Review of the Central Asian millipede genus *Elongeuma* Golovatch, 1982, with descriptions of two new species (Diplopoda: Chordeumatida: Kirkayakidae)

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**ABSTRACT.** The millipede genus *Elongeuma* Golovatch, 1982, is shown to currently comprise three species, all keyed, mapped, and confined to the Tien-Shang (= Tian Shan) Mts of Kyrgyzstan, Central Asia: *E. speophilum* Golovatch, 1982 (the type-species, revised), *E. reductum* sp.n., and *E. chichkan* sp.n.

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The small, central Palaearctic millipede family Kirkayakidae (= Altajellidae) is currently known to comprise only four genera, all monotypic: *Kirkayakus* Özdikmen, 2008 (= Altaiella Gulička, 1972, preoccupied and thus replaced) with *K. pallidus* (Gulička, 1972), from the Altai, Siberia [Mikhajlova, Golovatch, 2001; Mikhajlova, 2004, 2017], *Teleckophoron* Gulička, 1972 with *Teleckophoron montanum* Gulička, 1972, from the Altai, the southern part of Krasnoyarsk Province, and the Republic of Khakassia, Siberia [Mikhajlova, Golovatch, 2001; Mikhajlova, 2004, 2017; Nefediev et al., 2021], *Tarbagataya* Golovatch et Wytwer, 2003 with *Tarbagataya splendida* Golovatch et Wytwer, 2003, from the Tarbagatay Mountains in eastern Kazakhstan, Central Asia [Golovatch, Wytwer, 2003], and *Elongeuma* Golovatch, 1982, with *E. speophilum* Golovatch, 1982, from a cave in Tien-Shang Mountains, Kyrgyzstan (= Kirghizia), Central Asia [Golovatch, 1982]. The family (as Altajellidae) has been properly circumscribed, and all of its four constituent genera and species have been keyed [Golovatch, Wytwer, 2003].

Hüseyin Özdikmen, a controversial Turkish entomologist, in special search of homonyms in Diplopoda, proposed six new generic names (two confusingly constituting objective synonyms) and a new family-group name to replace perceived junior homonyms, including *Kirkayakus* Özdikmen, 2008 and *Kirkayakidae* Özdikmen, 2008 to substitute the preoccupied *Altajella* Gulička, 1972 and *Altajellidae* Mikhajlova et Golovatch, 2001, respectively [Shelley, Golovatch, 2015].

The family Kirkayakidae belongs to the trans-Palaearctic superfamilies Neoatractosomatoidea that represents by far the largest and most diverse suborder Craspedosomatidea in the entire order Chordeumatida [Minelli, 2015]. None of the species and genera of Kirkayakidae appears to be even grossly sympatric with any other member of Chordeumatida. Thus, the Tien-Shang and Dzungarsky Alatau mountains in Central Asia are populated by species of only one more chordeumatid genus, *Tianella* Attems, 1904 (extending south to the Himalayas), family Entomobielziidae, superfamly Cleidogonoidae, subfamily Craspedosomatidea, whereas Siberia, including the Altai Mountains, is dominated by species and genera of the very large family Diplomaragnidae, superfamly Diplomaragnioidea, suborder Heterochordeumatidea, also supporting two species of the Siberian genus *Ghilarovia* Gulič-
ka, 1972, family Anthroleucosomatidae, superfamily Anthroleucosomatoidae, suborder Craspedosomatidae [Minelli, 2015; Mikhailova, 2017]. Superficially, all Kirkayakidae are very easily distinguished by the subcylindrical bodies devoid of paraterga.

Like the other three genera of Kirkayakidae, the genus *Elongeuma* has hitherto been considered as monobasic, with the type-species *E. speophilum* Golovatch, 1982, described solely from the ♀ holotype originating from the Kendyn-kyry Cave, southern Tian-Shan (= Tian Shan) Mt. Kyrgyzstan (= Kirghizia), Central Asia. Based on a number of such obvious adaptations to cavernicolous or unpigmented body teguments and ocelli, strong eye reduction, elongated antennae, tergal macrochaetae and legs, *E. speophilum* has been regarded as either troglobitic [Golovatch, 1982] or troglobilophic [Turbanov et al., 2016].

The present paper provides descriptions of two new epigean species of *Elongeuma* collected during the 1993 Expedition to Central Asia and provisionally marked as such in its brief account [Read, Golovatch, 1994]. In addition, the description and diagnosis of *E. speophilum* are refined and corrected, based on a revision of the holotype. The species diversity of the genus is thus increased to three, and of the family to six. The genus is properly redescribed, all of its three constituent species being keyed, and their distributions mapped.

### Material and Methods

All type and non-type material is deposited in the collection of the Zoological Museum of the Moscow State University (ZMUM). The holotype of *E. speophilum* has also been revised, this allowing for some corrections to the original description and illustrations to be introduced. The pictures were taken with a Canon EOS 5D digital camera and stacked using Zerene Stacker software. Final image processing was performed with Adobe Photoshop CC.

Permanent micropreparations were mostly mounted by the second author JSP.

Abbreviations of country names used on the map (ISO 3166-1 alpha-2 codes): CN — China; KZ — Kazakhstan; TJ — Tajikistan; UZ — Uzbekistan. In the catalogue sections per species below, D stands for the original description, R for new or old records, and M for mere mention.

### Taxonomy

*Elongeuma reductum* sp. n.
Figs 1, 3–18, Map.

*Elongeuma sp. 2 — Read, Golovatch, 1994: 61, 62 (R, M).

**HOLOTYPE*** ♀ (ZMUM), Tian-Shang (= Tian Shan) Mts, Kyrgyzstan (= Kirghizia), Chatkal Mt. Range, Sary-Chekel Nature Reserve, near Arket, E 71º49′9″ N 41º51′8″, 1993; 2 ♀♀, 3 juv., Sary-Chekel Nature Reserve, 71º50′9″ N 41º51′5″, below Khoya-Ata river valley, in wet flushing, 1500–1600 m a.s.l., 30.V.1993, H. Read leg., 1 ♀, 2 ♀♀, 2 ♀ juv. (JSP180122-006, JSP120793-004, JSP077094-001), Sary-Chekel Nature Reserve, E 71º49′9″ N 41º85′9″, 4 ♀♀, 4 ♀ juv., 4 ♀♀ juv. (JSP180122-010, 011, 012), Sary-Chekel Nature Reserve, E 71º49′9″ N 41º85′9″, 1500–1600 m a.s.l., 27–31.V.1993, W. Schawaller leg.

**NAM**E to emphasize the particularly strongly reduced posterior gonopods.

**DIAGNOSIS.** Differs from congeners by the particularly strongly reduced posterior gonopods usually lacking any traces of coxal sacs (Figs 7, 10, 15–17), and by the structure of ♀ leg-pair 7 (Figs 7, 9) (see also key below).

**DESCRIPTION.** Length of adults 8–9 (♀) or 9–11 mm (♂), width 0.8–0.9 (♀) or 1.0–1.1 mm (♂). Holotype ca 8 mm long and 0.8 mm wide. Coloration of adults and subadults yellowish to brown, often apparently faded due to long preservation in ethanol (Fig. 1), sometimes with mottled brown to blackish spots dorsally and on sides of prozona, divided by a pale axial line and paler patches laterally and ventrolaterally. Metazonae almost entirely pale yellowish to brown, sometimes with somewhat darker, mottled knobs supporting macrochaetae. Antennae brown to dark brown throughout, except for a pulillid tip. Head especially dark on vertex, distinctly marbled. Venter yellowish. Legs pale to brown, increasingly darker toward distal podomerest.

Body with 28 segments, including telson (26p+1a+T), subcylindrical, without evident lateral swellings, let alone keels, on metazonae (Fig. 1), somewhat more slender in ♀ compared to ♂. Antennae long and slender, in situ reaching past segment 4 or 5 when stretched laterally, antennomere 3 being the longest. Frons flattened (♀) or regularly convex (♂). Eyes black, 16–18 ocelli in a roughly triangular field from each side of head. In width, collum < head = segment 2 = 3 < 4–22(23), gently and regularly tapering thereafter. Only two or three postcollum segments with poorly-developed, rounded, lateral swellings instead of paraterga. Metatetal macrochaetae borne on minute knobs, arranged in an almost transverse row, either medium-sized, pointed and thin on two or three anteriormost segments or increasingly thick, short, blunt and subbacilliform thereafter towards telson; lateral macrochaetae longest, reaching in length ca 1/4 metatetal width (Figs 1, 8).

Legs long and slender, a little shorter in ♀, with accessory claws, but only ♀ tarsi 3–6(7) sometimes with ventral papillae (Fig. 9), mostly appallate (Figs 3, 4). Pairs 1 and 2 distinctly reduced in size as usual, ♀ pairs 3–7 almost normal, only slightly enlarged due to coxites; ♀ leg 7 (Figs 3, 9) with a peculiar distosventral swelling on coxa and a smaller caudoparabasal cone on prefemur; ♀ pairs 10 and 11 each with coxal glands (Fig. 4), like a number of following pairs each with a ventral row of strong and spiniform setae on both femur and, especially, prefemur (Fig. 4); each ♀ coxa 2 with a strong, ventral, distally rounded, digitiform process forming a mediolaterally contiguous pair.
Figs 1, 2. Habitus of *Elongeuma reductum* sp.n., ♀ paratype, and *Elongeuma chichkan* sp.n., ♂ paratype, lateral views. Photographs by K.V. Makarov, taken not to scale.

Рис. 1, 2. Общий вид *Elongeuma reductum* sp.n., паратип ♀, и *Elongeuma chichkan* sp.n., паратип ♂, виды сбоку. Фотографии К.В. Макарова, сняты без масштаба.
Anterior gonopods (Figs 5, 6, 10–14) placed on an evident plate-like sternum (st) with lateral tracheal apodemes, high, held parallel to each other, fully independent, curved caudally, clearly tripartite: each composed of a lateral, relatively short, blunt to subacuminate, hyaline lamella (hl), vs slender and finger-shaped in *E. reductum* sp.n., semi-circular with a basal constriction in *E. chichkan* sp.n., and linguiform and blunt in *E. speophilum*; more mesally a longer, conspicuously divided solenomere (sl) carrying a small, midway, caudal lobule (j) and a barbed/fringed distal quarter; and a very long pseudoflagellum (pfl), slightly serrate or undulate at caudal margin. Posterior gonopods (Fig. 7, 10, 15–17) particularly simple, mostly composed of medially contiguous, elongated coxites, both somewhat excavate on caudal face, usually produced apically into a small and setose appendage (telopodite remnant) of varying shapes (Figs 15–17), often showing traces of a dark pigment inside, and only occasionally with dis-
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Figs 8–18. *Elongeuma reductum* sp.n., ♀ paratypes (8–17) and ♂ paratype (18): 8 — body rings 7 and 8, lateral view; 9 — legs 7, anterior view; 10 — both right gonopods, mesal view; 11 — both anterior gonopods, posterior view; 12 — distal part of anterior gonopod (without pseudoflagellum), mesal view; 13, 14 — variations in solenomere’s distal structure, mesal views; 15–17 — variations in posterior gonopod structure; 18 — vulva, lateral view. Abbreviations: cs — coxal sac vestige; hl — hyaline lobe; j — lateral lobule; pfl — pseudoflagellum; sl — solenomere; st — sternum; Scale bars: 0.1 mm.

Рис. 8–18. *Elongeuma reductum* sp.n., паратипы ♀ (8–17) и ♂ (18): 8 — сегменты тела 7 и 8, сбоку; 9 — ноги 7, спереди; 10 — оба правых гонопод, изнутри; 11 — оба передних гонопода, сзади; 12 — дистальная часть переднего гонопода (без ложного жгутика), изнутри; 13, 14 — изменчивость в дистальной орнаментации соленомера, изнутри; 15–17 — изменчивость в структуре заднего гонопода; 18 — вульва, сбоку. Обозначения: hl — гиалиновая пластинка; j — боковая пластинка; pfl — ложный жгутик; sl — соленомер; st — стернит; cs — остаток колыцевого кармана. Масштаб: 0,1 мм.
cernible coxal pouches or sacs (es) with small projections mediadally.

Vulva with a characteristic beak-shaped caudalateral structure behind operculum (Fig. 18).

**Elongeuma chichkan** sp.n.
Figs 2, 19–23, Map.

**Elongeuma sp. 3** — Read, Golovatch, 1994: 61, 62 (R, M).

**HOLOTYPE** ♀ (+ micropreparation) (ZMUM), Tien-Shang (= Tian Shan) Mts, Kyrgyzstan (= Kirghizia), Suusamyr Too Mt. Range, Chichkan River valley S of Alabel Pass, 1,700 m a.s.l., Betsula & Juniperus forest, 2 VI.1993, S.I. Golovatch leg.

**PARATYPES**: 3 ♀♀, 1 ♀ juv., 1 ♀ juv (JSP180121-007, 008, 009, 010, 011), same locality and date, leg. S.I. Golovatch.

**NAME.** Named after the type locality, Chichkan River, meaning “a small mouse” in the Kirghiz language.

**DIAGNOSIS.** Differs from congeners by the particularly strongly reduced posterior gonopods usually lacking any traces of a telopodite, and by the structure of ♀ leg-pair 7 (see also key below).

**DESCRIPTION.** Length ca 9 (♀ holotype) or 9–10 mm (♀ paratypes), width 0.85 (♀ holotype) or 0.9–1.0 mm (♀ paratypes).

All characters as in *E. reductum* sp.n., except as follows. Coloration more regular, less contrasting/vivid (Fig. 2). ♀ leg-pairs 3–6 more distinctly enlarged, with tarsal papillae distally; ♀ legs 7 (Fig. 19) with greatly enlarged coxites each carrying a caudoparabasal knob and a strongly reduced, 2-segmented telodepicted directed dorsolateral, devoid of tarsal papillae; several pairs behind gonopods (Fig. 20) likewise with a ventral row of strong and spiniform setae on both femur and, especially, prefemur.

Anterior gonopods (Figs 21, 22) much like in *E. reductum* sp.n., vs *hl* being slender and finger-shaped in *E. chichkan* sp.n., and linguiform and blunt in *E. speophilum*, also differing in the absence of a lobule (j) on each solenomere (sl). Posterior gonopods (Fig. 23) much more like in *E. speophilum*, coxites quite high, densely setose, caudoparabasal excavation very deep, each with a coxal pouch or sac (es) with a strong coniform projection medially.

Operculum of vulva with a similar, but stronger beak-shaped structure behind operculum, this structure being directed caudad, not caudolateral (Fig. 2).

**Elongeuma speophilum** Golovatch, 1982
Figs 24–31, Map.

**Elongeuma speophilum** Golovatch, 1982: 944 (D).

**Elongeuma speophilum** — Read, Golovatch, 1994: 64 (M); Turbanov et al., 2016: 1291 (M).

**HOLOTYPE** ♀ (ZMUM p1530), revised, Tien-Shang (= Tian Shan) Mts, Kyrgyzstan (= Kirghizia), Fergana Mt. Range, Kirgiz-indan River valley, Kendyn-kry (Kyndyn-kry, or Zindan) Cave, 100–120 m inside (off entrance), X.1978, V. Ogudin leg. (https://speleo.kg/expeditions/2021/alternativnyj-karstovyj-rajon-v-doline-reki-kuraves/).

**DIAGNOSIS.** Differs from congeners by a pallid coloration with only five light brown ocelli on each side of the head. ♀ leg-pairs 3–6 only slightly enlarged, with tarsal papillae distally; each ♀ leg 7 (Fig. 26) with a lateral-micropapillate coxa carrying a strong ventral hook directed distad, while prefemur with a small, glandular, parabasal knob ventrally; ♀ legs 10 and 11 with coxal sacs/glands (Figs 27, 28), usual, devoid of tarsal papillae like following legs.
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Figs 19–23. *Elongeuma chichkan* sp.n., ♂ holotype: 19 — legs 7, posterior view; 20 — legs 10, posterior view; 21, 22 — right anterior gonopod, mesal and posterior views, respectively; 23 — posterior gonopods, posterior view. Abbreviations: cs — coxal sac vestige; hl — hyaline lobe; pfl — pseudoflagellum; sl — solenomere; st — sternum. Scale bar: 0.1 mm.

Рис. 19–23. *Elongeuma chichkan* sp.n., голотип ♂: 19 — ноги 7, сзади; 20 — ноги 10, сзади; 21, 22 — правый передний гонопод, соответственно изнутри и сзади; 23 — задние гоноподы, сзади. Обозначения: cs — остатки коксального кармана; hl — гиалиновая пластина; pfl — ложный жгутик; sl — соленомер; st — стернит. Масштаб: 0,1 мм.

Anterior gonopods (Figs 29, 30) much like in *E. reductum* sp.n., but differing in the absence of a lobule (j) on each solenomere (sl), thus being very similar to those of *E. chichkan* sp.n.. Posterior gonopods (Fig. 31) also very similar to those in *E. chichkan* sp.n., both coxites being quite high, sac-shaped and densely setose, while coxal pouches or sacs (cs) with membranous projections.

REMARK. This species was observed living on ice inside the cave at an elevation of >2000 m a.s.l. (https://speleo.kg/expeditions/2021/alternativnyj-karstovyj-rajon-v-doline-reki-kuraves/).

**KEY TO SPECIES OF *ELONGEUMA***

1(2) Larger: length of adults ca 14 mm. Coloration pallid, only 5 light brown ocelli on each side of head. ♂ legs 7 with a pair of strong hooks on coxae and small glandular parabasal knobs of prefemora (Fig. 26). Coxal pouches (cs) of posterior gonopods with membranous projections (Fig. 31) ....................................................... *E. speophilum*

2(1) Smaller: adults up to 10 mm long. Coloration usually yellow-brown, adults and subadults often with distinct patterns. Up to 16–18 ocelli black. ♂ legs 7 otherwise. Coxal pouches (cs) of posterior gonopods either totally suppressed or with small and coniform projections ................................................................. 3

3(4) ♂ legs 7 leg-like, as in Figs 3 and 9. Solenomere (sl) of anterior gonopods (Figs 5, 6, 10, 12) with a distinct midway lobule (j). Posterior gonopods particularly strongly reduced (Fig. 5), usually without coxal pouch vestige ....................................................... *E. reductum* sp.n.

3(4) ♂ legs 7 with strongly reduced, 2-segmented telopodites (Fig. 19). Solenomere (sl) of anterior gonopods (Figs 21, 22) without lobule j. Coxal pouches (cs) of posterior gonopods with distinct and coniform projections (Fig. 23) ....................................................... *E. chichkan* sp.n.
Further notes on and a new diagnosis of *Elongeuma*

As the genus *Elongeuma* presently comprises already three described species, an analysis of intrageneric variations is possible. Because the original description of the type species *E. speophilum* (ZMUM, holotype restudied, see above) and illustrations [Golovatch, 1982] erred in several accounts (28, not 30, body segments, largely blunt metatergal macrochaetae, ♂ legs 7 mistakenly referred to and depicted as legs 6 etc.), most of which were corrected later [Golovatch, Wytwer, 2003], a fully rectified redescription has been given below.

The most pronounced variations in *Elongeuma* spp. seem to concern ♂ leg-pair 7 and the posterior gonopods. Indeed, whereas ♂ legs 7 are eventually leg-like in *E. speophilum* and *E. reductum* sp.n., with modifications mainly affecting the coxa, it is surprisingly strongly reduced in *E. chichkan* sp.n. (Fig. 19). In *E. reductum* sp.n., particularly strong...
reduction concerns the posterior gonopods, with the coxite not being hypertrophied, and the coxal pouch vestige usually being totally missing (Figs 7, 10, 15–17).

Traditionally, the presence or absence of the \( \text{tarsal papillae} \) has been considered as a family-run character (e.g. Attems [1926], Verhoeff [1926–1932] or Minelli [2015]). Tarsal papillae present in the genus \( \text{Elongeuma} \) spp. only in \( \text{legs 3–6(7)} \), these often being restricted to the distalmost parts of the tarsi, is rather unusual as compared to the remaining three genera and species of Kirkayakidae (cf. Golovatch, Wytwer [2003]).

Genus \( \text{Elongeuma} \) Golovatch, 1982

Type species: \( \text{Elongeuma speophilum} \) Golovatch, 1982, by original designation.

\text{DIAGNOSIS}. Body small (adults 8–14 mm long), with 28 segments \( (26+1+1) \), jaunoid, devoid of anadura. Clypeus flattened \( (\text{h}) \) or regularly convex \( (\text{h}) \). Metagaster macrochaetae mostly bacilliform. Gnathochilarium without prominence. Collum usual, not covering the head from above. Tegument smooth.

Legs long and slender, \( \text{legs 2} \) normal; only \( \text{legs 3–6(7)} \) with tarsal papillae, \( \text{legs 7} \) modified; both \( \text{legs 10} \) and 11 with coxal sacs.

Anterior gonopods placed on a plate-like sternum with retained tracheal apodemes; coxites always independent, contiguous medially, clearly curved caudal, held parallel to each other to slightly crossing each other distally, tripartite; each composed of a pair of lateral hyaline lamellae \( (\text{hl}) \); more mesally with a pair of longer, conspicuously divided solenomeres \( (\text{sl}) \), each conspicuously barbed/fringed distally; and a pair of mesal, very long pseudoflagella \( (\text{ Pf}) \) (or true flagella as derivatives of coxal glands?). Posterior gonopods far more simple, also placed on a plate-like sternum with retained tracheal apodemes, mostly composed of medically contiguous, elongated, sac-shaped and setose coxites either fully devoid of coxal pouches or retaining their vestiges \( (\text{cs}) \) medially near base.

Conclusion

This study has long been nearly accomplished, but remained shelved for nearly three decades in the hope for additional samples to come in. However, at present it appears best to publish it as it stands, however incomplete, because the collecting activities for Diplopoda in the Tien-Shang Mountains seem to have lately come to naught. At the moment, the known species seem to be confined to the western parts of Tien-Shang (Map), whereas the central and eastern parts seem to support only species of \( \text{Tianella} \), the sole other chordeumatid genus encountered in Central Asia. Allopathy seems to prevail between species or is manifest in both genera of Chordeumatida in the region. Thus, Sary-Chelek appears to support not only \( \text{Elongeuma reductum} \) sp.n., but also another kirkayakid, possibly \( \text{Elongeuma} \) species, represented by two females, both distinctly larger than \( \text{E. reductum} \) sp.n. Yet, in the absence of male material it is impossible to describe them as something new.

Indeed, given the huge size and orographic diversity of the region, more \( \text{Elongeuma} \) species may well be expected to occur in the Tien-Shang Mountains. The above key is meant to facilitate future descriptions.

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