ♂ paratype, 9–10 — ♀ paratype):10 (9–10 — ♂ paratype, 9–11 — ♀ paratype):10 (9–10 — ♂ ♀ paratype):11 (9–10 — ♂ paratype, 9–11 — ♀ paratype):10 (9–11 — ♂♀ paratype):7 (7–8 — ♂ ♀ paratype):4 (4–6 — ♂ ♀ paratype).

Chaetotaxy of ♂ sternites. II with 8 (8–13 — paratype) discal setae; 9 (5–8 — paratype) of which along anterior margin of genital opening (Fig. 4 C, H). III with 9 (5–9 — paratype) anterior setae; 6 (8–10 — paratype) discal setae; 13 (10–12 — paratype) posterior setae; 4 suprastigmal setae on each side. IV with 11 (8–12 — paratype) posterior setae; 7 (2–8 — paratype) discal setae; 4 suprastigmal setae on each side. V with 13 (10–12 — paratype) posterior setae; 10 (7–15 — paratype) discal setae. VI with 14 (14–17 — paratype) posterior setae; 15 (7–13 — paratype) glandular area setae; VII–XI with 17 (15–17 — paratype): 17 (12–17 — paratype): 14 (12–17 — paratype): 10 (11–14 — paratype): 5 (5–6 — paratype) setae. Ventral gland of ♂ with 2–3 glandular areas (Fig. 4C, H). The diameter of the ventral gland — 0.13–0.16 mm.

Chaetotaxy of ♀ sternites II–XI: 10–12:18–21 (+ 4 suprastigmal setae on each side):10–14 (+ 4 suprastigmal setae on each side):14–15:15–18 (+ 2 discal setae):16–19:16–18:13–17:11–14:5–7.

Anal cone with two ventral and two dorsal setae.

Genitalia. ♂ genitalia as in Fig. 4G, genital chamber with two unmodified setae; median genital sac with two branches. ♀ genitalia as in Fig. 4E.

Chelicera (Fig. 5A). Hand with five setae. Galeal seta (*gs*) 0.68 (0.63–0.70 — ♂♀ paratype) from base of movable finger. Galea absent in both sexes. Fixed finger with 9 (6–10 — ♂ ♀ paratype) large and 3 (3–6 — ♂ ♀ paratype) small teeth. Movable finger with 6 (6–8 — ♂♀ paratype) primary

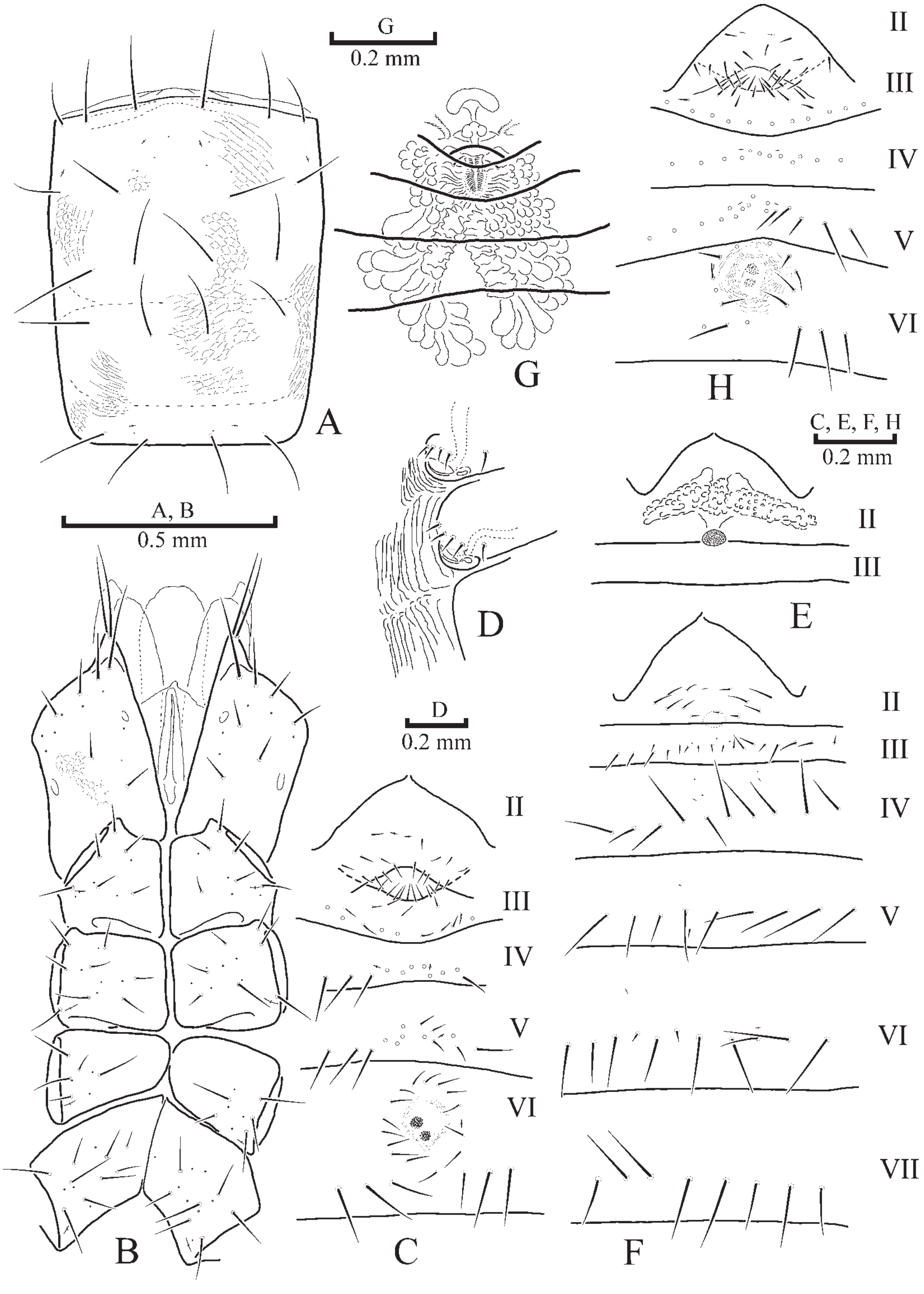

Fig. 4. *Pseudoblothrus golovatchi* sp.n. Holotype (♂) and paratypes (♂ ♀) from Kuban Cave. A — carapace, dorsal view (♂ holotype). B — coxae of pedipalp and legs I–IV, ventral view (♂ holotype). C — ♂ genital opening and sternites II–VI (lateral sides not shown), ventral view (♂ holotype). D — right stigmata of sternites III–IV and pleural membrane, ventral view (♂ holotype). E — ♀ genitalia, ventral view (♀ paratype). F — sternites II–VI, ventral view (lateral sides not shown) (♀ paratype). G — ♂ genitalia, ventral view (♂ holotype). H — ♂ genital opening and sternites II–VI (lateral sides not shown), ventral view (♂ paratype).

Рис. 4. *Pseudoblothrus golovatchi* sp.n. Голотип (♂) и паратипы (♂ ♀) из пещеры Кубань. A — карапакс, дорсально (♂ голотип). B — тазики педипальп и ног I–IV, вентрально (♂ голотип). C — генитальная область и стерниты II–VI (латеральные стороны не показаны), вентрально (♂ голотип). D — правая стигма стернитов III–IV и плевральная мембрана, вентрально (♂ голотип). E — гениталии, вентрально (♀ паратип). F — стерниты II–VI, вентрально (латеральные стороны не показаны) (♀ паратип). G — гениталии, вентрально (♂ голотип). H, генитальная область и стерниты II–VI (латеральные стороны не показаны), вентрально (♂ паратип).

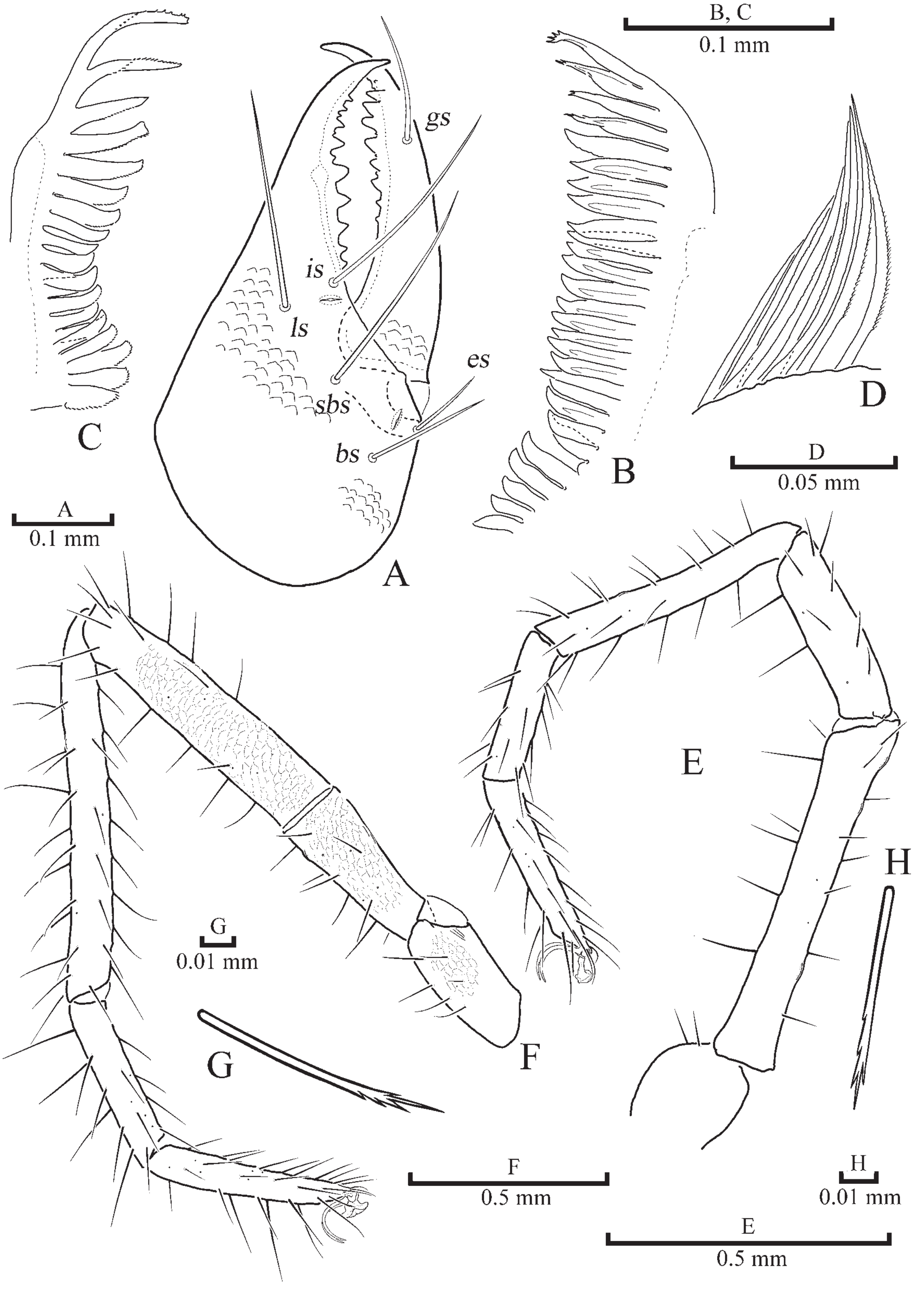

Fig. 5. *Pseudoblothrus golovatchi* sp.n. Holotype (♂) from Kuban Cave. A — right chelicera. B — serrula exterior of right chelicera, mesal view. C — serrula interior of right chelicera, ectal view. D — rallum of right chelicera, mesal view. E — right leg I. F — right leg IV. G — subdistal seta of leg IV. H — subdistal seta of leg I.

Рис. 5. *Pseudoblothrus golovatchi* sp.n. Голотип (♂) из пещеры Кубань. A — правая хелицера. B — внешняя серрула правой хелицеры, мезально. C — внутренняя серрула правой хелицеры, эктально. D — раллум правой хелицеры, мезально. E — правая нога I. F — правая нога IV. G — субдистальная щетинка ноги IV. H — субдистальная щетинка ноги I.

Table 4. *Pseudoblothrus golovatchi* sp.n. and *P. arcanus* sp.n., measurements (in mm) and ratios of body and appendages (except legs). H — holotype; P — paratypes.

Таблица 4. *Pseudoblothrus golovatchi* sp.n. и *P. arcanus* sp.n., размеры (в мм) и соотношения тела и придатков (за исключением ног). H — голотип; P — паратипы.

	P. golovatchi sp.n.				*P. arcanus* sp.n.			
	♂ H	♂ P	♀ P	trito-nymph	♀ H	♀ P	♂ P	trito-nymph
Body length	3.05	2.80–3.25	3.25–3.62	2.50–2.75	3.0	3.35–3.37	3.20	2.32
Body width	1.25	0.80–1.10	1.20–1.85	0.94–1.0	0.77	9.80–1.0	0.95	6.90
Carapace								
Length	0.81	0.85–0,87	0.82–0.90	0.66–0.73	0.83	0.81–0.88	0.92	0.65
Width (posterior)	0.62	0.55–0.66	0.64–0.70	0.50–0.55	0.60	0.65	0.66	0.50
Length/ posterior width ratio	1.30	1.28–1.58	1.25–1.37	1.27–1.32	1.38	1.24–1.35	1.39	1.30
Chelicera								
Length	0.50	0.50–0.53	0.53–0.57	0.40–0.42	0.53	0.50	0.55	0.39
Width	0.25	0.23–0.26	0.25–0.28	0.20	0.24	0.22–0.23	0.28	0.19
Length/width ratio	2.0	2.0–2.30	1.96–2.28	2.0–2.10	2.20	2.17–2.27	1.97	2.05
Movable finger length	0.33	0.31–0.35	0.35–0.39	0.26–0.27	0.33	0.30	0.35	0.25
Pedipalp								
Trochanter length	0.58	0.50–0.57	0.52–0.55	0.36–0.40	0.55	0.50–0.55	0.56	0.38
Trochanter width	0.21	0.20–0.24	0.20–0.25	0.17–0.20	0.20	0.20	0.24	0.17
Trochanter length/ width ratio	2.76	2.36–2.85	2.20–2.60	2.0–2.35	2.75	2.50–2.75	2.33	2.23
Femur length	1.26	1.10–1.28	1.23–1.29	0.89–0.91	1.26	1.25	1.35	0.85
Femur width	0.20	0.20–0.21	0.20–0.22	0.15–0.17	0.20	0.20	0.21	0.15
Femur length/ width ratio	6.30	5.50–6.40	5.85–6.20	5.23–6.06	6.30	6.25	6.42	5.66
Patella length	1.0	0.92–1.05	1.0–1.08	0.68–0.71	1.05	1.0–1.05	1.16	0.66
Patella width	0.25	0.21–0.25	0.26–0.29	0.20	0.24	0.23	0.25	0.20
Patella length/ width ratio	4.0	3.68–4.95	3.72–3.84	3.40–3.55	4.37	4.34–4.56	4.64	3.30
Chela^{+} length	2.0	1.90–2.12	2.05–2.10	1.42–1.46	2.02	2.0	2.20	1.40
Chela^{-} length	1.90	1.80–2.0	1.87–2.0	1.37–1.41	1.90	1.87	2.05	1.34
Hand width	0.41	0.38–0.40	0.41–0.43	0.32–0.33	0.35	0.38	0.38	0.29
Hand depth	0.40	0.38–0.40	0.41–0.43	0.33–0.34	0.35	0.38	0.37	0.29
Chela^{+} length/ width ratio	4.87	5.0–5.30	4.76–5.12	4.42–4.50	5.77	5.26	5.79	4.82
Chela^{-} length/ width ratio	4.75	4.67–5.0	4.45–4.87	4.27–4.34	5.42	4.92	5.40	4.62
Finger length	1.20	1.15–1.22	1.15–1.25	0.86–0.91	1.23	1.20	1.35	0.85
Hand^{+} length	0.80	0.73–0.90	0.80–0.95	0.55–0.56	0.79	0.80	0.85	0.55
Hand^{-} length	0,70	0.63–0.78	0.70–0.85	0.50–0.51	0.67	0.67	0.70	0.49
Hand^{+} length/width ratio	1.95	1.92–2.25	1.86–2.31	1.66–1.75	2.25	2.10	2.23	1.89
Hand^{-} length/ width ratio	1.70	1.65–1.95	1.62–2.07	1.51–1.59	1.91	1.76	1.84	1.68
Finger/ Hand^{+} lenght ratio	1.50	1.32–1.60	1.21–1.56	1.53–1.65	1.55	1.50	1.58	1.54
Chela^{+}/ carapace ratio	2.46	2.18–2.46	2.27–2.50	1.94–2.18	2.43	2.27–2.46	2.40	2.15
Chela^{+}/ femur ratio	1.58	1.60–1.76	1.58–1.69	1.58–1.62	1.60	1.60	1.63	1.64
Femur/ carapace ratio	1.55	1.26–1.48	1.36–1.53	1.21–1.37	1.51	1.42–1.54	1.47	1.30
Femur/ patella ratio	1.26	1.15–1.25	1.19–1.26	1.28–1.30	1.20	1.19–1.25	1.16	1.28

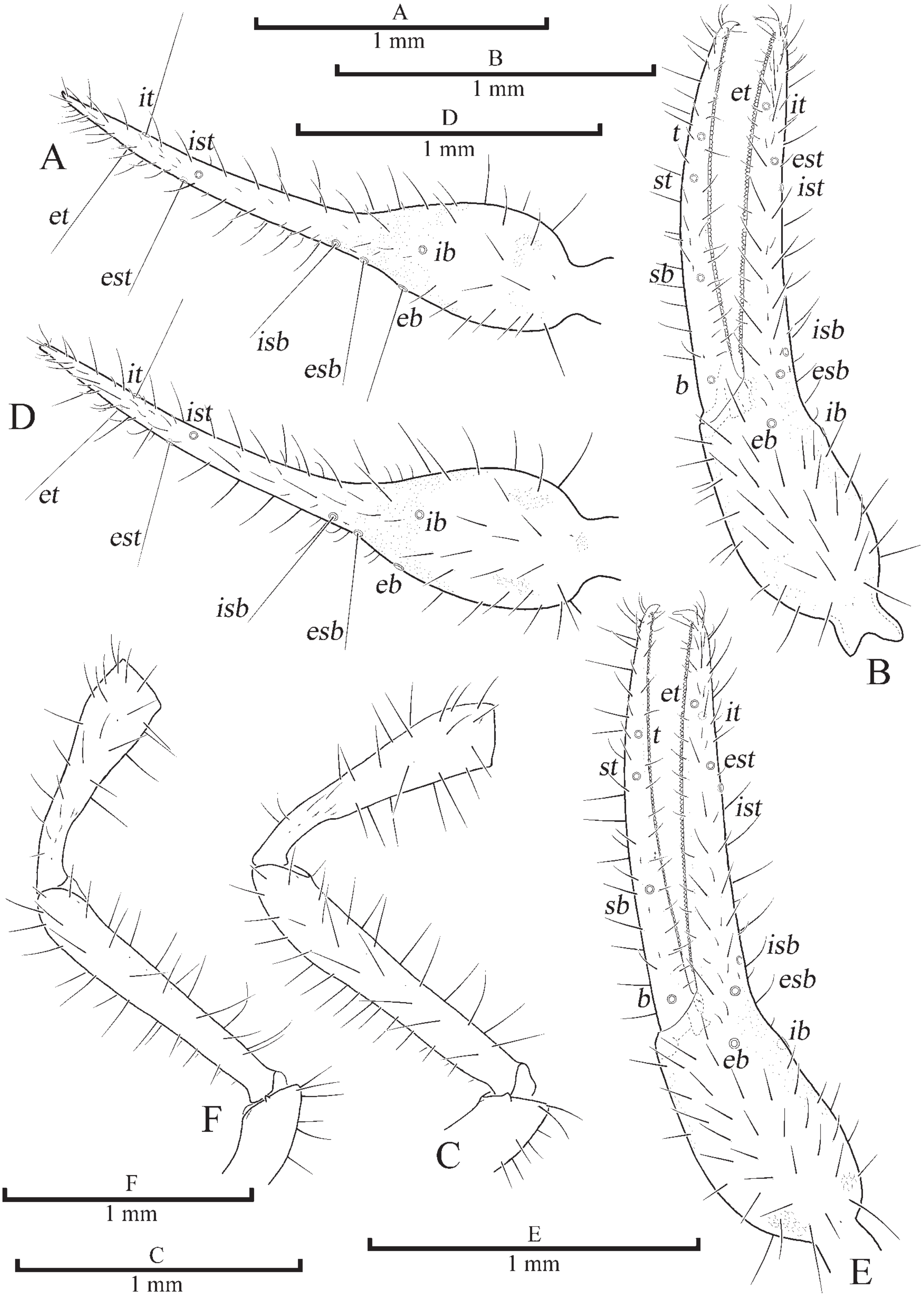

Fig. 6. *Pseudoblothrus golovatchi* sp.n. Holotype (♂) and paratype (♀) from Kuban Cave. A — left chela, dorsal view (♂ holotype). B — left chela, ectal view (♂ holotype). C — left pedipalp, minus chela, (♂ holotype). D — left chela, dorsal view (♀ paratype). E — left chela, ectal view (♀ paratype). F — left pedipalp, minus chela, (♀ paratype).

Рис. 6. *Pseudoblothrus golovatchi* sp.n. Голотип (♂) и паратип (♀) из пещеры Кубань. A — левая хела, дорсально (♂ голотип). B — левая хела, эктально (♂ голотип). C — левая педипальпа, без хелы, (♂ голотип). D — левая хела, дорсально (♀ паратип). E — левая хела, эктально (♀ паратип). F, левая педипальпа, без хелы (♀ паратип).

teeth, of which 3 (3–4 — ♂ ♀ paratype) larger than others, and 6 (0–6 — ♂ ♀ paratype) small teeth. Lyrifissures located at base of setae *is* and *es*. Rallum with 7 (7–8 — ♂ ♀ paratype) blades, each 0.14–0.17 mm long and finely serrate on anterior edge (Fig. 5D). Serrula exterior with 28 (26–28 — ♂ ♀ paratype) blades (Fig. 5B), serrula interior with 20 (17–20 — ♂ ♀ paratype) (Fig. 5C). Hand and base of fingers reticulate-granulate. Measurements of chelicera as in Table 4.

Pedipalp (Fig. 6A–F). Trochanter weak reticulated; femur, patella and fingers (except of base) smooth; hand and base of fingers with uniform, rounded granulation; base of hand and chelal pedicel reticulated. Femur long, gradually broadening distally. Patella clavate, slightly expanded on mesal side at 0.3 of length from base, where five lyrifissures of different sizes are located, two of them close together. Chela long, hand expanded at base and gradually narrowing distally, with nonparallel edges in dorsal views — paraxial edge of visibly convex. Fingers slightly curved when viewed from above. Altogether, 12 trichobothria: fixed finger with 4 in distal part of fixed finger (*et*, *it*, *ist* and *est*), 2 in basal part of fixed finger (*esb* and *isb*), and 2 on distal part of hand (*ib* and *eb*); *ist* placed close to *est*; movable finger with 4 trichobothria (*t*, *st*, *sb* and *b*). Trichobothriotaxy as in Fig. 6A, B, D, E. Hairs of trichobothria long, simple and filiform, trichobothrium *t* not lanceolate. Dorsal surface of chela, between finger and *ib*, with 1–2 irregular rows of microsetae (chemosensory setae, *sc*), ectal in position. Microsetae also observed over most of both fingers, adjacent to dental margin. Coupled sensilla (*pc*) present on movable finger between *st* and *sb*, near dental margin. A movable finger at the distal end carries two apical sensilla (am_1 and am_2), fixed finger — one apical sensilla (*af*). Lyrifissures arranged at base of hand on dorsal side, between levels of *b* and *esb* (1 lyrifissure), between *esb* and *isb* (1 lyrifissure), between *b* and *sb* (2 lyrifissures), between *sb* and *st* (1 lyrifissure) and between levels of *est* and *it* on dorsal side (1 lyrifissure). Fixed finger with 89–103 small, almost pointed, contiguous teeth. Teeth of fixed finger reaching to level of *isb*. Movable finger with similar teeth, 85–104 in number. Teeth of movable finger not reaching as far basally as those of fixed finger (difference equivalent to about 3–6 teeth). A row of four very small denticles at base of fixed finger. Fixed finger with a well developed venedens and venom gland. *Lamina defensor* (*ld*) appressed to venedens. Venom duct short, *nodus ramosus* well distad of *et*. Movable finger without venom apparatus, apodens short, with a small *lamina defensor*.

Legs I and IV (Fig. 5E, F). Surface weakly reticulate. Joint between femur and patella of leg IV perpendicular. Telotarsi not expanded, gradually tapering distally. Subterminal tarsal setae of all legs serrate distally, each with 2–3 barbs (Fig. 5G, H). Claws smooth, thin, arcuate, can carry one tooth (variability); arolia undivided and distinctly shorter than claws.

Measurements and ratios of adults as in Tables 4, 5.

DESCRIPTION OF TRITONYMPH. Carapace, pedipalps, pedipalpal coxae and chelicerae pale reddish brown, other parts pale yellow.

Carapace (Fig. 7A) longer than broad (Table 4), with two transverse furrows, without eyes or eye spots. Anterior margin without epistome, slightly curved forward, base of cheliceral tectum (λ) bent at an obtuse angle. Tegument covered with a weak meshwork of elongated rectangular cells. Setae thin, arranged in five main rows, chaetotaxy 5–6:4:4:4:4–5 (total 22). Three pairs of lyrifissures: two pairs between rows 1 and 2 and one pair between rows 4 and 5, respectively. Numerous minute pores all over carapace.

Coxae. Manducatory process triangular, acuminate, with two setae. Pedipalpal coxa covered with a fine mesh sculp-

Table 5. *Pseudoblothrus golovatchi* sp.n. and *P. arcanus* sp.n., measurements (in mm) and ratios of legs I and IV. H — holotype; P — paratypes.

Таблица 5. *Pseudoblothrus golovatchi* sp.n. и *P. arcanus* sp.n., измерения (в мм) и соотношения ног I и IV. H — голотип; P — паратипы.

	P. golovatchi sp.n.				*P. arcanus* sp.n.			
	♂ H	♂ P	♀ P	tritonymph	♀ H	♀ P	♂ P	tritonymph
Leg I								
Trochanter length	0.20	0.20–0.21	0.20	0.14–0.15	0.20	0.20	0.24	0.18
Trochanter depth	0.15	0.15	0.14–0.15	0.10–0.11	0.13	0.13–0.15	0.15	0.12
Trochanter length/ depth ratio	1.33	1.33–1.40	1.33–1.42	1.36–1.40	1.53	1.33–1.53	1.60	1.50
Femur length	0.67	0.65–0.70	0.61–0.72	0.44–0.50	0.75	0.60	0.81	0.40
Femur depth	0.08	0.08–0.09	0.09	0.07–0.08	0.09	0.08	0.11	0.08
Femur length/ depth ratio	8.37	7.22–8.75	6.77–8.0	5.75–7.14	8.33	7.50	7.36	5.0
Patella length	0.41	0.35–0.40	0.35–0.40	0.26–0.28	0.38	0.35	0.40	0.27
Patella depth	0.10	0.10	0.10	0.08–0.09	0.10	0.08–0.09	0.11	0.08
Patella length/ depth ratio	4.10	3.50–4.0	3.50–4.0	3.11–3.25	3.80	3.88–4.37	3.63	3.37
Tibia length	0.55	0.51–0.60	0.56–0.58	0.33–0.40	0.55	0.50	0.56	0.34
Tibia depth	0.08	0.07–0.08	0.08–0.09	0.07	0.08	0.08	0.08	0.07
Tibia length/ depth ratio	6.87	6.37–7.71	6.44–7.12	4.71–5.71	6.87	6.25	7.0	4.85

Table 5 (continued).
Таблица 5 (продолжение).

	P. golovatchi sp.n.				*P. arcanus* sp.n.			
	♂ H	♂ P	♀ P	trito-nymph	♀ H	♀ P	♂ P	trito-nymph
Leg I								
Basitarsus length	0.33	0.30–0.35	0.30–0.35	0.20–0.21	0.30	0.30	0.35	0.20
Basitarsus depth	0.08	0.07–0.09	0.07–0.08	0.07–0.08	0.07	0.08	0.07	0.07
Basitarsus length/ depth ratio	4.12	3.66–4.37	3.75–5.0	2.50–3.0	4.28	3.75	5.0	2.85
Telotarsus length	0.41	0.39–0.42	0.41–0.42	0.25–0.30	0.43	0.40–0.43	0.46	0.25
Telotarsus depth	0.08	0.07–0.09	0.07–0.09	0.08	0.07	0.07–0.09	0.07	0.08
Telotarsus length/ depth ratio	5.12	4.44–6.0	4.55–6.0	3.12–3.75	6.14	4.77–5.71	6.57	3.12
Femur/ patella ratio	1.63	1.70–1.85	1.55–1.84	1.64–1.92	1.97	1.71	2.03	1.48
Telotarsus/ basitarsus ratio	1.24	1.14–1.36	1.17–1.40	1.25–1.50	1.43	1.33–1.43	1.31	1.25
Leg IV								
Trochanter length	0.35	0.32–0.36	0.30–0.36	0.25–0.27	0.35	0.30–0.33	0.38	0.25
Trochanter depth	0.15	0.16–0.19	0.15–0.16	0.12–0.14	0.16	0.16–0.17	0.17	0.12
Trochanter length/depth ratio	2.33	1.78–2.25	1.87–2.25	1.92–2.16	2.18	1.76–2.06	2.23	2.08
Femur length	0.40	0.36–0.46	0.40–0.45	0.24–0.32	0.40	0.39–0.40	0.49	0.25
Femur depth	0.14	0.15–0.20	0.14–0.20	0.12–0.15	0.14	0.14	0.17	0.11
Femur length/ depth ratio	2.85	1.80–3.06	2.05–2.85	2.0–2.41	2.85	2.78–2.85	2.88	2.27
Patella length	0.70	0.66–0.72	0.71–0.75	0.49–0.51	0.73	0.60–0.64	0.84	0.35
Patella depth	0.14	0.15–0.19	0.14–0.18	0.12–0.14	0.14	0.13	0.16	0.10
Patella length/ depth ratio	5.0	3.47–4.80	4.16–5.28	3.64–4.16	5.21	4.61–4.92	5.25	3.50
Femur+patella	1.10	1.02–1.17	1.14–1.17	0.74–0.83	1.13	1.0–1.03	1.33	0.60
Tibia length	0.93	0.88–0.95	0.90–0.98	0.55–0.64	0.96	0.82–0.90	0.94	0.52
Tibia depth	0.10	0.08–0.11	0.10	0.08–0.09	0.10	0.09–0.10	0.10	0.07
Tibia length/ depth ratio	9.30	8.27–11.0	9.0–9.80	6.87–7.25	9.60	8.20–10.0	9.40	7.42
Basitarsus length	0.42	0.40–0.45	0.40–0.43	0.28–0.29	0.40	0.39–0.40	0.48	0.23
Basitarsus depth	0.08	0.07–0.09	0.08	0.07–0.08	0.08	0.08	0.08	0.07
Basitarsus length/ depth ratio	5.25	4.55–5.71	5.0–5.37	3.62–4.14	5.0	4.87–5.0	6.0	3.28
Telotarsus length	0.50	0.48–0.55	0.48–0.52	0.34–0.35	0.55	0.50–0.52	0.53	0.30
Telotarsus depth	0.08	0.07–0.08	0.08–0.09	0.07–0.09	0.08	0.09	0.08	0.08
Telotarsus length/ depth ratio	6.25	6.0–7.57	5.55–6.37	3.88–5.0	6.87	5.55–5.77	6.63	3.75
Telotarsus/ basitarsus ratio	1.19	1.20–1.29	1.14–1.30	1.17–1.25	1.37	1.25–1.33	1.11	1.30

turing; chaetotaxy: 7–8 (those of manducatory process setae not included). Surface of coxae I–IV smooth; chaetotaxy: 5:5–6:3–5:5–6.

Opisthosoma. Pleural membrane longitudinally striate. Tergites undivided, smooth. Chaetotaxy of tergites I–XI: 4:5:6:6:8–9:8–9:8–11:9–11:8–10:6–8:6. Chaetotaxy of sternites II–XI: 2–3:9–10 (+ 3 suprastigmal setae on each side):8–10 (+ 3 suprastigmal setae on each side):11–13:14–16 (+ 2–3 discal setae):15–16:13–17:10–14:10–13:4. Anal cone with two ventral and two dorsal setae.

Chelicera (Fig. 7B). Hand with five setae. Galeal seta (*gs*) 0.64–0.66 from base of movable finger. Galea absent in both sexes. Fixed finger with 7–9 large and 4–5 small teeth. Movable finger with 7–8 primary teeth, of which 3–4 larger than others, and 1–2 small teeth. Lyrifissures located at base of setae *is* and *es*. Rallum with 6 blades, each 0.12–0.15 mm long and finely serrate on anterior edge (Fig. 7E). Serrula exterior with 20–22 blades (Fig. 7D), serrula interior with 12–16 (Fig. 7C). Hand and base of fingers reticulate-granulate. Measurements of chelicera as in Table 4.

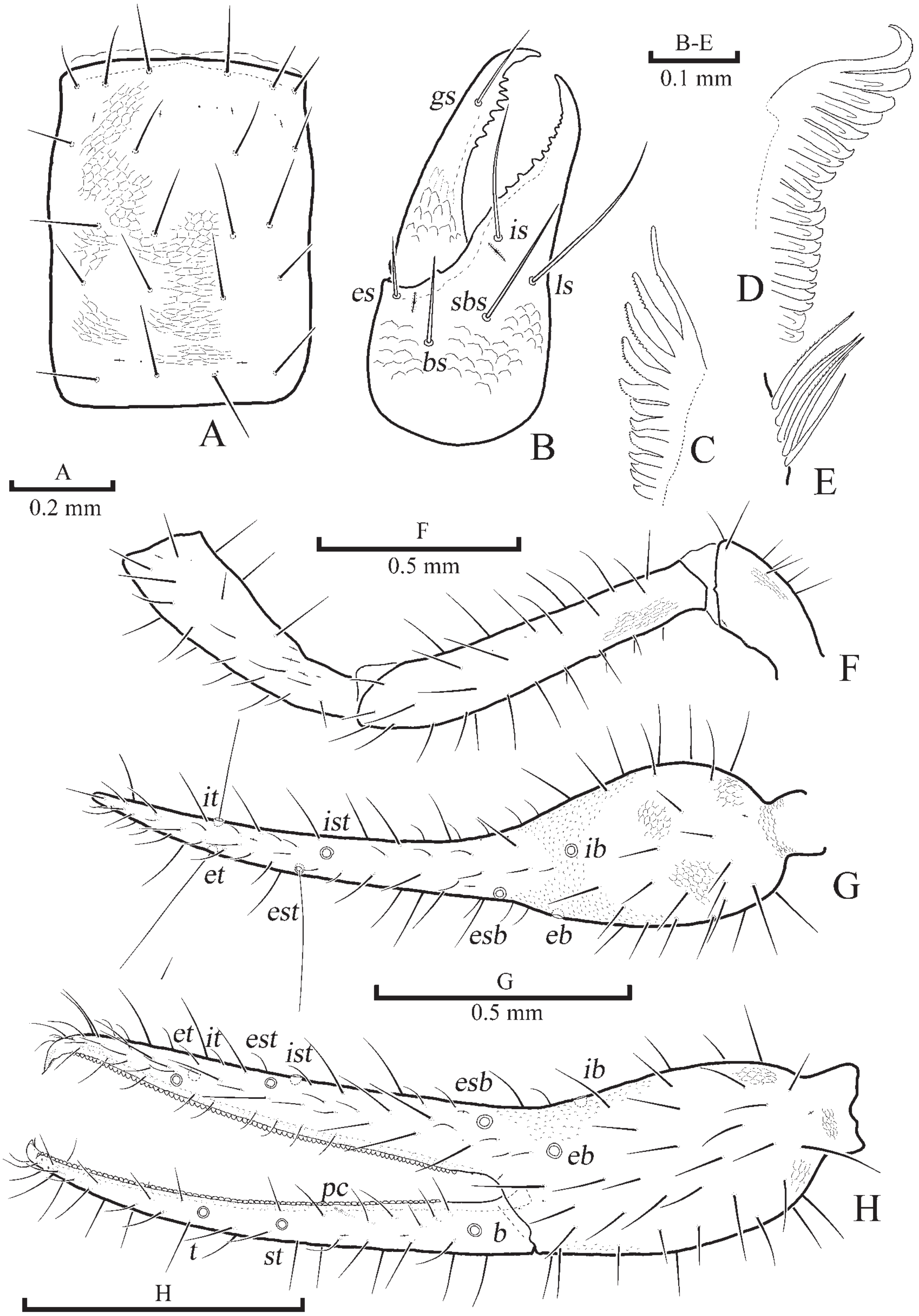

Fig. 7. *Pseudoblothrus golovatchi* sp.n. Tritonymph from Kuban Cave. A — carapace, dorsal view. B — left chelicera. C — serrula interior of left chelicera, mesal view, D — serrula exterior of left chelicera, ectal view. E — rallum of left chelicera, mesal view. F — left pedipalp, minus chela. G — left chela, dorsal view; H — left chela, ectal view.

Рис. 7. *Pseudoblothrus golovatchi* sp.n. Тритонимфа из пещеры Кубань. A — карапакс, дорсально. B — левая хелицера. C — внутренняя серрула левой хелицеры, мезально. D — внешняя серрула левой хелицеры, эктально. E — раллум левой хелицеры, мезально. F — левая педипальпа, без хелы. G — левая хела, дорсально. H — левая хела, эктально.

Pedipalp (Fig. 7F–H). Trochanter weak reticulated; femur, patella and fingers (except of base) smooth; hand and base of fingers with uniform, rounded granulation; base of hand and chelal pedicel reticulated. Femur long, gradually broadening distally. Patella clavate, slightly expanded on mesal side at 0.3 of length from base, where four lyrifissures of different sizes are located, two of them close together. Chela long, hand expanded at base and gradually narrowing distally, with nonparallel edges in dorsal views – paraxial edge of visibly convex. Fingers slightly curved when viewed from above. Ten trichobothria: fixed finger with 4 (*et*, *it*, *ist* and *est*) in distal part, 1 (*esb*) in basal part of fixed finger, 2 (*ib* and *eb*) in distal part of hand, trichobothrium *isb* absent; *ist* placed close to *est*; movable finger with 3 trichobothria (*t*, *st*, and *b*), *sb* absent. Trichobothriotaxy as in Fig. 7G, H. Hairs of trichobothria long, filiform, *t* not lanceolate. Setae of chela thin. Dorsal surface of chela with 1–2 irregular rows of microsetae (chemosensory setae, *sc*), ectal in position between *ib* and base of fixed finger. Microsetae also observed almost all over both fingers, adjacent to dental margin. Coupled sensilla (*pc*) present on movable finger between *st* and *b*, near dental margin. Movable finger at the distal end with two apical sensilla (am_1 and am_2), fixed finger — one apical sensilla (*af*). Lyrifissures arranged at base of hand on dorsal side, between *b* and *esb* (1 lyrifissure), proximal to *esb* (1 lyrifissure), between *b* and *st* (2 lyrifissures), and between *est* and *it* on dorsal side (1 lyrifissure). Fixed finger with 81–85 small, contiguous teeth. Teeth of fixed finger reaching to level of *esb*. Movable finger with 73–77 small, contiguous teeth. Teeth of movable finger not extending as far basally as those of fixed finger (difference equivalent to about 3–4 teeth). A row of four very small denticles at base of fixed finger. Fixed finger with well-developed venedens and venom gland, venom duct short, *nodus ramosus* clearly distal to *et*. *Lamina defensor* (*ld*) tightly appressed to venedens. Movable finger without venom apparatus, with a short, blunt apodens and a small *lamina defensor*.

Legs I and IV. Surface weakly reticulate. Joint between femur and patella of leg IV perpendicular. Telotarsi not expanded, gradually tapering distally. Subterminal tarsal setae of all legs serrate distally, each with 2–3 barbs. Claws smooth, thin, arcuate, can carry one tooth (variability); arolia undivided and distinctly shorter than claws.

Measurements and ratios of tritonymph as in Tables 4, 5.

Protonymph and deutonymph unknown.

REMARKS. *P. golovatchi* sp.n. is morphologically very similar to *P. arcanus* sp.n., but lacks four eye spots. *P. golovatchi* sp.n. is distinguished from *P. roszkovskii* by the shape of the chelal hand, which is expanded at the base and gradually narrowed distally, with nonparallel edges in dorsal views, by the paraxial edge visibly convex (the *P. roszkovskii* hand has subparallel edges), and by a smaller body and a smaller number of teeth on the chela. Recognition of the new species is based on the results of molecular genetic studies (see Phylogenetic analysis of the genus *Pseudoblothrus* from the Crimean caves above).

Pseudoblothrus arcanus **sp.n.**

Figs 3B, 8–11.

Obisium abeillei (E. Simon): Lebedev, 1914: 7; Turbanov, Kolesnikov, 2015: 83; Turbanov *et al*., 2016: 1286.

Ideoblothrus roszkovskii Redikorzev: Pliginsky, 1927: 172; Turbanov, Kolesnikov, 2015: 83; Turbanov *et al*., 2016: 1286.

Syarinidae Chamberlin: Turbanov, Kolesnikov, 2015: 83; Turbanov *et al*., 2016: 1286.

HOLOTYPE 1 ♀ (ZMUM TI-58), Crimea, Ai-Petri Karst Massif, Baydarskaya Valley, near Rodnikovskoe Village, Skelskaya Cave, 3.3.2015, leg. I.S. Turbanov.

PARATYPES: 1 ♂ (ZMUM TI-59), Crimea, Ai-Petri Karst Massif, Baydarskaya Valley, near Rodnikovskoe Village, Skelskaya Cave, 25.9.2018, leg. I.S. Turbanov; 1 ♀ (ZISP 1436), 1 tritonymph (ZMUM TI-60), Crimea, Ai-Petri Karst Massif, Karadagh Forest Area, Kuznetsova (= Koryta) Cave, 8.3.2014, leg. I.S. Turbanov; 1 ♀ (ISEA Ps. 001.0022), Crimea, Ai-Petri Karst Massif, Karadagh Forest Area, Kristalnaya (= Maksimovitcha) Cave, 3.5.2015, leg. I.S. Turbanov.

DISTRIBUTION. Known from the type locality so far.

NAME. From the Latin *arcanum*, which means secret, or mysterious.

DIAGNOSIS (ADULTS). A subterranean *Pseudoblothrus* from the Crimean Peninsula that differs from other species of the genus in the following combination of characters: four eye spots (without tapeta); carapace with 6 (rarely 5–7) setae in anterior row and 4 in posterior row; sternites III and IV with 4 stigmatal setae on each side, respectively; pedipalp smooth (hand and base of fingers with uniform, rounded granulation; base of hand and chelal pedicel reticulated); chela long, hand expanded at base and gradually narrowing distally, with nonparallel edges in dorsal views — paraxial edge of visibly convex; *ist* placed close to *est*; length of pedipalpal femur, 1.25–1.26 mm (6.25–6.30 times as long as broad), of patella, 1.0–1.05 mm (4.34–4.56×), of chela with pedicel, 2.0–2.02 mm (5.26–5.77×); fixed and movable chelal fingers with 94–96 and 89–94 teeth, respectively.

DESCRIPTION OF ADULTS (♂ ♀). Troglomorphic habitus (Fig. 3B). Carapace, pedipalps and tergites I–II reddish brown, tergites II–XI pale brown. Opisthosoma and legs pale.

Carapace (Figs 8A, B, 10D) longer than broad (Table 4), with two transverse furrows, with four eye spots (the front is twice as large as the rear), without tapeta. Eye spots may not be clear. Anterior margin without epistome, slightly curved forward, base of cheliceral tectum (λ) bent at an obtuse angle. Tegument covered with a weak meshwork of elongated rectangular cells. Setae thin, arranged in five main rows, chaetotaxy 5 (6–7 — ♀ paratype):4:4:4:4 (total ♀ — 21–23). The ♂ has an additional pair of bristles between the fourth and fifth row (total ♂ — 24). Three pairs of lyrifissures: two pairs between rows 1 and 2 and one pair between rows 4 and 5, respectively. Numerous minute pores all over carapace.

Coxae (Fig. 8D). Manducatory process triangular and acuminate, with two setae. Pedipalpal coxa covered with a fine mesh sculpturing, with several tiny pores, 8 (8–9 — ♂ ♀ paratype) setae (those of manducatory process setae not included). Leg coxae smooth, setae I: 5 (6–7 — ♂ ♀ paratype); II: 6 (7 — ♀ paratype, 8–9 — ♂ paratype); III: 4–6 (4–5 — ♂ ♀ paratype); IV: 9 (8–9 — ♂ ♀ paratype).

Opisthosoma (Figs 8E, 10E). Pleural membrane longitudinally striate (Fig. 8E). Tergites undivided, smooth. Chaetotaxy of tergites I–XI: 4:6:6:7 (6 — ♂ ♀ paratype):9 (9 — ♀ paratype, 7 — ♂ paratype):9 (9–10 — ♂ ♀ paratype):9 (9–10 — ♂ ♀ paratype):9:9:7 (7–8 — ♂ ♀ paratype):4 (5 — ♀ paratype, 6 — ♂ paratype).

Chaetotaxy of ♀ sternites. II–XI: 13 (8–13 — paratype):15 (15–16 — paratype) + 4 suprastigmal setae on each side:9 (9–10 — paratype) + 4 suprastigmal setae on each side:12 (12–14 — paratype):13 (13–16 — paratype) + 2 (1–2 — paratype) discal setae:15 (15–16 — paratype):14 (14–16 —

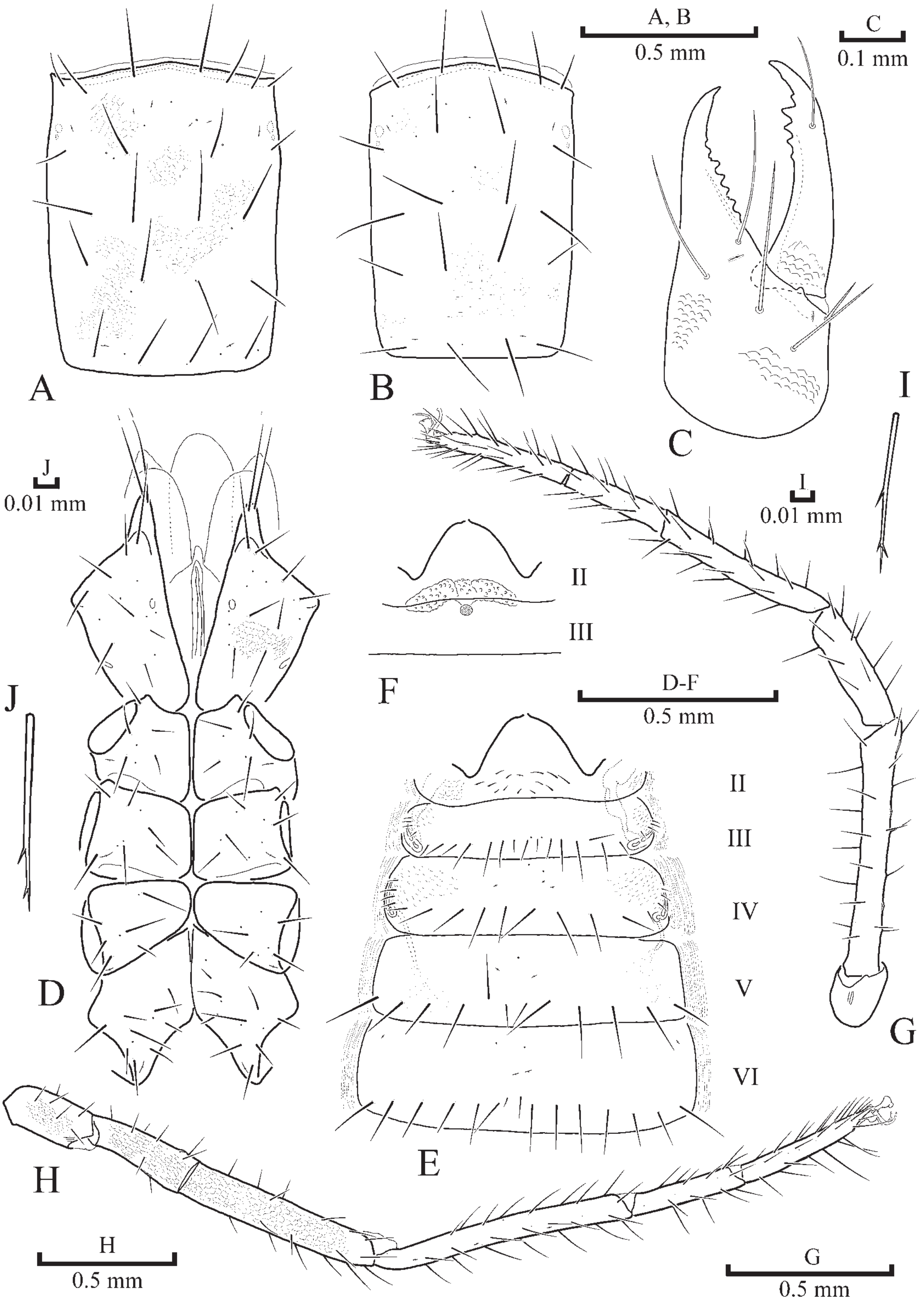

Fig. 8. *Pseudoblothrus arcanus* sp.n. Holotype (♀) from Skelskaya Cave and paratype (♀) from Kuznetsova Cave. A — carapace, dorsal view (♀ paratype). B — carapace, dorsal view (♀ holotype). C — right chelicera (♀ holotype). D — coxae of pedipalp and legs I–IV, ventral view (♀ holotype). E — sternites II–VI, ventral view (♀ holotype). F — ♀ genitalia, ventral view (♀ holotype). G — right leg I (♀ holotype). H — right leg IV (♀ holotype). I — subdistal seta of leg I (♀ holotype). J — subdistal seta of leg IV (♀ holotype).

Рис. 8. *Pseudoblothrus arcanus* sp.n. Голотип (♀) из пещеры Скельская и паратип (♀) из пещеры Кузнецова. A — карапакс, дорсально (♀ паратип). B — карапакс, дорсально (♀ голотип). C — правая хелицера (♀ голотип). D — тазики педипальп и ног I–IV, вентрально (♀ голотип). E — стерниты II–VI, вентрально (♀ голотип). F — гениталии, вентрально (♀ голотип). G — правая нога I (♀ голотип). H — правая нога IV (♀ голотип). I — субдистальная щетинка ноги I (♀ голотип). J — субдистальная щетинка ноги IV (♀ голотип).

paratype):13 (14–15 — paratype):12 (12–14 — paratype):6 (4 — paratype).

Chaetotaxy of ♂ sternites. II with 6 discal setae; 11 of which along anterior margin of genital opening (Fig. 10E). III with 8 anterior setae; 4 discal setae; 13 posterior setae; 4 suprastigmal setae on each side. IV with 11 posterior setae; 6 discal setae; 4 suprastigmal setae on each side. V with 14 posterior setae; 12 discal setae. VI with 18 posterior setae; 11 glandular area setae; VII–XI with 17:16:16:14:8 setae. Ventral gland of ♂ with 2 glandular areas (Fig. 10E). The diameter of the ventral gland — 0.14 mm.

Anal cone with two ventral and two dorsal setae.

Genitalia. ♀ genitalia as in Fig. 8F. ♂ genitalia as in Fig. 10F, genital chamber with two unmodified setae; median genital sac with two branches.

Chelicera (Fig. 8C). Hand with five setae. Galeal seta (*gs*) 0.69 (0.66–0.69 – ♂ ♀ paratype) from base of movable finger. Galea absent in both sexes. Fixed finger with 7 (7–10 — ♂ ♀ paratype) large and 2 (3–5 — ♂ ♀ paratype) small teeth. Movable finger with 5 (5–7 — ♂ ♀ paratype) primary teeth, of which 3 (3–4 — ♂ ♀ paratype) larger than others, and 0 (0–4 — ♂ ♀ paratype) small teeth. Lyrifissures located at base of setae *is* and *es*. Rallum with 7 blades, each 0.14–0.16 mm long and finely serrate on anterior edge. Serrula exterior with 28 (27–28 — ♂ ♀ paratype) blades, serrula interior with 20 (18–19 — ♂ ♀ paratype). Hand and base of fingers reticulate-granulate. Measurements of chelicera as in Table 4.

Pedipalp (Figs 9, 10A–C). Trochanter weak reticulated; femur, patella and fingers (except of base) smooth; hand and base of fingers with uniform, rounded granulation; base of hand and chelal pedicel reticulated. Femur long, gradually broadening distally. Patella clavate, slightly expanded on mesal side at 0.3 of length from base, where five lyrifissures of different sizes are located, two of them close together. Chela long, hand expanded at base and gradually narrowing distally, with nonparallel edges in dorsal views — paraxial edge of visibly convex. Fingers slightly curved when viewed from above. Altogether, 12 trichobothria (the ♀ from Koryta Ñave absent *ist* – teratology (Fig. 9E)): fixed finger with 4 in distal part of fixed finger (*et*, *it*, *ist* and *est*), 2 in basal part of fixed finger (*esb* and *isb*), and 2 on distal part of hand (*ib* and *eb*); *ist* placed close to *est* (distance *ist*-*est* slightly variable (Figs 9B, D, 10B); movable finger with 4 trichobothria (*t*, *st*, *sb* and *b*). Trichobothriotaxy as in Figs 9A–E, 10A, B. Hairs of trichobothria long, simple and filiform, trichobothrium *t* not lanceolate. Dorsal surface of chela, between finger and *ib*, with 1–3 irregular rows of microsetae (chemosensory setae, *sc*), ectal in position. Microsetae also observed over most of both fingers, adjacent to dental margin. Coupled sensilla (*pc*) present on movable finger between *st* and *sb*, near dental margin. Movable finger at the distal end with two apical sensilla (am_1 and am_2), fixed finger — one apical sensilla (*af*). Lyrifissures arranged at base of hand on dorsal side, between levels of *b* and *esb* (1 lyrifissure), between *esb* and *isb* (1 lyrifissure (in some cases this lyrifissure can be located between *isb* and *ist*, but it is observed only on one chela (Fig. 9A)), between *b* and *sb* (2 lyrifissures), between *sb* and *st* (1 lyrifissure) and between levels of *est* and *it* on dorsal side (1 lyrifissure). Fixed finger with 94–96 small, almost pointed, contiguous teeth. Teeth of fixed finger reaching to level of *isb*. Movable finger with similar teeth, 89–94 in number. Teeth of movable finger not reaching as far basally as those of fixed finger (difference equivalent to about 3–4 teeth). A row of four very small denticles at base of fixed finger. Fixed finger with a well-developed venedens and venom gland. *Lamina defensor* (*ld*) appressed to venedens. Venom duct short, *nodus ramosus* well distad of *et*. Movable finger without venom apparatus, apodens short, with a small *lamina defensor*.

Legs I and IV (Fig. 8G, H). Surface weakly reticulate. Joint between femur and patella of leg IV perpendicular. Telotarsi not expanded, gradually tapering distally. Subterminal tarsal setae of all legs serrate distally, each with 2–3 barbs (Fig. 8I, J). Claws smooth, thin, arcuate, can carry one tooth (variability); arolia undivided and distinctly shorter than claws.

Measurements and ratios of adults as in Tables 4, 5.

DESCRIPTION OF TRITONYMPH. Carapace, pedipalps, pedipalpal coxae and chelicerae pale reddish brown, other parts pale yellow.

Carapace (Fig. 11A) longer than broad (Table 4), with two transverse furrows, with two eye spots (without tapeta). Anterior margin without epistome, slightly curved forward, base of cheliceral tectum (λ) bent at an obtuse angle. Tegument covered with a weak meshwork of elongated rectangular cells. Setae thin, arranged in five main rows, chaetotaxy 6:4:4:4:4 (total 22). Three pairs of lyrifissures: two pairs between rows 1 and 2 and one pair between rows 4 and 5, respectively. Numerous minute pores all over carapace.

Coxae. Manducatory process triangular, acuminate, with two setae. Pedipalpal coxa covered with a fine mesh sculpturing; chaetotaxy: 7 (those of manducatory process setae not included). Surface of coxae I–IV smooth; chaetotaxy: 5–6:6:3–4:5–6.

Opisthosoma. Pleural membrane longitudinally striate. Tergites undivided, smooth. Chaetotaxy of tergites I–XI:4:5:6:6:7:9:10:9:9:7:5. Chaetotaxy of sternites II–XI: 3:8 (+ 3 suprastigmal setae on each side):9 (+ 3 suprastigmal setae on each side):11:13 (+ 2 discal setae):15:15:14:12:6. Anal cone with two ventral and two dorsal setae.

Chelicera (Fig. 11B). Hand with five setae. Galeal seta (*gs*) 0.64 from base of movable finger. Galea absent in both sexes. Fixed finger with 12 large and 3 small teeth. Movable finger with 7 primary teeth, of which 3 larger than others, and 4 small teeth. Lyrifissures located at base of setae *is* and *es*. Rallum with 6 blades, each 0.12–0.14 mm long and finely serrate on anterior edge. Serrula exterior with 22 blades, serrula interior with 12. Hand and base of fingers reticulate-granulate. Measurements of chelicera as in Table 4.

Pedipalp (Fig. 11C–E). Trochanter weak reticulated; femur, patella and fingers (except of base) smooth; hand and base of fingers with uniform, rounded granulation; base of hand and chelal pedicel reticulated. Femur long, gradually broadening distally. Patella clavate, slightly expanded on mesal side at 0.3 of length from base, where four lyrifissures of different sizes are located, two of them close together. Chela long, hand expanded at base and gradually narrowing distally, with nonparallel edges in dorsal views — paraxial edge of visibly convex. Fingers slightly curved when viewed from above. Ten trichobothria: fixed finger with 4 (*et*, *it*, *ist* and *est*) in distal part, 1 (*esb*) in basal part of fixed finger, 2 (*ib* and *eb*) in distal part of hand, trichobothrium *isb* absent; *ist* placed close to *est*; movable finger with 3 trichobothria (*t*, *st*, and *b*), *sb* absent. Trichobothriotaxy as in Fig. 11D, E. Hairs of trichobothria long, filiform, *t* not lanceolate. Setae of chela thin. Dorsal surface of chela with 1–2 irregular rows of microsetae (chemosensory setae, *sc*), ectal in position between *ib* and base of fixed finger. Microsetae also observed almost all over both fingers, adjacent to dental mar-

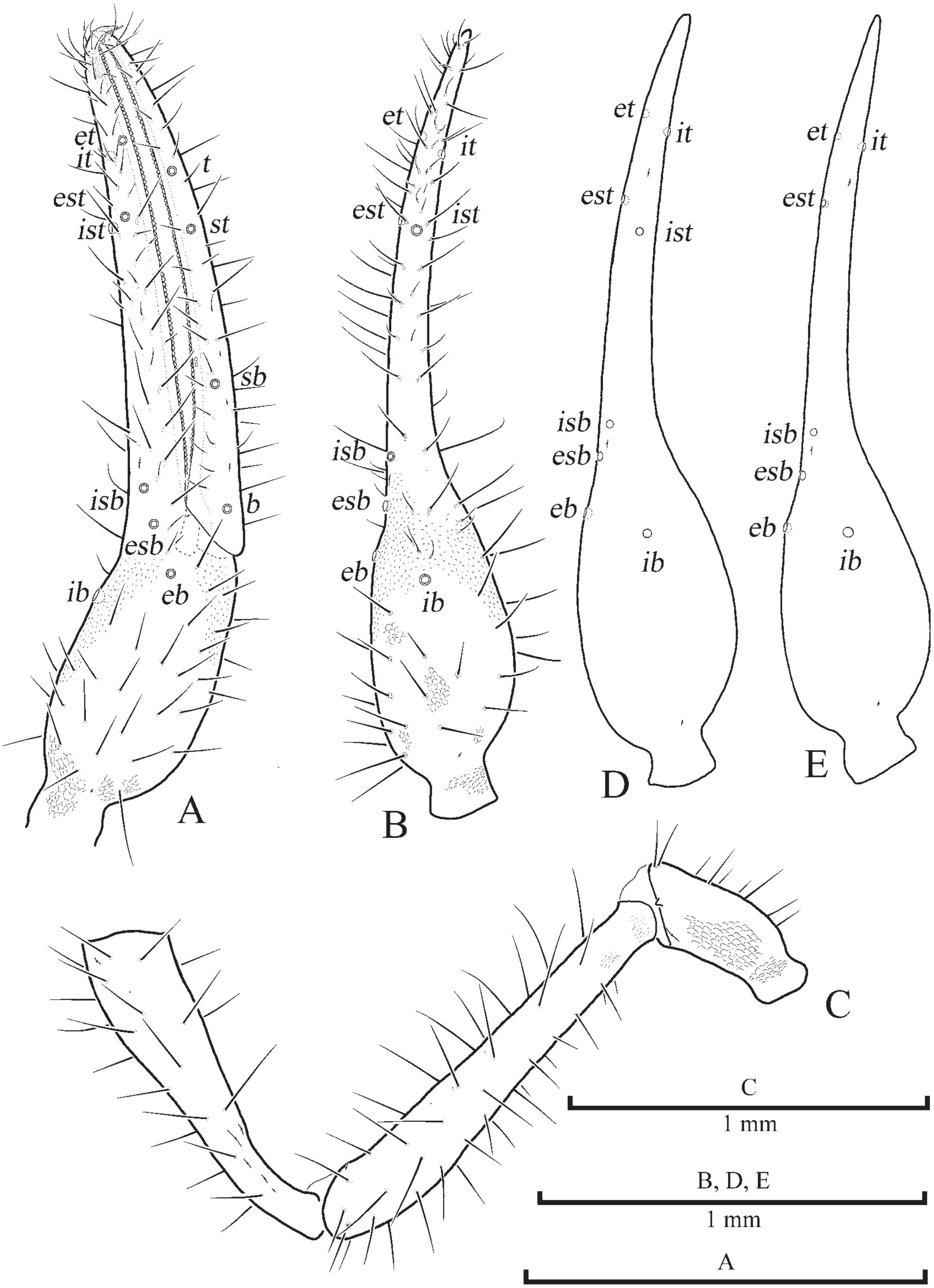

Fig. 9. *Pseudoblothrus arcanus* sp.n. Holotype (♀) from Skelskaya Cave and paratypes (♀) from Kristalnaya and Kuznetsova caves. A — right chela, ectal view (♀ holotype). B — left chela, dorsal view (♀ holotype). C — left pedipalp, minus chela, (♀ holotype). D — left chela, dorsal view, setae not illustrated (♀ paratype from Kristalnaya Cave). E — left chela, dorsal view, setae not illustrated (♀ paratype from Kuznetsova Cave).

Рис. 9. *Pseudoblothrus arcanus* sp.n. Голотип (♀) из пещеры Скельская и паратипы (♀) из пещер Кристальная и Кузнецова. A — правая хела, эктально (♀ голотип), B — левая хела, дорсально (♀ голотип). C — левая педипальпа, без хелы (♀ голотип). D — левая хела, дорсально, щетинки не показаны (♀ паратип из пещеры Кристальная). E — левая хела, дорсально, щетинки не показаны (♀ паратип из пещеры Кузнецова).

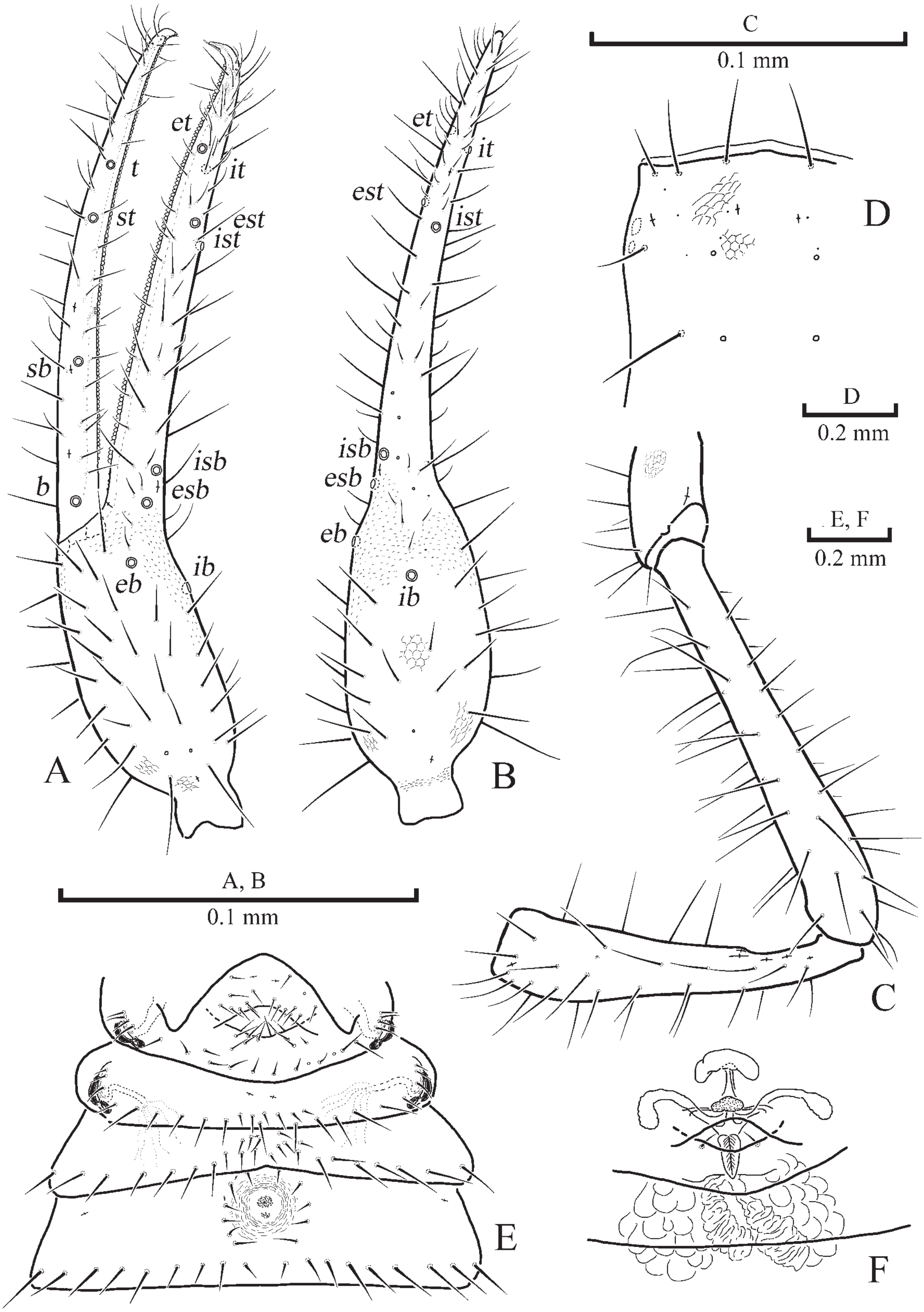

Fig. 10. *Pseudoblothrus arcanus* sp.n. Paratype (♂) from Skelskaya Cave. A — left chela, ectal view. B — left chela, dorsal view. C — left pedipalp, minus chela. D — anterolateral portion of carapace. E — sternites II–VI, ventral view. F — ♂ genitalia, ventral view.

Рис. 10. *Pseudoblothrus arcanus* sp.n. Паратип (♂) из пещеры Скельская. А — левая хела, эктально. В — левая хела, дорсально. С — левая педипальпа, без хелы. D — переднелатеральная часть карапакса. Е — стерниты II–VI, вентрально. F — гениталии, вентрально.

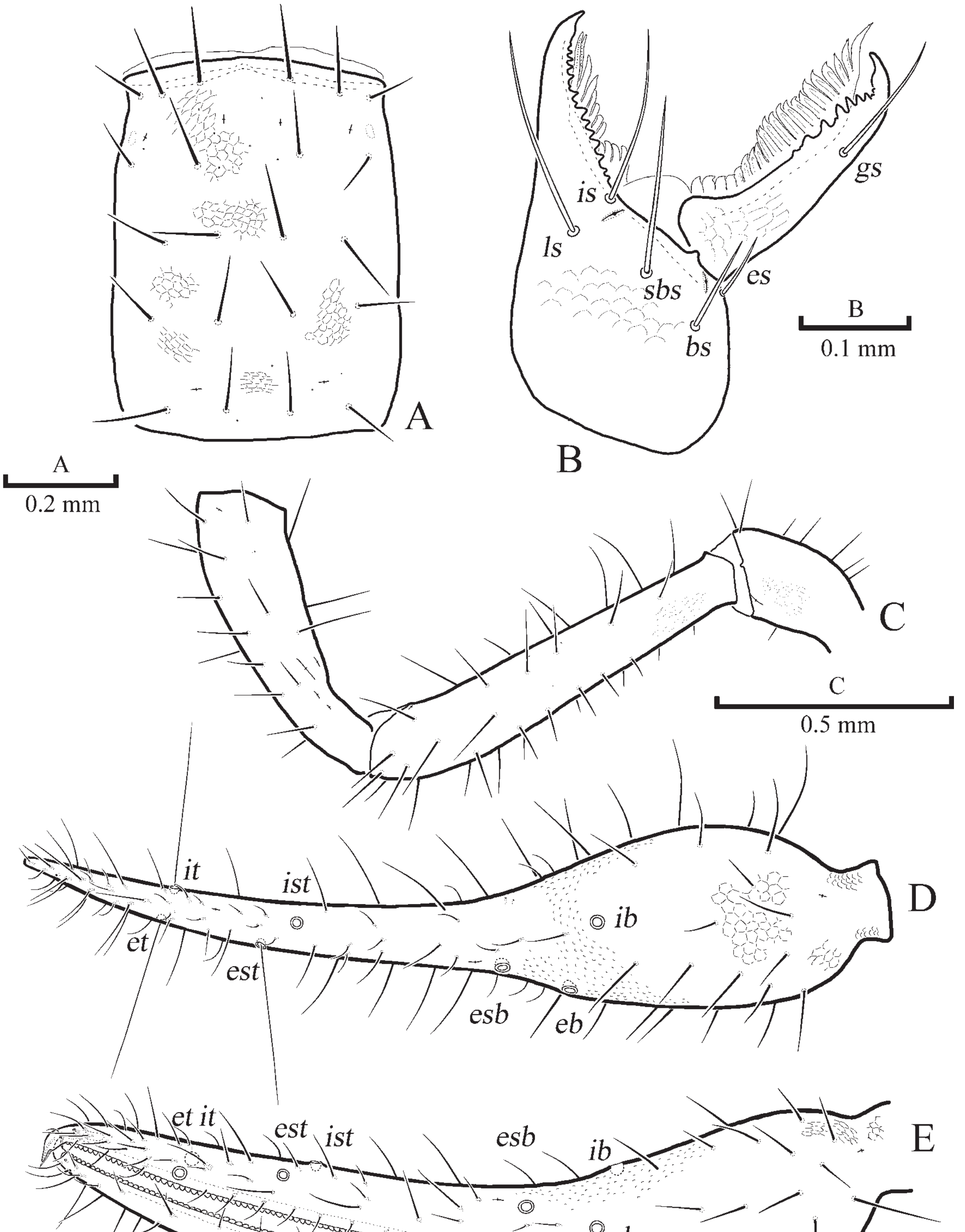

Fig. 11. *Pseudoblothrus arcanus* sp.n. Tritonymph from Kuznetsova Cave. A — carapace, dorsal view. B — right chelicera with serrula exterior and serrula interior. C — left pedipalp, minus chela. D — left chela, dorsal view. E — left chela, ectal view.

Рис. 11. *Pseudoblothrus arcanus* sp.n. Тритонимфа из пещеры Кузнецова. A — карапакс, дорсально. B — правая хелицера с внешней и внутренней серрулами. C — левая педипальпа, без хелы. D — левая хела, сверху. E — левая хела, эктально.

gin. Coupled sensilla (*pc*) present on movable finger between *st* and *b*, near dental margin. Movable finger at the distal end with two apical sensilla (*am*$_1$ and *am*$_2$), fixed finger — one apical sensilla (*af*). Lyrifissures arranged at base of hand on dorsal side, between *b* and *esb* (1 lyrifissure), proximal to *esb* (1 lyrifissure), between *b* and *st* (2 lyrifissures), and between *est* and *it* on dorsal side (1 lyrifissure). Fixed finger with 74 small, contiguous teeth. Teeth of fixed finger reaching to level of *esb*. Movable finger with 76 small, contiguous teeth. Teeth of movable finger extending almost as far basally as those of fixed finger (difference equivalent to about one teeth). A row of four very small denticles at base of fixed finger. Fixed finger with well-developed venedens and venom gland, venom duct short, *nodus ramosus* clearly distal to *et*. *Lamina defensor* (*ld*) tightly appressed to venedens. Movable finger without venom apparatus, with a short, blunt apodens and a small *lamina defensor*.

Legs I and IV. Surface weakly reticulate. Joint between femur and patella of leg IV perpendicular. Telotarsi not expanded, gradually tapering distally. Subterminal tarsal setae of all legs serrate distally, each with 2–3 barbs. Claws smooth, thin, arcuate, can carry one tooth (variability); arolia undivided and distinctly shorter than claws.

Measurements and ratios of tritonymph as in Tables 4, 5.

Protonymph and deutonymph unknown.

REMARKS. *P. arcanus* sp.n. is morphologically very similar to *P. golovatchi* sp.n., but has four eye spots (the front are twice as large as the rear) without tapeta. *P. arcanus* sp.n. is distinguished from *P. roszkovskii* by the shape of the chelal hand, which is expanded at the base and gradually narrowed distally, with nonparallel edges in dorsal view, by the paraxial edge visibly convex (in *P. roszkovskii* the hand has subparallel edges), and by a smaller body and a smaller number of teeth on the chela. Recognition of the new species is based on the results of molecular genetic studies (see Phylogenetic analysis of the genus *Pseudoblothrus* from Crimean caves above).

Pseudoblothrus roszkovskii (Redikorzev, 1918)

Ideoblothrus roszkovskii Redikorzev, 1918: 94–96, figs 3, 4, 4a; Pliginsky, 1927: 172; Ljovuschkin, 1966: 193.

Pseudoblothrus roszkovskii (Redikorzev): Beier, 1931: 21–22; Beier, 1932a: 136, fig. 167; Roewer, 1937: 249; Wolf, 1938: 618; Roewer, 1940: 345; Vachon, 1954: 217; Beier, 1963: 228, fig. 234; Ljovuschkin, 1966: 55, 193; Vachon, 1969: 392; Beier, 1970: 322, fig. 2; Muchmore, 1982: 218; Inzaghi, 1983: 46; Mahnert, 1990: 167; Harvey, 1991: 428; Zaragoza, 2010: 52, fig. 28; Gardini, 2015: 32; Turbanov, Kolesnikov, 2015: 83; Turbanov *et al*., 2016: 1286; Kolesnikov, Turbanov, 2017: 50–55, fig. 1; Kolesnikov, Turbanov, 2018: 524–544, figs 1–7.

Pseudoblothrus ljovuschkini Krumpál, 1984: 642–645, figs 11–16; Harvey, 1991: 428; Gardini, 2015: 32; Turbanov, Kolesnikov, 2015: 82; Kolesnikov, Turbanov, 2017: 50–55; Kolesnikov, Turbanov 2018: 524–544.

Obisium tauricum Lebedev, 1927: 44–47, figs 1–2; Ljovuschkin, 1966: 193; Turbanov, Kolesnikov, 2015: 83; Turbanov *et al*., 2016b: 1286; Kolesnikov, Turbanov, 2017: 50–55; Kolesnikov, Turbanov, 2018: 524–544.

Obisium touricum [sic]: Beier, 1932b: 277; Harvey, 1991: 671; Kolesnikov, Turbanov, 2018: 524–544.

NEW MATERIAL: 1 ♂ (IT), Crimea, Dolgorukovsky Karst Massif, Proval II Cave, 13.5.2017, leg. I.S. Turbanov.

REMARKS. This study adds new data regarding the distribution of *P. roszkovskii* in the Crimean Mountains caves — Emine-Bair-Khosar [Ljovuschkin, 1966] and Proval II [this study] caves (Fig. 1).

Discussion

Our data expand the knowledge of the origin of the genus *Pseudoblothrus*, species of which, as noted by Beier [1970], are paleoendemic troglobionts, and can be considered among the few extant remnants of an archaic fauna. Phylogenetic estimation of the genus divergence time remains impossible due to its extremely patchy distribution (it is known that the range lies from the Azores in the west and through the Alps to the Crimean Peninsula in the east) and current molecular genetic data being available only for species that occur in Crimea. However, based on the available data, it is possible to make a preliminary reconstruction of a probable evolution scenario for the modern range and to identify possible ways of speciation within the genus *Pseudoblothrus* in Crimea.

Our earlier study [Kolesnikov, Turbanov, 2018] showed that there is only one species of the genus *Pseudoblothrus* in the central Crimean Mountains, *P. roszkovskii*, which lives in caves of the Tshatyr-Dagh, Dolgorukovsky, and Karabi karst massifs. However, two new species (*P. golovatchi* sp.n. and *P. arcanus* sp.n.) have been recorded in the western Crimean Mountains, in a quite limited area in the caves of the Ai-Petri Karst Massif. It is most likely that the current distribution (Fig. 1) is shaped by the historical geology of Crimea, in particular by the effects of some paleoclimatic events that could influence the speciation.

According to our earlier studies [Prokopov, Turbanov, 2017], the most intense evolution of the Crimean troglobiont fauna occurred in the Middle and Late Pleistocene. Many researchers [Jannel, 1959; Vandel, 1964; etc.] assume that it was directly associated with alternating glacial and interglacial periods. Most probably, a land (soil) ancestral form of all modern species of the genus *Pseudoblothrus* lived in Crimea during the Mindel-Riss interglacial period. At the beginning of one of the most wide-scale Pleistocene glacial periods, the Riss glaciation, small flattop glaciers of the Crimean Mountains were formed [Vakhrushev, 2001; Vakhrushev, Amelichev, 2001]. This provoked the move of the ancestral form to karst voids, where the temperature was more stable. During that period, the Crimean Mountains karst area (the main range of the Crimean Mountains) had been actively becoming released from the Cretaceous-Paleogene cover [Vakhrushev, 2001]. Simultaneously, there was a process of orographic separation of the Crimean karst area foothills (the Inner and External ranges of the Crimean Mountains) from this mountain region and formation of the main karst massifs of the Crimean Mountains [Vakhrushev, 2001, 2009; Klimchouk *et al*., 2013). These events allow us to assume that the common land ancestral form gave rise to the intermediate form "*golovatchi-arcanus*" in the caves of the western Crimean Mountains (now the Ai-Petri Karst Massif) and to *P. roszkovskii* in the caves of their central part (now the Tshatyr-Dagh, Dolgorukovsky, and Karabi karst massifs). This divergence of the common ancestral form apparently initiated allopatric speciation due to the geographical separation of two isolated populations in the western and central Crimean Mountains. Evolution of the new species from the ancestral form of *P. roszkovskii* did not occur within the central Crimean Mountains [Kolesnikov, Turbanov, 2018], despite the orographic separation of the Tshatyr-Dagh, Dolgorukovsky, and Karabi karst massifs in the Late Pleistocene and Holocene [Vakhrushev, 2009, 2010]. Evolution of two modern species *P. golovatchi* sp.n. and *P. arcanus* sp.n. from the common intermediate form "*golovatchi-arcanus*" in the limited territory within the Ai-Petri Karst Massif is most probably the result of parapatric speciation. During this process, part of the population separated from the common ancestor (to whom, apparently, *P. arcanus* sp.n. is especially close, because its eye spots are not fully lost), moved to a territory with new environment, different from the parental range. It was caused by ancestral range shifts during the Riss-Würm interglacial and Würm glacial periods. This ancestral form settled in the Riss-Würm interglacial period and separated into isolated populations during the Würm glaciation period. The latter provoked the parapatric speciation because of a low settling ability. There are significant differences between the abiotic factors in the caves (absolute altitude above the sea level and temperature) within the range of *P. golovatchi* sp.n. and *P. arcanus* sp.n. *P. golovatchi* sp.n. occurs in the Kuban and Villyaburunskaya caves, which are located in the north-western Ai-Petri Karst Massif at 900–950 m a.s.l. The Villyaburunskaya Cave has a temperature gradient from 5.5 to 8.0 °C [Koval, 2001], and the Kuban Cave had a temperature gradient from 5.2 to 7.9 °C from May 4, 2013 to May 7, 2015 (A.G. Koval, personal communication). *P. arcanus* sp.n. occurs in the Skelskaya, Kuznetsova, and Kristalnaya caves, which are located in the western Ai-Petri Karst Massif at 350–830 m a.s.l. The Skelskaya Cave has a temperature gradient from 10.0 to 11.8 °C [Amelichev, 2008], and the Kristalnaya Cave had a temperature gradient from 7.7 to 11.6 °C during the period from May 1, 2013 to May 3, 2015 (A.G. Koval, personal communication). We assume that there is a narrow overlap of territories between the two parapatric ally evolved species with a possible hybridization zone. The existence of the hybridization zone in the Ai-Petri Karst Massif region needs further studying.

Troglomorphic millipedes of the genus *Caucasodesmus* Golovatch, 1985 (Diplopoda: Polydesmida: Trichopolydesmidae) have a similar distribution in the caves of the Crimean Mountains [Golovatch, VandenSpiegel, 2015; Golovatch *et al.*, 2017; Turbanov *et al.*, 2018]. There are two parapatric species within the Ai-Petri Karst Massif, *C. tauricus* Golovatch, 2011 in the north-western massif in the Villyaburunskaya and Beryu-Teshik caves and *C. svetlanae* Golovatch et VandenSpiegel, 2015 in the western Ai-Petri Karst Massif in the Skelskaya, Kuznetsova and Kristalnaya caves. In addition, there are two species in the central Crimean Mountains, *C. turbanovi* Golovatch et VandenSpiegel, 2015 in the Tuakskaya Cave (Karabi Karst Massif) and *C. birsteini* Golovatch, Turbanov et VandenSpiegel, 2017 in the Mramornaya Cave, the Tshatyr-Dagh karst massif. It is most likely that *C. turbanovi* and *C. birsteini* initially evolved as parapatric species in the Middle Pleistocene in the Tshatyr-Dagh–Dolgorukovsky–Karabi karst massif that was not yet divided. Only after the orographical separation of Tshatyr-Dagh from the Dolgorukovsky and Karabi karst massifs [Vakhrushev, 2009] in the Late Pleistocene, the reproductive barrier was finally formed based on spatial (geological) isolation.

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