



## Identities of the millipede genera *Skleroprotopus* Attems, 1901 and *Ansiulus* Takakuwa, 1940 (Diplopoda: Julida: Mongoliulidae), with emphasis on the postembryonic development of *Skleroprotopus coreanus* (Pocock, 1895)

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### Abstract

Based on a study of postembryonic growth of *Skleroprotopus coreanus* (Pocock, 1895), the following new synonyms and combinations are proposed: *Skleroprotopus* Attems, 1901 = *Ansiulus* Takakuwa, 1940, **syn. n.**, *Skleroprotopus coreanus* (Pocock, 1895) = *Skleroprotopus schmidtii* Golovatch, 1979, **syn. n.**, *Skleroprotopus aberrans* (Mikhaljova & Korsós, 2003), **comb. n.** = *Ansiulus aberrans* Mikhaljova & Korsós, 2003; *Skleroprotopus legitimus* (Golovatch, 1980), **comb. n.** = *Ansiulus legitimus* (Golovatch, 1980); *Skleroprotopus deminutus* (Mikhaljova, 2001), **comb. n.** = *Ansiulus deminutus* Mikhaljova, 2001; *Skleroprotopus matumotoi* (Takakuwa, 1940), **comb. n.** = *Ansiulus matumotoi* Takakuwa, 1940, the valid names being the former. 13 postembryonic stadia of males of *Skleroprotopus coreanus* were revealed: sexual dimorphism appears at stadium VIII, maturity is achieved in stadium XI.

**Key words:** Millipedes, *Skleroprotopus*, *Ansiulus*, taxonomy, new synonymy, new combinations, anamorphosis, postembryonic stadia

### Introduction

The genus *Skleroprotopus* was originally erected based on the single species *Skleroprotopus confucius* Attems, 1901, taken from Kalgan (misspelled as Khalgan) (at present Zhangjiakou City), Hebei Province, China (Attems 1901). At the moment the genus contains 21 species distributed in North China, Japan, Korea and the Far East of Russia. The Japanese genus *Senbutudoius* Miyosi, 1957 was recently proposed as the fourth junior subjective synonym of *Skleroprotopus* (Vagalinski *et al.* 2018) (after *Mongoliulus* Pocock, 1903, *Paraprotopus* Verhoeff, 1939 and *Nesoprotopus* Verhoeff, 1939).

The genus *Ansiulus* in the new subfamily Ansiulinae of the family Parajulidae was first proposed by Takakuwa (1940) for a new species from Ansyu, Korea: *A. matumotoi* Takakuwa, 1940. In his following publications Takakuwa placed the genus *Ansiulus* in the family Blaniulidae (Takakuwa & Takashima 1944; Takakuwa 1954). Later, *Ansiulus* was transferred to the family Mongoliulidae and the subfamily Skleroprotopodinae which became the senior synonym of Ansiulinae (Hoffman 1980). At the moment, this genus contains four species known from Korea and the Far East of Russia.

The genus *Ansiulus* seems to be particularly closely related to *Skleroprotopus*. The main differences between these genera are the presence, in *Ansiulus*, of reduced posterior gonopod telopodites and leg-like multisegmented telopodites of male leg pair 7, as well as lack of the latter's well-developed coxal processes, like those found in *Skleroprotopus* (Takakuwa 1940). In addition, species of *Ansiulus* and *Skleroprotopus* appear to be morphologically rather variable (Mikhaljova & Korsós 2003). The male leg pair 7 and the gonopods are most often subject to variability. The number of segments of the leg pair 7 telopodite is particularly unstable, and differences may even occur between both sides of the same specimen (Mikhaljova & Korsós 2003). That the close resemblance between *Ansiulus* and *Skleroprotopus*, in combination with the high variability, might be evidence for the synonymy of these genera, has long been suspected (Golovatch 1980; Mikhaljova & Korsós 2003; Mikhaljova 2004, 2017).

Abundant material of *Skleroprotopus coreanus* (Pocock, 1895) and specimens looking like species of *Ansiulus* were accumulated in the course of my many-year study of the millipedes of the southern part of the Russian Far East. The material revealed a large number of heterogeneous forms of males which differ from each other by the structure of leg pairs 1, 7 and gonopods, as well as by the presence or absence of reduced posterior gonopod telopodites and various combinations of these characters. Since in the southern part of the Russian Far East there occurs no other genus of the Mongoliuludae with a structure of leg pair 1, leg pair 7 and gonopods similar to *Skleroprotopus* and *Ansiulus*, it was supposed that these forms are juveniles belonging to different postembryonic stadia of *Skleroprotopus coreanus*, including *S. schmidtii* Golovatch, 1979. This assumption is supported by the fact that in the abundant material from different localities, collected over several decades, no clear-cut lines of morphologically different juveniles are evident.

The aim of the paper is not to reveal and describe the postembryonic stadia of *Skleroprotopus coreanus* in order to reconstruct the pathway of anamorphosis. The focus is on the description and analysis of these stadia under the main assumption of a synonymy of *Ansiulus* and *Skleroprotopus*.

## Material and methods

The material treated here derives from three collections: the Federal Scientific Center of the East Asia Terrestrial Biodiversity, Far Eastern Branch of the Russian Academy of Sciences, Vladivostok, Russia (FSCB), the Zoological Museum of the Moscow State University, Moscow, Russia (ZMUM) and the Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia (ZIP). Only males and juveniles were studied. Specimens were kept in 70–75% ethanol. Gonopods and some other body parts were dissected from a limited number of males and mounted in temporary glycerin micropreparations. SEM micrographs were prepared at the Centre of Collective Use "Biotechnology and Gene Engineering" of the Federal Scientific Center of the East Asia Terrestrial Biodiversity, Far Eastern Branch of the Russian Academy of Sciences in Vladivostok, Russia using a Merlin 62–15 scanning electron microscope. Mounts for SEM were made through air-drying after transfer to acetone via 96% alcohol, mounting on stubs, and coating with chromium. After examination, SEM material was removed from stubs and returned to alcohol. SEM images were processed in PhotoShop by the author.

The postembryonic stadia were determined by the eyerow method which is based on the observation that during anamorphosis (especially in Juliformia) one row of ocelli is added per moult (Enghoff *et al.* 1993). The number of rows of ocelli was counted on the posterior side of the ocular field. In addition, the numbers of podous rings (including body ring 7 and the apodous collum which is conventionally called the first podous ring although it is devoid of legs, but excluding telson) and apodous (before telson) rings were counted. Counts of podous and apodous rings or of leg pairs are sufficient for determining early stadia in Julida, whereas in later stadia specimens with the same number of rings may belong to two or more stadia (Enghoff *et al.* 1993). The structures of the gonopods, leg pair 1 and leg pair 7 were studied in each distinct stadium.

Leg pair 1 of all juveniles is somewhat smaller and thicker compared to other legs, but is otherwise unmodified; this state was designated as "without modifications".

A "body ring formula" indicates the number of podous and apodous segments in an individual. This formula is  $x(-y)$  where  $x$  = sum of podous and apodous body rings excluding telson,  $y$  = number of apodous body rings excluding telson.

## Results

### *Skleroprotopus coreanus* (Pocock, 1895)

Figs 1–71.

*Paraiulus coreanus* Pocock 1895: 365, figs 12, 12a.

*Mongoliulus coreanus*—Pocock 1903: 522; Takakuwa & Takashima 1940: 180; Takakuwa & Takashima 1944: 24; Takakuwa 1954: 152; Paik 1958: 363; Jędryczkowski 1982: 375; Mikhajlova 1982: 1265.

*Skleroprotopus similiserratus* Golovatch 1979: 906, fig. 2. Synonymized by Mikhajlova (1982).

*Skleroprotopus similiserratus*—Lokšina & Golovatch 1979: 387; Kurcheva & Mikhajlova 1980: 121; Golovatch 1980: 50; Mikhajlova 1981: 87; 1982: 1265.

*Skleroprotopus schmidtii* Golovatch 1979: 904, fig. 1; **syn. n.**

*Skleroprotopus schmidtii*—Lokšina & Golovatch 1979: 387; Mikhajlova 1993: 16; 1998: 66, figs 264–271, map 17; 2004: 82, figs 159–169, map 11; 2009b: 3; Ganin 2011: 347; Mikhajlova 2002: 147.

*Paraiulus coreanus*—Mikhajlova 1982: 1265.

*Skleroprotopus coreanus*—Mikhajlova 1982: 1266, fig. 1; 1983: 87; 1988: 70; 1993: 15, map; 1997: 145; 1998: 66, figs 272–277, map 17; 2002: 148; 2004: 84, figs 170–185, map 11; 2006: 129; 2007: 81; 2009a: 602; 2009b: 3; 2009c: 393; 2012: 23, figs 16–17; 2016: 10; 2017: 108, figs 205–220, map 14; Mikhajlova & Petukhova 1983: 53; Ursova 1983: 305; Ganin 1987: 66; 1988: 7; 1989: 145; 1993: 126; 1994: 60; 1995: 369; 1997: 10; 1998: 81; 2000: 33; 2008: 100; 2009: 153; 2011: 97; Mikhajlova & Bakurov 1989: 40; Mikhajlova & Kim 1993: 36; Mikhajlova & Lim 2000: 148; Mikhajlova & Korsós 2003: 220; Mikhajlova & Marusik 2004: 4; Turbanov *et al.* 2016: 1292; Nguyen *et al.* 2016: 45.

*Ansiulus matumotoi*—Mikhajlova 2002: 147.

*Ansiulus aberrans*—Mikhajlova 2004: 87, figs 186–193, map 10; 2009a: 602; 2017: 111, figs 221–228, map 13.

**Material examined.** All from Russia (Far East): 60 samples (FSCB): Jewish Autonomous Region, 25 km N of Birobidzhan, "Bastak" Nature Reserve, "Dubovaya Sopka", "Ryabinovii" Cordons, block 140, Bastak sector, valley of Bastak River, leaved and mixed forests, swamp, July, September 2004–2005, leg. E.V. Mikhajlova, M.G. Ponomarenko, V.N. Kuznetsov; Jewish Autonomous Region, near Budukan, Gremyachii Stream, valley broadleaved forest, 30.IX.2005, leg. L. Kapitonova; 1 sample (FSCB): Primorskii krai, Anuchinskii District, Sinii Mountain Range, traps, 6–14.X.1979, leg. B.D. Bakurov; 1 sample (FSCB): Primorskii krai, Lazovskii Nature Reserve, Tretii Log, tributary of the Perekatnaya River, 30.V.1979, leg. T.S. Vshivkova; 1 sample (FSCB): Primorskii krai, Lazovskii Nature Reserve, Korpada, *Chosenia* forest, 18.VI.2005, leg. S.Yu. Storozhenko, V.S. Sidorenko, S.K. Kholin, Yu. Sundukov; 1 sample (FSCB): Primorskii krai, Lazovskii Nature Reserve, Ta-Chin-Gouza Cordon, 23.V.2007, leg. S.A. Shabalin; 2 samples (FSCB): Primorskii krai, Partizanskii District, 7 km E of Fridman station, forest, 5–6.VIII.2002, leg. E.V. Mikhajlova; 1 sample (FSCB): Primorskii krai, "Kedrovaya Pad" Nature Reserve, *Abies holophylla* forest, litter, 7.VII.1979, leg. E.V. Mikhajlova; 14 samples (FSCB): Primorskii krai, Ussuriyskii District, about 20 km SW of Krounovka village, leaved forest, litter, 13.IX.2002, leg. E.V. Mikhajlova; 1 sample (FSCB): Primorskii krai, Ussuriyskii District, near Nikolo-Lvovskoe village, 22.IV.2003, leg. E.V. Mikhajlova; 2 samples (FSCB): Primorskii krai, Pogranichnii District, about 3 km E of Barabash-Levada village, 24 and 26.VI.2003, leg. E.V. Mikhajlova; 5 samples (FSCB): Primorskii krai, Oktyabrskii District, about 18 km E of Pokrovka village, 26–27.X.2003, leg. M.G. Ponomarenko; 18 samples (FSCB): Primorskii krai, Ussuriyskii Nature Reserve, leaved and coniferous forests, litter and under the bark of a rotten tree, June–July, September, October, 1964 and 1977–1979, leg. E.V. Mikhajlova and unknown collector.

**Material re-examined.** Specimens published by Golovatch 1979; Mikhajlova 2002, Mikhajlova 2004, 2009a, 2017: 1 sample (ZIP): Russia, Far East, Primorskii krai, Amerika Gulf, Kozmina Bay, near Solenoe Lake (at present near Nakhodka), 12.V.1900, leg. P.Yu. Shmidt; 1 sample (FSCB): Russia, Far East, Primorskii krai, Ussuriyskii Nature Reserve, left bank of Komarovka River, under the bark of a dead tree, 28.VIII.1979, leg. E.V. Mikhajlova; 1 sample (FSCB): Russia, Far East, Primorskii krai, Petra Velikogo Bay, Naumova Island, coastal grass and bushes, litter, 18.IX.2001, leg. L.A. Prozorova; 1 sample (FSCB): Russia, Far East, Primorskii krai, Partizanskii District, ca. 7 km of Fridman village, leafy forest, litter, 5–6.VIII.2002, leg. E.V. Mikhajlova.

## Postembryonic development of male sexual characters

**Stadia I–VII.** Assuming that the early anamorphosis of *Skleroprotopus* and *Ansiulus* follows the same course as in the vast majority of Julida (Enghoff *et al.* 1993), the first postembryonic stadium (stadium I, not found in the studied material) will have 4 podous + 2 apodous rings before telson, and three pairs of legs.

Taking into account that in most Julida, stadium IV is the first to incorporate a variable number of podous rings but that the variability may occur already in stadium III in some species of Nemasomatidae (Enghoff *et al.* 1993), it was assumed that stadium III marks the onset of variable increments in the mongoliulid *Skleroprotopus coreanus*.

Juveniles with 2 (stadium III), 3 (stadium IV), 4 (stadium V) and 5 (stadium VI) rows of ocelli, 4–6 apodous, 11–28 podous rings and body length 2–10 mm are devoid of any sexual characters (Table 1). These stadia are characterized by unmodified leg pairs 1 and 7, as well as morphologically quite normal legs of body ring 7 and the absence of a penis.

Juveniles with 6 (stadium VII) rows of ocelli, 5–6 apodous, 31–33 podous rings and body length 12–14 mm

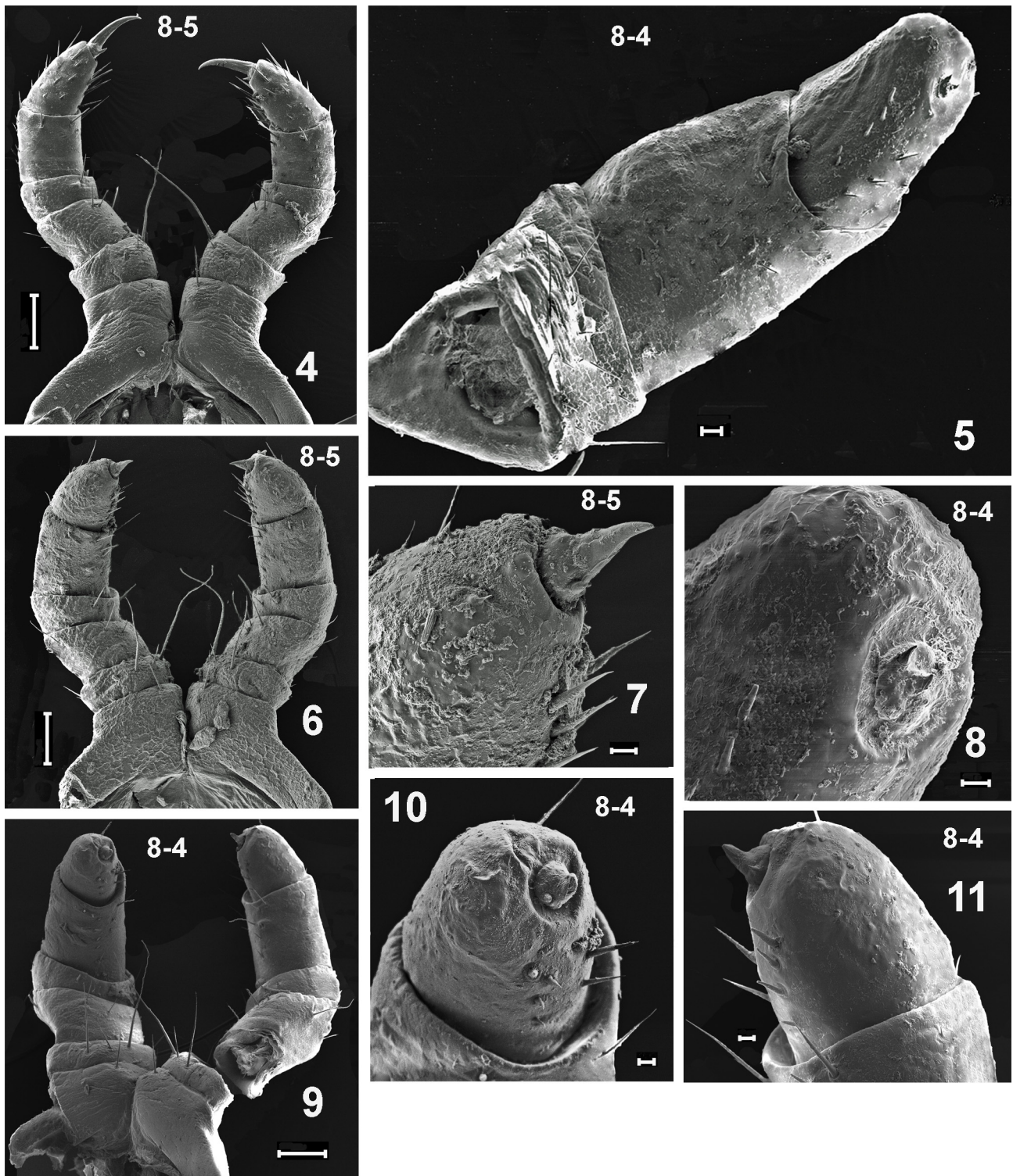
are characterized by unmodified leg pairs 1 and 7 as well as the absence of gonopods and a penis. In some juveniles (possibly females) the distance between leg pairs 2 and 3 can be slightly increased.

**Stadium VIII.** In Julida species, maturity can be achieved in several different stadia; the development of the gonopods usually takes place over three moults (occasionally more), moreover, each stadium may include juveniles of varying degrees of maturity of the sex structures (Enghoff *et al.* 1993).



**FIGURES 1–3.** *Skleroprotopus coreanus* (Pocock, 1895), juvenile males (postembryonic stadium VIII): leg pair 1 (frontal view); 1, specimen with 6 apodous rings; 2–3, specimens with 5 apodous rings; formulae 7–6 and 7–5: 7—number of eye rows, 6 and 5—number of apodous rings. **Scales:** 100 µm.



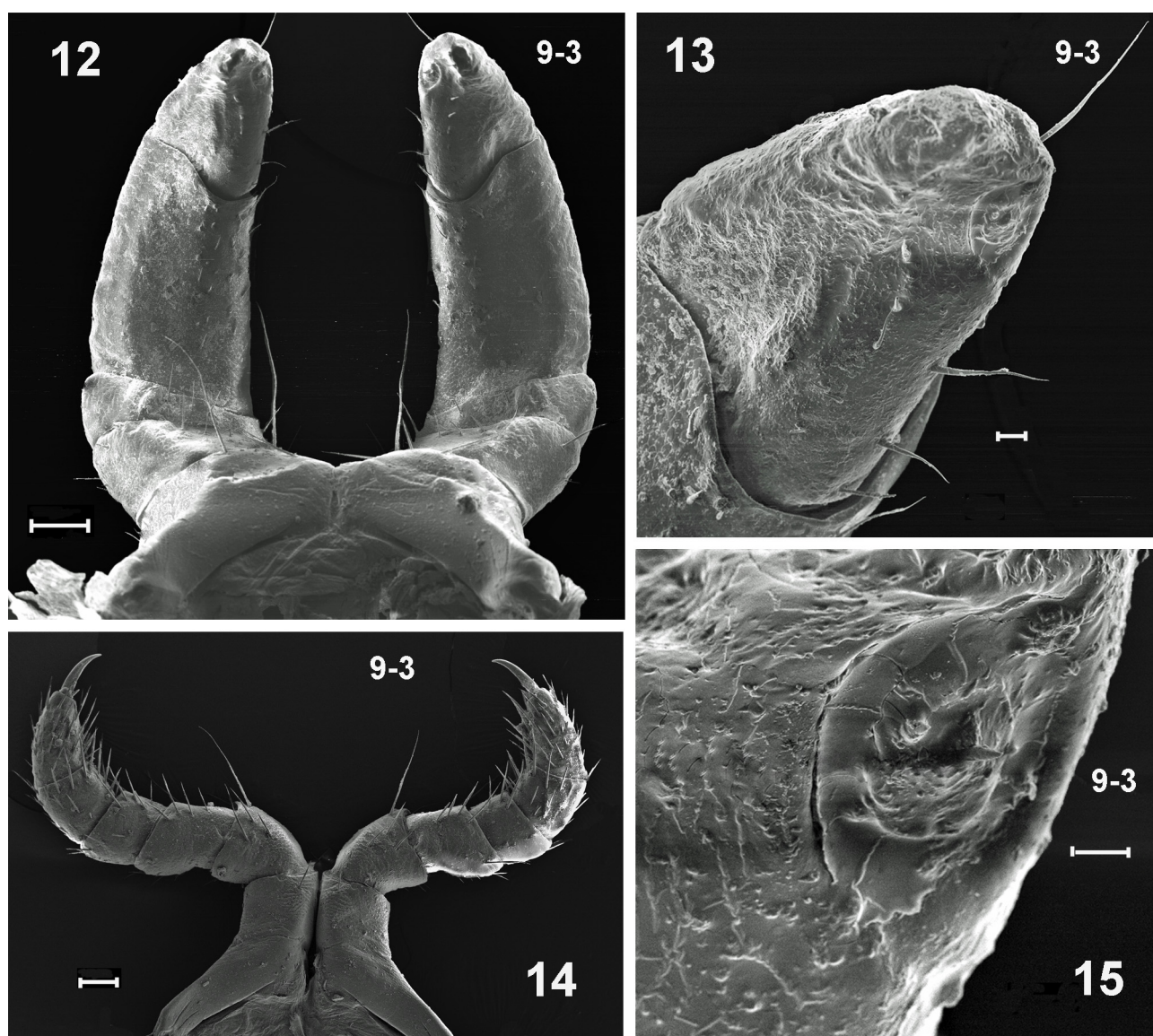


**FIGURES 4–11.** *Skleroprotopus coreanus* (Pocock, 1895), juvenile males (postembryonic stadium IX): **4, 6, 9**, leg pair 1 (frontal view); **7 & 8, 10 & 11**, tip of leg pair 1; **5**, leg 1; **4, 6–7**, specimens with 5 apodous rings; **5, 8–11**, specimens with 4 apodous rings; formulae 8–5 and 8–4: 8—number of eye rows, 5 and 4—number of apodous rings. **Scales:** 10 µm (figs 7, 8, 10, 11), 20 µm (Fig. 5), 100 µm (Figs 4, 6, 9).

In *Skleroprotopus coreanus* sexual dimorphism appears at stadium VIII (7 rows of ocelli, mostly 5, rarely 4 and 6, sporadically 3 and 7 apodous rings, 31–44 podous ones before the telson, body length 13–23 mm). Leg pairs 1 and 7 are either unmodified (more often in juvenile females) or modified in one way or another (leg pair 1 may be somewhat thickened, bearing a long claw at the top (Figs 1–3); leg pair 7 may be normal but size-reduced, its coxal



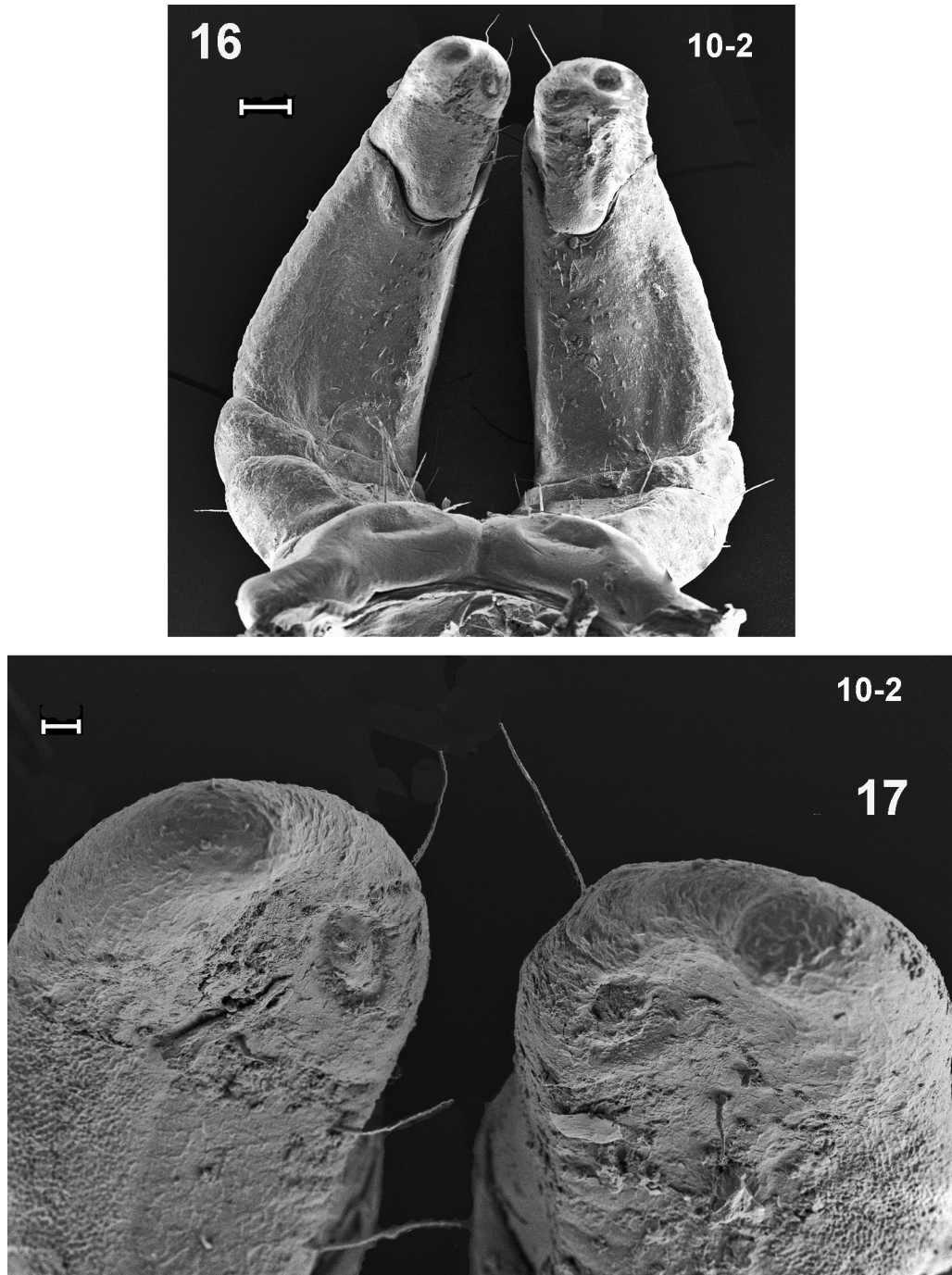
processes may be very low or absent; leg pair 7 may bear low coxal processes and thin multisegmented telopodites; one of the legs of pair 7 may be greatly reduced and thin while the opposing second leg is normal (Figs 19–21)). The penis was not detected in this stadium. Starting from stadium VIII, the degree of development of the gonopods and male leg pairs 1 and 7 at the same stadium can vary greatly among specimens from different regions and localities that differ in hydrothermal conditions. Gonopods may be absent (even in juvenile males). The seventh ring may carry the size-reduced thin leg pairs 8 and 9 (Fig. 41) or only a very thin leg pair 8. Also, this ring may be devoid of any leg pairs. In addition, the gonopods may be present, but in this case they are very small and poorly developed: the posterior gonopods have poorly developed coxae without two branches but with apical setae and large remnants of telopodites (Fig. 42). The anterior gonopods may bear rudiments of flagella, tuberculate coxal processes and 2-segmented apically setose telopodites (the second lateral telopoditomere is quite large). Alternatively, the anterior gonopods may be simple outgrowths. Modifications of structures in different specimens are combined with each other in different ways.



**FIGURES 12–15.** *Skleroprotopus coreanus* (Pocock, 1895), juvenile males (postembryonic stadium X): **12, 14**, leg pair 1 (frontal view); **13**, tip of leg 1; **15**, portion of apex of leg 1; 12–15, specimens with 3 apodous rings; formula 9–3: 9—number of eye rows, 3—number of apodous rings. **Scales:** 10  $\mu$ m (Fig. 15), 20  $\mu$ m (Fig. 13), 100  $\mu$ m (Figs 12, 14).

**Stadium IX.** Sexual characters are not fully formed at stadium IX (8 rows of ocelli, mostly 4, rarely 2, 3 and 5 apodous rings, 38–48 podous ones before the telson, body length 15–29 mm). Juvenile females are characterized by unmodified leg pairs 1 and 7. Leg pair 1 of most juvenile males of this stadium is reduced and thick, with 5–

segmented telopodites and small apical claws (Figs 4–11). However, some juvenile males have an unmodified leg pair 1 coupled with a modified leg pair 7 and poorly developed gonopods. The penis is somewhat narrowed towards the apex bearing several apical setae; it reaches up to almost the middle of coxa of leg 2. Leg pair 7 is developed to different degrees (Figs 22–31): in the majority of juvenile males of this stadium it is small, with low or medium length rounded coxal processes and thin multi-segmented telopodites (as a rule, this form is found in individuals with 4–5 apodous rings). Besides, longer coxal processes are also more acute coupled with shorter telopodites. In addition, the number of the telopodite segments may vary within the same individual (Figs 24–31).



**FIGURES 16, 17.** *Skleroprotopus coreanus* (Pocock, 1895), adult male (postembryonic stadium XI): 16, leg pair 1 (frontal view); 17, tips of leg pair 1; 16–17, specimen with 2 apodous rings; formula 10–2: 10—number of eye rows, 2—number of apodous rings. **Scales:** 20  $\mu$ m (Fig. 17), 100  $\mu$ m (Fig. 16).

The gonopods are small and low. The anterior gonopods have 2-segmented setose telopodites (the second lateral telopoditomeres are tiny in juvenile males with 4 apodous rings as compared with large those of males with



5 apodous rings; the first telopoditomeres bear setae at the apex only in males with 5 apodous rings), low flat coxal processes (longer in juvenile males with 4 apodous rings), relatively short flagella bearing small spinules apically (Figs 43–46). Posterior gonopods have two branches, anterior branches are pointed apically, posterior ones bear setae, length of the posterior branches (without setae) is about half of the length of the anterior branches; the posterior gonopods are provided with 1–2-segmented remnants of telopodites at the base (Figs 53–60).



**FIGURE 18.** *Skleroprotopus coreanus* (Pocock, 1895), adult male (postembryonic stadium XIII): leg pair 1 (frontal view); specimen with 1 apodous ring; formula 12–1: 12—number of eye rows, 1—number of apodous rings. **Scale:** 100  $\mu$ m.

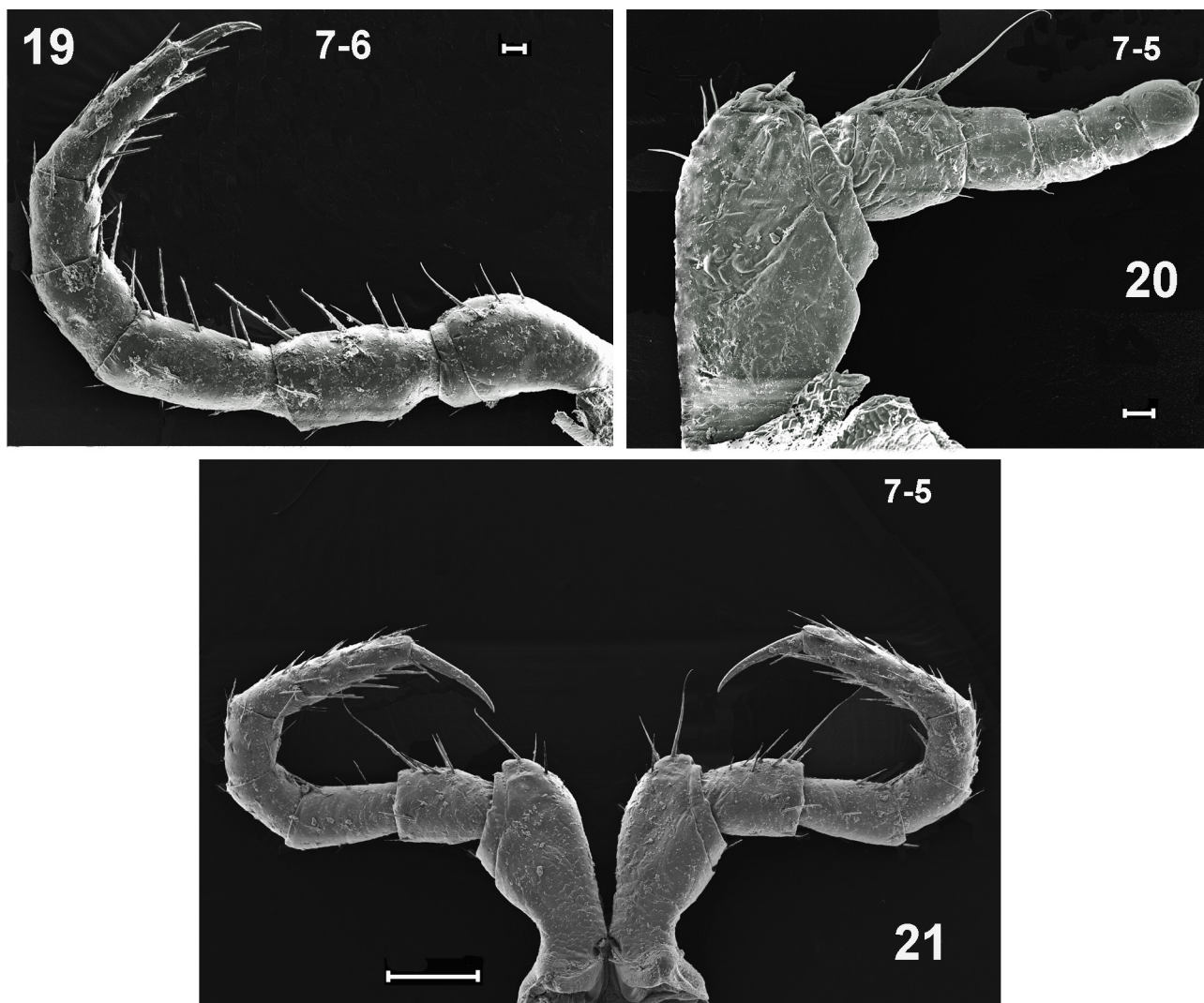
**Stadium X.** At stadium X (9 rows of ocelli, mostly 3, rarely 4, sporadically 1 or 2 apodous rings, 42–52 podous ones before the telson, body length 22–34 mm) legs are normal in juvenile females, but the second body ring is somewhat thick with protruding ventral edge. In juvenile males of this stadium leg pair 1 is usually modified to a different degree: either less, with 5-segmented telopodites and a long apical claws, or more, with 4-segmented telopodites bearing a remnant of the claw and a small lateral knob apically (Figs 12, 13, 15); sometimes juvenile males with a normal leg pair 1 are found (Fig. 14). The penis is somewhat narrowed towards the apex bearing four setae, reaching up to the middle of coxa of leg 2. Leg pair 7 is usually modified, with a poly- or 2-segmented telopodites and comparatively long or short, pointed or round coxal processes bearing setae (Figs 32, 33). Sometimes leg pair 7 is normal.

Gonopods are higher than those of stadium IX. The anterior gonopods have 2-segmented setose telopodites (second lateral telopoditomeres are tiny and flat), flat coxal processes with serrate lateral edge; relatively long flagella, bearing small spinules apically (Figs 47, 48). Posterior gonopods have two branches, anterior branches are pointed apically, posterior ones bear setae, length of the posterior branches (without setae) is about 2/3 of the length

of the anterior branches. The posterior gonopods are usually provided with remnants of telopodites (Figs 61, 62).

The male from Anuchinskii District with 3 apodous and 47 podous rings has a near normal leg pair 1 (Fig. 14). But its leg pair 7 (Fig. 32) and gonopods are modified like ones of stadium IX; its posterior gonopods bear remnants of telopodites.

**Stadium XI.** At stadium XI (10 rows of ocelli, mostly 2, sporadically 1 or 4 apodous rings, 45–53 podous ones before the telson, body length 23–34 mm) leg pair 1 is large, thick, with 4-segmented telopodites and with both a transverse protrusion and a trace of the claw apically (Figs 16, 17). Penis is conical bearing three-four setae apically, reaching up to the end of the coxa or the beginning of the telopodite of leg 2. Leg pair 7 is modified, with 2-segmented telopodites and relatively long setose coxal processes (Figs 34, 35). Anterior gonopods have 2-segmented setose telopodites (second lateral telopoditomerites are tiny; first telopoditomerites are usually provided with basal protrusion), flat coxal processes, relatively long flagella, bearing small spinules apically (Fig. 49). Posterior gonopods have two branches, anterior branches are pointed apically, posterior ones bear setae, length of the posterior branches (without setae) is about 2/3 of the length of the anterior branches. Posterior gonopods are provided with remnants of telopodites or tubercles in the place of telopodites (Figs 63–65).

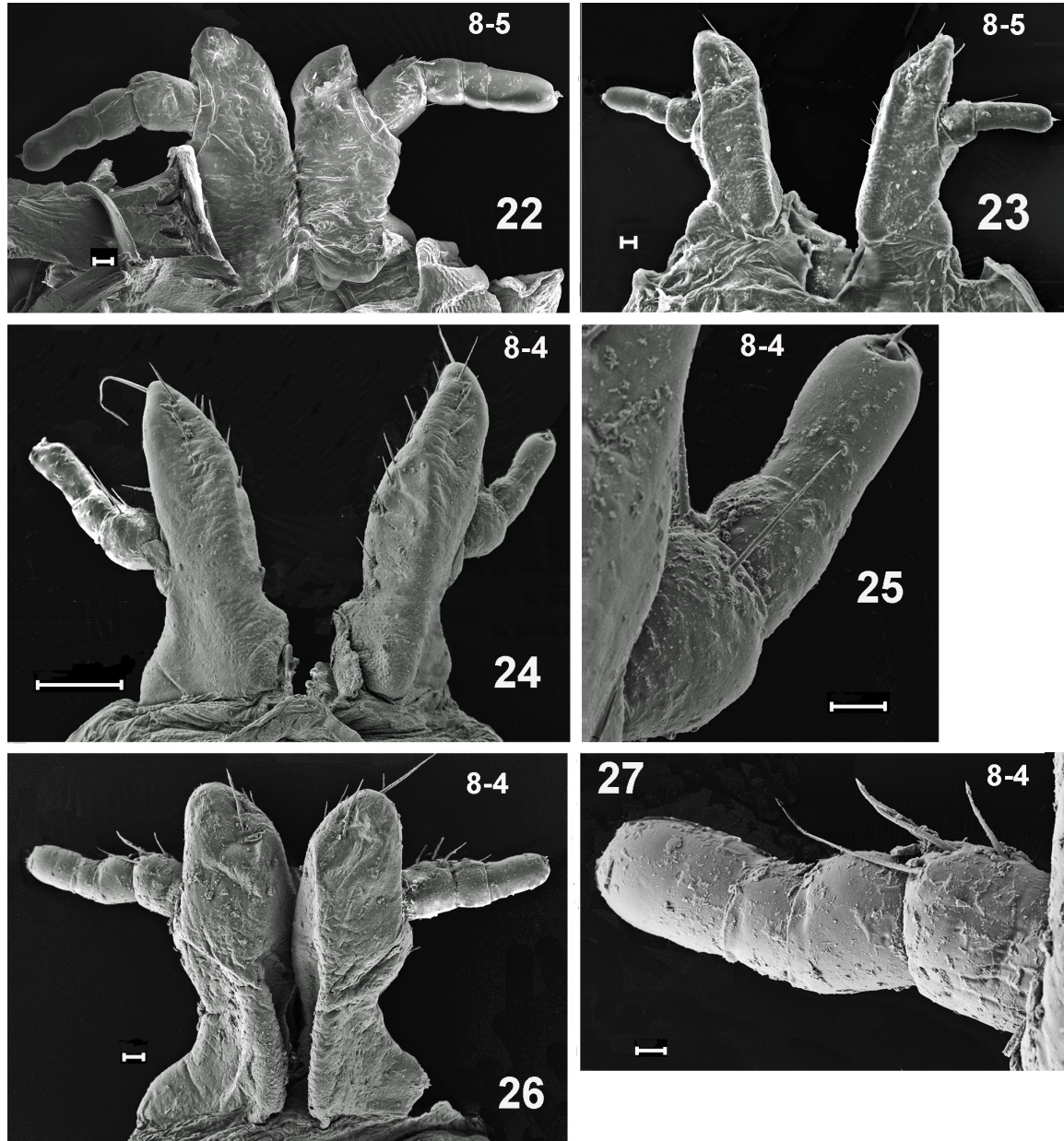


**FIGURES 19–21.** *Skleroprotopus coreanus* (Pocock, 1895), juvenile males (postembryonic stadium VIII): **19 & 20**, leg 7 (caudal view); **21**, leg pair 7; 19, specimen with 6 apodous rings; 20–21, specimens with 5 apodous rings; formulae 7–6 and 7–5: 7—number of eye rows, 6 and 5—number of apodous rings. **Scales:** 20  $\mu$ m (Figs 19, 20), 100  $\mu$ m (Fig. 21).

**Stadium XII.** At stadium XII (11 rows of ocelli, mostly 2, rarely 1 apodous ring, 48–57 podous ones before the telson, body length 27–47 mm) leg pair 1 is large, thick, with 4-segmented telopodites and a transverse protrusion apically, a trace of the claw may be present. Penis is conical bearing four setae apically, it reaches up to the beginning or middle of the second telopoditomerite of leg 2. Leg pair 7 is provided with 2-segmented telopodites

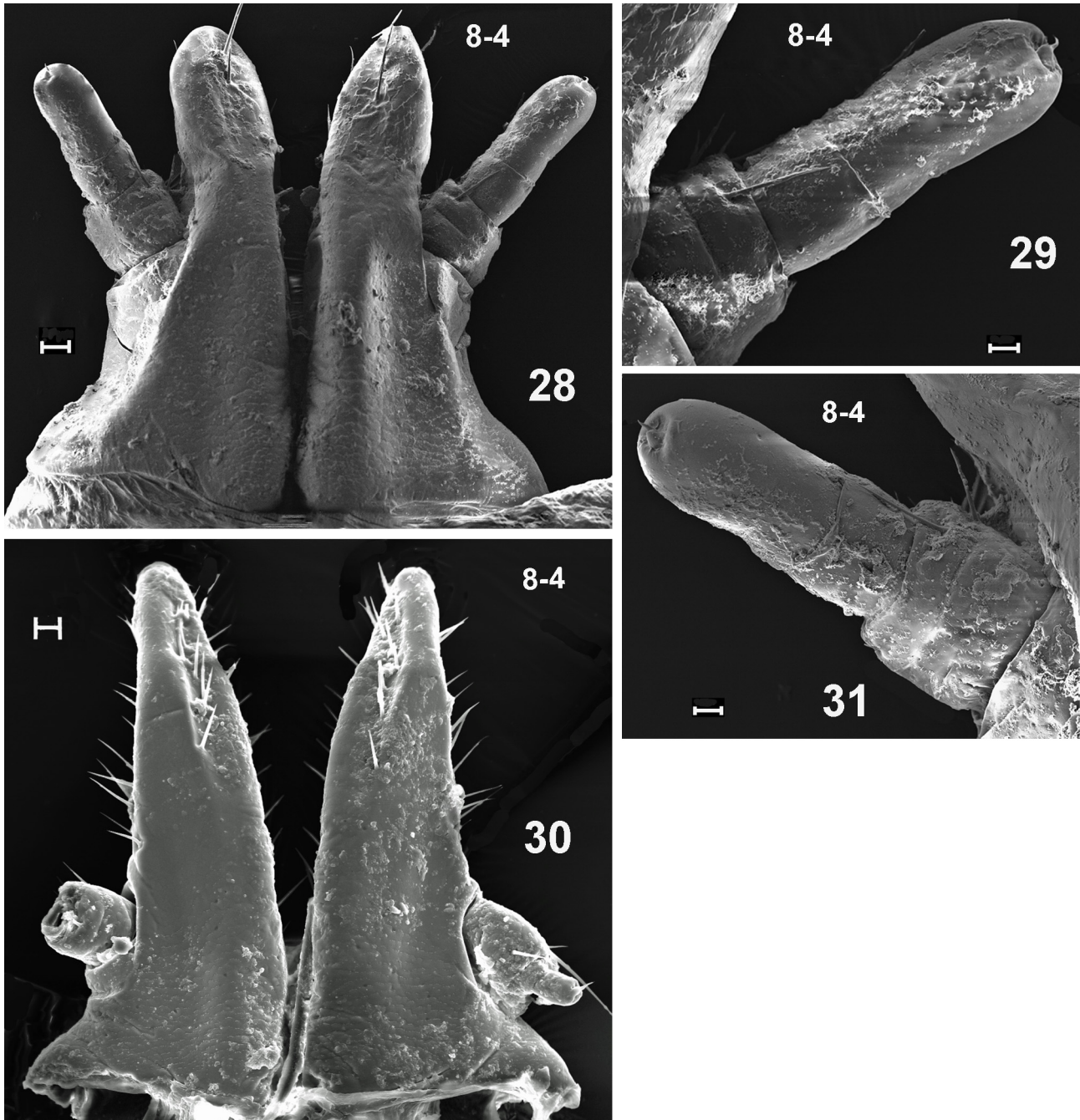


and long setose coxal processes (Figs 36–38). Anterior gonopods have 2-segmented setose telopodites (second lateral telopoditomeres are tiny; first telopoditomeres are provided with basal protrusion), flat coxal processes with serrate lateral edge, long flagella, bearing small spinules apically (Figs 50, 51). Posterior gonopods have two branches, anterior branches are pointed apically, posterior ones bear setae, length of the posterior branches (without setae) is about 2/3 of the length of the anterior branches. Posterior gonopods are either provided with tubercles in the place of telopodites (Figs 66, 67), or are entirely devoid of telopodites.



**FIGURES 22–27.** *Skleroprotopus coreanus* (Pocock, 1895), juvenile males (postembryonic stadium IX): **22–24, 26**, leg pair 7 (caudal view); **25, 27**, telopodite of leg 7; **22–23**, specimens with 5 apodous rings; **24–27**, specimens with 4 apodous rings; formulae **8–5** and **8–4**: **8**—number of eye rows, **5** and **4**—number of apodous rings. **Scales:** 10  $\mu$ m (Fig. 27), 20  $\mu$ m (Figs 22, 23, 25, 26), 100  $\mu$ m (Fig. 24).

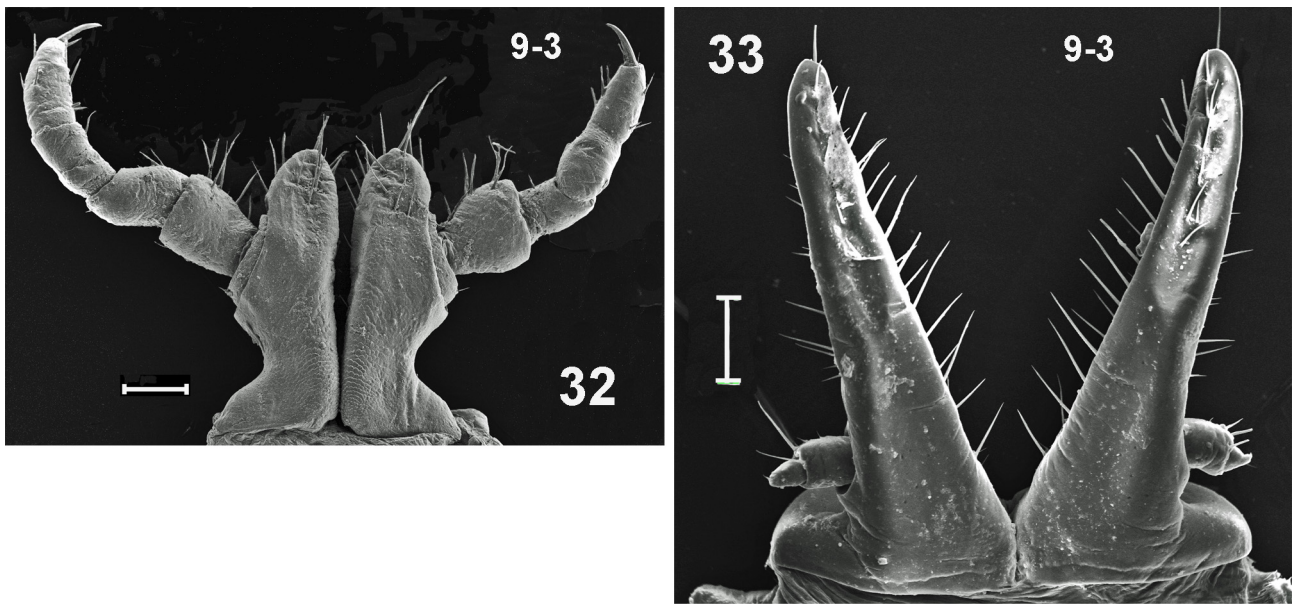
**Stadium XIII.** At stadium XIII (12 rows of ocelli, 1 apodous ring, 53–59 podous ones before the telson, body length 34–48 mm) leg pairs 1, 7, penis and anterior gonopods (Figs 18, 39, 40, 52) are the same as in stadium XII. Leg pair 1 is devoid of a trace of the claw apically. Posterior gonopods have two branches, anterior branches are pointed apically, posterior ones bear setae, length of the posterior branches (without setae) is about 2/3 of the length of the anterior branches. Posterior gonopods are either provided with tiny tubercles in the place of telopodites (Figs 68–70), or are entirely devoid of telopodites.



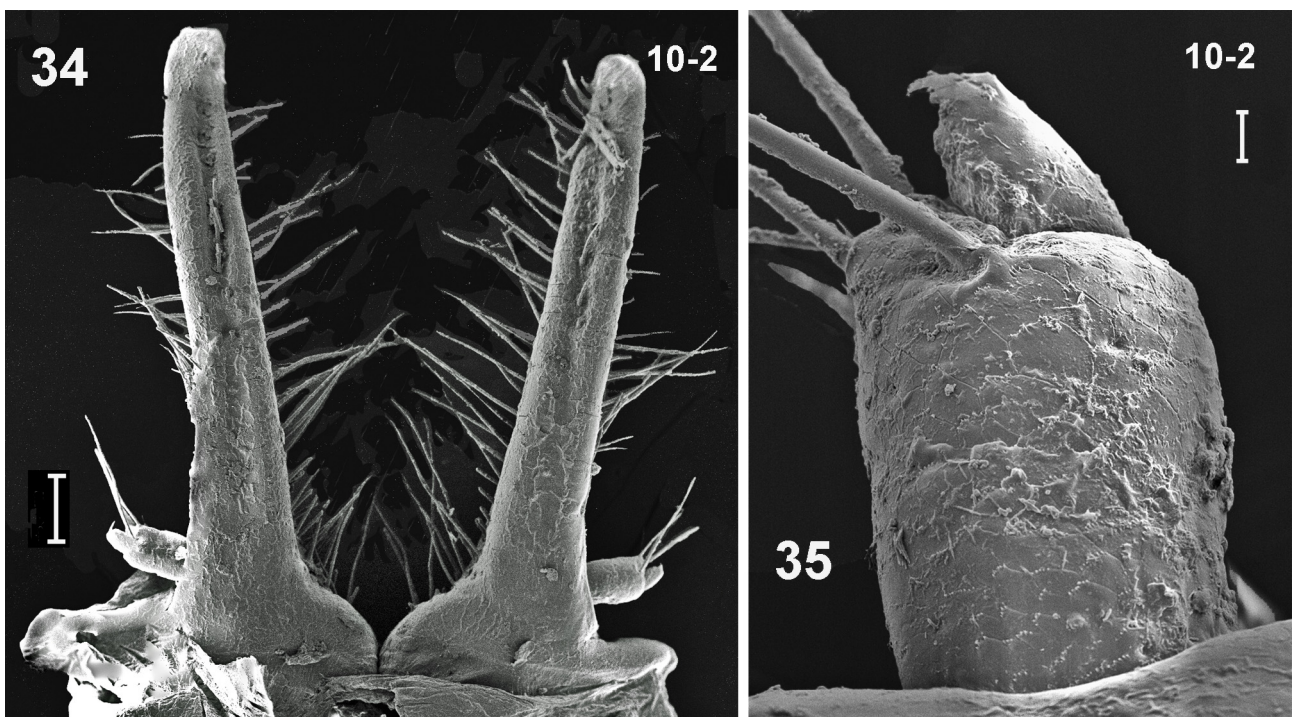
**FIGURES 28–31.** *Skleroprotopus coreanus* (Pocock, 1895), juvenile males (postembryonic stadium IX): **28, 30**, leg pair 7 (caudal view); **29, 31**, tepopodite of leg 7; 28–31, specimens with 4 apodous rings; formula 8–4: 8—number of eye rows, 4—number of apodous rings. **Scales:** 10  $\mu\text{m}$  (Figs 29, 31), 20  $\mu\text{m}$  (Figs 28, 30).

Thus, the gonopods of the *Skleroprotopus coreanus* male are fully-formed and maturity is achieved starting from stadium XI. The criteria for this interpretation are as follows: penis is conical bearing several setae apically, it reaches up to the telopodites of leg pair 2; leg pair 1 is large, thick, with 4-segmented telopodites and both a transverse protrusion and a trace of a claw apically; leg pair 7 is modified, with 2-segmented telopodites and a considerably long setose coxal processes; anterior gonopods have 2-segmented setose telopodites (second lateral telopoditomeres are tiny), flat coxal processes, relatively long flagella, bearing small spinules apically; posterior gonopods have two branches, anterior branches are pointed apically, posterior ones bear setae, length of the posterior branches (without setae) is about 2/3 of the length of the anterior branches; posterior gonopods are either provided with remnants of telopodites, or the tubercles in the place of telopodites, or are devoid of telopodites.





**FIGURES 32, 33.** *Skleroprotopus coreanus* (Pocock, 1895), juvenile males (postembryonic stadium X): leg pair 7 (caudal view); 32–33, specimens with 3 apodous rings; formula 9–3: 9—number of eye rows, 3—number of apodous rings. **Scales:** 100 µm.



**FIGURES 34, 35.** *Skleroprotopus coreanus* (Pocock, 1895), adult male (postembryonic stadium XI): **34**, leg pair 7 (caudal view); **35**, telopodite of the leg 7; 34–35, specimen with 2 apodous rings; formula 10–2: 10—number of eye rows, 2—number of apodous rings. **Scales:** 10 µm (Fig. 35), 100 µm (Fig. 34).

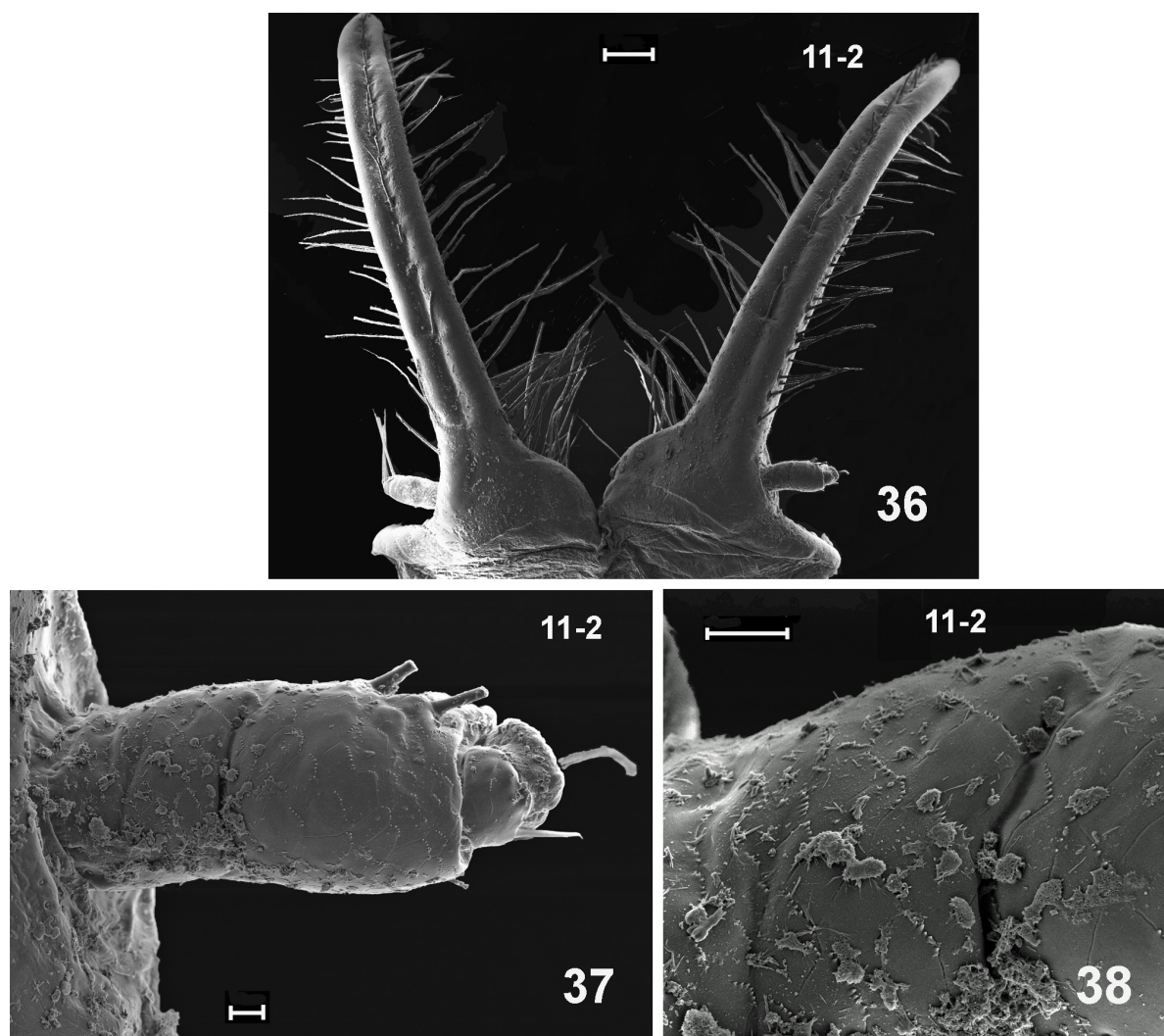
### Taxonomic implications

The presence of poly-segmented telopodites, the lack of coxal processes on male leg pair 7, and the presence of reduced posterior gonopod telopodites in *Ansiulus* are the main differences between this genus and *Skleroprotopus* (see Takakuwa 1940). Yet the material examined here shows reduced telopodites on posterior gonopods and poly-segmented telopodites on the male leg pair 7 in postembryonic stadia of *Skleroprotopus coreanus*. In addition, the

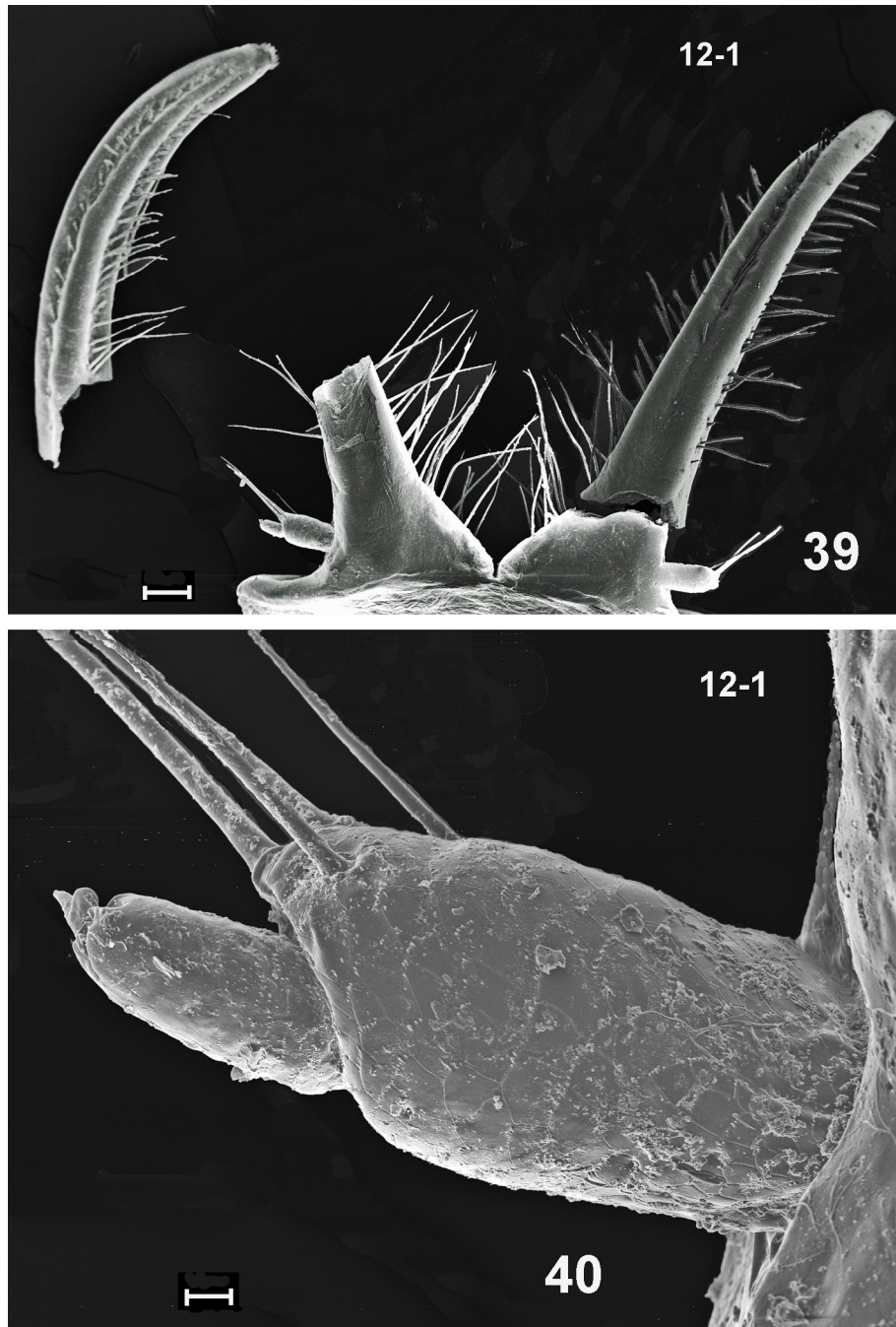


gonopods of the Korean *Ansiulus aberrans* appear to be rather variable concerning the structures of posterior gonopods and male leg pair 7 telopodites: the posterior gonopods in the holotype have reduced telopodites instead of tubercles as in the paratype; also, the length of telopoditomere 3 of leg pair 7 varies (see figs 45–46 and 48–49 in Mikhaljova and Korsós 2003). These characters thus cannot be considered as sufficiently stable to distinguish the two genera compared. Hence, the new synonymy: *Skleroprotopus* Attems, 1901 = *Ansiulus* Takakuwa, 1940, **syn. n.**, the valid name being the former. Consequently the following new combinations are introduced: *Skleroprotopus aberrans* (Mikhaljova & Korsós, 2003), **comb. n.**; *Skleroprotopus legitimus* (Golovatch, 1980), **comb. n.**; *Skleroprotopus deminutus* (Mikhaljova, 2001), **comb. n.**; *Skleroprotopus matumotoi* (Takakuwa, 1940), **comb. n.**

Originally described on one male and one juvenile from near Nakhodka, Primorskii krai (Golovatch 1979), *Skleroprotopus schmidtii* appears to be a postembryonic stadium of *Skleroprotopus coreanus*. Based on the original description, the holotype has about 30 ocelli which correspond to postembryonic stadium IX. The structure of both leg pairs 1, 7 and gonopods (see Fig. 1 from Golovatch 1979) is similar to stadium IX of *S. coreanus*, too. Golovatch (1979), describing *Skleroprotopus schmidtii*, distinguished it from *Skleroprotopus coreanus* mainly by the presence in the former species of an additional basal (not lateral) narrow telopoditomere in the anterior gonopod. However, this telopoditomere is in reality a coxal fold at the base of the telopodite, which is clearly seen in other similar specimens. Examination of a micropreparation of the gonopod of the *S. schmidtii* holotype clearly showed that the gonopod was located in such a way that this fold can be taken for an additional segment. Hence, the new synonymy: *Skleroprotopus coreanus* (Pocock, 1895) = *Skleroprotopus schmidtii* Golovatch, 1979, **syn. n.**, the valid species name being the former.



**FIGURES 36–38.** *Skleroprotopus coreanus* (Pocock, 1895), adult male (postembryonic stadium XII): **36**, leg pair 7 (caudal view); **37**, telopodite of the leg 7; **38**, middle part of the first telopoditomere of the leg 7; 36–38, specimen with 2 apodous rings; formula 11–2: 11— number of eye rows, 2—number of apodous rings. **Scales:** 10  $\mu$ m (figs 37, 38), 100  $\mu$ m (Fig. 36).



**FIGURES 39–40.** *Skleroprotopus coreanus* (Pocock, 1895), adult male (postembryonic stadium XIII): **39**, leg pair 7 (caudal view), coxal processes broken; **40**, telopodite of the leg 7; 39–40, specimen with 1 apodous ring; formula 12–1: 12—number of eye rows, 1—number of apodous rings. **Scales:** 10  $\mu$ m (Fig. 40), 100  $\mu$ m (Fig. 39).

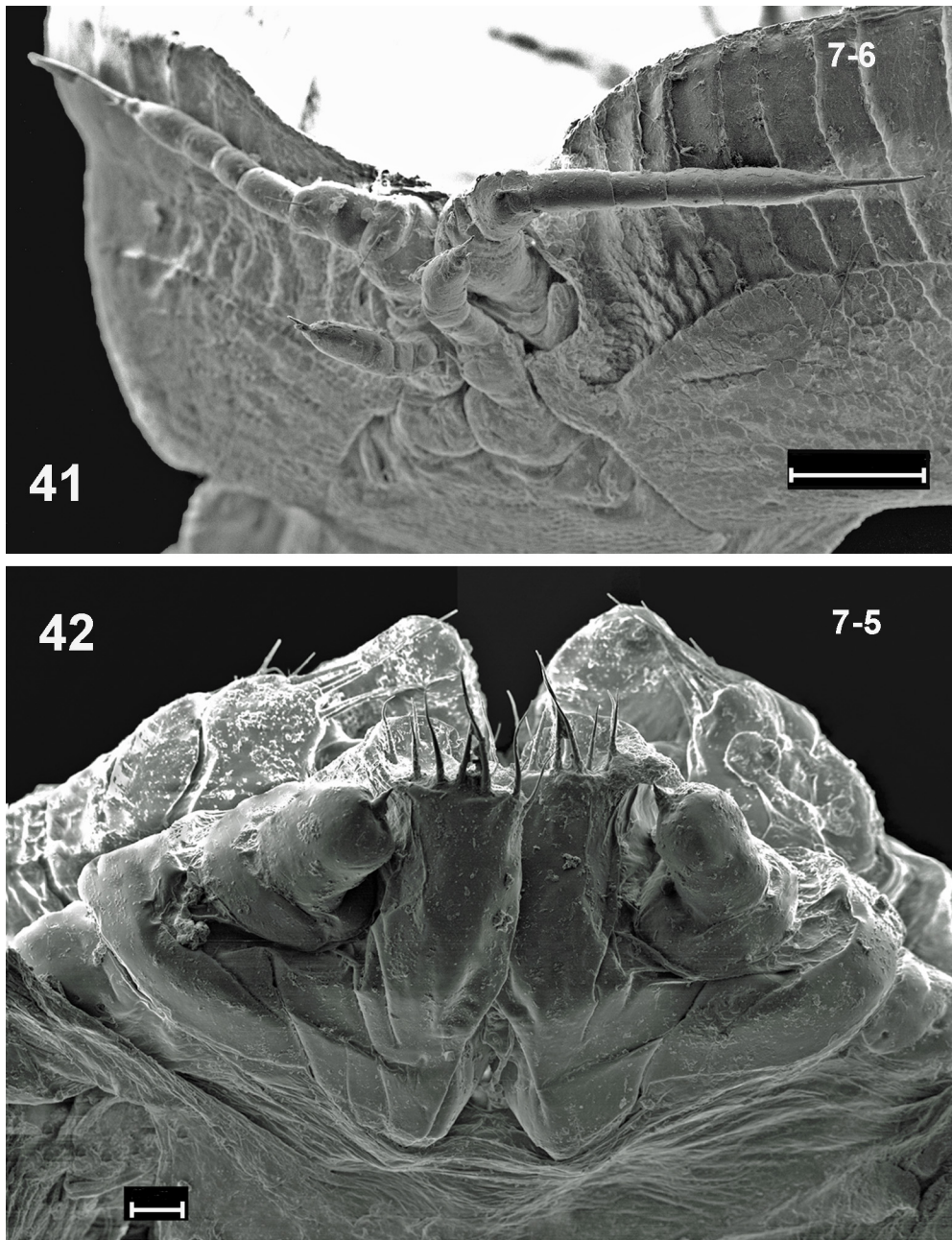
A restudy of the specimen from the Naumova Island, which was originally determined as *Skleroprotopus schmidtii* (see Mikhajlova 2002), then as *Ansiulus aberrans* (Mikhajlova 2004, 2009a) but later again as *Skleroprotopus schmidtii* (Mikhajlova 2017), shows that it is a juvenile male in stadium IX of *S. coreanus*. As evidence of this re-identification may be mentioned: somewhat thickened leg pair 1 with remnants of claws, small gonopods, the posterior ones with telopodites, modified leg pair 7 (one of the telopodites is thin and short, in contrast to the leg-like other telopodite; one of the coxal process is long, in contrast to a short and pointed other coxal process), 4 apodous rings, 48 podous ones before telson, body length 24–25 mm.

A restudy of the specimen from the environs of Fridman, Partizanskii District, which was originally determined as *Ansiulus aberrans* (Mikhajlova 2004, 2017), shows that it is a juvenile male of stadium IX of *S. coreanus*, too. Evidence for the identification are as follows: somewhat thickened leg pair 1 with remnants of



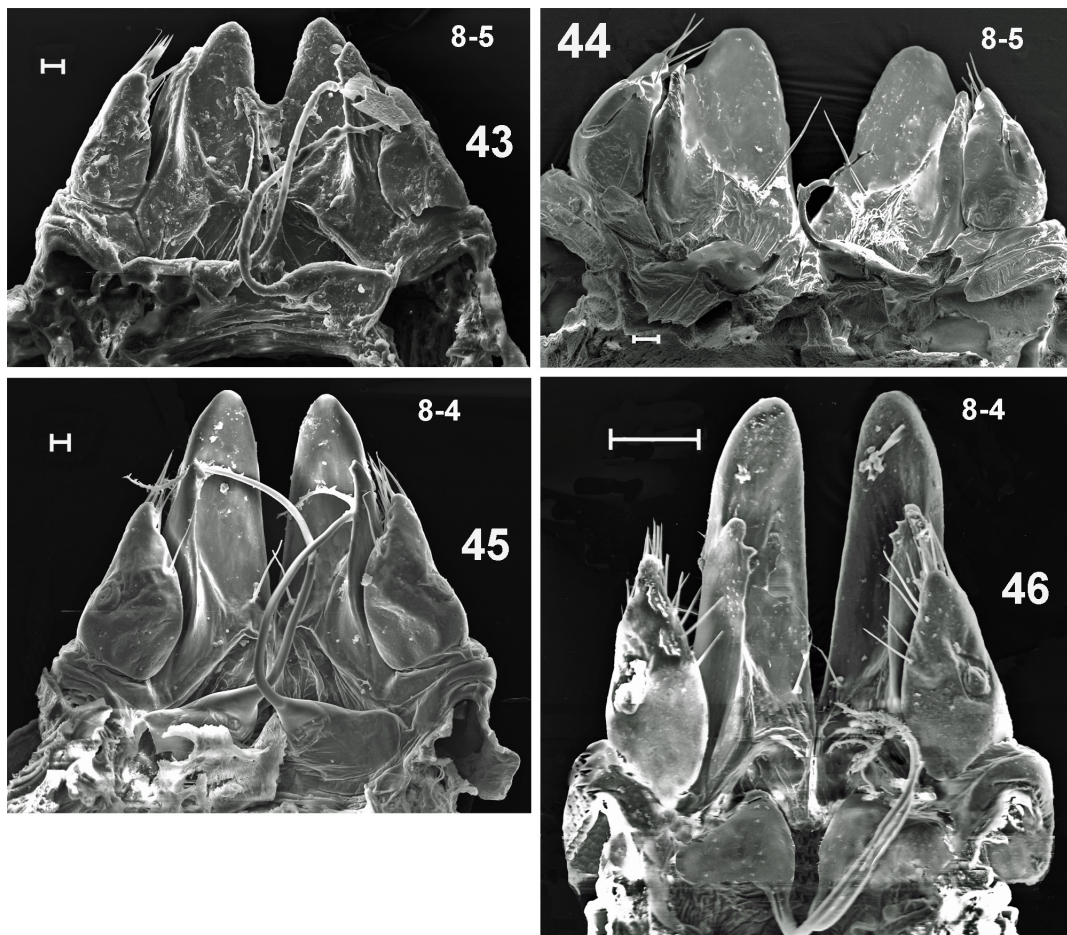
claws, a small leg pair 7 with low round coxal processes and poly-segmented telopodites (Fig. 26), small gonopods, the posterior ones with telopodites, 4 apodous rings, 45 podous ones before telson, body length 24–25 mm.

The specimen from the Ussuriyskii Nature Reserve, left bank of Komarovka River, has originally been identified as *Ansiulus matumotoi* (Mikhaljova 2002). Subsequently the record of this species in the Primorskii krai, Russian Far East has been regarded as due to a misidentification (Mikhaljova 2004; 2017). A restudy of this specimen shows that it is a juvenile male of stadium IX of *S. coreanus*, too. Evidence for the identification are as follows: somewhat thickened leg pair 1 with long claws, unmodified leg-like (but somewhat thinner and smaller as compared to normal legs) leg pair 7, gonopods like ones of postembryonic stadium IX, however posterior gonopods with a remnant of a telopodite in one of the gonopods but with small tubercles instead of reduced telopodite in the other gonopod.

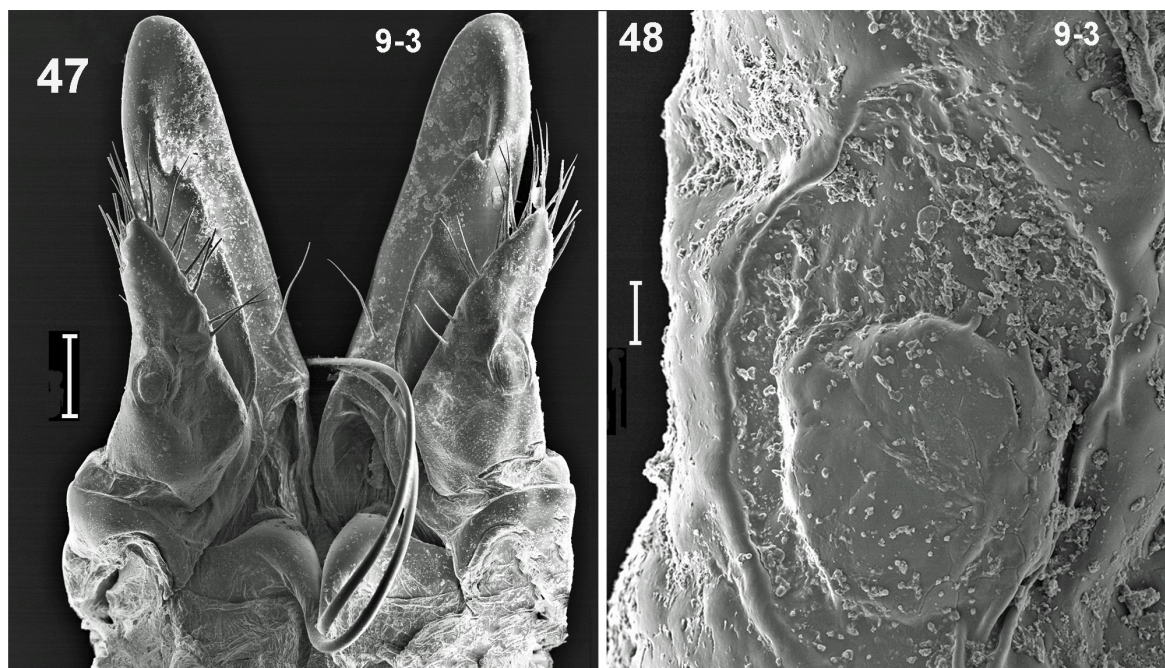


**FIGURES 41–42.** *Skleroprotopus coreanus* (Pocock, 1895), juvenile males (postembryonic stadium VIII): **41**, leg pairs 8 and 9; **42**, gonopods (caudal view); **41**, specimen with 6 apodous rings; **42**, specimen with 5 apodous rings; formulae 7–6 and 7–5: 7—number of eye rows, 6 and 5—number of apodous rings. **Scales:** 20  $\mu$ m (Fig. 42), 100  $\mu$ m (Fig. 41).





**FIGURES 43–46.** *Skleroprotopus coreanus* (Pocock, 1895), juvenile males (postembryonic stadium IX): anterior gonopods (caudal view); 43–44, specimens with 5 apodous rings; 45–46, specimens with 4 apodous rings; formulae 8–5 and 8–4: 8—number of eye rows, 5 and 4—number of apodous rings. **Scales:** 20  $\mu$ m (Figs 43–45), 100  $\mu$ m (Fig. 46).

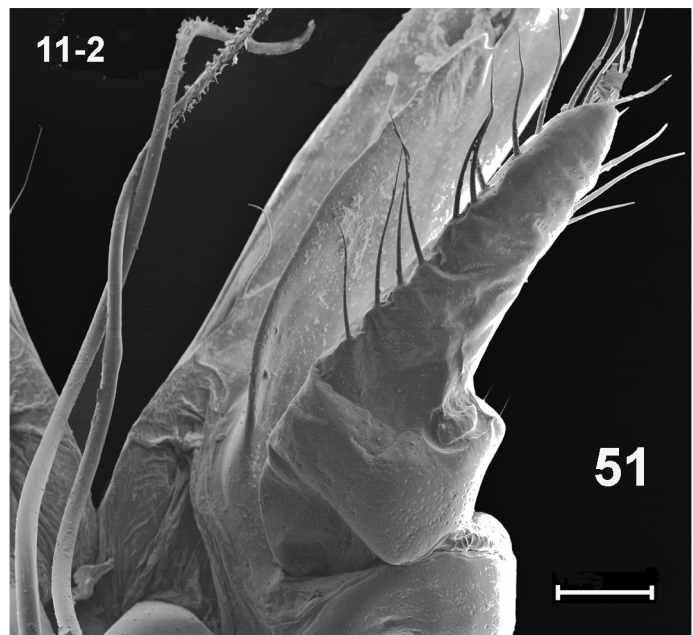


**FIGURES 47, 48.** *Skleroprotopus coreanus* (Pocock, 1895), juvenile male (postembryonic stadium X): 47, anterior gonopods (caudal view); 48, second telopoditome of anterior gonopod; 47–48, specimen with 3 apodous rings; formula 9–3: 9—number of eye rows, 3—number of apodous rings. **Scales:** 10  $\mu$ m (Fig. 48), 100  $\mu$ m (Fig. 47).

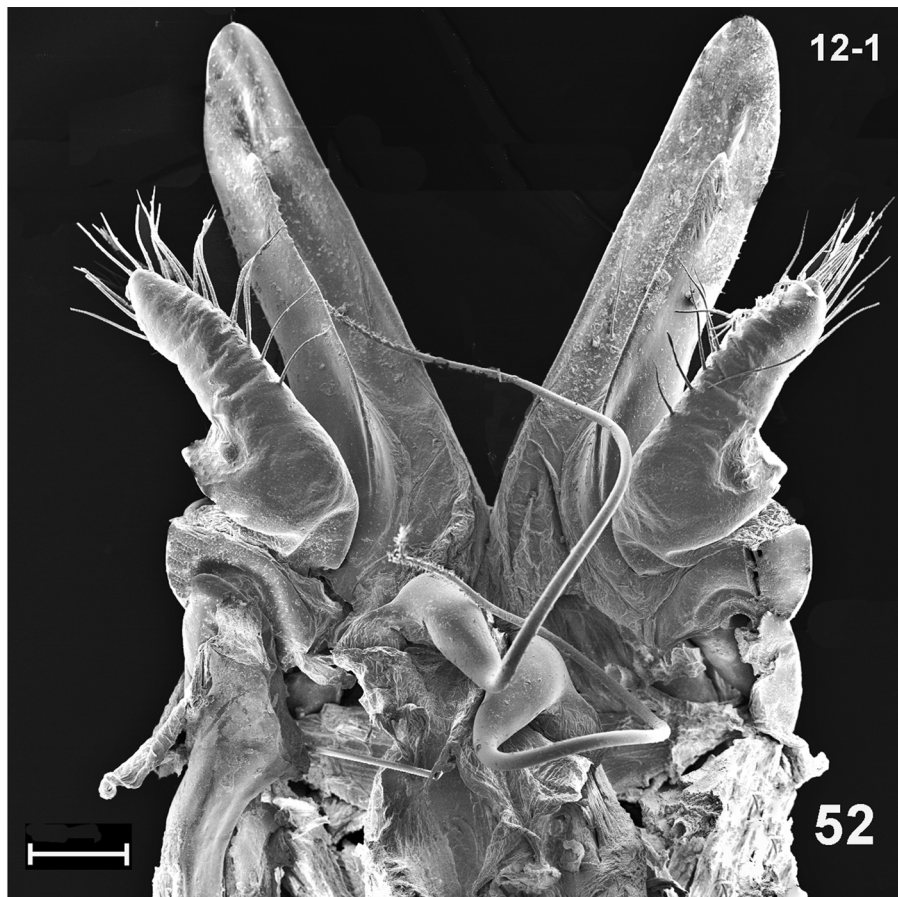




**FIGURE 49.** *Skleroprotopus coreanus* (Pocock, 1895), adult male (postembryonic stadium XI): anterior gonopods (caudal view); specimen with 2 apodous rings; formula 10-2: 10—number of eye rows, 2—number of apodous rings. **Scale:** 100  $\mu$ m.



**FIGURES 50, 51.** *Skleroprotopus coreanus* (Pocock, 1895), adult male (postembryonic stadium XII): **50**, anterior gonopods (caudal view); **51**, half of anterior gonopod; 50–51, specimen with 2 apodous rings; formula 11-2: 11—number of eye rows, 2—number of apodous rings. **Scales:** 100  $\mu$ m.



**FIGURE 52.** *Skleroprotopus coreanus* (Pocock, 1895), adult male (postembryonic stadium XIII): anterior gonopods (caudal view); specimen with 1 apodous ring; formula 12-1: 12—number of eye rows, 1—number of apodous rings. **Scale:** 100  $\mu$ m.

Finally, it is necessary to add to the description of *Skleroprotopus coreanus* the presence of an incomplete distodorsal corolla of numerous sensory bacilli on the distal antennomeres (Fig. 71) since this character was omitted in the original description of *Paraiulus coreanus* (see Pocock 1895). In addition, in the original description of *Skleroprotopus similiserratus* (= junior synonym of *Skleroprotopus coreanus*) the antennae are erroneously described without any sensory bacilli (see Golovatch 1979). In turn, Mikhaljova (1998, 2004, 2017), based on Golovatch's description, repeated this mistake.

***Skleroprotopus aberrans* (Mikhaljova & Korsós, 2003), comb. n.**

*Ansiulus aberrans* Mikhaljova & Korsós 2003: 230, figs 42–49.

*Ansiulus aberrans*—Nguyen *et al.* 2016: 45.

non *Ansiulus aberrans*—Mikhaljova 2004: 87, figs 186–193, map 10; 2009a: 602; 2017: 111, figs 221–228, map 13.

**Type material.** Male holotype and 1 male paratype, in the Hungarian Natural History Museum, Budapest, Hungary; 1 male paratype, in ZMUM.

**Type locality.** North Korea, Ryanggang Province, Mt. Paekdu-san, Unhung.

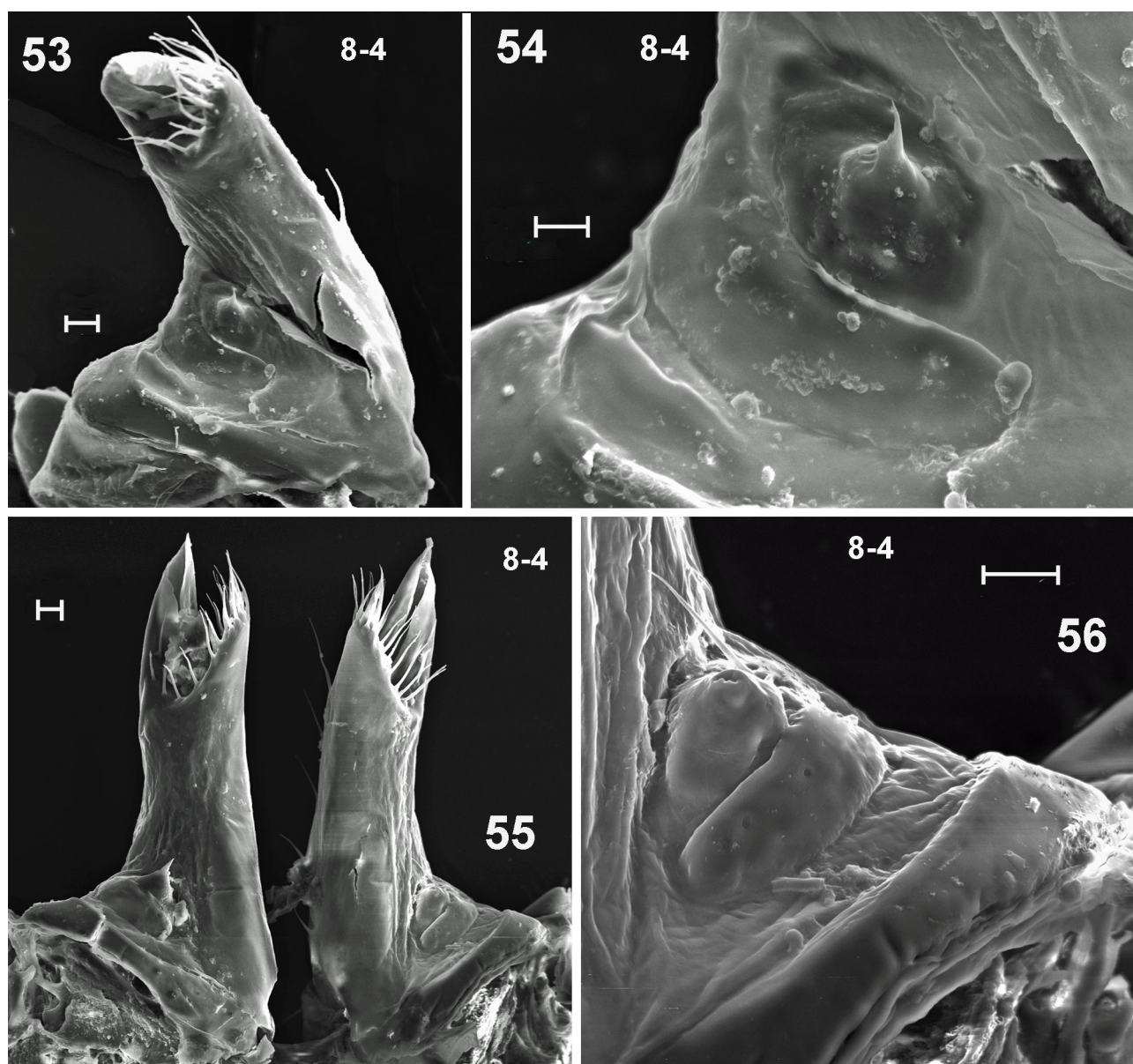
**Material examined.** 1 male paratype (ZMUM), North Korea, North Pyongan Prov., Mt. Myohyang-san, Hotel Myohyangsan, near Hotel, No. 1037, 11.Oct.1987, leg. Korsós Z. and Ronkay L.

**Distribution.** Korea.

**Remarks.** A restudy of the paratype revealed the presence of 2 apodous, strongly sclerotized rings before the telson, 54 podous rings, body length 43–44 mm and 10 rows of ocelli. Holotype and second paratype have 2–3 apodous rings before telson and about 40 ocelli. These data may indicate an adult stadium. Gonopods of the species look quite similar to those of adult stadia of *S. coreanus*. However, penis, leg pairs 1 and 7 are similar to those of



juvenile stadia of *S. coreanus*. Anyway, the true course of anamorphosis in this species and problem of its taxonomical status need to be ascertained by examination of additional material.



**FIGURES 53–56.** *Skleroprotopus coreanus* (Pocock, 1895), juvenile males (postembryonic stadium IX): **53**, posterior gonopod (caudal view); **54**, **56**, remnant of posterior gonopod telopodite; **55**, posterior gonopods (caudal view); 53–56, specimens with 4 apodous rings; formula 8–4: 8—number of eye rows, 4—number of apodous rings. **Scales:** 10  $\mu$ m (Fig. 54), 20  $\mu$ m (Figs 53, 55, 56).

***Skleroprotopus legitimus* (Golovatch, 1980), comb. n.**

*Ansiulus legitimus* Golovatch 1980: 51, figs 3–8.

*Ansiulus legitimus*—Nguyen *et al.* 2016: 45.

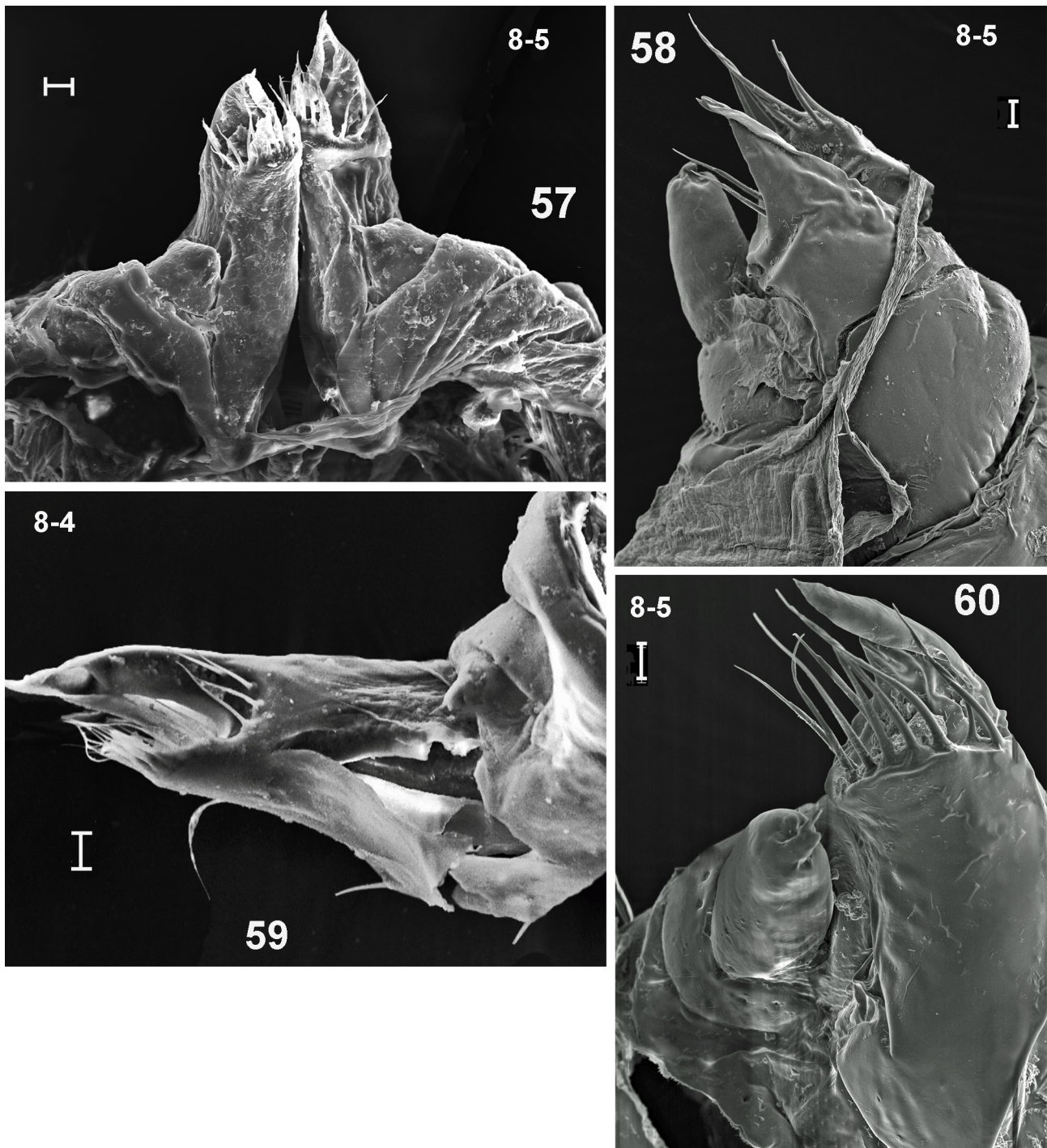
**Type material.** Male holotype, 3 males and 3 females paratypes, in the Hungarian Natural History Museum, Budapest, Hungary; 1 male and 1 female paratypes, in ZMUM.

**Type locality.** North Korea, North Hwanghae Province, Sinpyong, Pyongwa-ri.

**Material examined.** 1 male paratype (ZMUM), North Korea, North Hwanghae Province, Sinpyong, Pyongwa-ri, under stones at forest edge, 15.X.1978, leg. A. Vojnits, L. Zombori.

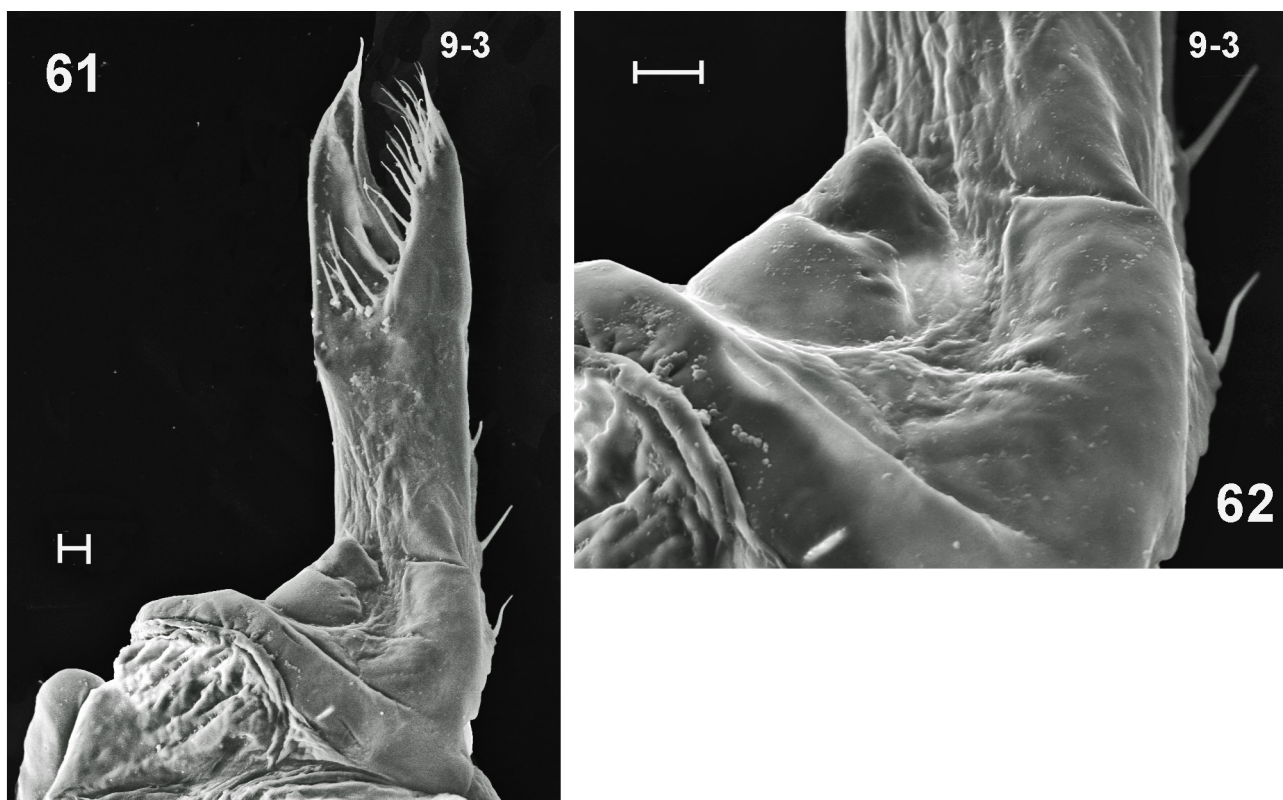
**Distribution.** Korea.

**Remarks.** A restudy of the paratype revealed the presence of four apodous rings before telson, 44 podous rings, body length about 24 mm and 7 rows of ocelli. These data may indicate a juvenile stadium. At the same time, the material includes adult males with 67(–1) and 66(–3) body rings excluding telson (see Golovatch 1980). The true course of anamorphosis in this species needs to be ascertained by examination of additional material.



**FIGURES 57–60.** *Skleroprotopus coreanus* (Pocock, 1895), juvenile males (postembryonic stadium IX): **57**, posterior gonopods (caudal view); **58–60**, posterior gonopod (caudal view); **57–58, 60**, specimens with 5 apodous rings; **59**, specimen with 4 apodous rings; formulae **8–5** and **8–4**: **8**—number of eye rows, **5** and **4**—number of apodous rings. **Scales:** 10  $\mu$ m (Figs 58, 60), 20  $\mu$ m (Figs 57, 59).





**FIGURES 61, 62.** *Skleroprotopus coreanus* (Pocock, 1895), juvenile male (postembryonic stadium X): **61**, posterior gonopod (caudal view); **62**, remnant of posterior gonopod telopodite; 61–62, specimen with 3 apodous rings; formula 9–3: 9—number of eye rows, 3—number of apodous rings. **Scales:** 20  $\mu\text{m}$ .

***Skleroprotopus deminutus* (Mikhaljova, 2001), comb. n.**

*Ansiulus deminutus* Mikhaljova in Mikhaljova & Lim 2001: 26, figs 40–48.

**Type material.** Male holotype, in the Chonbuk National University, Jeonju, Republic of Korea; 1 male paratype, in FSCB.

**Type locality.** Republic of Korea, Gyeongsangbuk-do, Goreong.

**Material examined.** 1 male paratype (FSCB), Republic of Korea, Gyeongsangbuk-do, Goreong, 25.IX.1990, leg. K.Y. Lim.

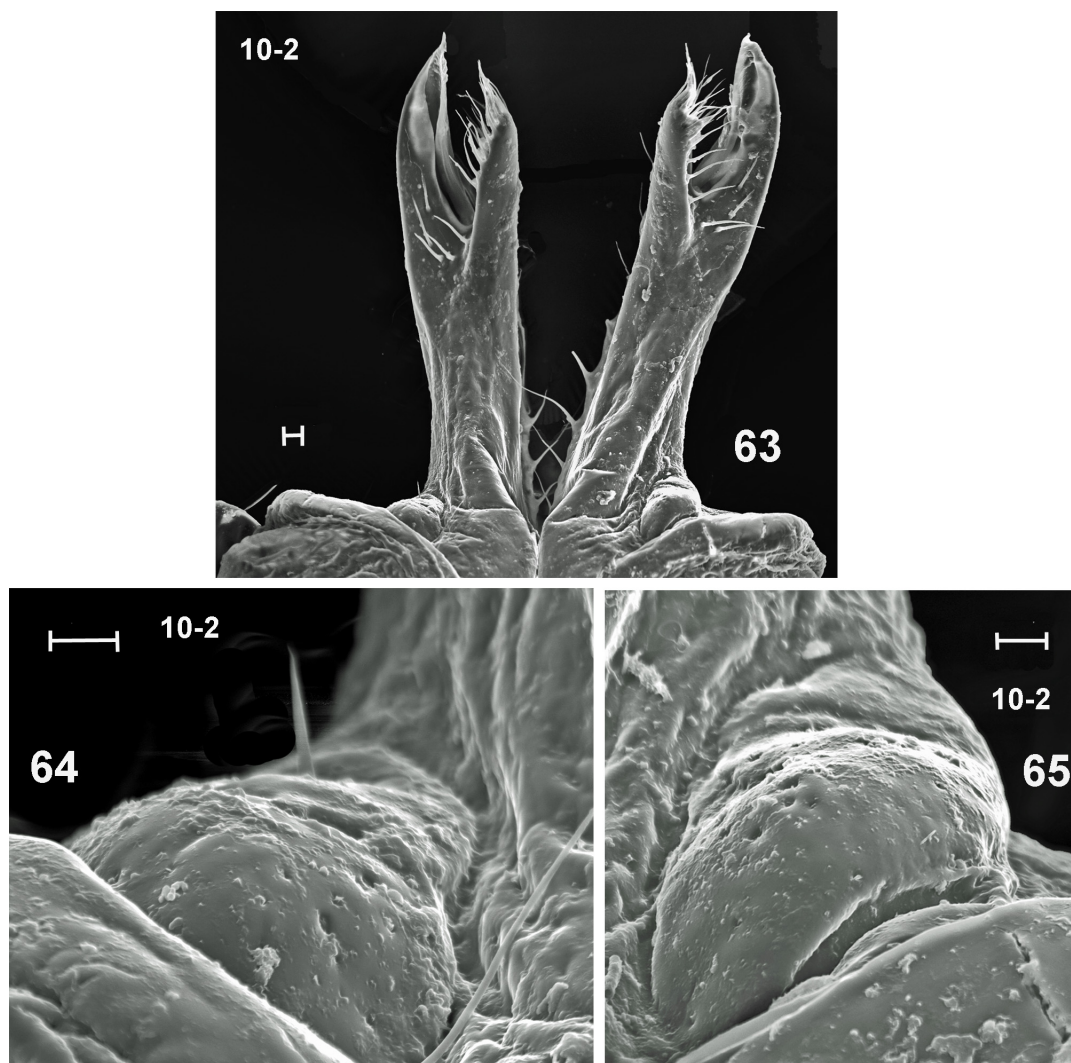
**Distribution.** Korea.

**Remarks.** Very likely, this species was originally described based on two juvenile males. Both holo- and paratype consist of anterior body portions only (16 somites in holotype, 6 in paratype). Hence, neither full podous-apodous segment number nor body length is available. A restudy of the paratype has revealed the presence of 8 rows of ocelli. The number of ocelli and particularly the leg-like leg pair 7 without coxal processes, as well as the very small gonopods, indicate that these specimens may be juvenile males. Anyway the true identification of the species and the course of its anamorphosis need to be ascertained by examination of additional material.

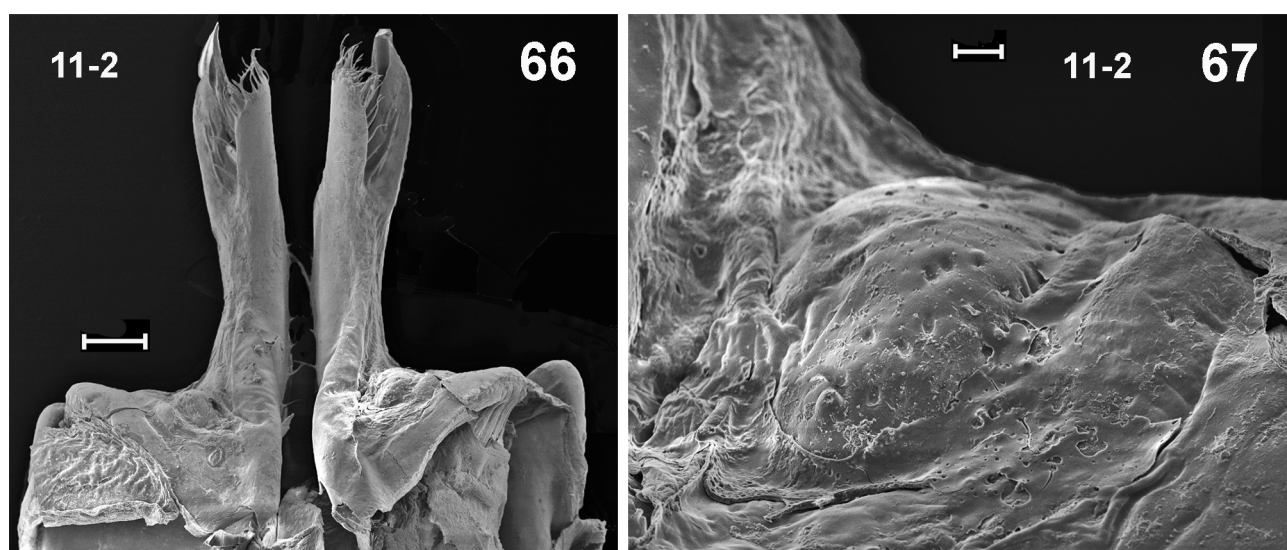
***Skleroprotopus matumotoi* (Takakuwa, 1940), comb. n.**

*Ansiulus matumotoi* Takakuwa 1940: 118, figs 1–3.

*Ansiulus matumotoi*—Takakuwa & Takashima 1940: 182; Takakuwa 1954: 148; Paik 1958: 363; Nguyen *et al.* 2016: 45. non *Ansiulus matumotoi*—Mikhaljova 2002: 147.



**FIGURES 63–65.** *Skleroprotopus coreanus* (Pocock, 1895), adult male (postembryonic stadium XI): **63**, posterior gonopods (caudal view); **64 & 65**, remnant of posterior gonopod telopodite; 63–65, specimen with 2 apodous rings; formula 10–2: 10—number of eye rows, 2—number of apodous rings. **Scales:** 10  $\mu$ m (Figs 64, 65), 20  $\mu$ m (Fig. 63).



**FIGURES 66, 67.** *Skleroprotopus coreanus* (Pocock, 1895), adult male (postembryonic stadium XII): **66**, posterior gonopods (caudal view); **67**, tubercles in the place of posterior gonopod telopodite; 66–67, specimen with 2 apodous rings; formula 11–2: 11—number of eye rows, 2—number of apodous rings. **Scales:** 10  $\mu$ m (Fig. 67), 100  $\mu$ m (Fig. 66).



**TABLE 1.** Characteristics of postembryonic stadia of *Skleroprotopus coreanus*

| stadium number | number of rows of ocelli | number of apodous rings before telson | number of podous rings including collum and ring 7 | approximate body length (mm) |
|----------------|--------------------------|---------------------------------------|----------------------------------------------------|------------------------------|
| III            | 2                        | 4                                     | 12                                                 | 2                            |
| III            | 2                        | 4                                     | 11                                                 | 2                            |
| IV             | 3                        | 6                                     | 17                                                 | 6–7                          |
| IV             | 3                        | 5                                     | 16                                                 | 6                            |
| IV             | 3                        | 5                                     | 17                                                 | 6                            |
| IV             | 3                        | 5                                     | 16                                                 | 6                            |
| IV             | 3                        | 5                                     | 17                                                 | 6                            |
| V              | 4                        | 5                                     | 18                                                 | 5                            |
| V              | 4                        | 5                                     | 20                                                 | 7                            |
| VI             | 5                        | 6                                     | 28                                                 | 9–10                         |
| VI             | 5                        | 6                                     | 26                                                 | 8                            |
| VI             | 5                        | 6                                     | 28                                                 | 10                           |
| VI             | 5                        | 6                                     | 21                                                 | 7                            |
| VII            | 6                        | 6                                     | 32                                                 | 12–13                        |
| VII            | 6                        | 6                                     | 32                                                 | 14                           |
| VII            | 6                        | 5                                     | 31                                                 | 12–13                        |
| VII            | 6                        | 5                                     | 32                                                 | 13–14                        |
| VII            | 6                        | 5                                     | 33                                                 | 12                           |
| VIII           | 7                        | 7                                     | 33                                                 | 14–16                        |
| VIII           | 7                        | 6                                     | 32                                                 | 14–15                        |
| VIII           | 7                        | 6                                     | 31                                                 | 15                           |
| VIII           | 7                        | 6                                     | 31                                                 | 15                           |
| VIII           | 7                        | 6                                     | 33                                                 | 23                           |
| VIII           | 7                        | 6                                     | 41                                                 | 15                           |
| VIII           | 7                        | 5                                     | 38                                                 | 15–18                        |
| VIII           | 7                        | 5                                     | 38                                                 | 15–16                        |
| VIII           | 7                        | 5                                     | 40                                                 | 17–19                        |
| VIII           | 7                        | 5                                     | 40                                                 | 17–19                        |
| VIII           | 7                        | 5                                     | 40                                                 | 17–19                        |
| VIII           | 7                        | 5                                     | 39                                                 | 16–17                        |
| VIII           | 7                        | 5                                     | 40                                                 | 17                           |
| VIII           | 7                        | 5                                     | 33                                                 | 13–14                        |
| VIII           | 7                        | 5                                     | 39                                                 | 15–17                        |
| VIII           | 7                        | 5                                     | 36                                                 | 19                           |
| VIII           | 7                        | 5                                     | 35                                                 | 16–17                        |
| VIII           | 7                        | 5                                     | 36                                                 | 16–17                        |
| VIII           | 7                        | 5                                     | 41                                                 | 20                           |
| VIII           | 7                        | 5                                     | 38                                                 | 18                           |
| VIII           | 7                        | 5                                     | 40                                                 | 15–18                        |
| VIII           | 7                        | 5                                     | —                                                  | 15                           |
| VIII           | 7                        | 4                                     | 44                                                 | 17                           |

.....continued on the next page

**TABLE 1.** (Continued)

| stadium number | number of rows of ocelli | number of apodous rings before telson | number of podous rings including collum and ring 7 | approximate body length (mm) |
|----------------|--------------------------|---------------------------------------|----------------------------------------------------|------------------------------|
| VIII           | 7                        | 4                                     | 40                                                 | 16                           |
| VIII           | 7                        | 4                                     | 40                                                 | 18–19                        |
| VIII           | 7                        | 3                                     | 41                                                 | 18–19                        |
| IX             | 8                        | 5                                     | 39                                                 | 18                           |
| IX             | 8                        | 5                                     | 41                                                 | 22–23                        |
| IX             | 8                        | 5                                     | 43                                                 | 24–25                        |
| IX             | 8                        | 5                                     | 42                                                 | 15–20                        |
| IX             | 8                        | 5                                     | 38                                                 | 15                           |
| IX             | 8                        | 4                                     | 45                                                 | 27                           |
| IX             | 8                        | 4                                     | 46                                                 | 25–27                        |
| IX             | 8                        | 4                                     | 45                                                 | 24–25                        |
| IX             | 8                        | 4                                     | 48                                                 | 24–25                        |
| IX             | 8                        | 4                                     | 43                                                 | 25–27                        |
| IX             | 8                        | 4                                     | 43                                                 | 22–23                        |
| IX             | 8                        | 4                                     | 43                                                 | 20                           |
| IX             | 8                        | 4                                     | 43                                                 | 23–25                        |
| IX             | 8                        | 4                                     | 45                                                 | 24–26                        |
| IX             | 8                        | 4                                     | 43                                                 | 23–25                        |
| IX             | 8                        | 4                                     | 43                                                 | 23                           |
| IX             | 8                        | 4                                     | 43                                                 | 18–19                        |
| IX             | 8                        | 4                                     | 42                                                 | 20                           |
| IX             | 8                        | 4                                     | 41                                                 | 20–21                        |
| IX             | 8                        | 4                                     | 41                                                 | 20                           |
| IX             | 8                        | 4                                     | 41                                                 | 20                           |
| IX             | 8                        | 4                                     | 45                                                 | 23–25                        |
| IX             | 8                        | 4                                     | 41                                                 | 23–25                        |
| IX             | 8                        | 4                                     | 44                                                 | 24–25                        |
| IX             | 8                        | 4                                     | 46                                                 | 26–27                        |
| IX             | 8                        | 3                                     | 43                                                 | 23–24                        |
| IX             | 8                        | 3                                     | 43                                                 | 25                           |
| IX             | 8                        | 3                                     | 44                                                 | 20–23                        |
| IX             | 8                        | 3                                     | 42                                                 | 19–20                        |
| IX             | 8                        | 3                                     | 47                                                 | 28–29                        |
| IX             | 8                        | 2                                     | 45                                                 | 22                           |
| X              | 9                        | 4                                     | 43                                                 | 22–23                        |
| X              | 9                        | 4                                     | 43                                                 | 22–23                        |
| X              | 9                        | 4                                     | 43                                                 | 32–33                        |
| X              | 9                        | 3                                     | 43                                                 | 23                           |
| X              | 9                        | 3                                     | 43                                                 | 25                           |
| X              | 9                        | 3                                     | 43                                                 | 23–24                        |
| X              | 9                        | 3                                     | 43                                                 | 25–26                        |

.....continued on the next page



TABLE 1. (Continued)

| stadium number | number of rows of ocelli | number of apodous rings before telson | number of podous rings including collum and ring 7 | approximate body length (mm) |
|----------------|--------------------------|---------------------------------------|----------------------------------------------------|------------------------------|
| X              | 9                        | 3                                     | 44                                                 | 23–25                        |
| X              | 9                        | 3                                     | 44                                                 | 23–25                        |
| X              | 9                        | 3                                     | 46                                                 | 29–30                        |
| X              | 9                        | 3                                     | 47                                                 | 25–26                        |
| X              | 9                        | 3                                     | 48                                                 | 33–34                        |
| X              | 9                        | 3                                     | 52                                                 | 30–32                        |
| X              | 9                        | 2                                     | 48                                                 | 30–31                        |
| X              | 9                        | 1                                     | 52                                                 | 32–33                        |
| XI             | 10                       | 4                                     | 45                                                 | 27                           |
| XI             | 10                       | 2                                     | –                                                  | 25                           |
| XI             | 10                       | 2                                     | 49                                                 | 30–31                        |
| XI             | 10                       | 2                                     | 49                                                 | 34                           |
| XI             | 10                       | 2                                     | 49                                                 | 29–30                        |
| XI             | 10                       | 1                                     | 53                                                 | –                            |
| XII            | 11                       | 2                                     | 51                                                 | 36–37                        |
| XII            | 11                       | 2                                     | 50                                                 | 27–28                        |
| XII            | 11                       | 2                                     | 54                                                 | 39                           |
| XII            | 11                       | 2                                     | 49                                                 | 35                           |
| XII            | 11                       | 2                                     | 49                                                 | 31                           |
| XII            | 11                       | 2                                     | 48                                                 | 30                           |
| XII            | 11                       | 2                                     | 57                                                 | 41–43                        |
| XII            | 11                       | 1                                     | 49                                                 | 35–37                        |
| XII            | 11                       | 1                                     | –                                                  | 35                           |
| XII            | 11                       | 1                                     | 56                                                 | 45–47                        |
| XIII           | 12                       | 1                                     | 54                                                 | 34–35                        |
| XIII           | 12                       | 1                                     | 59                                                 | 43–45                        |
| XIII           | 12                       | 1                                     | 53                                                 | 37–38                        |
| XIII           | 12                       | 1                                     | 58                                                 | 47–48                        |
| XIII           | 12                       | 1                                     | 54                                                 | 42                           |

\* Information is given for each examined specimen

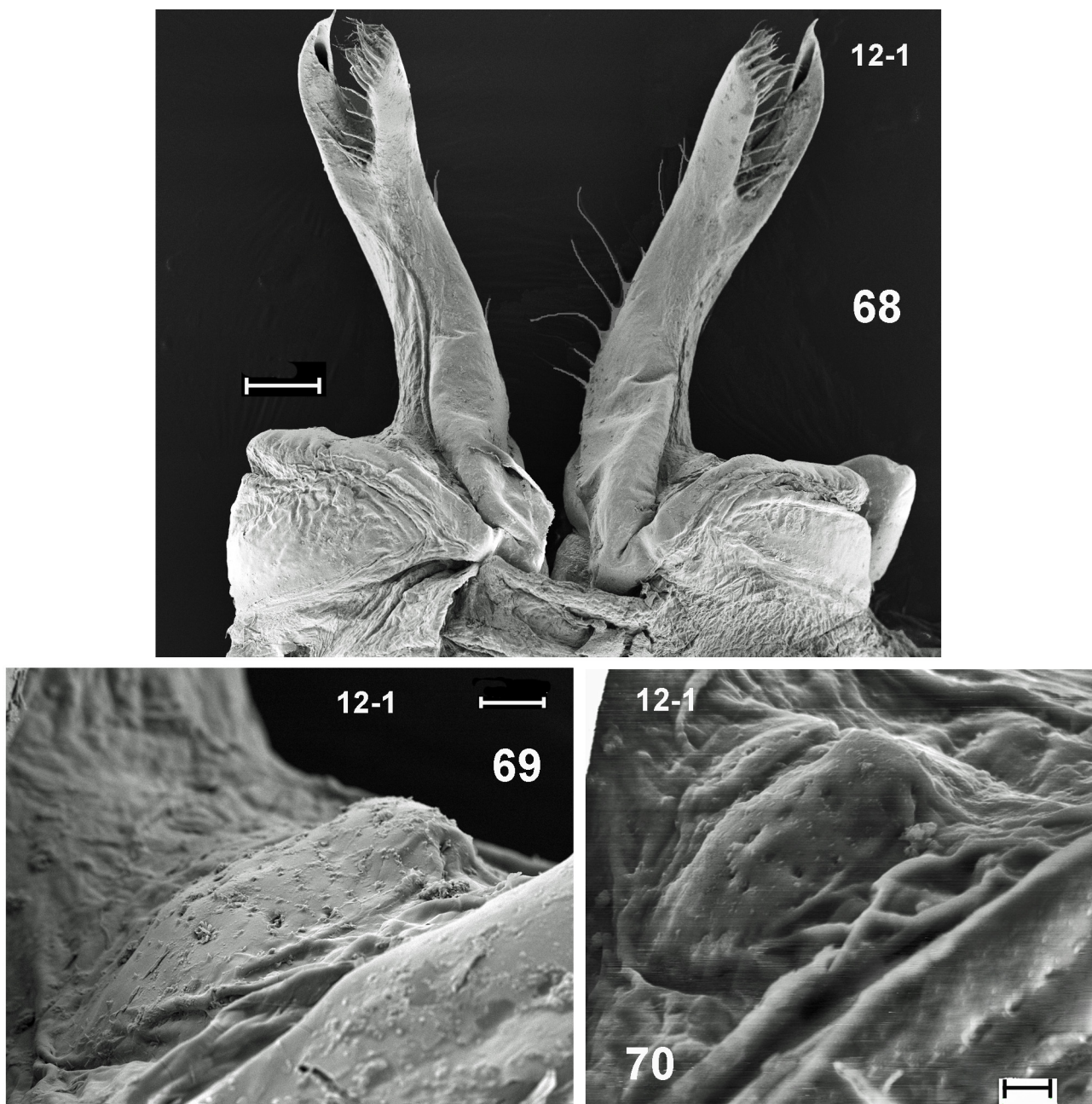
**Type material.** Depository unknown.

**Type locality.** Korea, Ansyu.

**Distribution.** Korea.

**Remarks.** A specimen from Russia, Far East, Primorskii krai (Maritime Prov.), Kedrovaya Pad' Nature Reserve, middle flow of Kedrovaya River, bank, under stones, 26.V.1968, leg. F.Z. Popov, originally identified as *Ansiulus matumotoi* (Mikhaljova 2002), is kept in the Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia and was not restudied. However, it is safe to say that this specimen also belongs to a juvenile stadium of *Skleroprotopus coreanus* because in the abundant material from "Kedrovaya Pad" Nature Reserve (including "Material examined"), collected over several decades, no *Ansiulus matumotoi* is evident. *Ansiulus matumotoi* has never been registered in Russia.

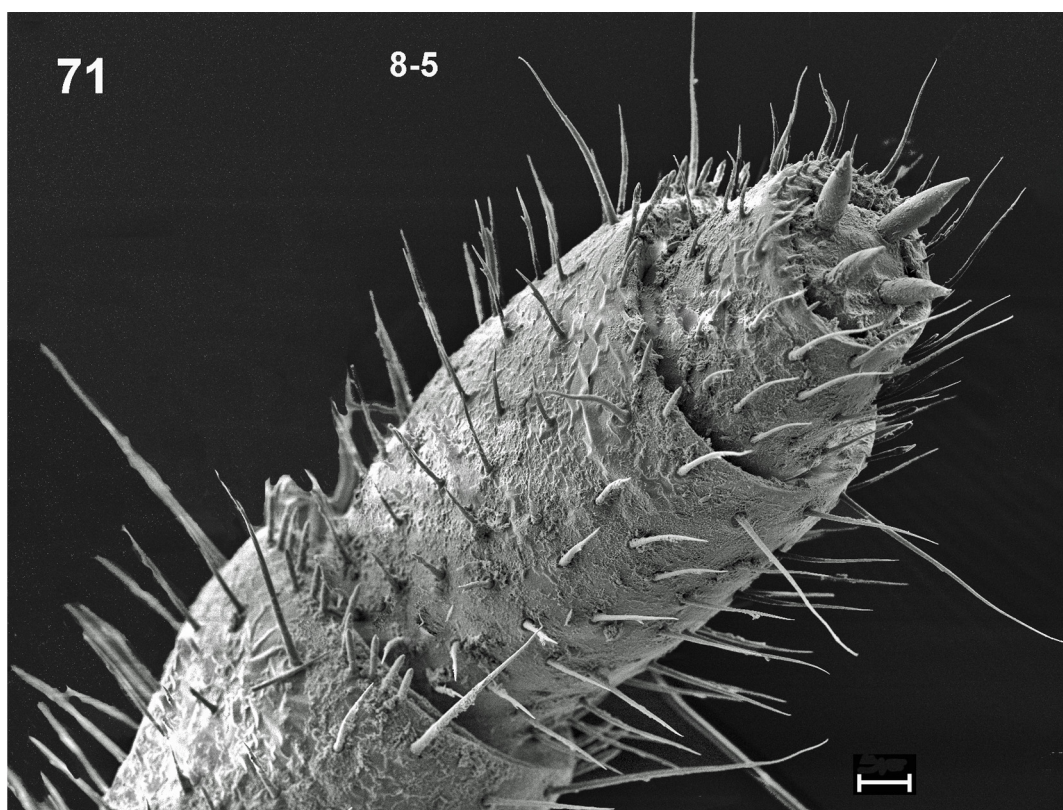
Korean *Skleroprotopus matumotoi*, **comb. n.** needs to be re-examined.



**FIGURES 68–70.** *Skleroprotopus coreanus* (Pocock, 1895), adult males (postembryonic stadium XIII): **68**, posterior gonopods (caudal view); **69 & 70**, tubercle in the place of posterior gonopod telopodite; 68–70, specimens with 1 apodous ring; formula 12–1: 12—number of eye rows, 1—number of apodous rings. **Scales:** 10  $\mu$ m (figs 69, 70), 100  $\mu$ m (Fig. 68).

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**FIGURE 71.** *Skleroprotopus coreanus* (Pocock, 1895), juvenile male (postembryonic stadium IX): distal part of antenna; specimen with 5 apodous rings; formula 8–5: 8—number of eye rows, 5—number of apodous rings. **Scale:** 20  $\mu\text{m}$ .

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