

## Notes on the genus *Ilyocryptus* Sars, 1862 (Cladocera: Anomopoda: Ilyocryptidae). 7. Two new species from South Africa, with first record of *Ilyocryptus* from rockpools

### Заметки о роде *Ilyocryptus* Sars, 1862 (Cladocera: Anomopoda: Ilyocryptidae). 7. Два новых вида из Южной Африки, и первая находка *Ilyocryptus* из наскальных луж

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КЛЮЧЕВЫЕ СЛОВА: ветвистоусые ракообразные, Cladocera, Anomopoda, *Ilyocryptus*, морфология, систематика, Африка.

ABSTRACT. *Ilyocryptus* Sars, 1862 (Cladocera: Anomopoda: Ilyocryptidae) with a subdistal anus is unknown from Africa. But, recently we found two new species in South Africa with this morphology: *Ilyocryptus martensi* sp.n. from a rockpool in the mountains of Lesotho, and *Ilyocryptus africanus* sp.n. from Cape Point, Republic of South Africa. These species represent the first finding of an ilyocryptid in rockpools. Also, these species are congeners of species with a subdistal anus from the southern hemisphere: *I. brevidentatus* Ekman, 1905 and *I. smirnovi* Kotov & Timms, 1998. But, in contrast to the latter pair, *I. martensi* sp.n. and *I. africanus* sp.n. have a remarkably short antenna I, with the distal segment bearing rows of denticles, and also a row of paired spines reaching the distal third of the postanal margin of the postabdomen. The two new species described here are the closest relatives of *I. nevadensis* Cervantes-Martínez, Gutiérrez-Aguirre & Elías-Gutiérrez, 2000. Differences between *I. nevadensis*, *I. martensi* sp.n. and *I. africanus* sp.n. are reported.

All species with incomplete moulting and a subdistal anus in the Southern Hemisphere are endemics or have a narrow distribution. Perhaps these species are the relicts of a large group, which had a very wide, if not cosmopolitan, geographical distribution in the past (in the Lower Mesozoic?).

РЕЗЮМЕ. До настоящего времени из Африки не было описано ни одного вида *Ilyocryptus* Sars, 1862 (Cladocera: Anomopoda: Ilyocryptidae) с субдистальным анусом. Мы нашли два новых вида из Южной Африки, *Ilyocryptus martensi* sp.n. из наскальных луж в горах Лесото и *Ilyocryptus africanus*

sp.n. из окрестностей Кейп Поинт, ЮАР. Оба они являются родственниками других видов с субдистальным анусом из южного полушария: *I. brevidentatus* Ekman, 1905 и *I. smirnovi* Kotov & Timms, 1998. Но, в отличие от последних, *I. martensi* sp.n. и *I. africanus* sp.n. снабжены крайне короткой антенной I, с дистальным члеником несущим ряды шипиков, а также рядом парных шипов, продолжающемся на дистальной трети постанального края постабдомена. Два новых вида, описанных здесь, — ближайшие родственники *I. nevadensis* Cervantes-Martínez, Gutiérrez-Aguirre & Elías-Gutiérrez, 2000. Обсуждены отличия между этим видом, *I. martensi* sp.n. и *I. africanus* sp.n.

Все виды с неполной линькой и субдистальным анусом из южного полушария являются эндемиками или имеют узкие ареалы. Вероятно все эти виды являются остатками некоей большой группы видов, некогда (в мезозойскую эру?) имевшей широкое, если не космополитическое, распространение.

### Introduction

The systematics of European [Štifter, 1991; Kotov, 2001], South American [Paggi, 1992; Kotov et al., 2002a], North American [Kotov et al., 2002b] and Asian [Kotov & Sanoamuang, 2004; Kotov & Tanaka, 2004] species of *Ilyocryptus* have recently been investigated. But only a few articles on African ilyocryptids have been published [Kotov, 2000; Kotov & Dumont, 2000]. Not one species of *Ilyocryptus* with a subdistal anus has been found in Africa, except for the dubious record of *I. acutifrons* Sars, 1862 by Harding [1961].

Prof. N.N. Smirnov obtained numerous South African samples from Prof. K. Martens (Royal Belgian Institute of Natural Sciences, Brussels, Belgium) for total study of cladocerans, and found *Ilyocryptus* in 34 samples among about 250 studied. He asked us to look at *Ilyocryptus*, and we revealed that a single population from the mountains of Lesotho belongs to a new species, *I. martensi* sp.n., described below. Our re-examination of Harding's [1961] sample in the Natural History Museum, London (catalogue number NHM 1959.7.9.81) revealed that '*I. acutifrons*' recorded by him is a new species, *I. africanus* sp.n.

So, the aim of present communication is to describe these two new species of *Ilyocryptus* with a subdistal anus from South Africa.

## Material and methods

Animals were isolated from the samples under a stereomicroscope, washed in commercial detergent and in distilled water, and used for morphometry. The following measurements (based on adult parthenogenetic females) were made, see a scheme of these measurements in Kotov et al. [2002b]: body length (BL), height (BH) and width (BW); head length (HL) and width (HW); eye diameter (ED); valve length (VL); number of marginal elements (NE); number of setae in antero-ventral bunch (NB); number of setae with single basal spines (NS); maximal length of a seta on antero-ventral (AV) and postero-ventral valve portion (PV); postabdomen length (from base of claw to base of postabdominal setae) (PL) and height (PH); anus length (AN), length of preanal part of postabdomen (PR); number of preanal teeth or/and clusters of teeth (NT); number of big paired spines of distal part (NP); number of large (NL), medium-sized (NM) and rudimentary (NR) lateral setae; postabdominal claw length (CL); length of more distal (DS) and more basal spine (BS) on base of claw; number of distal denticles on claw (DD); rudimentary additional denticles on middle part of claw (AD); postabdominal ("natatorial") seta length (SN); length of the basal segment of postabdominal seta (BA); antenna I length (AL), maximal diameter (DA) and its proximal segment length (PS); length of antenna II (without apical setae) (SL); length of exopod apical spine (AS), length of endopod apical spine (AP); length of third exopod segment (TH) and of spine on its second segment (SE); maximal length of apical swimming seta (SW) of second antennae, length of distal (DI) and proximal (PX) lateral swimming seta on antennal exopod. After that, some relative parameters were calculated for each animal, as applied in a series of previous publications [Kotov et al., 2002a, b].

For *I. martensi* sp.n., we had relatively ample material, and two females were dissected for accurate study of their appendages. These specimens were not kept. Twenty one females of *I. africanus* sp.n. in alcohol from the NHM were available (together with two slides given us by Prof. N. N. Smirnov). We did not dissect this species, keeping all specimens for the Museum collection as types.

## Results

### *Ilyocryptus martensi* sp.n.

Figs 1–28.

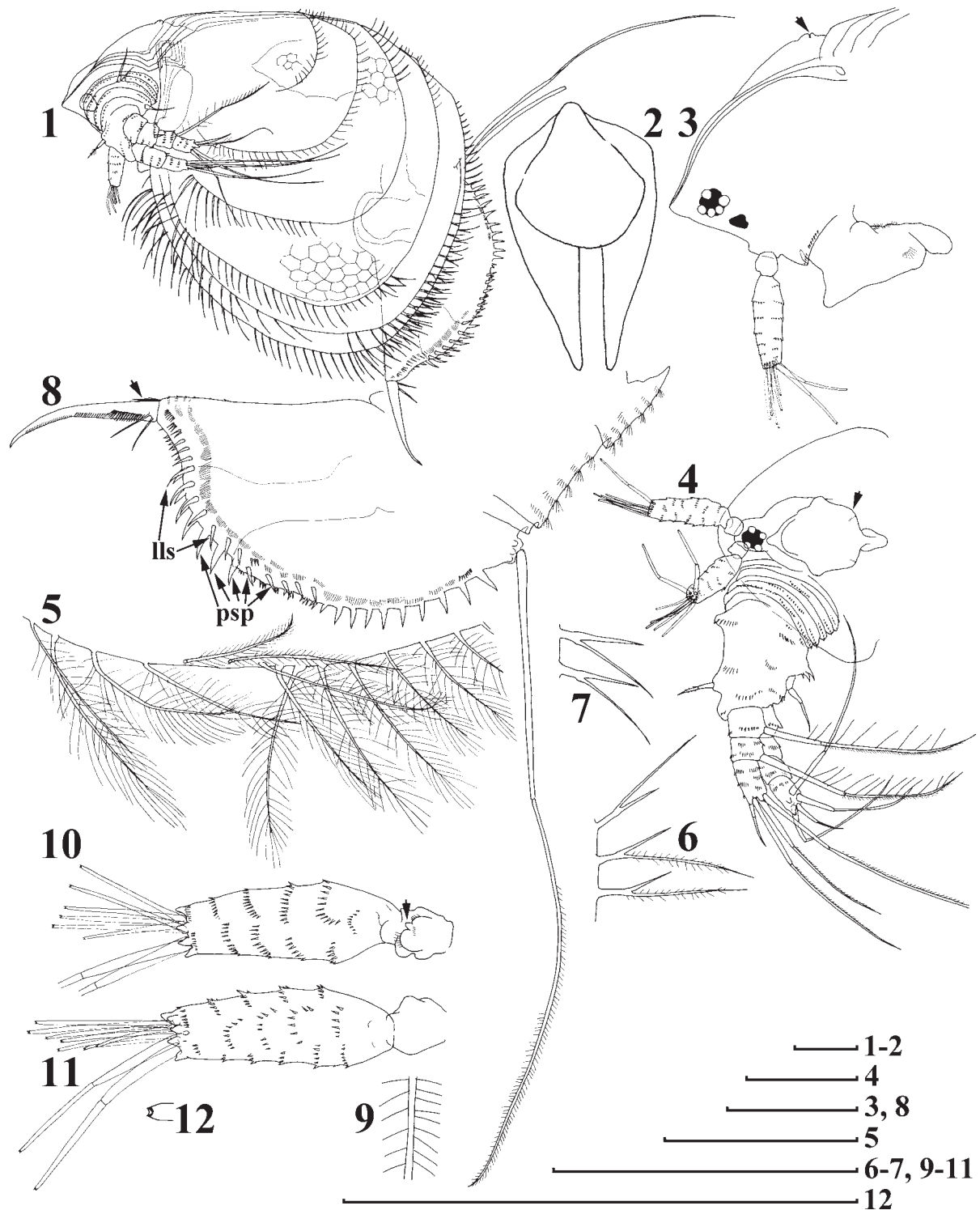
**TYPE LOCALITY.** A rockpool at 2450 m.a.s.l., Sehlabathebe, Lesotho, Africa. Coordinates: 29°51'44"S, 29°07'26"E. The locality was sampled in 15.xi.1996 by K. Martens, and marked as 'rockpool 5'. At time of collecting, the following measurements were made: water temperature 20.4°C, pH 6, conductivity 2.9 µS/cm. The species co-occurs with a single other cladoceran, *Alona* cf. *intermedia*, and also with some Ostracoda and Calanoida.

**MATERIAL.** Holotype: adult parthenogenetic ♀ in 95% alcohol, tube MGU Ml 30, deposited at the invertebrate collection of the Zoological Museum of Moscow State University. Label of the holotype: "*Ilyocryptus martensi* sp. nov., 1 parth. ♀ from rockpool 5, Sehlabathebe, Lesotho, coll. 15.11.1996 by K. Martens, HOLOTYPE". Paratypes: 14 parthenogenetic ♀♀ in 95% alcohol, tube MGU Ml 31.

### DIAGNOSIS OF PARTHENOGENETIC FEMALE.

Body triangular-ovoid, dorsal margin almost straight, postero-dorsal angle expressed, dorsal keel low and thick, moulting incomplete. Head with straight ventral margin, minute denticles at base of labrum. Valves with distinct reticulation, six anteriormost setae protruding sparsely and, posteriorly to them, a bunch of 4–6 closely located setae. Each seta at posterior margin with a thick base armed with a single, stout spine-like setule. Postabdomen with height maximal in basal portion and subdistal anus, no spinules on internal wall of anus. Preanal margin in basal half with a row of regularly distributed, relatively short, straight teeth, prominent at approximately right angle with the margin, in distal half this row continued by a row of clusters of small denticles. No spinules on lateral faces of postabdomen basally. Paired spines start on postanal margin and continue up to distal third of preanal margin, large lateral setae markedly shorter than paired spines, the proximalmost lateral seta located on distalmost portion of preanal margin. No denticles in distal and medium parts of postabdominal claw. Distalmost spine on postabdominal claw of similar length with basalmost one, or even somewhat longer. A group of long setules at claw base ventrally. Postabdominal seta as long as body, or somewhat shorter, its basal segment with short hairs. Antenna I short, its proximal segment with a rudimentary finger-like projection, but with distinct hillocks, distal segment with rows of denticles, distal end with concentric row of relatively strong hillocks. Antenna II with two sensory setae with lengths different twice on its coxal part. Distal sensory seta long, distal burrowing spine shorter than it, robust. All apical swimming setae short, their distal segments without hooks on tips, asymmetrically setulated with short setules. Proximal and distal lateral swimming seta of proportions varying among individuals, both with long, rare setules along one side basally, and asymmetrically setulated distally. Spine on second segment of exopod longer than half of third segment. A single, large, unilaterally setulated seta on outer distal lobe of limb I. Two ejector hooks, a large, bisegmented seta near them, a gnathobase I as a naked hillock without setae. No beating seta near gnathobase III. Filter plate V with 4 setae. Limb VI with continuous row of long setules along inner margin subdivided into six bunches. Size up to 710 µm in accessible material.

**DESCRIPTION.** Adult parthenogenetic female. *General.* In lateral view body triangular-ovoid (Fig. 1), of medium height for the genus (BH/BL = 0.75–0.82). Dorsal margin



Figs 1–12. *Ilyocryptus masrtensi* sp.n., parthenogenetic ♀ from a rockpool in Sehlabathebe, Lesoto, Africa, collected in 15.xi.1996 by K. Martens: 1, 2 — lateral and anterior view; 3, 4 — head in lateral and ventral view; 5 — setae at anterior portion of valve; 6, 7 — setae at posterior margin of valve; 8 — postabdomen; 9 — distal segment of postabdominal seta; 10, 11 — antenna I in anterior and lateral view; 12 — tip of aesthetasc. Scale 100 μm.

Рис. 1–12. *Ilyocryptus masrtensi* sp.n., партеногенетическая ♀ из наскальной лужи в горах Лесото, Африка, собранная 15.11.1996 К. Мартенсом: 1, 2 — вид сбоку и спереди; 3, 4 — голова сбоку и с брюшной стороны; 5 — щетинки в передней части вентрального края; 6, 7 — щетинки на заднем крае створки; 8 — постабдомен; 9 — вооружение дистального сегмента постабдоминальной щетинки; 10, 11 — антенна I спереди и сбоку; 12 — верхушка эстетаска. Масштаб 100 мкм.

almost straight, postero-dorsal angle expressed. In anterior view, body rhomboid-ovoid (Fig. 2), BW/BL = 0.55–0.60, with a low, thick dorsal keel. Moulting incomplete, reticulation well-expressed on head shield and valves.

*Head* of medium size for the genus (HL/BL = 0.30–0.34), its ventral margin in posterior part with prominent basis for antennae I, labrum base surrounded with a low fold, a series of denticles on the latter (Fig. 3). In ventral view head shield relatively narrow (HW/BL = about 0.32), with prominent fornices (Fig. 4). Dorsal head pore located on a low prominence (Fig. 3, arrow). Compound eye of common size for genus (ED = 23–28  $\mu$ m), ocellus of irregular shape, its maximal length somewhat smaller than half of eye diameter.

*Labrum* subquadrangular in lateral view, with a distinct medial projection in its basal portion. In ventral view, labrum wide, with lateral projections on each side in medial portion, a row of setules on each side in its distal portion, latero-distal angles smooth (Fig. 4, arrow).

*Valves* trapezium-ovoid, VL/BL = 0.79–0.83. Numerous setae along free margin (NE = 64–70), six anteriormost setae protruding sparsely, first four setae located immediately on margin, while fifth-sixth setae located submarginally, on external face of valve, posteriorly to them, a bunch (NB=4–6) of closely located setae (AV/BL = 0.12–0.14), the first seta in bunch protruding posterior, crossing following setae (Fig. 5). Setae at ventral margin short, no postero-ventral bunch of setae, length of setae there significantly varies among individuals (PV/BL = 0.08–0.14), each seta at posterior margin with an inflated base armed with a single, stout spine (NS = 31–34), distal parts of these setae in ventral portion of posterior margin with rare denticles (Fig. 6), in dorsal portion of margin distal portions of setae naked (Fig. 7).

*Abdomen* dorsally with cross rows of setules, a relatively small projection on the first segment (Fig. 8).

*Postabdomen* relatively large for the genus, PL/BL = 0.54–0.58 (Fig. 8), not high (PH/PL = 0.47–0.52), height maximal in basal portion (Fig. 8). Anus relatively large (AN/PL = 0.16–0.20), opens subdistally, no spinules on its internal wall. Preanal margin long (PR/PL = 0.68–0.71), although not too long as in *I. uenoi* (see Kotov & Tanaka [2004]), in basal half with a row of 9–13 regularly located, straight teeth, prominent at approximately right angle with the margin, in distal half this row continued by a row of 6–8 clusters of small denticles (NT = 16–21). Series of small setules near each preanal tooth. No spinules on lateral faces of postabdomen basally in contrast to many other species. A row of paired spines (Fig. 8: psp) starts on anal margin and continues up to distal third of preanal margin (NP = 9–13, rudimentary spines on postanal margin not counted), large lateral setae (Fig. 8: lls) (NL = 7–10) markedly shorter than paired spines, the proximalmost lateral seta located on distalmost portion of preanal margin. On the distal part of postabdomen, the row of lateral setae fluently turned into the group of middle-sized setae (NM = 3–6), the latter, more distally, - into group of rudimentary setae (NR = 2–5).

*Postabdominal claw* relatively short (CL/PL = 0.34–0.39), bent in distal half. No denticles in distal and middle portion of claw (DD=0, AD=0). Two relatively large spines on the base of each claw dorsally, distal one of similar length with basal one, or even somewhat longer (DS/BS = 0.93–1.04). A group of long setules on claw base ventrally (Fig. 8, arrow).

*Postabdominal seta* markedly longer than postabdomen, although its length varies greatly among individuals (SN/PL = 1.25–1.40), basal segment markedly shorter than distal

one (BA/SN = 0.33–0.38), the latter regularly feathered with short hairs (Fig. 9).

*Antenna I* remarkably short, thick and robust for *Ilyocyrtus* (AL/BL = 0.15–0.17; DA/AL = 0.25–0.26), straight. Bases of antennae I not compressed against each other (Fig. 4). Proximal segment relatively long (PS/AL = 0.23–0.25), with a rudimentary finger-like projection (Fig. 10, arrow) and distinct, low hillocks, some of them setulated, which was never described in other species. Distal segment with rows of denticles, distal end truncated, with concentric row of relatively strong hillocks (Fig. 11). Nine aesthetascs of unequal length, end of each aesthetasc depressed (Fig. 12).

*Antenna II* short, SL/BL = 0.28–0.35, at coxal part with two sensory setae with lengths different twice (Figs. 13–14). Distal sensory seta on basal segment long, slender, with short setules (Fig. 15), distal burrowing spine shorter than distal sensory seta, robust, with long setules distally (Fig. 16). Antennal branches robust, on all segments, there are well-developed denticles around distal segment ends, and groups of similar denticles in middle part. Swimming setae 0-0-0-3/1-1-3, spines 0-1-0-1/0-0-1. All apical swimming setae relatively short (SW/BL = 0.26–0.38), bisegmented, distal segments without hooks on tips, asymmetrically setulated with short setules, these setules on setae of endopod (Fig. 17) longer than those on exopod (Fig. 18). Proximal and distal lateral swimming seta of proportions varying among individuals (PX/DI = 0.8–1.2), with long, rare setules along one side basally, and asymmetrically setulated distally (Fig. 19). Spines on apical segments of endopod and exopod of similar size (AS/AP = 0.97–1.13), both longer than their distal segments, slightly curved. Spine on second segment of exopod longer than half of third segment (SE/TH = 0.57–0.69), setulated distally (Fig. 20).

*Maxilla I* as a small hillock with three similar seta, and four, thick and fully setulated seta (Fig. 21).

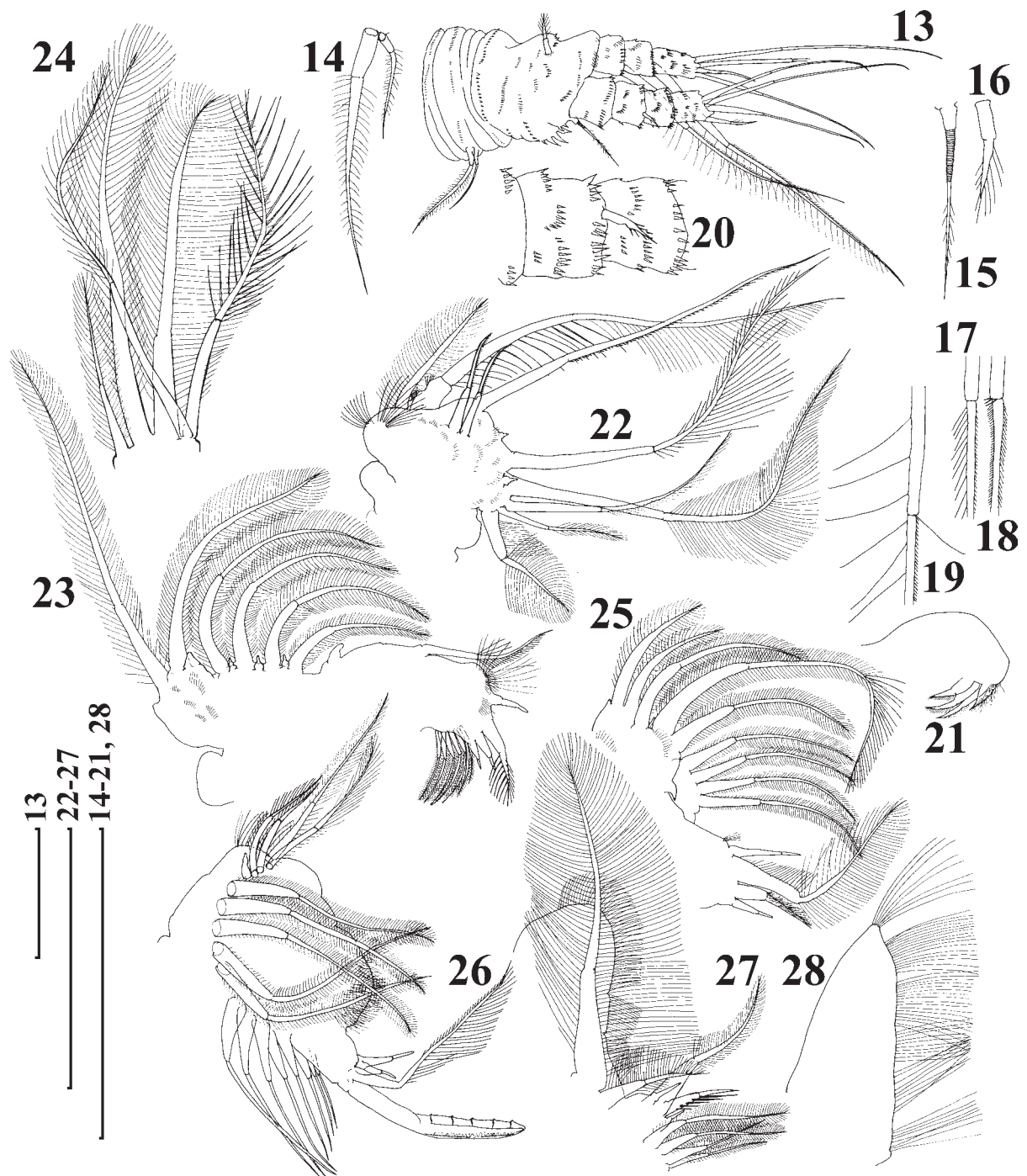
*Limb I* (Fig. 22). Epipodite small, ovoid. Cylindrical outer distal lobe with a single large, unilaterally setulated seta, a bilaterally setulated accessory seta near base of outer distal lobe. Two ejector hooks of similar size, a large bisegmented seta on ventral margin of limb near them. On inner margin of limb I, five differently armed setae and two receptors. A gnathobase I as naked hillock without setae.

*Limb II* (Fig. 23). Epipodite small, globular. A distal lobe with series of fine setules, two long, bilaterally setulated setae and a distinct bud-like hillock. Along ventral margin of limb corm, four bilaterally setulated setae, small receptors near first, second and third setae of row. Inner portion of limb strongly projected, a small, curved sensillum at the base of this projection. A single bisegmented beating seta in distal part of limb, near gnathobase. Distal armature of gnathobase with four closely located elements. Filter plate with eight setae.

*Limb III*. Epipodite globular. Exopodite with five terminal setae, armed in different style (Fig. 24), and three lateral setae, typical for the genus and not pictured here. Distal endite with two soft, relatively short setae, and three large, bisegmented setae of different size, the middle seta very long, and has particularly long setules distally; a small receptor near base of longest seta. Basal endite with four bisegmented setae of similar size, and a curved sensillum near border with distal endite (Fig. 25). No beating seta near gnathobase. Four differently armed setae in distal armature of gnathobase, filter plate with eight setae.

*Limb IV*. Exopodite with 8 setae typical for the genus (not pictured). Distal portion of inner face as a small lobe, with a series of four thin setae, among them, two distal setae





Figs 13–28. *Ilyocryptus masrtensi* sp.n., head and thoracic appendages of parthenogenetic female from a rockpool in Sehlabathebe, Lesoto: 13 — antenna II; 14 — sensory setae on its coxal part; 15, 16 — distal sensory seta and distal burrowing spine on basal segment; 17, 18 — armature of apical swimming seta of exopod and endopod; 19 — armature of lateral swimming seta; 20 — second and third segments of exopod; 21 — maxilla I; 22 — limb I; 23 — limb II; 24 — distal setae on exopod III; 25 — inner portion of limb III; 26 — inner portion of limb IV; 27 — inner portion of limb V; 28 — limb VI. Scale 100  $\mu$ m.

Рис. 13–28. *Ilyocryptus masrtensi* sp.n., головные и грудные конечности партеногенетической самки из наскальной лужи в Лесото: 13 — антенна II; 14 — чувствительные щетинки на коксе; 15, 16 — дистальная чувствительная щетинка и дистальный шип на базальном сегменте; 17, 18 — вооружение апикальной щетинки экзоподита и эндоподита; 19 — вооружение латеральной плавательной щетинки; 20 — второй и третий членик экзоподита; 21 — максилла I; 22 — нога I; 23 — нога II; 24 — дистальные щетинки на экзоподите ноги III; 25 — внутренняя доля ноги III; 26 — внутренняя доля ноги IV; 27 — внутренняя доля ноги V; 28 — нога VI. Масштаб 100 мкм.

long, while two basal setae short, a tri-lobed sensillum near basalmost seta (Fig. 26). Basally and medially, five long, bilaterally setulated setae. Distal armature of gnathobase with four elements, filter plate with 8 setae, no distinct border between filter plate and row of setae of inner limb face.

*Limb V.* Exopodite with seven large setae typical for the genus (not pictured). Distal portion of inner face of limb V in the form of flat lobe, with three-lobed, setulated inner margin, two setulated setae near margin on the posterior face of limb (Fig. 27). Distal armature of gnathobase with four setae, filter plate with 4 setae.

*Limb VI* (Fig. 28). As a small plate with continuous row of long setules along inner margin, subdivided into six bunches by small incisions on the margin.

Ehippial female, male. Unknown.

SIZE. Holotype 695  $\mu\text{m}$ ; parthenogenetic females from type locality 460–710  $\mu\text{m}$  ( $n = 15$ ). Size range was apparently underestimated, i.e., the minimal size was measured for a single female of the second instar.

ETYMOLOGY. This species is dedicated to Koen Martens, renowned Belgian investigator of Ostracoda, who collected the type series.

DIFFERENTIAL DIAGNOSIS. See chapter on *I. africanus* sp.n., and Table 1.

DISTRIBUTION. *I. martensi* sp.n. is known only from the type locality. This is apparently a rare species, because it was found only in a single sample from South Africa among about 250 samples examined.

#### *Ilyocryptus africanus* sp.n.

Figs 29–52.

*Ilyocryptus acutifrons* Sars in Harding, 1961: 43.

TYPE LOCALITY. Sirkels Vlei near Cape Point, Western Cape, Republic of South Africa (approximately 34°16'S, 18°35'E, altitude about 100 m.a.s.l.). The holotype and five paratypes were collected in 09.i.1957 by A. D. Harrison & B.R. Allanson, and determined by Harding [1961] as *I. acutifrons*. Two females on slides from the same locality were obtained from Prof. N.N. Smirnov.

MATERIAL. Holotype: an adult parthenogenetic ♀, 740  $\mu\text{m}$ , in 95% alcohol, NHM 1959.7.9.81, deposited at the Natural History Museum, London, United Kingdom. Label of the holotype: "*Ilyocryptus africanus* sp. nov., 1 parth. fem. from Sirkels Vlei near Cape Point, Western Cape, Republic of South Africa, HOLOTYPE". Paratypes: 21 parthenogenetic ♀♀ (excluded from the tube NHM 1959.7.9.81), new number NHM 2005.242-251; 2 parthenogenetic ♀♀ from the type locality, coll. in 1981 by A.J.C. Gardiner, slides MGU Ml 35 and 36, deposited at the Zoological Museum of Moscow State University, Russia.

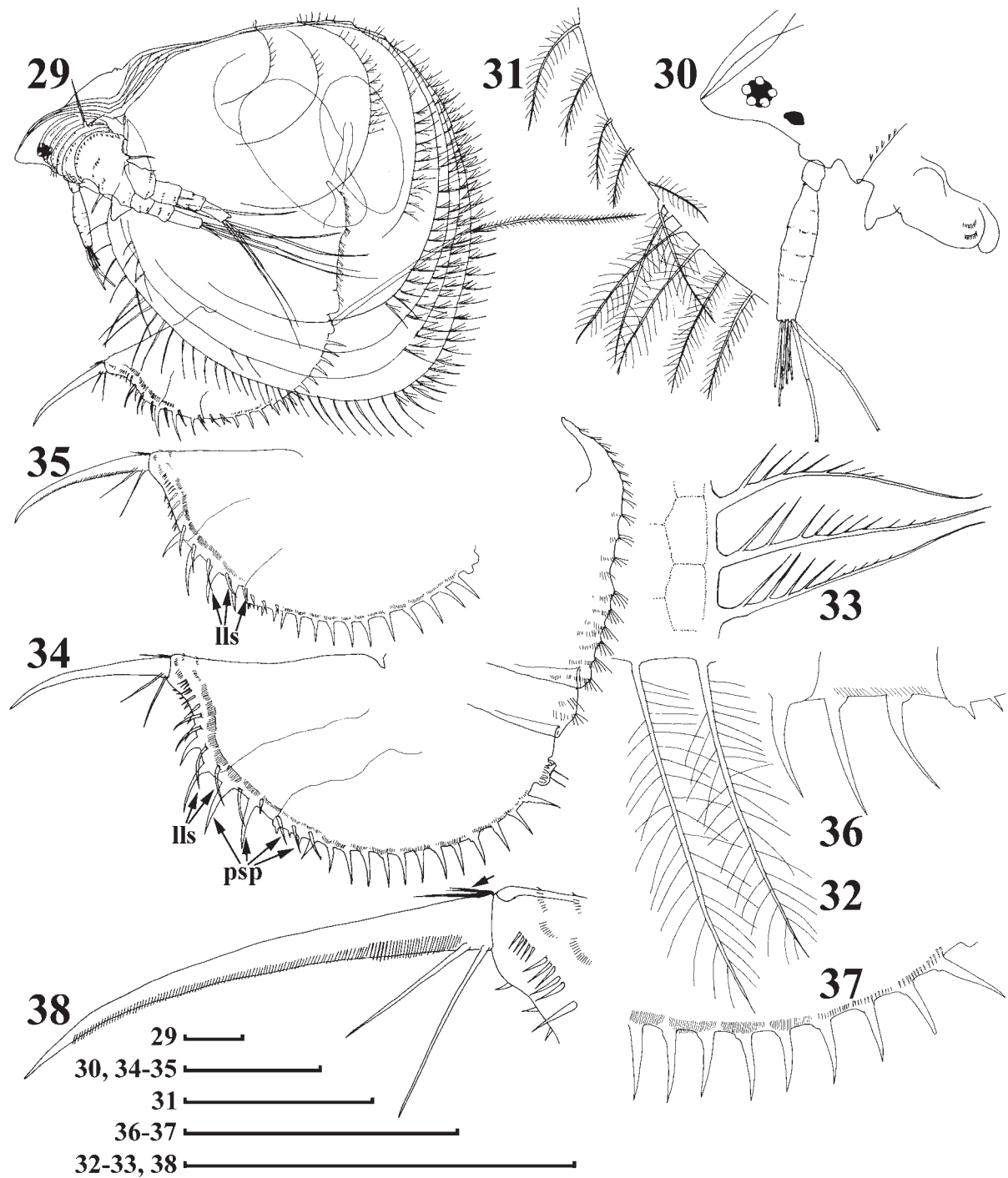
DIAGNOSIS OF PARTHENOGENETIC FEMALE. Body triangular-ovoid (BH/BL = 0.74–0.83), dorsal margin almost straight, postero-dorsal angle expressed (Fig. 29), body moderately compressed laterally (BW/BL = 0.52–0.57), dorsal keel low and thick, moulting incomplete. Head of medium length for the genus (HL/BL = 0.29–0.33), with convex ventral margin supplied with a pedestal for antennae I, relatively thick denticles near base of labrum (Fig. 30), compound eye relatively small (ED = 20–25  $\mu\text{m}$ ); in dorsal view head shield wide (HW/BL = about 0.36). Valve large (VL/BL = 0.76–0.83), with fine reticulation and marginal setae not too numerous as in previous species (NE = 56–59). Five anteriormost setae protruding sparsely and, posteriorly to them, a bunch (NB = 3–4; AV/BL = 0.14–0.18) closely located setae (Fig. 31). Each seta at ventral margin plumose

(Fig. 32) (PV/BL = 0.11–0.15), while each seta at posterior margin (NS = 30–34) supplied with a series of spine-like setules decreasing in size distally, while its distal portion with minute setules or naked (Fig. 33). Postabdomen (PL/BL = 0.48–0.52; PH/PL = 0.46–0.53) with height maximal in middle (Figs 34, 35), numerous delicate spinules on internal wall of anus (Fig. 36), AN = 0.19–0.22. Preanal margin long (PR/PL = 0.65–0.72), with a row of regularly distributed, relatively long, straight teeth (NT = 14–16), prominent at approximately right angle with the margin (except of basalmost one) (Fig. 37), two-three distalmost teeth as rudimentary clusters. No spinules on lateral faces of postabdomen basally. Paired spines (NP = 7–9) start on postanal margin and continue up to distal portion of preanal margin, these spines in anus region very large (Fig. 34: psp), large lateral setae markedly shorter than paired spines (NL = 5–6), the proximalmost lateral seta located on anal margin (Fig. 34) or distalmost region of preanal margin (Fig. 35). Middle-sized setae (NM = 5–7), and rudimentary setae (NR = 6–12) varying in number. Postabdominal claw relatively long (CL/PL = 0.41–0.47), no denticles in its distal and medium parts (DD = 0). Distalmost spine on postabdominal claw always shorter than basalmost one (DS/BS = 0.73–0.80). A group of long setules at claw base ventrally (Fig. 38, arrow). Postabdominal seta as long as body, or somewhat shorter, SN/PL = 1.40–1.55, its basal segment (BA/SN = 0.36–0.42) with numerous short hairs. Antenna relatively I short (Figs. 30, 39) (AL/BL = 0.17–0.19; DA/AL = 0.20–0.22), although markedly longer than that in *I. martensi* sp.n., its proximal segment (PS/AL = 0.20–0.24) with a rudimentary finger-like projection (Fig. 39, arrow), and low hillocks; distal segment with rows of denticles, which are not too strong as in *I. martensi* sp.n.; distal end with concentric row of relatively strong hillocks. Antenna II (SL/BL = 0.35–0.45) with two sensory setae with lengths different in three-four times on its coxal part (Figs 40–41). Distal sensory seta long (Fig. 42), although not too long as that in *I. martensi* sp.n., distal burrowing spine relatively short, robust (Fig. 43). All apical swimming setae relatively short (SW/BL = 0.35–0.45), although longer than those in *I. martensi* sp.n., their distal segments without hooks on tips, asymmetrically setulated, but style of armature very different in different setae of exopod and endopod (Figs 44–48, corresponding with the same numbers on Fig. 40). Proximal lateral swimming seta shorter than distal one (PX/DI = 0.65–0.83), both symmetrically armed basally and distally with long, rare setules (Figs 49, 50). Apical spine of exopod (Fig. 51) longer than apical spine of endopod (Fig. 52), AS/AP = 1.21–1.33. Spine on second segment of exopod as long as half of third segment (SE/TH = 0.56–0.62). A single, large, unilaterally setulated seta on outer distal lobe of limb I. Two ejector hooks, a large, bisegmented seta near them. Limb VI with continuous row of long setules along inner margin subdivided into six bunches. Size 560–740  $\mu\text{m}$  in accessible material ( $n = 6$ , the range clearly underestimated).

Ehippial female, male. Unknown.

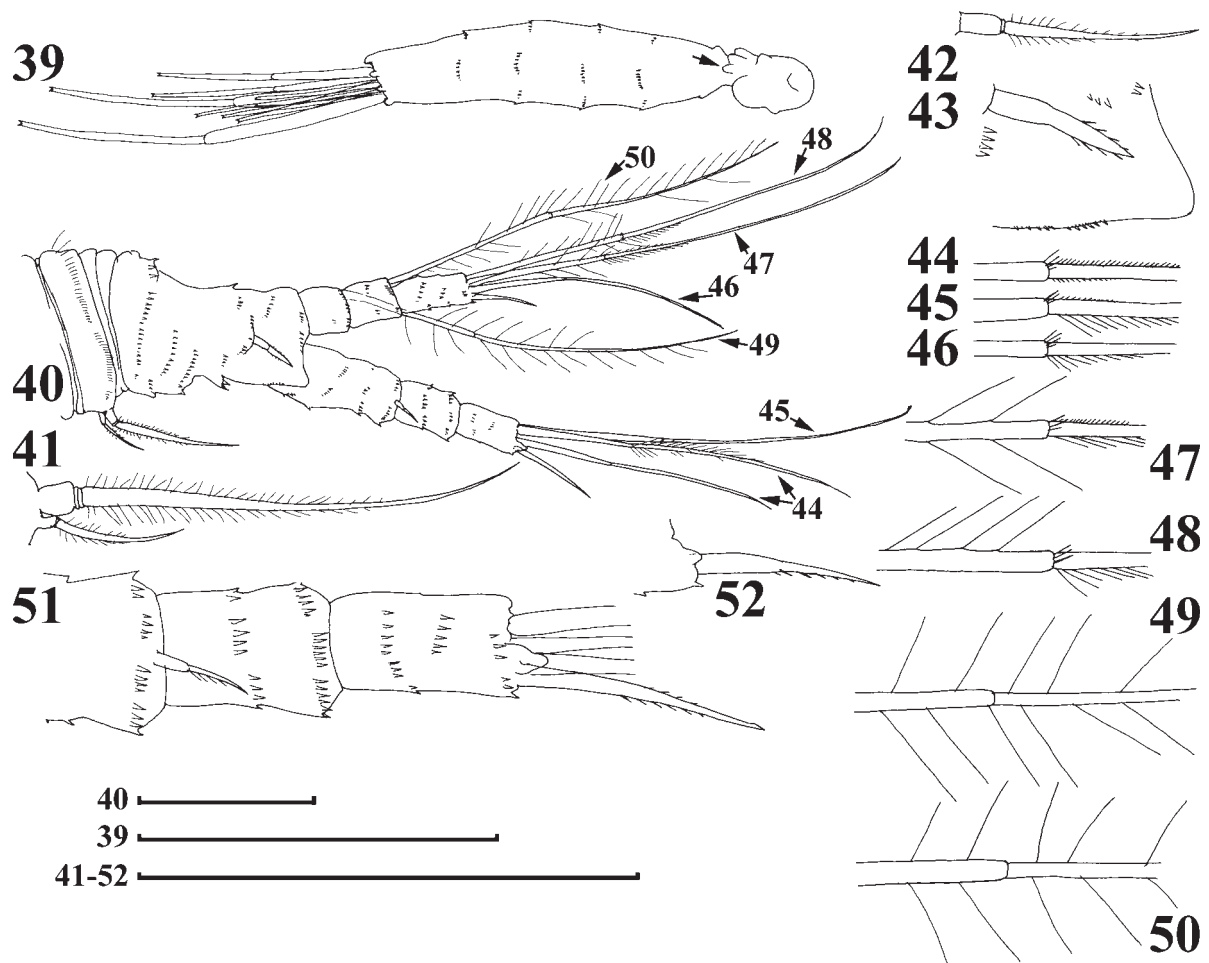
ETYMOLOGY. The epitheton refers to the continent from which the species was first found, Africa.

DIFFERENTIAL DIAGNOSIS. Only two other species with a subdistal anus were known from the southern hemisphere: *I. brevidentatus* Ekman, 1905 from Subantarctic Islands and southernmost portion of South America, and *I. smirnovi* Kotov & Timms, 1998 from Australia. Both are obviously related with *I. martensi* sp.n. and *I. africanus* sp.n. But, in contrast to the latter pair of species, the African pair has significantly longer antenna I, with distal segment



Figs 29–38. *Ilyocryptus africanus* sp.n., parthenogenetic ♀ from Sirkels Vlei near Cape Point, Republic of South Africa, collected in 09.i.1957 by A. D. Harrison & B. R. Allanson (29–34, 36–38) and collected in 1981 by A. J. C. Gardiner (35): 29 — lateral view; 30 — head in lateral view; 31 — setae at anterior portion of valve; 32, 33 — setae at ventral and posterior margin of valve; 34, 35 — postabdomen; 36 — anus, internal view; 37 — preanal margin; 38 — postabdominal claw. Scale 100  $\mu$ m.

Рис. 29–38. *Ilyocryptus africanus* sp.n., партеногенетическая ♀ из Сиркелс Влей, около Кейп Понт, Южноафриканская Республика, Африка, собранная 09.01.1957 А. Д. Гаррисоном и Б. Р. Аллансоном (29–34, 36–38) и собранная А. Дж. Гардинером (35): 29 — вид сбоку; 30 — голова сбоку; 31 — щетинки в передней части вентрального края; 32, 33 — щетинки на брюшном и заднем крае створки; 34, 35 — постабдомен; 36 — анус; 37 — преанальный край; 38 — постабдоминальный коготок. Масштаб 100 мкм.



Figs 39–52. *Ilyocryptus africanus* sp.n., parthenogenetic ♀ from Sirkels Vlei, collected in 09.i.1957 by A. D. Harrison & B. R. Allanson: 39 — antenna I in anterior view; 40 — antenna II in anterior view; 41 — sensory setae on coxal part; 42, 43 — distal sensory seta and distal burrowing spine on basal segment; 44–48 — apical swimming setae; 49, 50 — basal and distal lateral setae; 51 — exopod; 52 — apical spine of endopod. Scale 100 µm.

Рис. 39–52. *Ilyocryptus africanus* sp.n., партеногенетическая ♀ из Сиркелс Влей, собранная 09.01.1957 А. Д. Гаррисоном и Б. Р. Аллансоном: 39 — антенна I, вид спереди; 40 — антенна II, вид спереди; 41 — чувствительная щетинка на коксе; 42, 43 — дистальная чувствительная щетинка и дистальный шип на базальном членике антенны II; 44–48 — апикальные плавательные щетинки; 49, 50 — базальная и дистальная латеральные щетинки; 51 — экзоподит; 52 — апикальный шип на эндоподите. Масштаб 100 мкм.

lacking of any denticles or spinules, and row of paired spines only reaching distalmost portion of postanal margin of the postabdomen. In addition, *I. smirnovi* has no finger-like projection on basal segment of antenna I. Differences between *I. martensi* sp.n. and *I. africanus* sp.n. are represented in Table 1.

Based on the following characters: subdistal anus, row of paired spines occupying distal portion of preanal margin of postabdomen, short antenna I, with distal segment armed with rows of denticles and concentric row of hillocks at its distal end, the new species seem to be closely related to Mexican *I. nevadensis* Cervantes-Martínez, Gutiérrez-Aguirre & Elías-Gutiérrez, 2000. But *I. africanus* sp.n. differs from the latter in having numerous spine-like setules on each seta at the valve posterior margin, long preanal teeth, longer antenna I and symmetrically armed distal segments of lateral swimming setae. *I. martensi* sp.n. is more similar to *I. nevadensis*, but the latter has all preanal teeth rudimentary

and clustered, no finger-like projection on basal segment of antenna I, no long setules on distal segments of lateral swimming setae, and relatively long setules on distal segment of the large seta, located on limb I near ejector hooks (see Cervantes-Martínez et al. [2000]).

DISTRIBUTION. *I. africanus* sp.n. is known only from the type locality. This is apparently a rare species.

## Discussion

*Ilyocryptus vitali* Chirkova, 1982 and *I. spinosus* Štifter, 1988, the species with incomplete moulting and a subdistal anus from the Northern Hemisphere, are relatively rare and found only in northern portion of Europe [Chirkova, 1984; Štifter, 1988]. Both are unknown from Asia. Kotov et al. [2002b] found *I. cf. spinosus* in British Columbia, Canada, but a conclu-



Table 1. Morphological differences between *I. martensi* sp.n. and *I. africanus* sp.n.  
Таблица 1. Морфологические различия между *I. martensi* sp.n. и *I. africanus* sp.n.

Character	<i>I. martensi</i> sp.n.	<i>I. africanus</i> sp.n.
A single, robust spine on base of seta at posterior margin	+	-
Number of preanal teeth (including clusters of small teeth)	16-21	14-16
Teeth on basal portion of preanal portion of postabdomen long	-	+
Distal 1/3-1/2 of preanal portion occupied with clusters of small teeth	+	-
Number of large paired spines	9-13	7-9
Both paired spines and lateral setae short	+	-
Numerous setules on internal wall of anus	-	+
Basalmost spine on base of postabdominal claw markedly longer than distalmost one	-	+
Antenna I diameter/length	0.25-0.26	0.20-0.22
Antenna I with numerous and relatively large denticles	+	-
Distal sensory seta on basal segment of antenna II long	+	-
Apical swimming setae of endopod setulated in different styles	-	+
Lateral swimming setae armed asymmetrically	+	-

sion of its conspecificity with true (European) *I. spinosus* will be possible only after a detailed redescription of the latter. The third congener from Northern Hemisphere, *I. nevadensis*, is found only in a single crater, and may be a micro-endemic. All species with incomplete moulting and a subdistal anus from the Southern Hemisphere are also endemics, or highly restricted in their distributions. It seems to us that all these species are remainders of a large group, which had a very wide, if not cosmopolitan, distribution in the past (in the Lower Mesozoic?).

It is a remarkable fact that mountain regions are localities with endemic ilyocryptids, such as *I. nevadensis*, *I. martensi* sp.n., or *I. denticulatus* Delachaux, 1919. We think that further investigations of mountain faunas, especially in South America, Africa and Asia, will result in the finding of other species new to science.

Ilyocryptids are quite common animals in large water bodies of all continents, including large lakes located in high altitudes [Harding, 1955; Smirnov, 1976]. The present article deals with the first description of *Ilyocryptus* from rockpools. Different (and sometimes very specific) anomopods were found in granite pools from different continents [Ranta, 1982; Frey, 1993; Smirnov & Bayly, 1995], but no ilyocryptids have been recorded previously from rockpools. Perhaps, *I. martensi* sp.n. is a specialised inhabitant of this type of water body, and, due to the rare sampling of rockpools it was not found previously.

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## References

- Cervantes-Martínez A., Gutiérrez-Aguirre M., Elías-Gutiérrez M. 2000. Description of *Ilyocryptus nevadensis* (Branchiopoda, Anomopoda), a new species from a high altitude crater lake in the volcano Nevado de Toluca, Mexico // *Crustaceana*. Vol.73. P.311–321.
- Chirkova Z.N. 1984. [Palearctic species of *Ilyocryptus* (Cladocera, Macrothricidae)]. Apatity: Publ. Murmansk Marine Biol. Inst. 105 pp. [in Russian].
- Frey D.G. 1991. The species of *Pleuroxus* and of three related genera (Anomopoda, Chydoridae) in Southern Australia and New Zealand // *Rec. Austral. Mus.* Vol.43. P.291–372.
- Harding J.P. 1955. Percy Sladen Trust expedition. XIX. Crustacea: Cladocera // *Trans. Linn. Soc. London*. Vol.1. No.3. P.329–354.
- Harding J.P. 1961. Some South African Cladocera collected by Dr. A. D. Harrison // *Ann. South Afr. Mus.* Vol.46. No.3. P.35–46.
- Kotov A.A. 2000. Redescription of *Ilyocryptus tuberculatus* Brehm, 1913 (Anomopoda, Branchiopoda) // *Hydrobiologia*. Vol.428. P.115–128.
- Kotov A.A. 2001. Analysis of some nominal species of *sordidus*-like *Ilyocryptus* (Anomopoda, Branchiopoda) // *Arthropoda Selecta*. Vol.10. No.3. P.185–194.
- Kotov A.A., Dumont H.J. 2000. Analysis of the *Ilyocryptus spinifer* s. lat. species group (Anomopoda, Branchiopoda), with description of a new species // *Hydrobiologia*. Vol.428. P.85–113.
- Kotov A.A., Dumont H.J., Vandamme K. 2002a. Redescription of *Ilyocryptus sarsi* Stingelin, 1913 // *Hydrobiologia*. Vol.472. P.207–222.

- Kotov A.A., Elías-Gutiérrez M., Williams J.L. 2002b. A preliminary revision of *sordidus*-like species of *Ilyocryptus* Sars, 1862 (Anomopoda, Branchiopoda) in North America, with description of *I. benerae* n. sp. // *Hydrobiologia*. Vol.472. P.141–176.
- Kotov A.A., Sanoamuang L. 2004. *Ilyocryptus thailandensis* sp. nov. (Cladocera: Anomopoda: Ilyocryptidae) from North Thailand // *Internat. Rev. Hydrobiol.* Vol.89. P.206–214.
- Kotov A.A., Tanaka S. 2004. *Ilyocryptus uenoi* sp. nov. (Anomopoda, Cladocera, Branchiopoda) from Japan // *Hydrobiologia*. Vol.518. P.111–121.
- Paggi J.C. 1992. A new species of *Ilyocryptus* (Anomopoda: Macrothricidae) from Argentina // *Hydrobiologia*. Vol.231. P.141–151.
- Ranta E. 1982. Animal communities in rock pools // *Ann. Zool. Fenn.* Vol.19. P.337–347.
- Smirnov N.N. 1976. [Macrothricidae and Moinidae of the World fauna] // *Fauna SSSR, n. ser., Rakoobraznye T.I. №3*, Leningrad: "Nauka" Publ. 237 p. [in Russian].
- Smirnov N.N., Bayly I.A.E. 1995. New records and further description of *Macrothrix hardingi* Petkovski (Cladocera) from granite pools in Western Australia // *J. Roy. Soc. West. Austr.* Vol.78. P.13–14.
- Štifter P. 1988. Two new species of the genus *Ilyocryptus* (Cladocera, Crustacea) confused with *I. sordidus* Liévin // *Věst. česk. Společ. Zool.* Vol.52. P.290–301.
- Štifter P. 1991. A review of the genus *Ilyocryptus* (Crustacea: Anomopoda) from Europe // *Hydrobiologia*. Vol. 225. P.1–8.