

A revision of the cladoceran genus *Simocephalus* (Crustacea, Daphniidae)

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SYNOPSIS. *Simocephalus*, a world-wide genus of littoral freshwater Daphniidae is reviewed in full for the first time. Four subgenera are recognized, one subgenus and two species are newly described. Eight species and subspecies are synonymized, a number of previously synonymized species are reinstated and two species are transferred to the genus *Daphnia*. Thus, twenty species are considered as valid members of the genus *Simocephalus*: subgenus *Simocephalus* s. str.: *S. vetulus*, *S. elizabethae*, *S. gibbosus*, *S. vetuloides*, *S. mixtus* and *S. punctatus* sp. nov.; subgenus *S. (Coronocephalus)*: *S. serrulatus*, *S. semiserratus* and *S. mirabilis* sp. nov.; subgenus *S. (Aquipiculus)*: *S. latirostris*, *S. lusaticus* and *S. heilongjiangensis*; new subgenus *S. (Echinocaudus)*: *S. exspinosus*, *S. congener*, *S. acutirostratus*, *S. obtusatus*, *S. daphnoides*, *S. rostratus*, *S. brehmi*, *S. victoriensis*. For each species, accounts are given of nomenclature, distribution and morphology (with original figures). A key for identification of subgenera and species is provided.

INTRODUCTION

Freshwater Daphniidae of the genus *Simocephalus* Schödler, 1858 are common in littoral aquatic vegetation all over the world. These 'tailless water fleas' have been known since the middle of the 18th century (Schaeffer, 1755), but their taxonomy remains unsettled, with 61 specific and subspecific names proposed. Morphological variability is poorly known. This makes the taxonomic status of certain forms doubtful, since they may not represent taxa, but merely morphological varieties. The descriptions of numerous species are inadequate. Furthermore, some species which are supposed

to be cosmopolitan, pantropical *etc.* are in fact groups of closely related species, with restricted distributions. Obviously, a world-wide revision of *Simocephalus* is necessary. Such an attempt is made here.

The genus *Simocephalus* has been divided into four species groups: *S. (vetulus)*, *S. (exspinosus)*, *S. (serrulatus)* and *S. (latirostris)* (Orlova-Bienkowskaja, 1993a). The diagnostic characters of the groups are stable and well-expressed in all representatives. Intermediate forms are absent. Furthermore, different characters are congruent, that is, they combine species into the same groups. Thus the species groups are given the rank of subgenera.

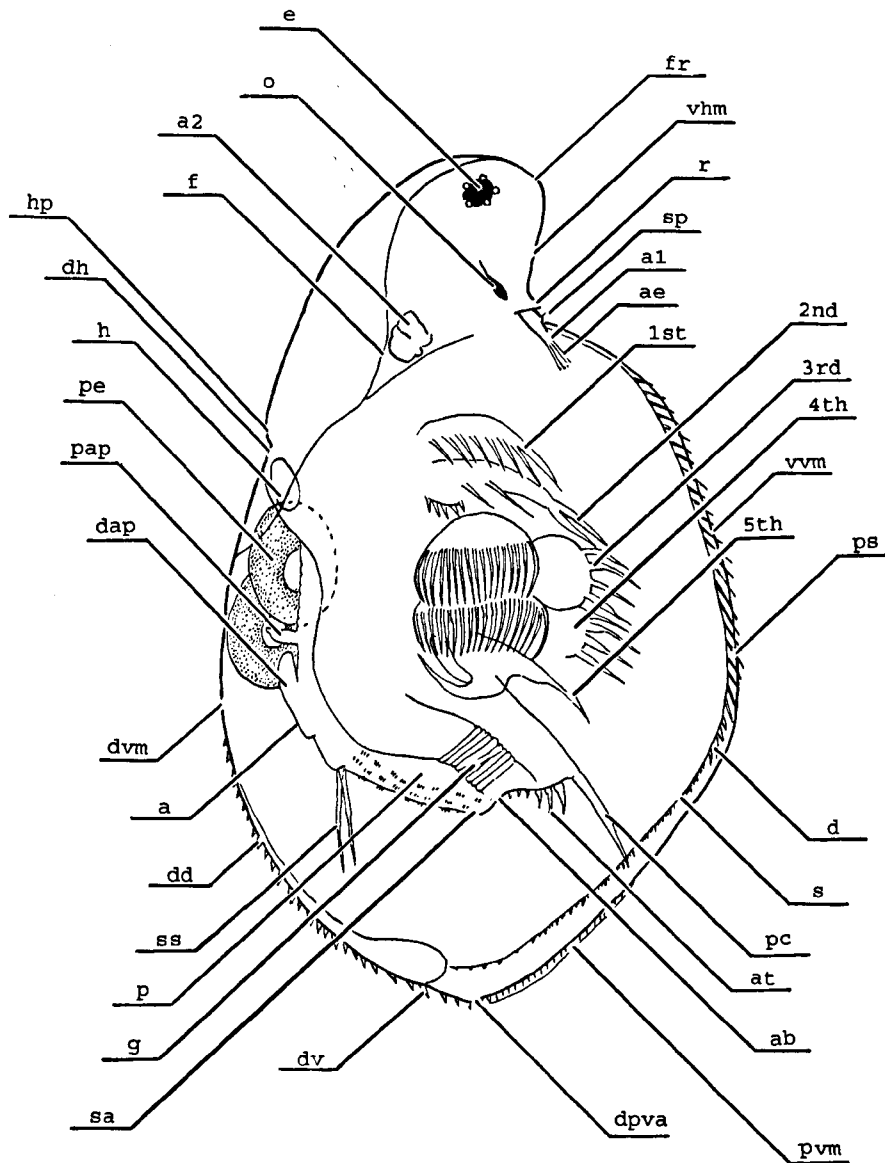


Fig. 1 Morphology of *Simocephalus*. a – abdomen, ab – anal bay, ae – aesthetes, at – anal teeth, a1 – antennule, a2 – base of antenna (antenna is not shown), d – denticles of inner surface of ventro-posterior valve angle, dap – distal abdominal process, dd – denticles of dorsal valve margin, dh – depression of head shield between head and valves, dpva – dorso-posterior valve angle, dv – point of divergence of valves, dvm – dorsal valve margin, e – eye, f – fornices, fr – frons, g – gut, h – heart, hp – the place of head pores, o – ocellus, p – postabdomen, pap – proximal abdominal process, pc – postabdominal claw, pe – parthenogenetic eggs, ps – plumose setae of inner surface of ventral valve margin, pvm – posterior valve margin, r – rostrum, s – setules of inner surface of posterior valve margin, sa – supra-anal angle, sp – sensory papilla of antennule, ss – sensory setae, vhm – ventral head margin, vvm – ventral valve margin, 1st – 1st trunk limb, 2nd – 2nd trunk limb, 3rd – 3rd trunk limb, 4th – 4th trunk limb, 5th – 5th trunk limb.

MATERIALS AND METHODS

About ten thousand specimens from more than three hundred localities all over the world have been studied. Females of all species except *S. lusaticus*, males of nine species, and museum types of fifteen taxa have been examined. Material examined is in the following collections and institutions: AC – author's collection deposited in Zoological Museum of Moscow State University, AM – Australian Museum, Sydney, Australia, BMNH – The Natural History Museum, London, Great Britain, MCA – Museum of Central Africa, Tervuren, Belgium, MNO – Museum of Nature, Olten, Switzerland, MV – Museum of Victoria, Australia, SAM – South Australian Museum, Adelaide, Australia, ZI – Zoological Institute of the Russian Academy of Sciences, St.-Petersburg, Russia, ZICC – Cladocera collection of ZI, ZICW – G.Ju. Werestchagin's collection in ZI, ZIPD – plankton depository of ZI, ZMC – Zoological Museum of Copenhagen, Denmark, ZMO – Zoological Museum of Oslo University, Norway, ZMU – Zoological Museum of Uppsala University, Sweden.

Original figures are made with the aid of a camera lucida. Keys and diagnoses are based on adult specimens. The following additional abbreviations are used: CBS – canadian balsam slide, MPA – material preserved in alcohol, PSEM – preparation for scanning electron microscopy, PVAS – polyvinyl alcohol slide, ♀ ad. – adult parthenogenetic female, ♀ juv. – juvenile parthenogenetic female, ♀ e. – ephippial female. Morphological terms used below are shown on Fig. 1.

In some cases I use a cluster analysis and diagrams of characters for differentiation between closely related species. Four metric characters are used (Fig. 2): W/L – ratio between width of dorso-posterior valve prominence and body length, M/L – ratio between length of dorso-posterior valve prominence and body length, G/L – ratio between height of dorsal valve margin and body length, D/L – ratio between diameter of dorso-posterior valve prominence and body length. Body length (L) was measured with an ocular micrometer. Other measurements were made by drawing the body outline of each specimen with the aid of the camera lucida and measuring the details with an ordinary rule.

Statistical analysis employed the computer system 'Statgraphics'. Two-dimensional diagrams of characters are used for the detection of morphological hiatus between closely related species. Each specimen of each series is represented as a point on a coordinate plane. Coordinates of the point are equal to measurements of the specimen. Each series or group of series is represented with the polygon including the points corresponding to all specimens. If the polygons of two series/ groups of series do not overlap, there is a

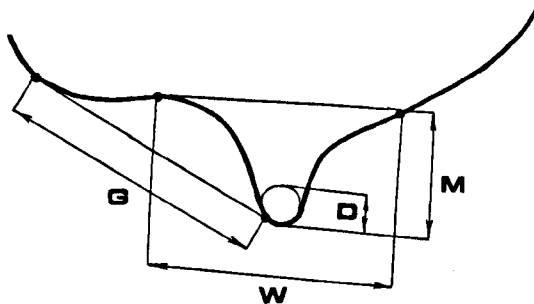


Fig. 2 Measurements of valves. G – height of dorsal valve margin, W – width of dorso-posterior valve angle, D – diameter of dorso-posterior valve angle, M – length of dorso-posterior valve angle.

morphological hiatus between them. I also use four-dimensional cluster analysis (average method) to determine which series are close to each other. Diagrams of characters and cluster analysis are independent of each other, because the former operates only with extreme values, the latter only with average values of characters. Therefore, if both methods give the same result, it is reliable.

MORPHOLOGY

Female

Valves

Maximum height of valves posterior to the middle. (Figs 1; 3B,C). Posterior margin (Fig. 1:pvm) oblique, almost straight. Point of divergence of valves (Fig. 1:dv) dorsal to dorso-posterior angle (Fig. 1:dpva). Dorsal, posterior and ventral margins with denticles or smooth. Denticles arranged in 2 rows on dorsal margin (Fig. 1:dd). Inner valve surface with a row of plumose setae on ventral margin (Fig. 1:ps), a row of setules groups on posterior margin (Fig. 1:s) and 2–5 plumose denticles near ventro-posterior angle (Fig. 1:d). Parthenogenetic female with 1–30 eggs in brood pouch. Ephippium containing 1 egg (Fig. 3C).

Reticulation

Valves and head reticulated. Reticulation consists of oblique stripes somewhat intersecting in most of carapace and head and of polygons along valve margin and in front of eye.

Head

Comparatively small, noticeably delimited by depression on dorsal side (Fig. 1:dh). Rostrum always pointed, long or moderate. Frons (Fig. 1:fr) rounded, pointed or right-angled, with denticles or devoid of them. Ventral head margin (Fig. 1:vhm) with depression, deep or shallow, near rostrum. Fornices very broad (Figs 4; 5; 1:f). Posterior part of head with 3 main connected head pores, transversally orientated (Fig. 5, HP) and 2 minute lateral head pores seen only with scanning electron microscope, or without head pores. Eye and ocellus always present.

Appendages

Antennule tubular (Figs 6C), having 9 aesthetes at end and 1 sensory papilla proximally. Mandibles, maxillule and labrum as shown in Figs 4, 6. Antenna (Fig. 7) comparatively short, ends of distal segments reach only middle of valves. Proximal part of basipod with 2 setae (Fig. 7E), outer side of distal part with a seta (Fig. 7D), inner side of distal part with a spine (Fig. 7C). Contrary to the opinion of Manujlova (1964), the length of the distal seta does not differ in different species. Exopod of antenna of 4; endopod of 3 cylindrical segments. Second segment of exopod with a short spine, third with a seta, fourth with 3 setae, of which one shorter than others and curved (Fig. 7B). First and second endopod segment each with 1 seta, third segment with 3 setae. Contrary to the opinion of Behning (1912) and Manujlova (1964) number of setae on each trunk limb does not differ in different species. Interspecific differences concern only the length of certain setae. The structure of trunk limbs (Figs 6; 8–11) has been described in detail (Orlova-Bienkowskaja, 1993b).

Postabdomen (Figs 1:p; 12A,B)

High, with anal bay (Fig. 1:ab), supra-anal angle (Fig. 1:sa) and 2 rows of anal teeth (Fig. 1:at). Distal anal teeth large, covered with setules. Proximal teeth small, smooth. Dorsal part with groups of

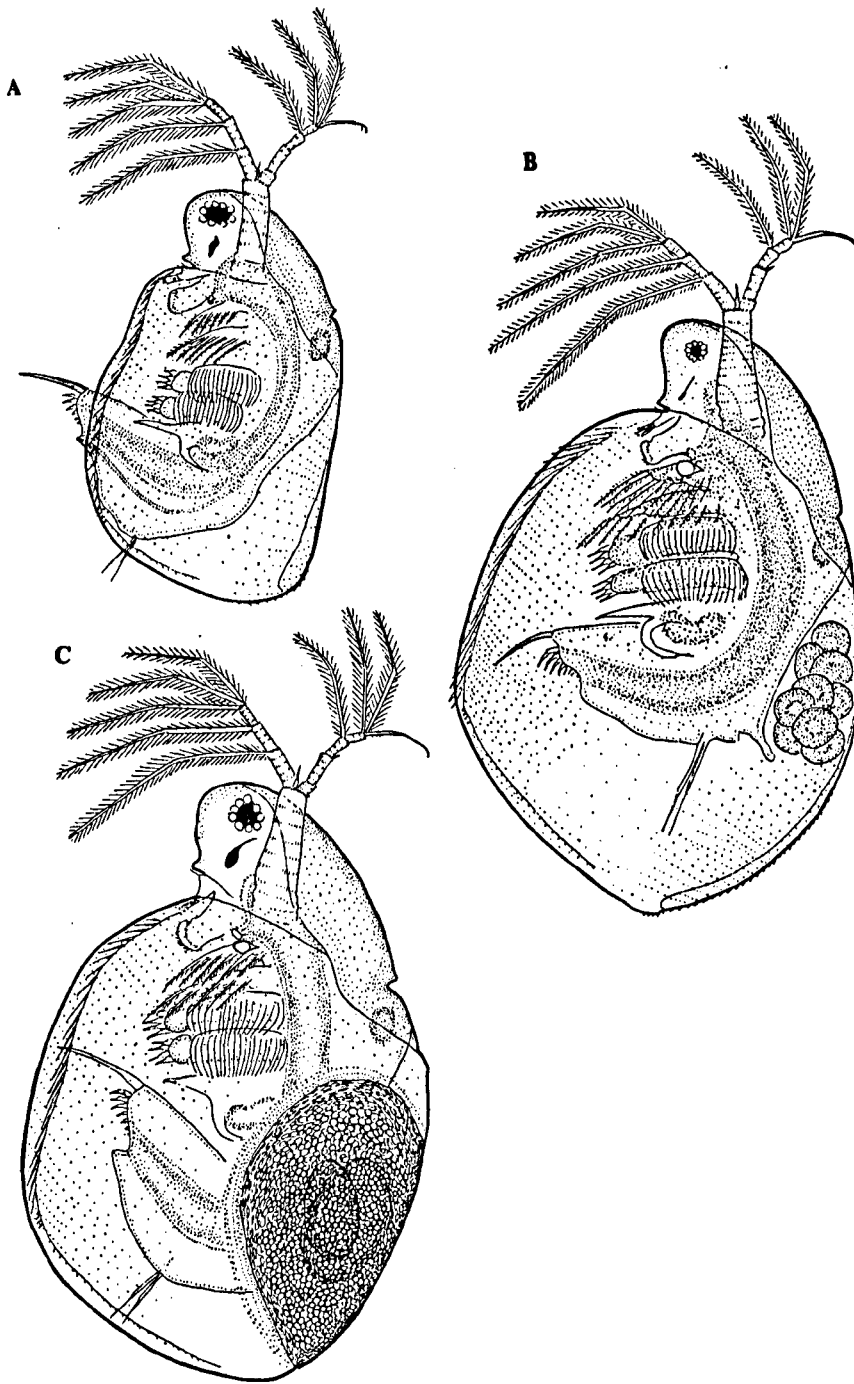


Fig. 3 *S. vetulus*. A, male, B, parthenogenetic female attached to a surface, C, ehippial female.

setules. Postabdominal claws long (Fig. 1:pc), slightly curved, with 2 rows of setules and/or spines on concave side. Anus (Fig. 1:ab) in anal bay.

Abdomen with 2 processes (Fig. 1:pap,dap).

Male

Dorsal valve margin straight (Fig. 3A), ventral margin with an embayment anteriorly. Head pores larger, antennules shorter and

more distended than in female (Fig. 6B), with 2 sensory papillae proximally. First and second trunk limbs (Figs 8B,C; 13) differ from corresponding limbs of female in several details (Orlova-Bienkowskaja, 1993b) (Figs 8A and C). Postabdomen narrower than in female (Fig. 14A). Vas deferens opening on supra-anal angle (Fig. 14B,C) or distally. Fewer anal teeth than in female.

Abdominal processes absent.

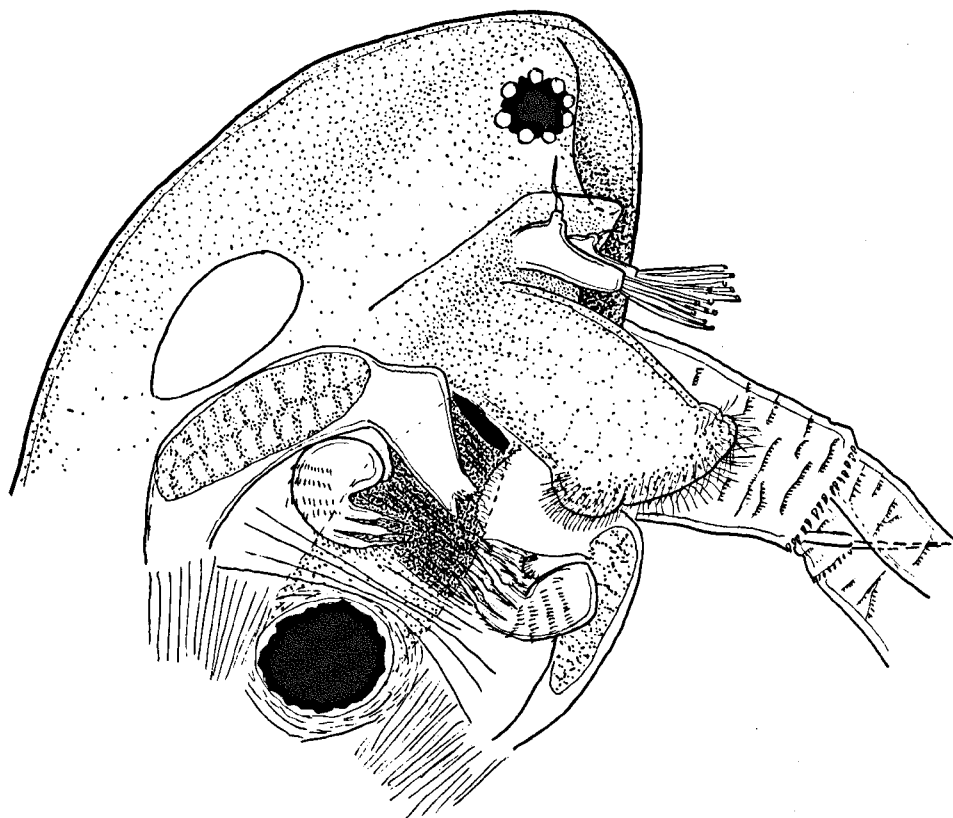


Fig. 4 *S. vetulus* head and mouth parts.

VARIABILITY

Age variability is similar in all species (Fig. 15). New-born females do not differ much from males: The brood pouch is small and the dorsal valve margin almost straight. The prominence on the dorso-posterior valve angle, if it present, is not distinct. Carapace denticles are small and cover less of the valves than in adults. Older females have a more distinct and sharp dorso-posterior valve prominence. The shape of the brood pouch in the adult depends on the number of eggs. The head grows slower than the carapace. Valve shape in new-born males differs from that of adults only in the absence of an embayment in the proximal part of the ventral margin. The number of anal teeth correlates with size in females. The ocellus in juveniles is shorter than in adults. The postabdomen of neonates of both sexes lacks an anal bay, supra-anal angle (Figs 12C; 15C), abdominal processes. The fourth endite prominence of the first limb has a large hook bearing a denticle at its end in the adult male (Fig. 8B) and small hook lacking a denticle in the juvenile (Fig. 8D). The curved setae of the second, third and fourth endite prominences of the second limb are short in juvenile males and longer than the base of the plumose seta of the first prominence in adults (Fig. 13B–D). The morphology of third, fourth and fifth trunk limbs in males and all trunk limbs in females does not depend on age.

Eye and ocellus size are subject to seasonal variation. This was discovered in the following way: two series of *S. vetulus* were collected in the same water-body in the Moscow region on 12. 5. 1990 and 5. 11. 1990. All specimens from the first sample had a

small eye and ocellus (Fig. 16A) and all those from the second (parthenogenetic and ephippial females and males) a large one (Fig. 16B). Individuals from the sample of 5. 11. 1990 were kept at room temperature. By the 17th day the size of the eye and ocellus in all cases had become small (Fig. 16C). A similar result was obtained for *S. serrulatus*.

Ocellus size is also affected by illumination intensity. It decreases in darkness (Jermakov, 1924) and if the ventral part of the head is covered by epibionts (personal observation) (Fig. 16D). Ocellus shape varies within populations. In females of *Simocephalus* s. str. it is straight or curved, widened in the middle or bifurcated at the end. In males of these species and in both sexes in species of other subgenera it is round or rhomb-like. The frons in *S. (Coronocephalus)* bears a variable number of denticles. Individuals with and without a prominence at the ventral head margin occur in all species except *S. gibbosus*, *S. elizabethae* and *S. obtusatus*. A dorsal embayment between carapace and head is more or less developed in all species. Sometimes, there is a small prominence on the head near this embayment (Fig. 16F).

There are pigmented spots in the valve tissue. Their shape and colour differ within populations. The colour is green, brown or orange and as a rule correlates with the colour of the gut contents. According to Green (1966) carotenoid pigmentation depends on the food composition.

The number of denticles at the ventro-posterior angle of the valves varies from two to six. No correlation between number of denticles and size was observed. There is some variability in shape of the postabdomen and abdominal processes (Fig. 17).

SYSTEMATIC ACCOUNTS

Subgenus *Simocephalus* s. str.

TYPE SPECIES. *Simocephalus vetulus* (O.F. Müller, 1776)

DIAGNOSIS. Both sexes. Frons rounded, without denticles (Fig. 18). Head shield without depression. Head pores present (Fig. 5). Insertion of antennules at base of rostrum. Antennule short in correspondence with short rostrum, with neither ridges nor denticles on inner side (Fig. 6B,C). Aesthetes longer than base of antennule. Postabdominal claws without spines (Fig. 12D,E). Inner and outer side of claw with fine setules. Anal bay of postabdomen narrow, rounded, with anal teeth (Fig. 12A).

Female. Dorso-posterior valve angle rounded or with rounded prominence. Valves without dorsal keel. Posterior corner of ephippium without protuberance (Fig. 3C). Ocellus elongate (exception: *S. punctatus*). Setae of 2nd and 3rd endite prominence of 2nd trunk limb as long as 0.3 and 0.2 of basal segment of plumose seta of 1st prominence respectively (Fig. 9B). Postabdomen with 10–15 anal teeth on each side. Supra-anal angle rounded (Fig. 12A). Male. Supra-anal angle pointed (Fig. 14). Vas deferens opening there. Postabdomen with 5–8 anal teeth on each side. Dorso-posterior valve angle rounded or with small rounded prominence (Fig. 3A). Males of the following species have been examined: *S. vetulus*, *S. mixtus*, *S. vetuloides*, *S. punctatus*, *S. elizabethae*. They do not differ from each other, so only females are described.

REMARKS. Fig. 19A gives the cluster analysis of sixteen series (each consisting of twenty specimens) from sixteen European

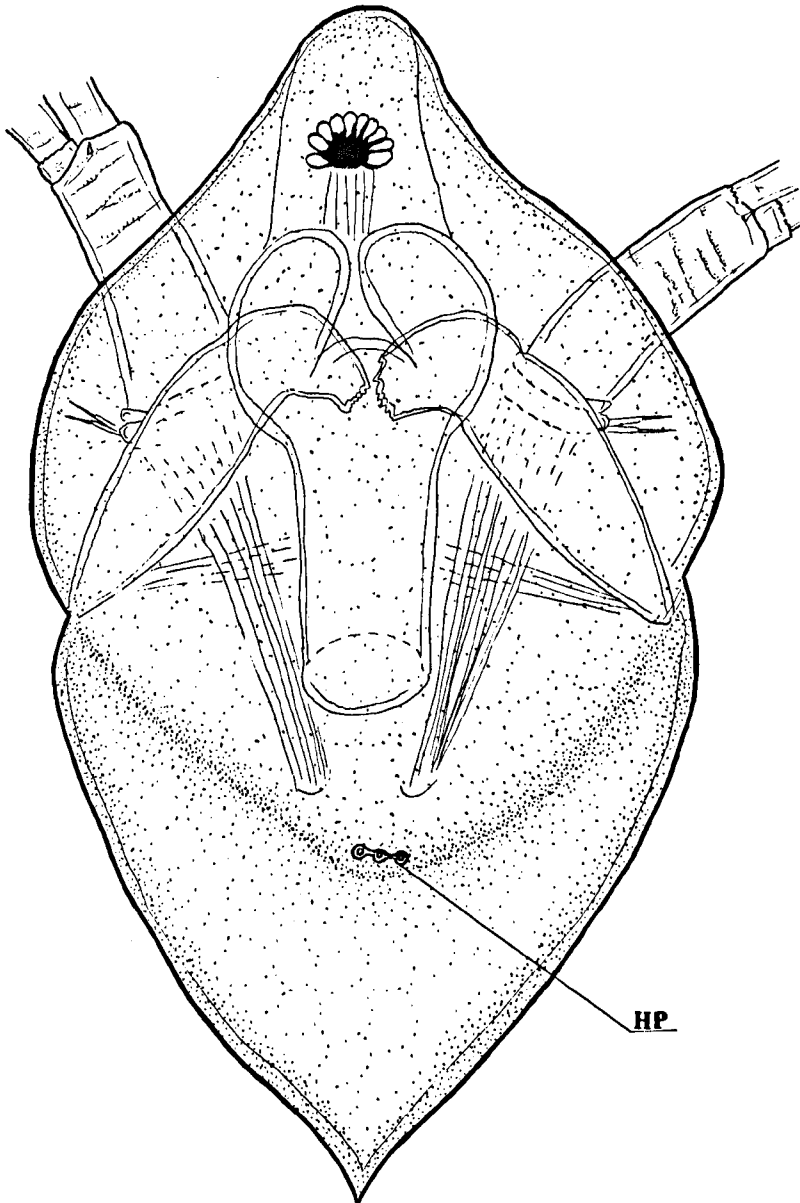


Fig. 5 *S. vetulus*. Head shield. HP – head pores.

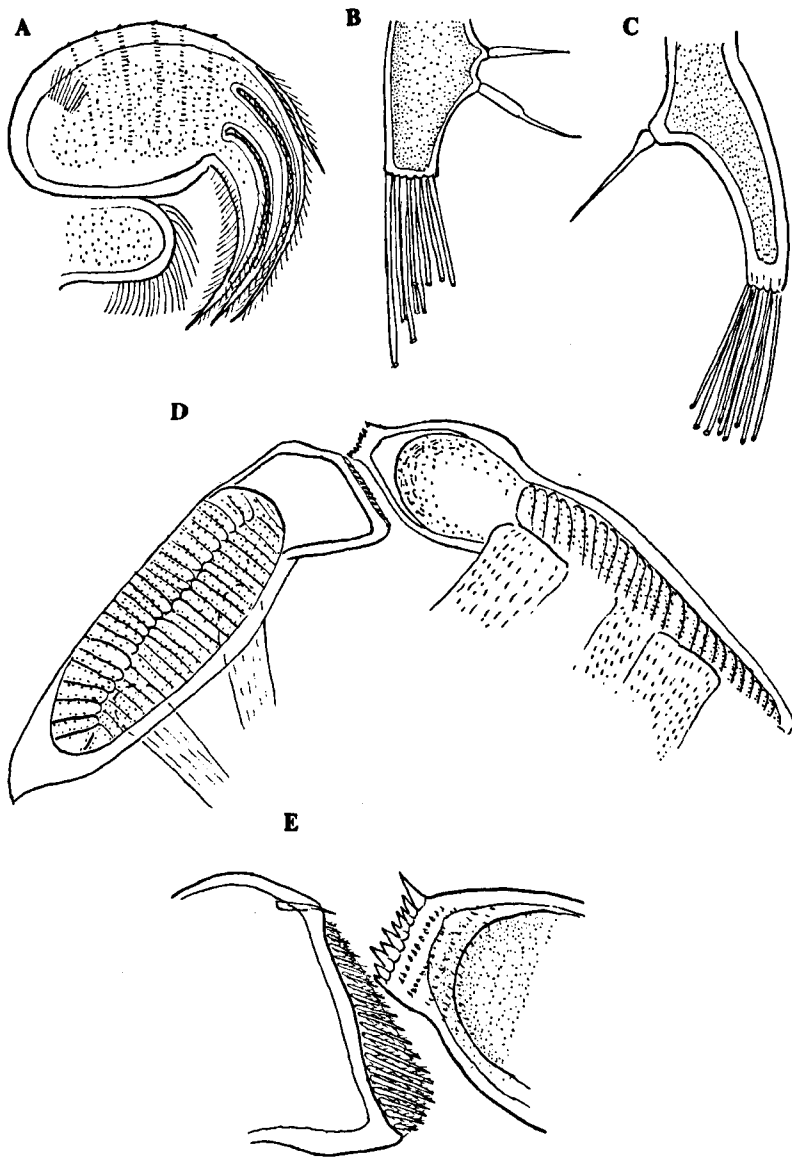


Fig. 6 *S. vetulus*. A, maxillule, B, antennule of male, C, antennule of female, D, mandibles, E, molar region of mandibles.

populations of *Simocephalus* s. str. The dendrogram consists of 2 large clusters. The first of them combines the populations 1–13 (thin line), and the second combines 14–16 (thick line). This means that the similarity within both clusters is stronger than between them. In other words, we can presume that populations 1–13 and 14–16 belong to two separate species. The diagrams of characters provide support for this presumption (Fig. 19B,C). The areas occupied by populations 1–13 (thin line) and by populations 14–16 (thick line) on the diagram only overlap to a minor extent at one point. Therefore, there is a morphological hiatus between these groups. Examination of the types shows that one of these species is *S. vetulus* (1–13); the other is *S. mixtus* (14–16).

Similar reasoning shows that 2 species of *Simocephalus* s. str.: *S. mixtus* and *S. vetuloides* occur in Eastern Siberia (Fig. 20). There appear to be 3 species in Eurasia: *S. vetulus* in Europe, *S. vetuloides* in Eastern Siberia and *S. mixtus* in all regions of Asia and in Eastern Europe. The latter species is rather variable.

All measured African specimens (9 series) belong to *S. mixtus*. I

have also one series of *S. vetulus* from Morocco, but these specimens are in poor condition and it is impossible to measure them.

S. vetulus (O.F. Müller, 1776)

Figs 3–18

Daphne vetula O.F. Müller, 1776: 199; *Daphnia sima* O.F. Müller, 1785: 91; *Monoculus nasutus* Jurine, 1820: 133; *Monoculus sima*: Jurine, 1820: 129; *Simocephalus vetulus*: Schödler, 1858: 18; *S. vetulus* var. *angustifrons* Lilljeborg, 1900: 171; *S. vetulus* var. *brandtii* Cosmovici, 1900: 156 syn. nov. (nec *Daphnia brandtii* Fischer, 1848); *S. vetulus angustifrons*: Behning, 1941: 181; *S. vetulus gebhardti* Ponyi, 1955: 313; *S. mixtus hungaricus* Ponyi, 1956: 57.

TYPE MATERIAL. The types appear to be lost. *S. vetulus* is often confused with closely related species, so the designation of a neotype is necessary. Neotype (designated here): Denmark, Zealand, vicinity of Copenhagen. Dyrehaven, 55°46'N, 12°34'E, 11. 5. 1901: MPA: ♀ ad. (ZMC, CRU-319).

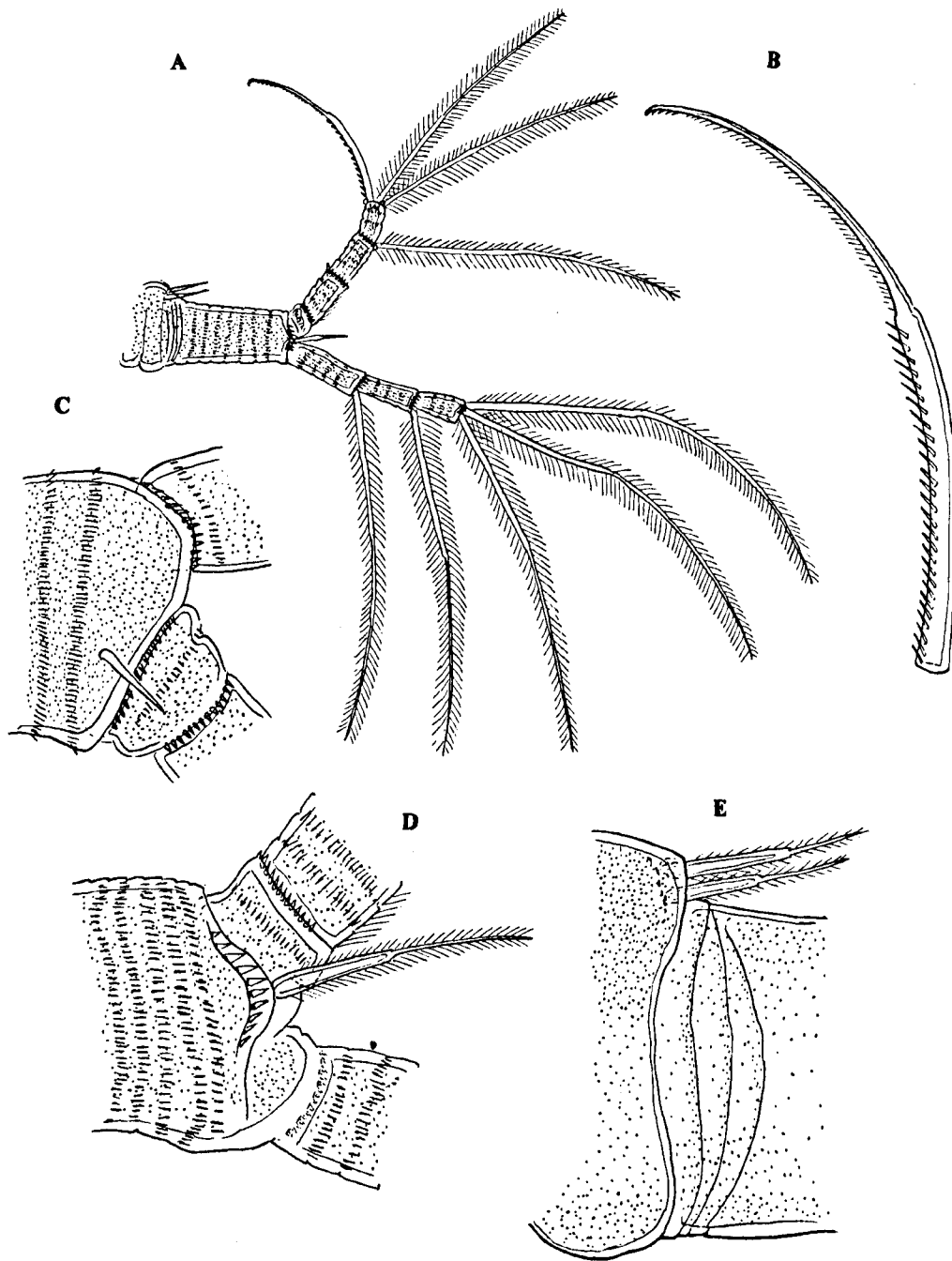


Fig. 7 *S. vetulus*, antenna. A, general view, B, curved seta of exopod distal segment, C, inner side of basipod, distal part, D, outer side of basipod, distal part, E, basipod proximal part.

MATERIAL EXAMINED. Neotype. Type material of junior synonyms: *S. vetulus angustifrons* Lilljeborg, 1900: Lectotype (designated here): Sweden, Uppsala, 9. 10. 1882, leg. Lilljeborg: MPA: ♀ ad. (ZMU, 399). Paralectotypes collected with lectotype: MPA: 13 ♀ ad., 33 ♀ juv., 7 ♀ e., 5 ♂ (ZMU, 399). Other specimens: More than 2000 specimens (♀ ad., ♀ juv., ♀ e., ♂) from 30 localities (Fig. 21) in Denmark, Greenland, Poland, Bulgaria, European Russia, Ukraine, Georgia, Morocco, deposited in AC, ZMC, ZICW. Some specimens are selected from the samples from ZIPD.

DIAGNOSIS. Measurements. ♀ ad.: 1.3–2.9mm., ♀ e.: 1.2–1.9mm, ♂: 1.1–1.3mm.

Female. Dorso-posterior valve prominence short, with narrow base and large diameter (Fig. 18). Its diameter greatly exceeds its length (Fig. 2). Dorsal valve margin low, not protruding backward. Depressions above and below dorso-posterior prominence small and shallow. Ventral head margin straight or slightly concave, sometimes with small prominence. Deep depression on ventral head margin near rostrum. Ocellus elongate.

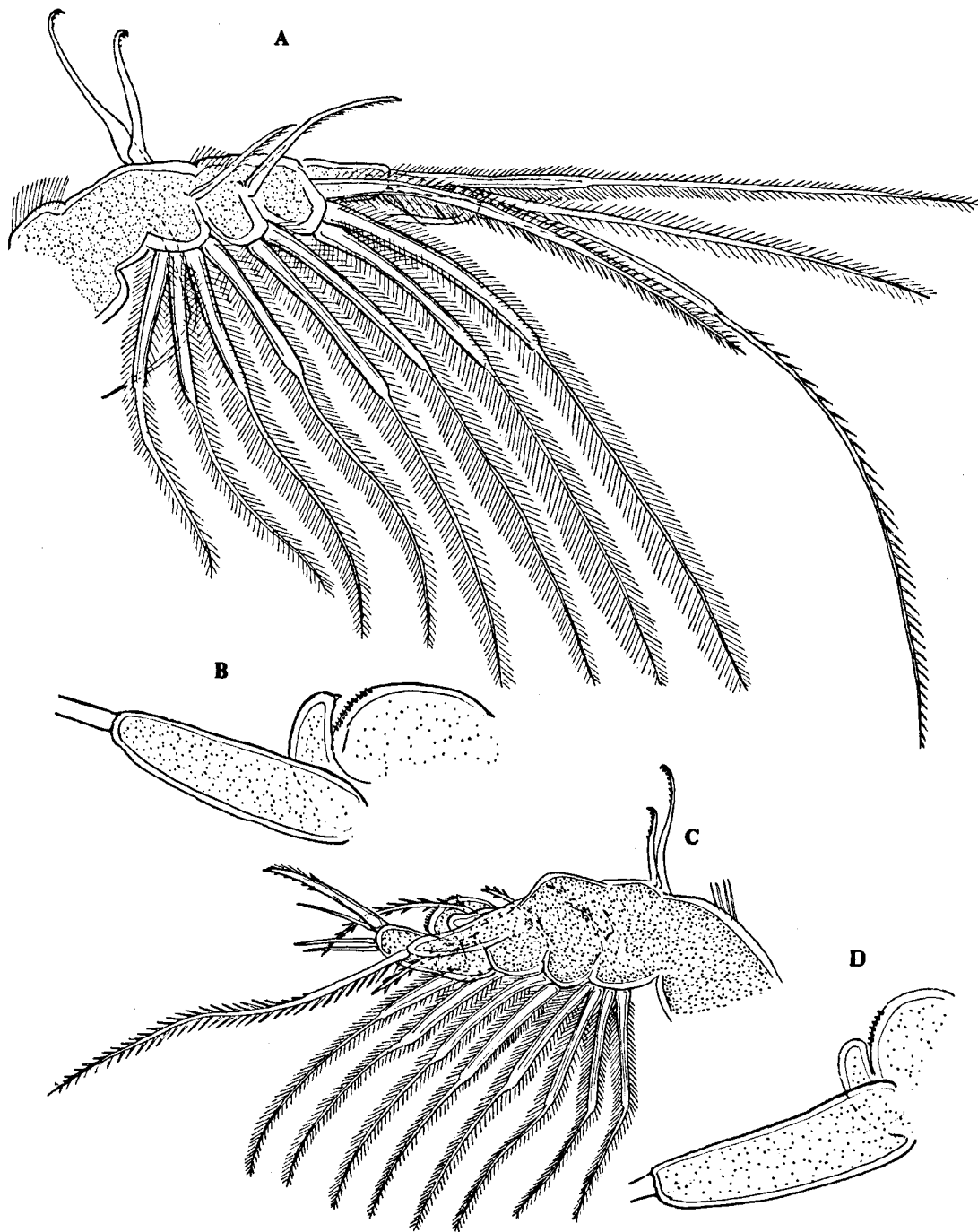


Fig. 8 *S. vetulus*. A, 1st limb of female, B, hook of endopod of 1st limb of adult male, C, 1st limb of male, D, hook of endopod of 1st limb of juvenile male.

DISTRIBUTION. (Fig. 21) Europe, North Africa. This species was previously assumed to be cosmopolitan (Manujlova, 1964). But the investigation of specimens from different regions shows, that *S. vetulus* occurs in Europe and North Africa only. In other regions it is replaced by closely related species: *S. mixtus*, *S. venuloides*, *S. gibbosus*, *S. elizabethae* and *S. punctatus*.

REMARKS. The original description of *S. vetulus* is very short: 'Daphne Vetula cauda inflexa, testa mutica' (Müller, 1776). This is appropriate for any species of *Simocephalus*. Later, Müller (1785)

renamed this species *Daphnia sima*. The name 'vetulus' is not grammatically correct (Dumont, 1977). 'Vetula' means 'an old woman'. This is not an adjective, but a substantive. Its gender cannot alter. However, it is not necessary to change the name '*S. vetulus*', because it has come into common use.

Some authors in the 19th century (Lievin, 1848; Baird, 1850; Leydig, 1860) supposed *S. exspinosus* and *S. congener* to be synonyms of *S. vetulus*. According to recent data, *S. vetulus* differs very much from these species and even belongs to another subgenus.

According to Jurine (1820), *S. nasutus* (*Monoculus nasutus*

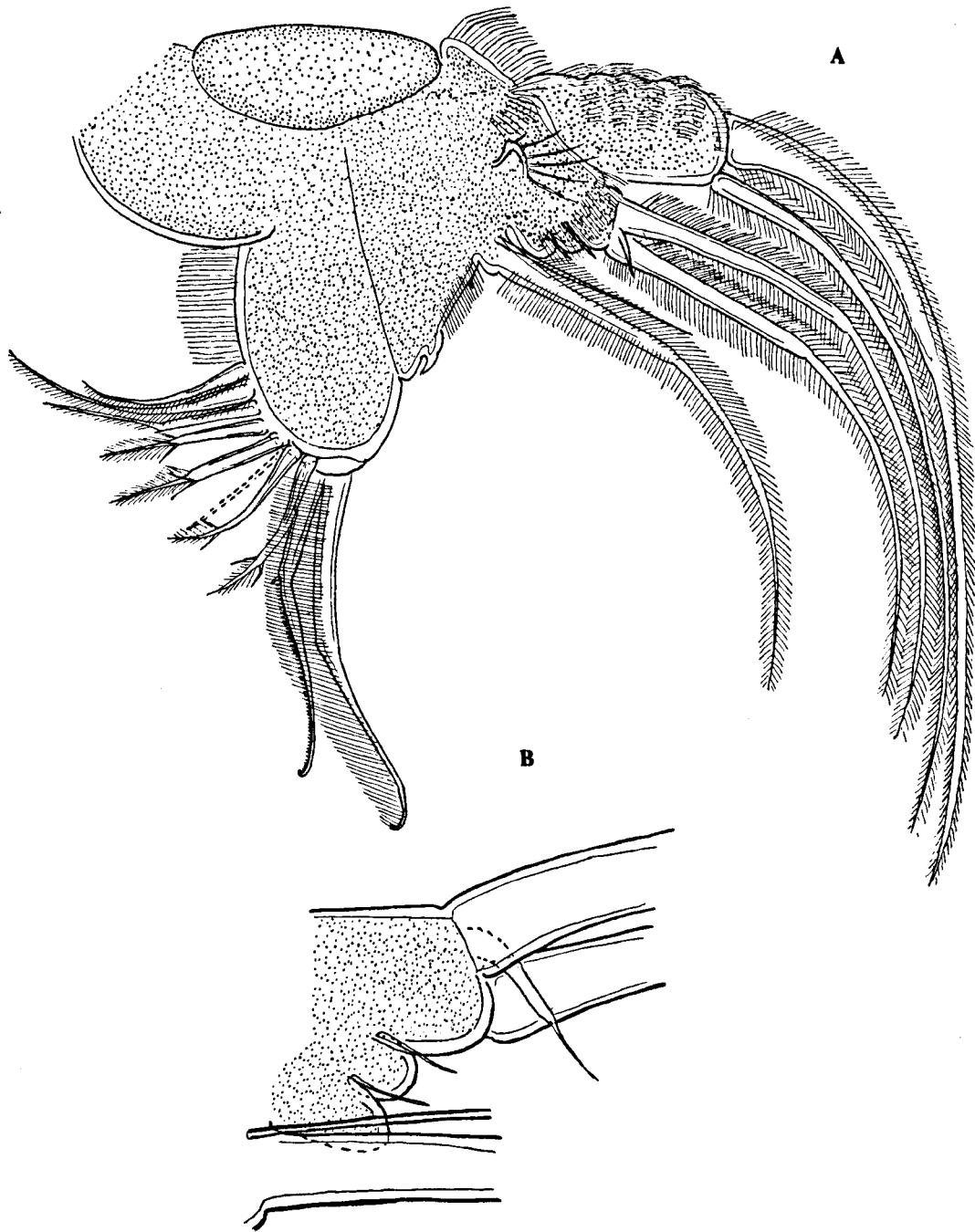


Fig. 9 *S. vetulus*, female 2nd trunk limb. A, general view, B, endopod.

differs from *S. vetulus* (*Monoculus sima*) in rostrum shape. However, judging from the illustrations in the original description, these species are identical. Information about the types of *S. nasutus* is lacking. I agree with Lilljeborg (1900), that *S. nasutus* is a junior synonym of *S. vetulus*.

S. vetulus var. *brandtii* Cosmovici was described from Romania. There is no information about the type material. Cosmovici (1900) writes that he named this variety thus because it is intermediate between *S. vetulus* and *S. brandtii* Fischer (= *S. serrulatus*). Referring to the illustrations by Cosmovici, it is the junior synonym of *S. vetulus*.

S. vetulus var. *angustifrons* Lilljeborg differs from the typical form in the presence of a prominence on the ventral head margin. Some authors (Behning, 1941; Manujlova, 1964) consider this variety to be a subspecies, but I believe it to be a synonym, because I have found specimens both with and without the prominence in the type material of *S. vetulus* var. *angustifrons* (Fig. 22). Moreover the animals with such a prominence sometimes occur in the most of *Simocephalus* species.

S. vetulus gebhardti and *S. mixtus hungaricus* were described from Hungary. The author (Ponyi, 1955, 1956) writes that these subspecies differ from *S. vetulus vetulus* in head shape and denticles

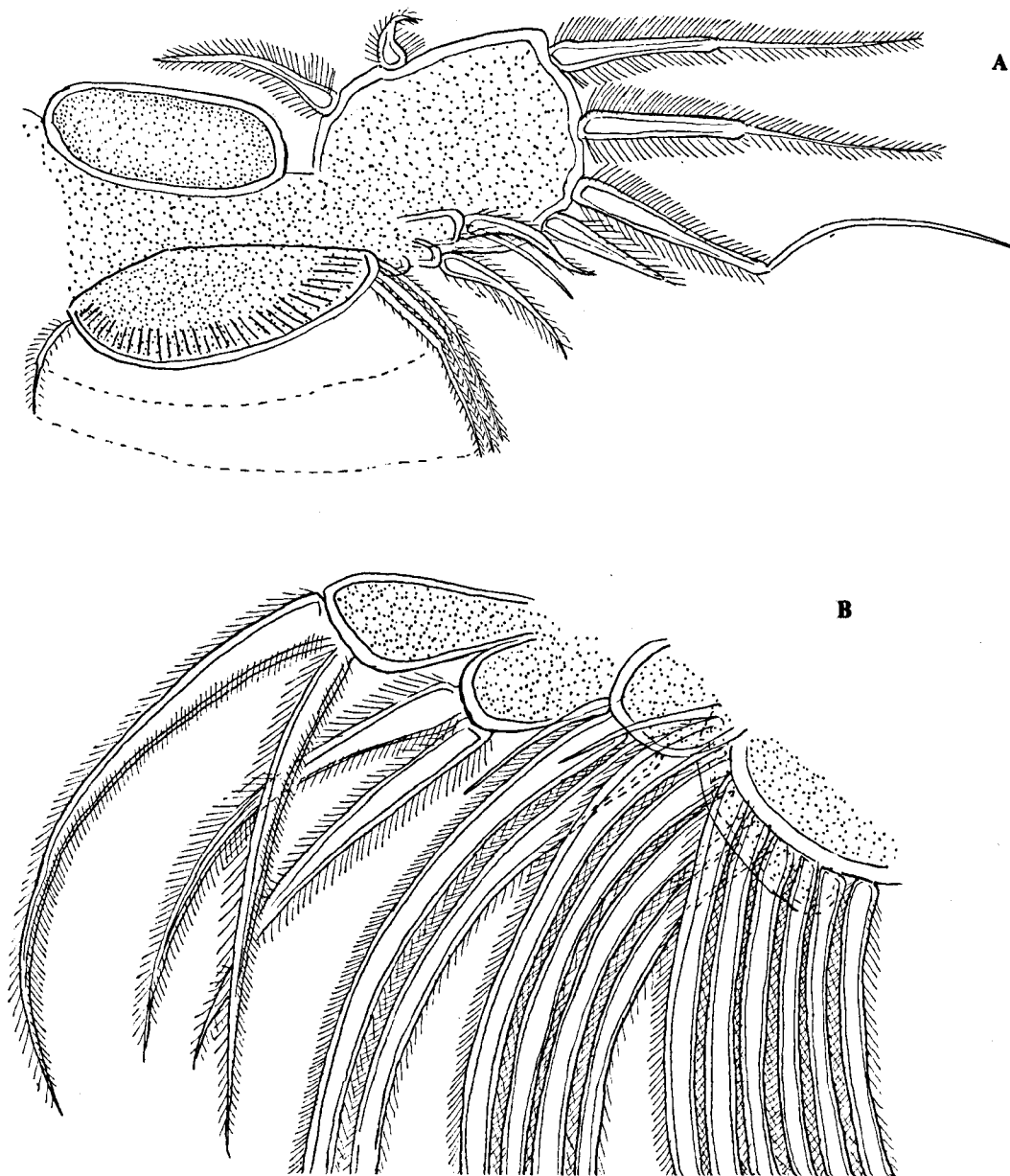


Fig. 10 *S. vetulus*, female 3rd trunk limb. A, general view, B, endopod.

on the dorsal margin of valves. However, judging from illustrations, *S. vetulus gebhardti* and *S. mixtus hungaricus* are identical to *S. vetulus vetulus*. The type material was destroyed during the battle in Budapest in 1956 (Ponyi, personal communication). I agree with Negrea (1983), that both names are the junior synonyms of *S. vetulus*.

***S. mixtus* Sars, 1903**

Fig. 23

Simocephalus mixtus Sars, 1903: 174; *S. corniger* Methuen, 1910: 158 syn. nov.; *S. elizabethae*: Manujlova, 1964: 148, partim; *S. vetulus*: Flössner, 1986: 179, partim. *S. beianensis* Shi, Shi, 1994: 405 syn. nov.

TYPE MATERIAL. Lectotype (designated here): Mongolia, Eastern slope of Khingan mountain, 8. 11. 1911: MPA: ♀ ad. (BMNH, 1995.742). Paralectotypes collected with lectotype: MPA: 14 ♀ ♀ ad., 16 ♀ ♀ juv. (BMNH, 1995.743–752).

MATERIAL EXAMINED. Lectotype, paralectotypes and other specimens: more than 2500 specimens (♀ ♀ ad., ♀ ♀ juv., ♀ ♀ e., ♂ ♂) from 58 localities (Fig. 21) in Russia, Azerbaijan, Uzbekistan, Tadjikistan, Kirgizia, Kazakhstan, Mongolia, China, Sri-Lanka, India, Pakistan, Bangladesh, Vietnam, Azores, Algeria, Sudan, Egypt, Ethiopia, USA, Jamaica. Material is deposited in AC, ZICW. Some specimens are selected from the samples in ZIPD.

DIAGNOSIS. Measurements. ♀ ♀ ad.: 1.0–2.9mm, ♀ ♀ e.: 1.2–1.9mm, ♂ ♂: 1.0–1.3mm.

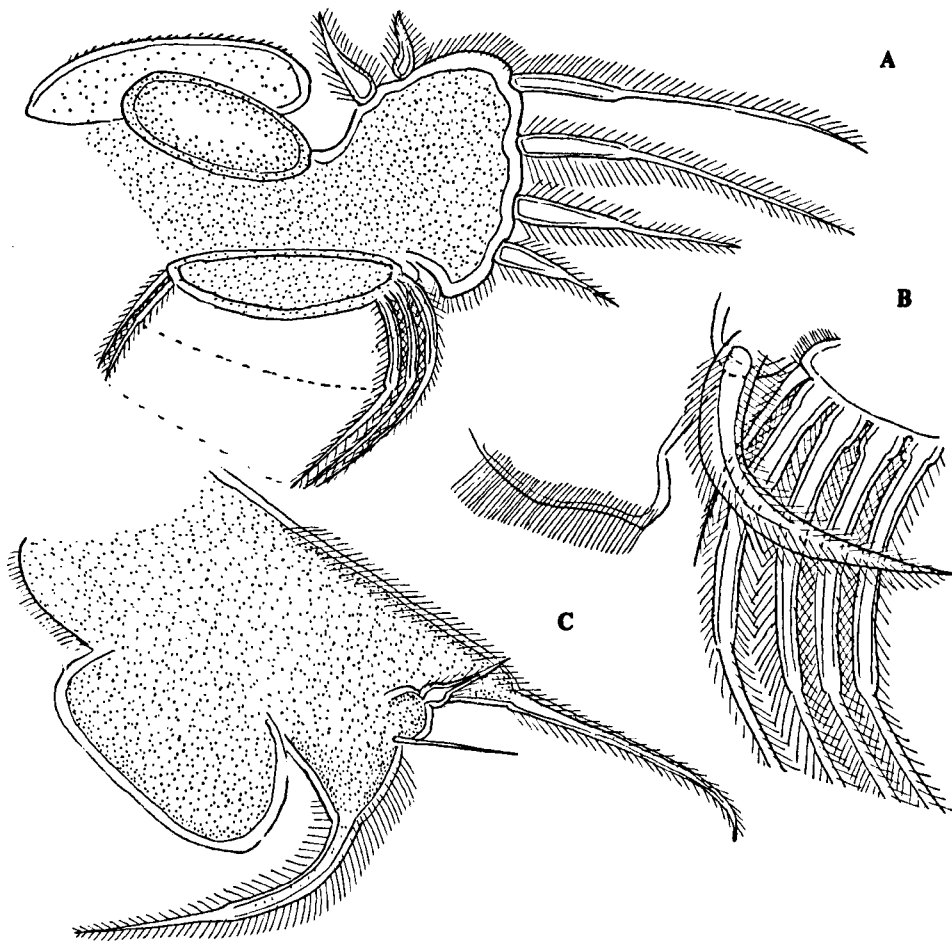


Fig. 11 *S. vetulus*, female trunk limbs. A, 4th limb, B, endopod of 4th limb, C, 5th limb.

Female. Dorso-posterior valve prominence of moderate length, with wide base and large diameter (Fig. 23). Its diameter (Fig. 2) exceeds its length. Dorsal valve margin high, protruding backward. Depressions above and below dorso-posterior prominence of moderate size (deeper than in *S. vetulus*, but more shallow than in *S. vetuloides*, *S. gibbosus* and *S. elizabethae*). Ventral head margin straight or slightly concave, sometimes with small prominence. Depression on ventral head margin near rostrum deep. Ocellus elongate.

DISTRIBUTION. (Fig. 21) Asia, Eastern Europe, N. Africa, N. America.

REMARKS. Behning (1941) supposes *S. mixtus* to be a separate species. Manujlova (1964) believes it to be a synonym of *S. elizabethae*. Negrea (1983) and Flössner (1972) consider it to be a synonym of *S. vetulus*. Investigation of the type has shown that *S. mixtus* differs from both *S. vetulus* and *S. elizabethae*.

S. corniger Methuen was described from South Africa. There is no information about the type material. The original description (Methuen, 1910) is very brief. Judging from illustrations, *S. corniger* is a junior synonym of *S. mixtus*.

S. beianensis Shi, Shi, 1994 was described from China (Heilongjiang Province, 48°16'N, 126°31'E) (Shi & Shi, 1994). The authors write that this species differs from *S. vetulus* in details of ocellus and in number of the anal teeth. Both characters are variable.

Referring to the illustration, the ocellus of *S. beianensis* does not sufficiently differ from the ocellus of *S. vetulus* and *S. mixtus*. The number of anal teeth does not also differentiate these species.

S. mixtus hungaricus Ponyi, 1956 is not in fact *S. mixtus*. It is a synonym of *S. vetulus* (see above). *S. serrulatus* var. *mixta* Grochmalicki (1915) belongs to another subgenus. It is a junior homonym of *S. mixtus*.

S. vetuloides Sars, 1898

Fig. 24

Simocephalus vetuloides Sars, 1898: 328; *S. elizabethae*: Behning, 1941: 182 partim; Manujlova, 1964: 148; *S. vetulus*: Fryer, 1957: 225 partim; Negrea, 1983: 138 partim.

TYPE MATERIAL. Lectotype (designated here): Russia, North Siberia, Jana river, 30. 6. 1885, leg. Ignatov: MPA: ♀ ad. (ZICC, 4690). Paralectotypes collected with lectotype: 38 ♀ ad. (ZICC, 4690). The vicinity of Jana river: CBS: ♀ ad. (ZICW). Dolgulach, 16–18. 6. 1885: 3 ♀ ad. (ZICW).

MATERIAL EXAMINED (Fig. 21). Lectotype, paralectotypes and other specimens from AC: Russia, vicinity of Yakutsk, 7. 1990, leg. Smirnov: 18 ♀ ad., 9 ♀ juv. Chita, sand-pit, 9. 9. 1991, leg. Smirnov: more than 70 ♀ ad., 70 ♀ juv., 100 ♂♂, 40 ♀♀ e.

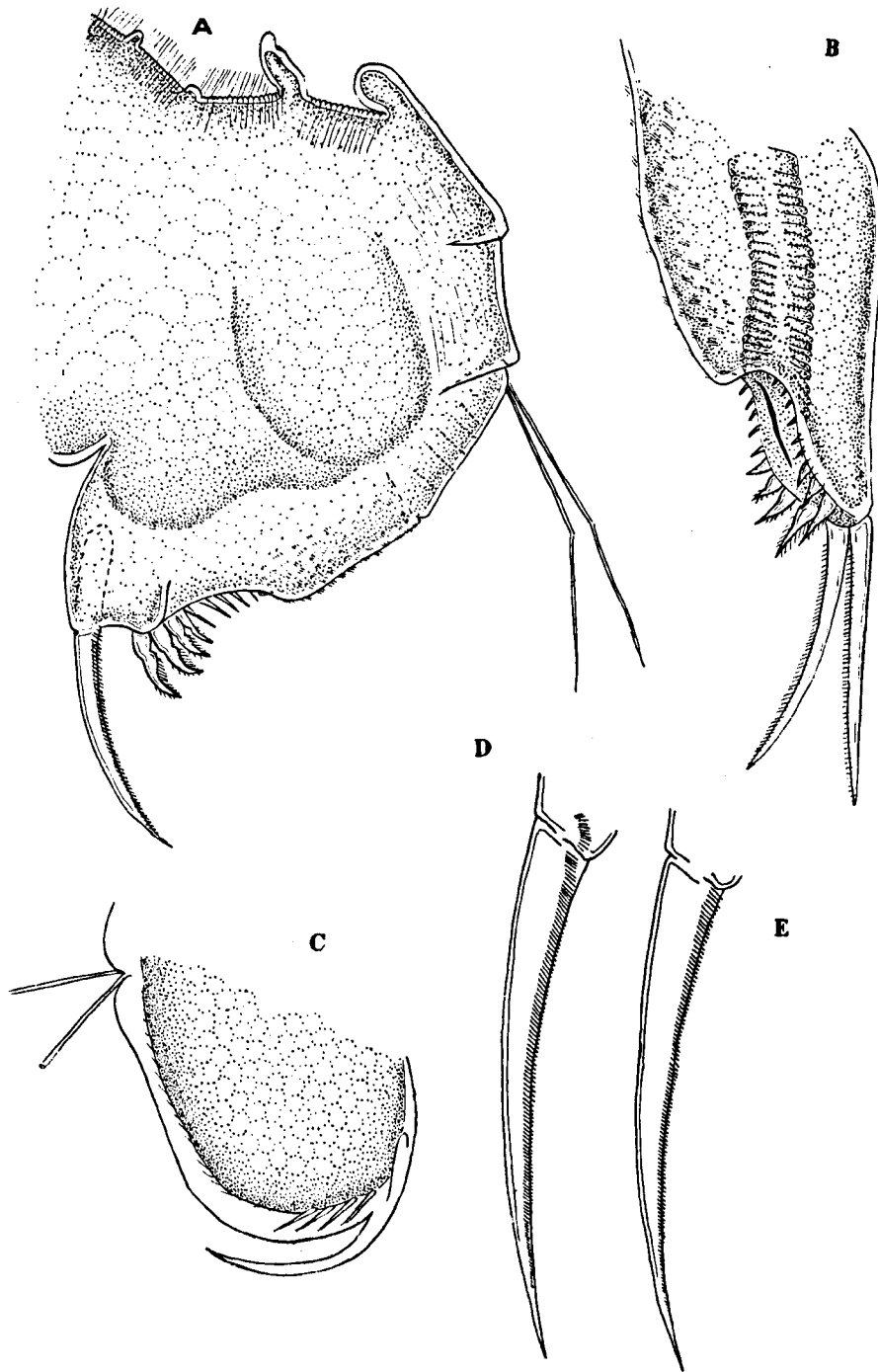


Fig. 12 *S. vetulus*, female postabdomen. A, lateral view, B, dorsal view, C, postabdomen of neonate, D, outer side of postabdominal claw, E, inner side of postabdominal claw.

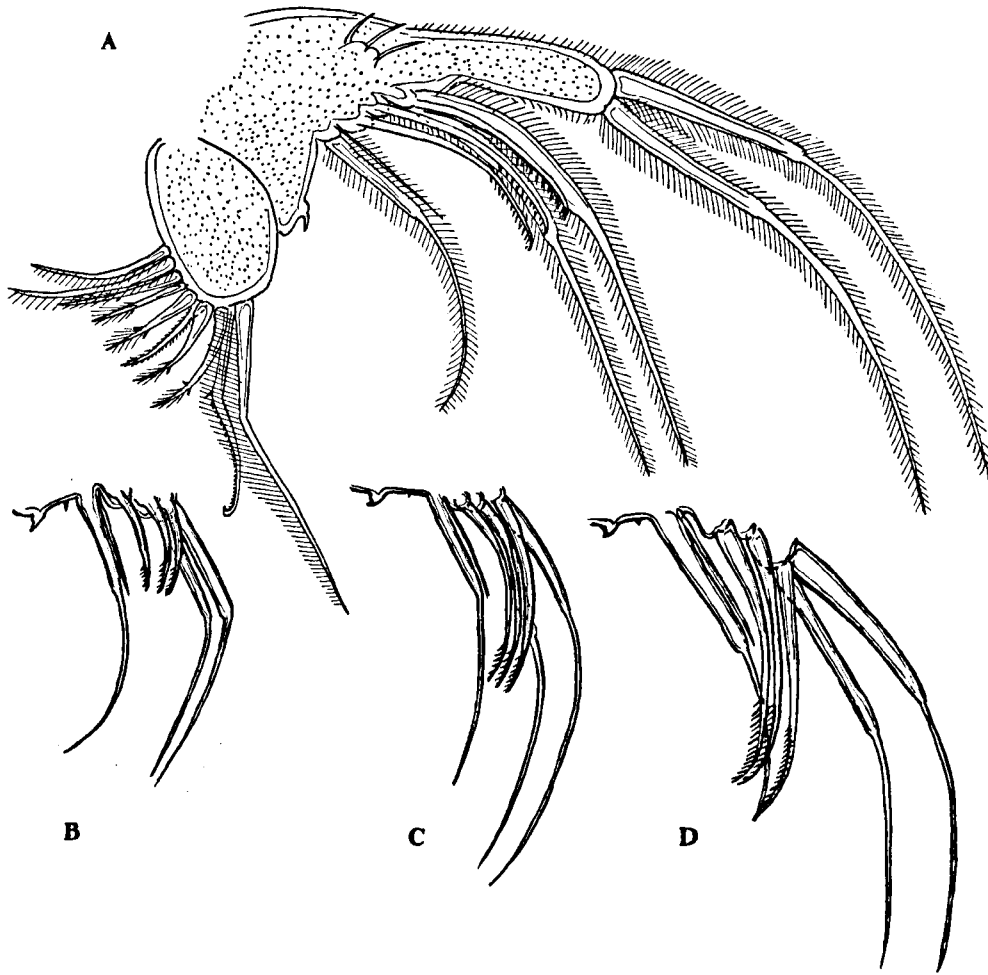


Fig. 13 *S. vetulus*, male 2nd trunk limb. A, general view, B, endite of neonate, C, endite of juvenile, D, endite of adult.

Kolyma river basin, Zhirkovo lake, 28. 6. 1967, leg. Streletskaia: 4 ♀ ad., 2 ♀ e. Magadan region, Verkhnee lake, 18. 8. 1981, leg. Streletskaia: 13 ♀ ad., 8 ♀ juv.

DIAGNOSIS. Measurements. ♀ ad.: 1.3–2.4 mm., ♀ e.: 1.2–1.9 mm, ♂♂: 1.0–1.3 mm.

Female. Dorso-posterior valve prominence long, with very wide base and small diameter (Fig. 24). Its diameter (Fig. 2) less than its length. Dorsal valve margin very high, not protruding backward. Depressions above and below dorso-posterior prominence wide and deep. Ventral head margin straight or slightly concave, sometimes with small prominence. Depression on ventral head margin near rostrum deep. Ocellus elongate.

DISTRIBUTION. (Fig. 21) Eastern Siberia *S. vetuloides* has been described from the Jana river basin. Sars (1903) reports it also from Kazakhstan. However, the illustration in this article shows that the specimens found in Kazakhstan belong to *S. mixtus*. *S. vetuloides* is reported from China (Chiang & Du, 1979), Mongolia (Flössner, 1986) and South Africa (Sars, 1916). But the identification of species within the subgenus *Simocephalus* s. str. is rather difficult. And probably the name *S. vetuloides* was misused for other species.

REMARKS. Behning (1941) and Manujlova (1964) suppose *S. vetuloides* to be a synonym of *S. elizabethae*. Other authors (Fryer,

1957; Negrea, 1983; Michael & Sharma, 1988) regard it as a synonym of *S. vetulus*. Investigation of the type material and other specimens shows that it is a separate species. It is sympatric with *S. mixtus* and there are no intermediate forms between these species. *S. vetuloides* differs from *S. vetulus* in the shape of the dorso-posterior valve prominence and from *S. elizabethae* in the head shape.

Contrary to the opinion of Manujlova (1964), the length of the distal seta of the antennal basipod does not differ in this species from the others (Fig. 24B). The basipod bears a seta on the outer and a spine on the inner side of the distal part.

S. punctatus sp. nov.

Fig. 25

TYPE MATERIAL. Holotype: Shallow eutrophic vernal pool in river bottom below a dam on the Friant River, Tulare Co. California, 37°N 119°45'W, leg. Berner: MPA: ♀ ad. (BMNH) 1997. 1698. Paratypes collected with holotype: MPA: more than 50 ♀ ad., 20 ♀ juv., 20 ♀ e., 20 ♂♂ (BMNH 1997. 1699–1708 and AC).

DIAGNOSIS. Measurements. ♀ ad.: 1.5–2.23 mm., ♀ e.: 1.2–1.9 mm, ♂♂: 1.1–1.3 mm.

Female. Dorso-posterior valve prominence absent, dorso-posterior angle not separated above and below by depressions (Fig. 25).

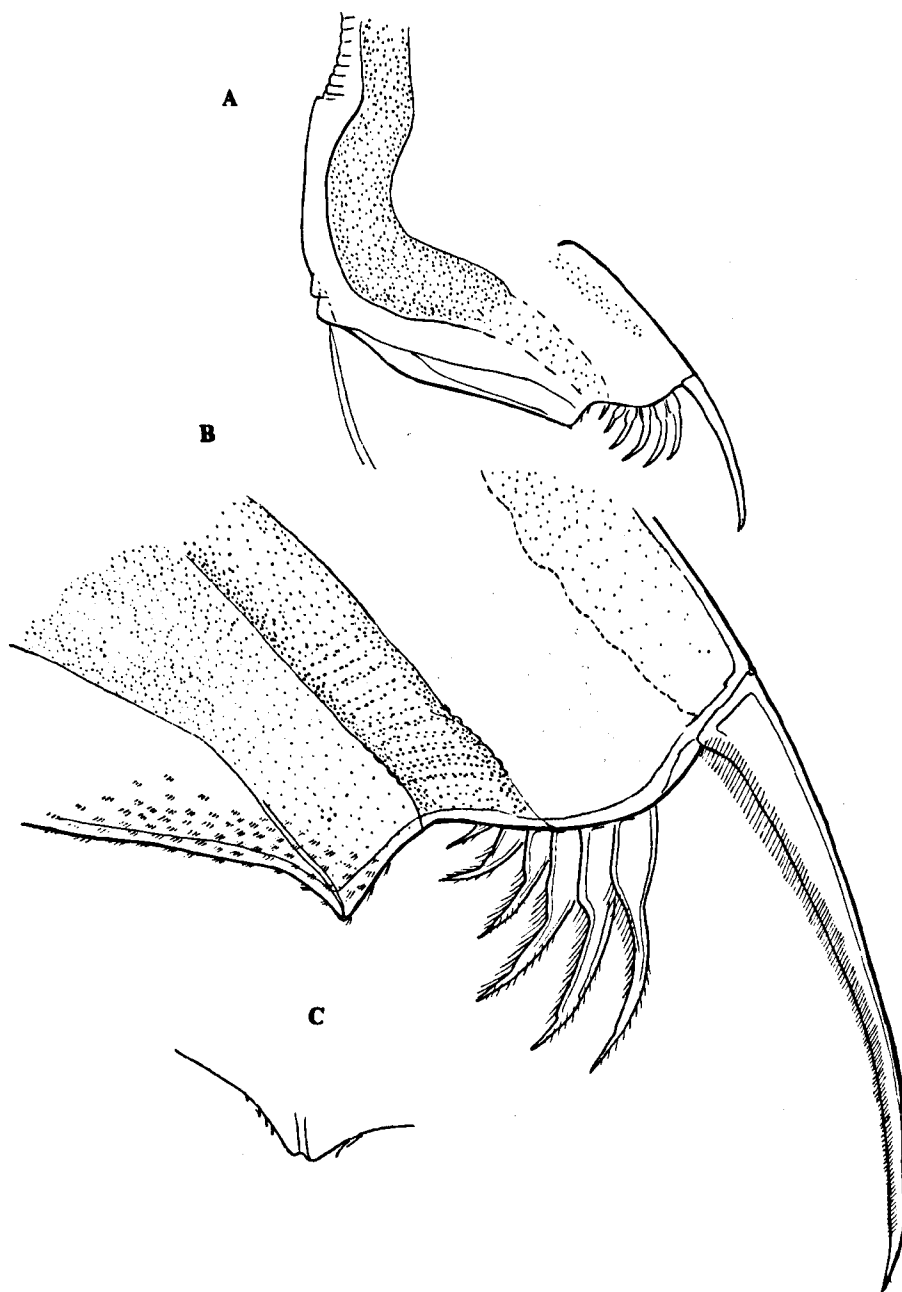


Fig. 14 *S. vetulus*, male postabdomen. A, lateral view, B, distal part, C, supra-anal angle with vas deferens.

Diameter of circle inscribed in it large. Dorsal valve margin low, not protruding backward. Ventral head margin straight or slightly concave, sometimes with small prominence. Depression on ventral head margin near rostrum deep. Ocellus point-like.

ETYMOLOGY. The name '*punctatus*' refers to the point-like ocellus that is typical of this species.

REMARKS. The shapes of the head and valves are similar in *S. punctatus* and *S. vetulus*. The former species differs distinctly from the latter, and from all other species of this subgenus, in the shape of the ocellus, which is point-like in all available specimens of *S. punctatus*.

S. gibbosus Sars, 1896

Fig. 26

Simocephalus gibbosus Sars, 1896: 15; *S. vetulus gibbosus*: Dumont, 1983: 102.

TYPE MATERIAL. Lectotype (designated here): Australia, Sydney, Centennial park: CBS: ♀ ad. (ZMO, F 9766, Mp. 170). Paralectotypes collected with lectotype: 5 ♀ ♀ ad. (ZMO, F 9766, Mp. 170), MPA: 15 ♀ ♀ ad. (ZMO, F 19261).

MATERIAL EXAMINED (Fig. 21). Lectotype, paralectotypes and other specimens: more than 250 specimens (♀ ♀ ad. and ♀ ♀ juv.)

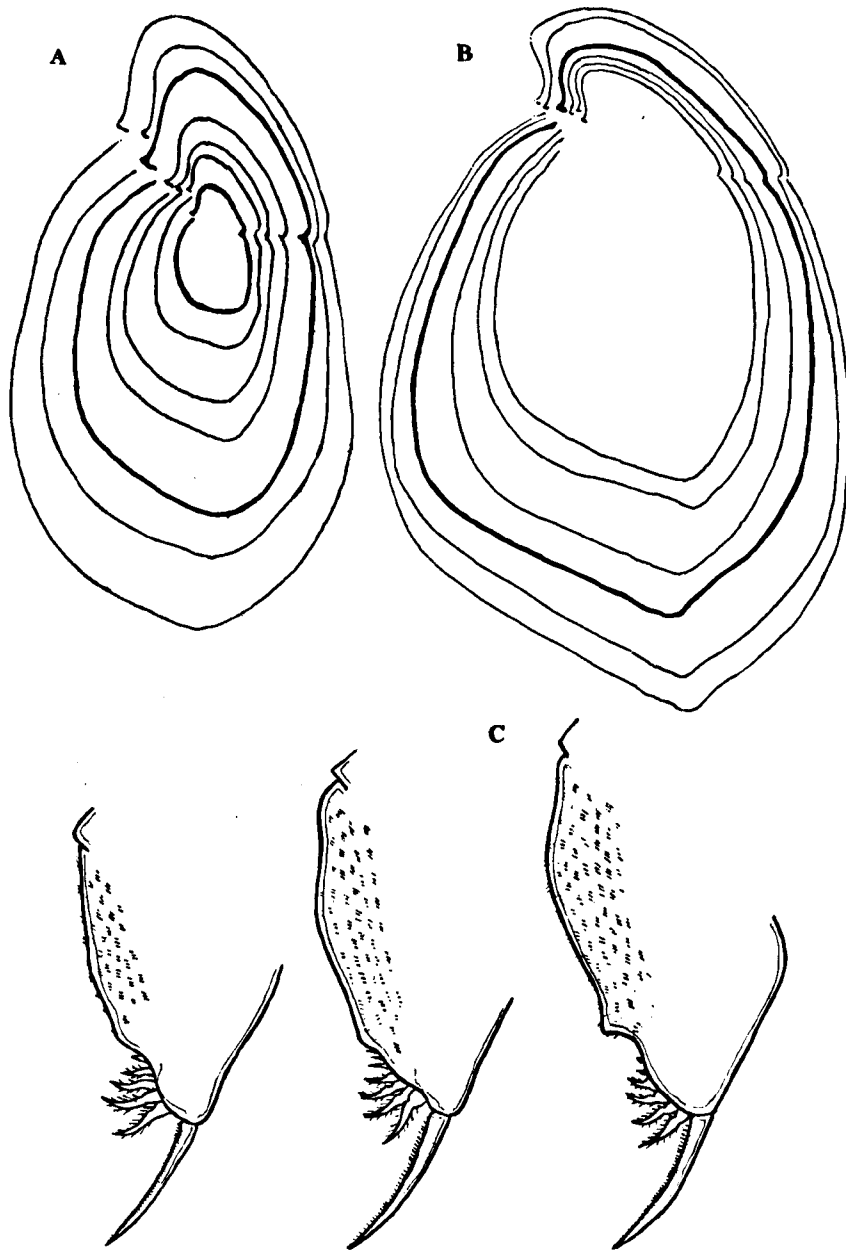


Fig. 15 Age variation in shape. A, *S. vetulus* female, B, *S. exspinosus* female, C, *S. vetulus* male postabdomen.

from 11 localities in Australia: New South Wales, Victoria, Queensland, Northern Territory. The material is in AM and AC.

DIAGNOSIS. Measurements. ♀ ♀ ad.: 1.0–2.4mm., ♀ ♀ e.: 1.2–1.9. Female. Dorso-posterior valve prominence long, with very wide base and small diameter (Fig. 26). Its diameter less than its length (Fig. 2). Dorsal valve margin very high, protruding backward strongly. Depressions above and below dorso-posterior prominence wide and deep. Ventral head margin always with prominence, without depression under eye. Depression on ventral head margin near rostrum very shallow, sometimes absent. Ocellus elongate. Male. unknown.

DISTRIBUTION. (Fig. 21) Australia.

REMARKS. The original description of this species (Sars, 1896) is comprehensive and provided with good illustrations. Dumont (1983) supposes *S. gibbosus* and *S. elizabethae* to be subspecies of *S. vetulus*. Examination of *S. gibbosus* type material and specimens of *S. elizabethae* shows that these species differ from *S. vetulus* in the shape of the valves and head. In addition, they are sympatric and consequently cannot be subspecies of one species.

***S. elizabethae* (King, 1853)**

Fig. 27

Daphnia Elizabethae King, 1853a: 247; *Simocephalus vetulus*: Schödler, 1877: 18 partim, Negrea, 1983: 138 partim; *S. vetulus elizabethae*: Dumont, 1983: 98; *S. dulvertonensis* Smith, 1909: 81.

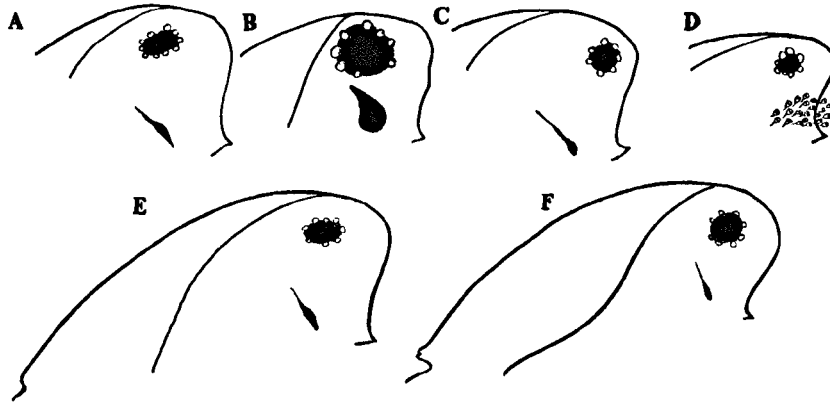


Fig. 16 *S. vetulus*, variation. A–C, variation of ocellus size, A, female collected 12. 5. 1990, B, female collected 5. 9. 1990, C, female from the same sample after 17 days in room temperature, D, head covered with epibionts, E, head without prominence in dorso-posterior part, F, head with prominence in dorso-posterior part.

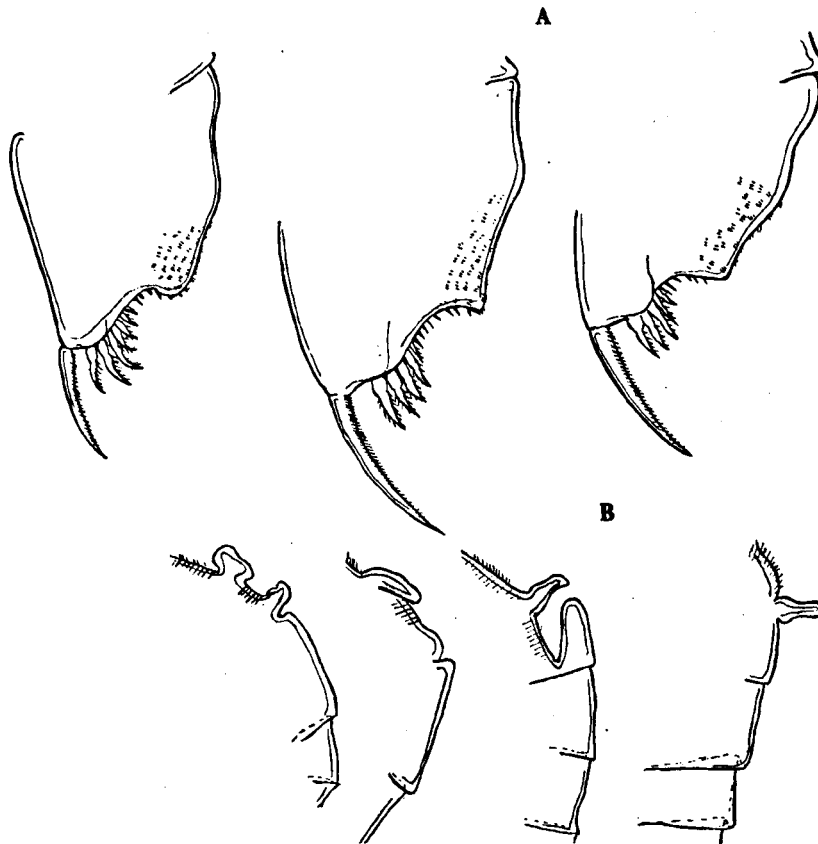


Fig. 17 *S. vetulus*, variation of abdomen and postabdomen, female. A, postabdomen, B, abdominal processes.

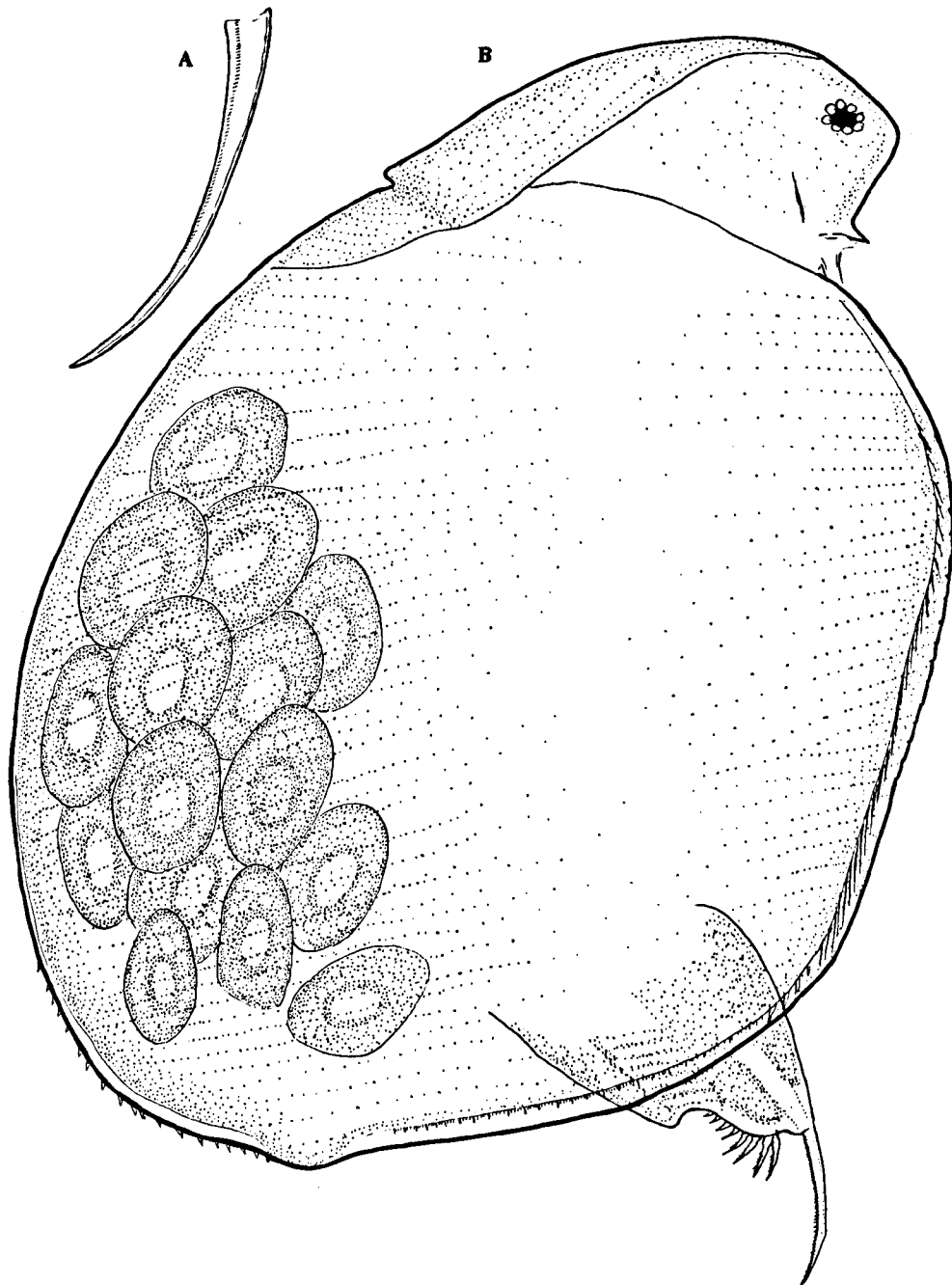


Fig. 18 *S. vetulus*, neotype, parthenogenetic female. A, postabdominal claw, B, lateral view.

TYPE MATERIAL. Types were probably not preserved by King. At least, they are not to be found in AM, SAM and MV. The specimens were from Sydney, New Town, Parramatta, the Cowpastures, and from River Karuah, near Stroud, Port Stephens. Type locality not indicated in the original description (King, 1853a).

MATERIAL EXAMINED. More than 550 specimens (♀♀ ad., ♀♀ juv., ♀♀ e., ♂♂) from 15 localities in Tasmania, New Guinea and Australia (New South Wales, South Australia, Western Australia, Victoria, Northern Territory, Queensland) (Fig. 21) (AM, SAM, MV).

DIAGNOSIS. Measurements. ♀♀ ad.: 1.2–3.4 mm., ♀♀ e.: 1.2–1.9, ♂♂: 1.1–1.3 mm.

Female. Dorso-posterior valve prominence long, with very wide base and small diameter (Fig. 27): diameter less than its length (Fig. 2). Dorsal valve margin very high, not protruding backward. Depressions above and below dorso-posterior prominence wide and deep. Ventral head margin with depression just under eye. Depression on ventral head margin near rostrum shallow, sometimes absent. Ocellus elongate.

DISTRIBUTION. (Fig. 21) Australia, Tasmania, New Guinea. The species is reported from Ceylon (Daday, 1898), Sumatra, Java,

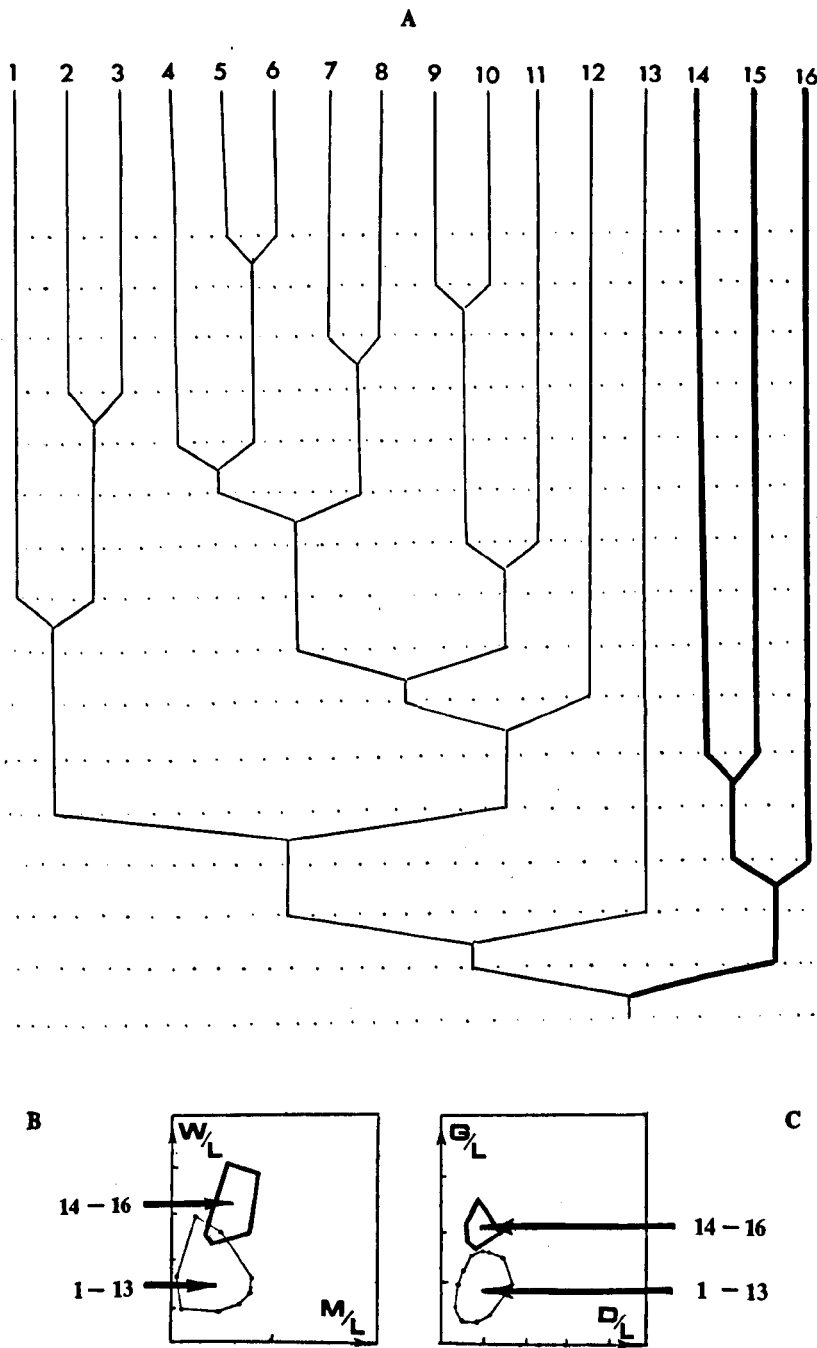


Fig. 19 Statistical analysis of 16 series of *Simocephalus* s. str. from Europe. 1-13 - *S. vetulus*, 14-16 - *S. mixtus*. A, result of cluster analysis, B, C, diagrams of characters.

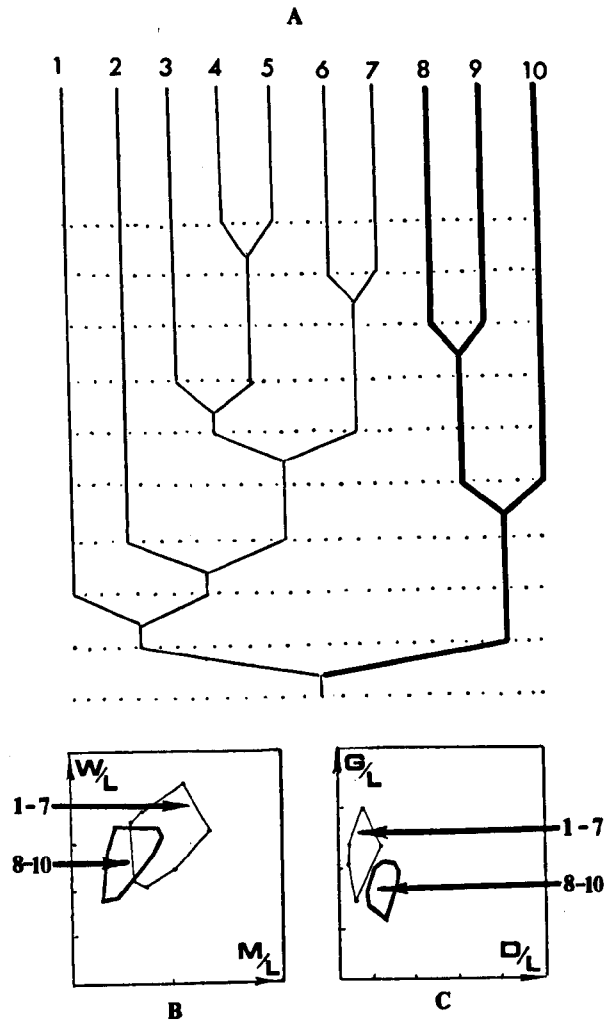


Fig. 20 Statistical analysis of ten series of *Simocephalus* s. str. from East Siberia and Far East. 1-7 - *S. vetuloides*, 8-10 - *S. mixtus*. A, result of cluster analysis, B, C, diagrams of characters.

China (Stingelin, 1904), India (Biswas, 1971), Niger (Dumont & Van De Velde, 1977a), Nepal (Dumont & Van De Velde, 1977b), Central Asia (Manujlova, 1964). But judging from illustrations, these authors had specimens not of *S. elizabethae* but of *S. mixtus*.

REMARKS. The original description (King, 1853a) contains the characters of two species. The first adequate description of this species was made by Sars (1888). Schödler (1877) and Negrea (1983) suppose *S. elizabethae* to be a synonym of *S. vetulus*. Dumont (1983) regards it as a subspecies of *S. vetulus*. I believe *S. elizabethae* to be a separate species, because it differs from *S. vetulus* in the shape of the ventral head margin and dorso-posterior valve prominence. These differences are not less than the differences between other species within this subgenus.

Judging from the original description (Smith, 1909), the Tasmanian species *S. dulvertonensis* belongs to *Simocephalus* s.str. Information about the type material is lacking. Available specimens from Tasmania differ slightly from Australian material in the shape of the dorso-posterior valve prominence, but this difference is insufficient to assign them to a separate species or subspecies. I agree with Brehm (1953) and Dumont (1983), that *S. dulvertonensis* is a synonym of *S. elizabethae*.

Subgenus *S. (Echinocaudus)* subgen. nov.

TYPE SPECIES. *Simocephalus exspinosus* (De Geer, 1778).

DIAGNOSIS. Both sexes (Figs 28; 29). Frons rounded or pointed, without denticles. Head shield without depression. Head pores present. Insertion of antennules at base of rostrum. Antennule long or short in correspondence with long or short rostrum, with neither ridges nor denticles on inner side. Aesthetes longer than base of antennule. Postabdominal claw with basal pecten of spines at outer side. Inner side and distal part of outer side with fine setules. Anal bay of postabdomen narrow, rounded, with anal teeth.

Female. Dorso-posterior valve angle with rounded prominence or without it. Valves without dorsal keel. Posterior corner of ephippium without protuberance. Ocellus short. Setae of 2nd and 3rd endite prominence of 2nd trunk limb as long as 0.7 and 1.1 of basal segment of plumose seta of 1st prominence respectively (Fig. 30B). Postabdomen with 9-22 anal teeth on each side (Fig. 28C). Supra-anal angle rounded.

Male. Supra-anal angle rounded (Fig. 29). Vas deferens opening near its base. Postabdomen with 5-6 anal teeth on each side. Dorso-posterior valve angle with rounded or pointed prominence.

ETYMOLOGY. The name '*Echinocaudus*' is derived from the words '*echinus*' – 'hedgehog' and '*cauda*' – 'tail' and refers to the pecten of spines at the base of postabdominal claw that is typical of this subgenus.

S. obtusatus (Thomson, 1878)

Fig. 31

Daphnia obtusata Thomson, 1878: 261; *Simocephalus obtusatus*: Sars, 1894.

TYPE MATERIAL. No information. Type locality: New Zealand, Dunedin.

MATERIAL EXAMINED. New Zealand, Lake Takapuna, leg. Henry: ♀ ad. (AM, 7182).

DIAGNOSIS. Measurements. ♀ ♀ ad.: 2.0–2.5mm, ♂ ♂: 1.0–1.2mm. Both sexes. Frons rounded (Fig. 31D). Ventral head margin very convex. Rostrum short. Setules on inner side of posterior valve margin slender. Dorso-posterior valve angle without prominence (Fig. 31A,F). One supra-anal angle (Fig. 31E). Basal pecten of postabdominal claw with 10–12 large well-spaced spines (Fig. 31C). Size of spines maximal in middle.

DISTRIBUTION. (Fig. 32) New Zealand.

REMARKS. The original description was provided with an illustration and shows that *S. obtusatus* differs markedly from all other

species in head shape (Thomson, 1878). The most detailed description of the female and the first description of the male was given by Sars (1894).

S. daphnoides Herrick, 1883

Fig. 33

Simocephalus daphnoides Herrick, 1883: 503; *S. Iheringi* Richard, 1897: 279 syn. nov.; *S. fonsecai* Bergamin, 1939: 82 syn. nov.; *S. fonsecai* var. *sinucristatus* Bergamin, 1939: 84 syn. nov.

TYPE MATERIAL. Probably the types were not indicated by Herrick as in the case of other species described by this author (D. Frey, personal communication through N.N. Smirnov). Type locality: U.S.A., Alabama, Decatur.

MATERIAL EXAMINED. Argentina, Rio Parana, Catay pond, 1973, leg. Frutos: 3 ♀ ♀ ad., 3 ♀ ♀ juv. (AC). Peru, vicinity of Pucalpa, pond near Ucayali river, 2. 1987, leg. Pegasov: 4 ♀ ♀ ad. (AC).

DIAGNOSIS. Measurements. ♀ ♀ ad.: about 1 mm. Female. Frons rounded (Fig. 33). Ventral head margin concave, straight or with small prominence. Rostrum short. Setules on inner side of posterior valve margin slender. Dorso-posterior valve angle with large, pointed prominence. One supra-anal angle. Basal pecten of postabdominal claw of 20–30 small, close-set spines of equal length. Male unknown.

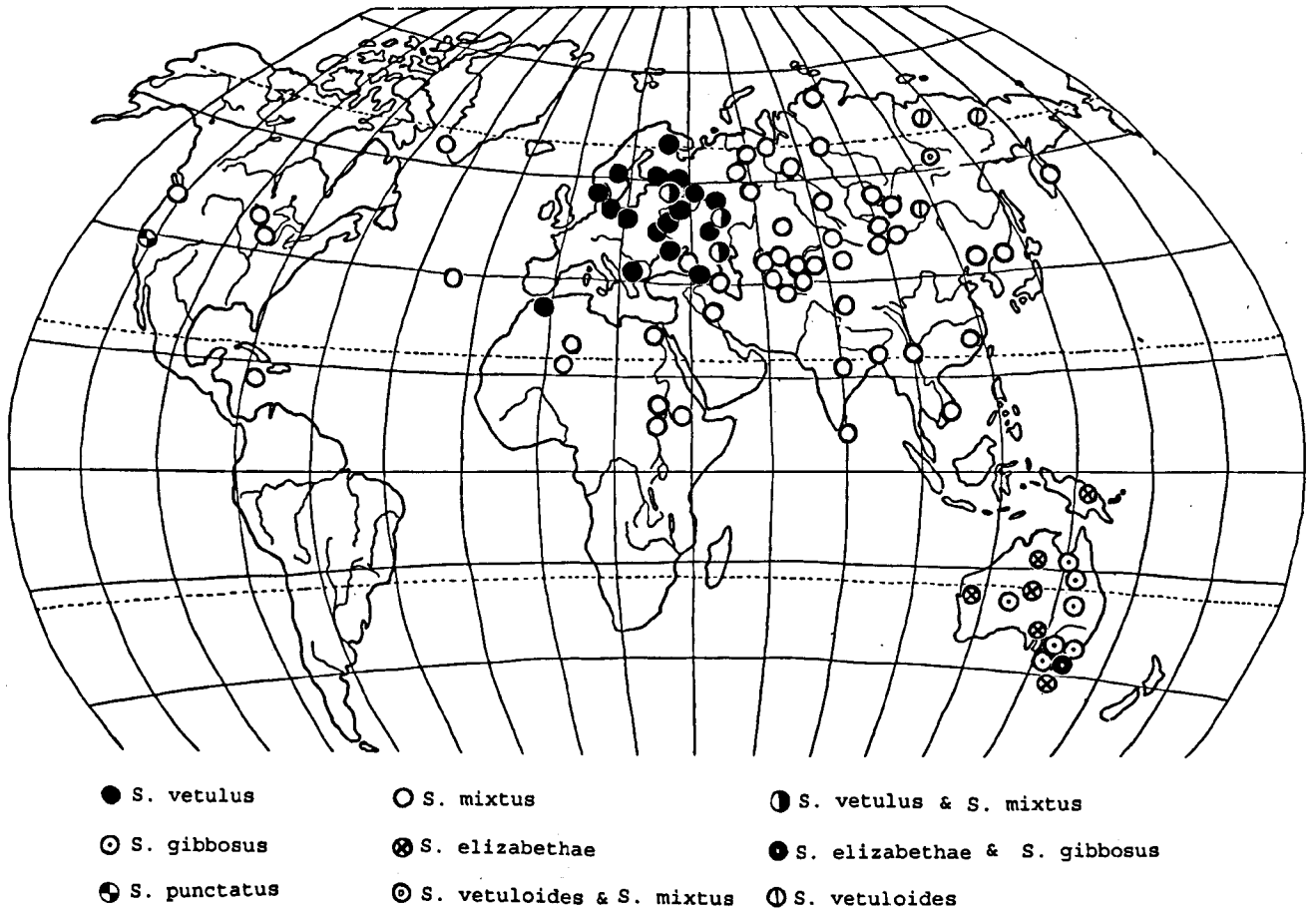


Fig. 21 Locations, where studied material of *Simocephalus* s. str. was collected.

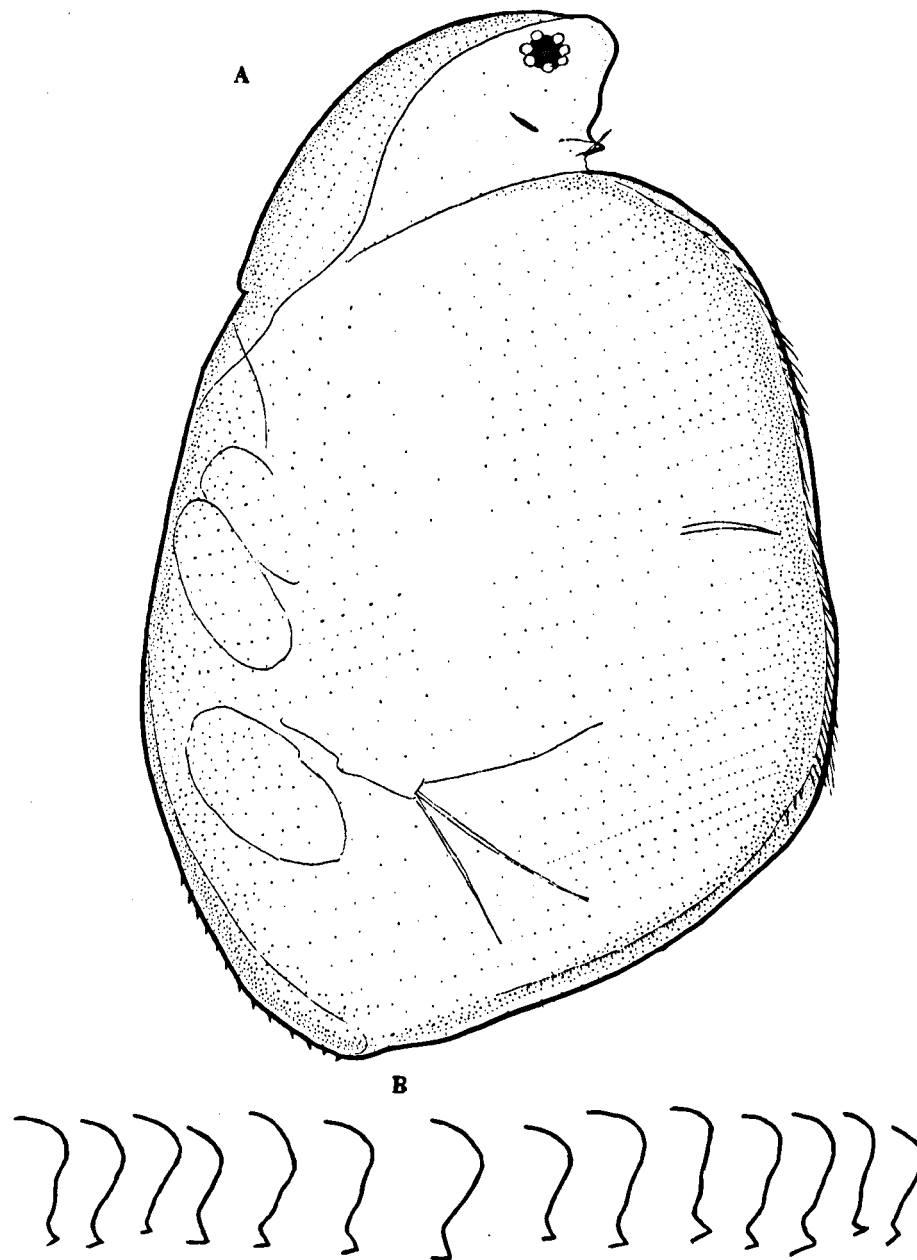


Fig. 22 *S. vetulus* var. *angustifrons* (= *S. vetulus*), type series. A, parthenogenetic female, lectotype, B, variability of ventral head margin.

DISTRIBUTION. (Fig. 32). U.S.A., Alabama (Herrick, 1883), Argentina (Sars, 1901 and our data), Brasil (Richard, 1897), Paraguay, Columbia (Olivier, 1960), Peru (our data).

REMARKS. The original description of this curious species is short but provided with a good illustration (Herrick, 1883). Obviously, *S. daphnoides* is the senior synonym of *S. iheringi*. The latter name is used (Olivier, 1960) while the former name has been forgotten. *S. iheringi* was described from Brasil (Richard, 1897). There is no information about the types. The male was originally described by Sars (1901).

S. fonsecai and *S. fonsecai* var. *sinucristatus* were described from Brasil. There is no information about the types. Harding (1955) supposes *S. fonsecai* to be a synonym of *S. iheringi*. The original description (Bergamin, 1939) supplied with the lateral view of both

varieties and the view of the postabdomen of *S. fonsecai* shows that both names are junior synonyms of *S. daphnoides*.

S. (EXSPINOSUS) species group

DIAGNOSIS. Both sexes (Figs 28–30). Frons rounded. Ventral head margin concave, straight or with small prominence. Rostrum short. Setules on inner side of posterior valve margin slender. Dorso-posterior valve angle without prominence or with small rounded prominence. One supra-anal angle. Basal pecten of postabdominal claw of 8–25 close-set spines of equal length.

S. exspinosus (De Geer, 1778)

Figs 28–30

Monoculus exspinosus De Geer, 1778: 457; *Daphnia exspinosus*: Koch, 1841: 35; *Daphnia sima*: Lievin, 1848; Baird, 1850: 95; *Simocephalus exspinosus* Schödler, 1858: 20; Lilljeborg, 1900: 177; *Daphnia australiensis* Dana, 1852: 1271; Sars, 1888: 15; *S. exspinosus australiensis*: Dumont, 1983: 104; *S. sibiricus* Sars, 1898: 329 syn. nov.; *S. productus* Sars, 1903: 173; *S. himalayensis* Chiang & Chen, 1974: 129 syn. nov.; *S. vamani* Rane, 1985b: 225.

TYPE MATERIAL. The types appear to be lost. There are no specimens of this species in the collection of De Geer deposited in the Museum of Natural History in Stockholm (L. Sandberg, curator of Crustacea, personal communication). The type locality is not indicated in the original description (De Geer, 1778).

MATERIAL EXAMINED. Type material of junior synonyms: *S. sibiricus* Sars, 1898: Lectotype (designated here): Russia, Siberia, Verkhoyansk, 1885: MPA: ♀ ad. (ZICC, 4691). Paralectotypes collected with lectotype: 9 ♀ ad. (ZICC, 4691). *S. productus* Sars, 1903: Lectotype (designated here): Kazakhstan, Akmolinsk region: MPA: ♀ ad. (ZICC, 7098). Paralectotypes collected with lectotype: 35 ♀ ad. (ZICC, N7098). Other specimens: more than 1000 specimens (♀ ad., ♀ juv., ♀ e., ♂♂) from 56 localities in Russia, Ukraine, Georgia, Kazakhstan, Uzbekistan, Tadjikistan, Mongolia,

China, India, Pakistan, Bangladesh, Egypt, Algeria, Rwanda, South Africa and Australia. Material is deposited in AC, ZICW, ZICC, MCA, SAM, AM. Some specimens are selected from the samples from ZIPD.

DIAGNOSIS. Measurements. ♀ ad.: 1.8–3.5mm., ♀ e.: 1.2–1.9mm, ♂♂: 1.0–1.3.

Female. (Fig. 28). 12–22 anal teeth. Prominence of dorso-posterior valve angle small or absent. Basal pecten of postabdominal claw of 8–12 spines of moderate size.

DISTRIBUTION. This species is assumed to be cosmopolitan by many authors, but its range needs to be redefined. It occurs with certainty in Europe, Asia, Africa, Australia (Fig. 32). The available specimens from different continents belong to one morphological species. Unfortunately, I have no specimens from America.

REMARKS. The original description of *S. exspinosus* is very short: 'Monoculus exspinosus branchiis dichotomis cauda simplici inflexa testa postice rotundata non spinosa' (De Geer, 1778). This is appropriate for any species of *Simocephalus*. Koch and Schödler are often erroneously thought to be the authors of the species, because Koch (1841) described and drew it and Schödler (1858) was the first to

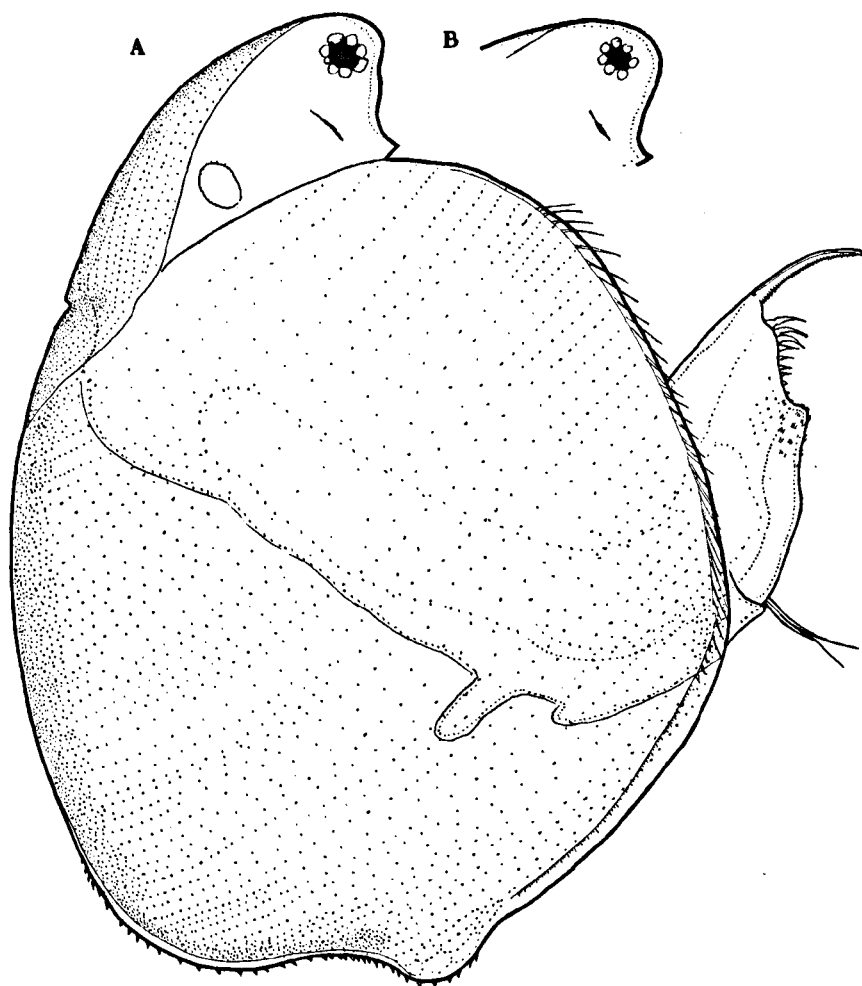


Fig. 23 *S. mixtus*, type series A, parthenogenetic female, lectotype, B, ventral part of the head of paralectotype.

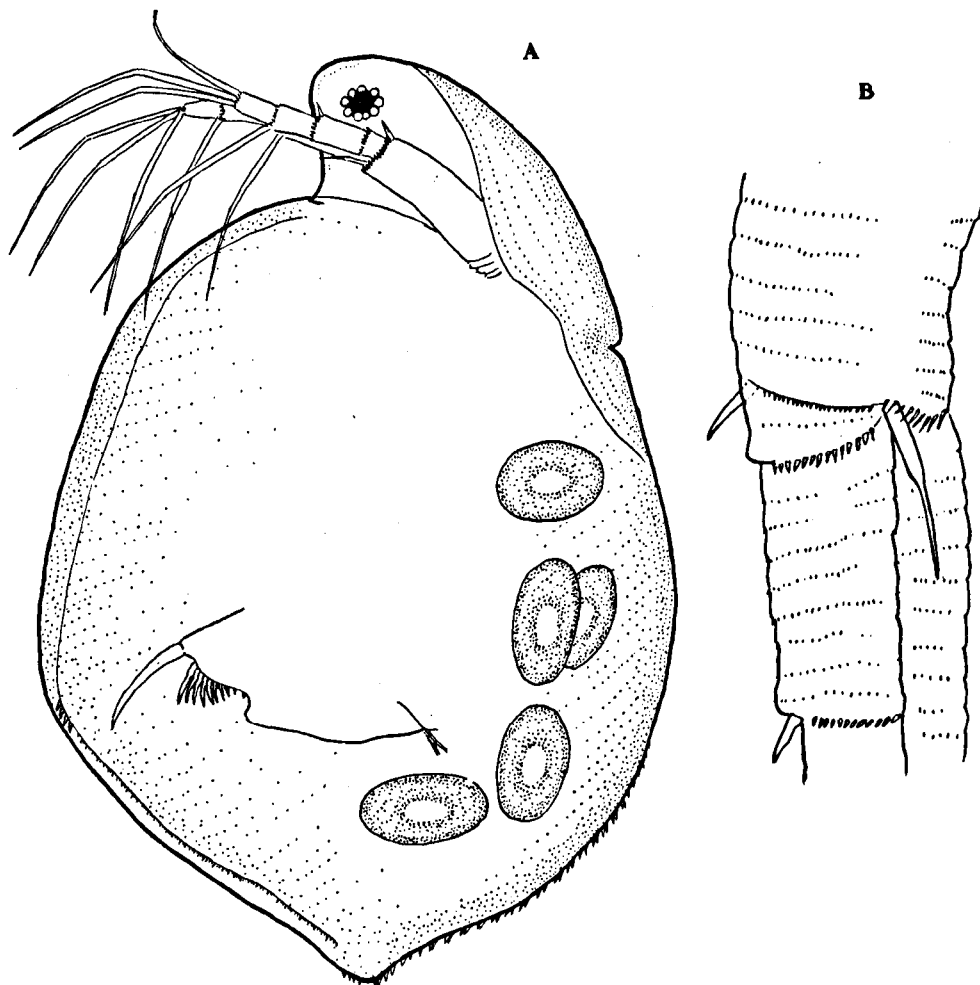


Fig. 24 *S. vetuloides*, lectotype, parthenogenetic female. A, general view, B, distal part of antenna basipod with a seta on outer side and a spine on inner side.

assign it to the genus *Simocephalus*. But their descriptions are insufficient. Some authors supposed *S. exspinosus* to be the junior synonym of *S. vetulus* (*Daphnia sima*) (Lievin, 1848; Baird, 1850). Lilljeborg (1900) was the first to describe this species appropriately.

S. australiensis was originally described insufficiently (Dana, 1852). Dana's collection with the type was lost on a ship which sank (D. Frey, personal communication through N.N. Smirnov). Sars is often supposed to be the author of this species (Negrea, 1983) because he is the first to describe it appropriately (Sars, 1888). He believed *S. australiensis* to be a separate species closely related with *S. exspinosus* and differing from it by 'the peculiar oblique form of the carapace and well-marked, though obtuse, projection of its posterior extremity; likewise too by the broad tail, and more especially by the highly characteristic armature of the caudal claws'. Dumont (1983) regards *S. australiensis* as a subspecies of *S. exspinosus*. Other authors regard it as a synonym (Flössner, 1972; Negrea, 1983; Margaritora, 1985; Michael & Sharma, 1988). I agree with the latter opinion, because the diagnostic characters used by Sars and Dana are rather variable and because all available specimens of the *S. (exspinosus)* species group from Australia do not differ from European *S. exspinosus*.

According to Sars (1898, 1903), *S. sibiricus* and *S. productus* differ from each other and from *S. exspinosus* in the head shape, the

size of the dorso-posterior valve prominence and the armature of the postabdominal claw. Manujlova (1964) mentions *S. sibiricus* as a separate, highly variable species. Judging from illustrations, she confuses two species under this name. *S. productus* is believed to be a synonym of *S. exspinosus* (Manujlova, 1964; Michael & Sharma, 1988). Investigation of the type has shown that *S. productus* and *S. sibiricus* do not differ from *S. exspinosus*. The frons shape varies from rounded to almost right-angled. The head height also varies within populations. Therefore these features cannot be diagnostic characters.

S. himalayensis is described from the Himalayas (Chiang & Du, 1979). The type is in China and I have not seen it. Reference to the original description and illustrations suggests that *S. himalayensis* is a synonym of *S. exspinosus*.

According to Rane (1985b), *S. vamani*, described from Jabalpur (India) differs from *S. exspinosus* in its moderate size, a comparatively small rostrum, and the presence of 6–7 denticles on the postabdomen near the insertion of the claw. This author also states that *S. austarliensis* differs from *S. vamani* in the upturned rostrum. According to my data, the group of 6–7 denticles near the claw occurs in all *Simocephalus* species and the size and orientation of the rostrum is subject to individual variability. The type is deposited in the National collection of the Zoological Survey of India (Calcutta).

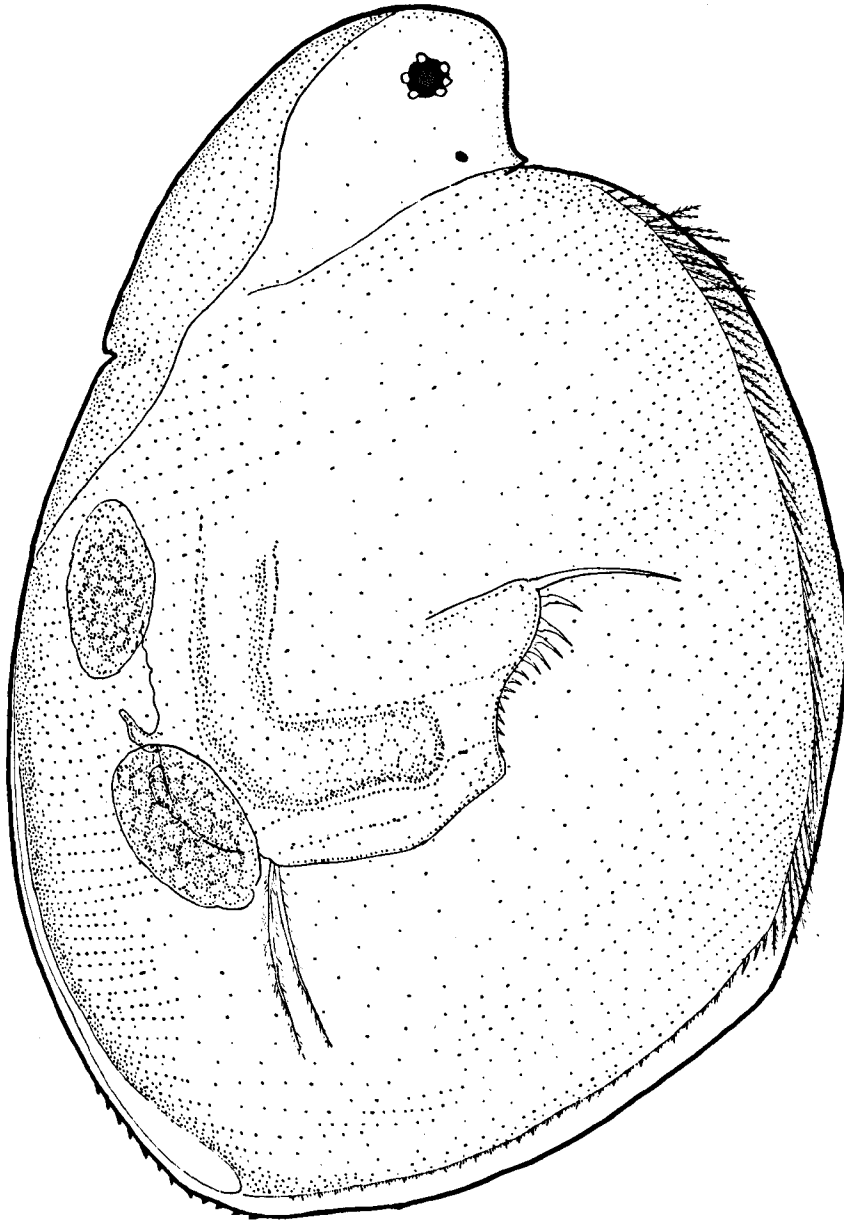


Fig. 25 *S. punctatus* sp. nov., holotype, parthenogenetic female.

Sharma & Sharma (1990) sink *S. vamani* into the synonymy of *S. exspinosus* on the base of the investigation of the type. I agree with them because all available specimens of the *S. (exspinosus)* group from India belong to *S. exspinosus*.

***S. congener* (Koch, 1841)**

Fig. 34

Daphnia congener Koch, 1841: 35; *Simocephalus congener*: Schödler, 1858: 20; Šrámek-Hušek *et al.*, 1962: 265; *S. exspinosus* var. *congener*: Lilljeborg, 1900: 177; *S. exspinosus*: Sars, 1888: 16; Flössner, 1972: 184.

TYPE MATERIAL. The types appear to be lost. Type locality not indicated in the original description. Probably it is in Germany.

MATERIAL EXAMINED. Russia, Moscow region, Ruza district, Terekhovskiy pond near Glubokoe lake, 29. 7. 1983, 29. 7. 1983, leg. Korovchinsky., 19. 8. 1989, leg. Orlova-Bienkowskaja: more than 20 ♀ ♀ ad., 20 ♀ ♀ juv., 10 ♀ ♀ e. Vicinity of the Lake Baikal, Maloe More, pool at the swamp, 19. 8. 1982, leg. Glagolev: 10 ♀ ♀ ad., 14 ♀ ♀ juv. Vicinity of the Lake Baikal, Proval, water-meadow at Oblom, 20. 8. 1982, leg. Glagolev: 2 ♀ ♀ ad. All series are in AC.

DIAGNOSIS. Measurements. ♀ ♀ ad.: 1.5–2.2mm, ♀ ♀ e.: 1.2–1.8mm. Female. (Fig. 34). 9–18 anal teeth. Prominence of dorso-posterior valve angle absent. Basal pecten of postabdominal claw of 20–25 small spines.

DISTRIBUTION. (Fig. 32) This species was previously confused with *S. exspinosus*, so its range needs to be redefined. It occurs with certainty in Central and Eastern Europe and Siberia.

REMARKS. The original description of *S. congener* is insufficient (Koch, 1841). Lilljeborg (1900) was the first to describe it appropriately, though this author believes this species to be a variety of *S. exspinosus*. Most authors suppose *S. congener* to be a synonym of *S. exspinosus* (Sars, 1888; Flössner, 1972; Margaritora, 1985; Sharma & Michael, 1988) or a variety (subspecies) (Behning, 1941). But Šrámek-Hušek *et al.* (1962) regard it as a separate species. I believe the latter opinion to be correct because there is a morphological hiatus between *S. exspinosus* and *S. congener* in the number and size of spines on the postabdominal claw. In addition, these species are sympatric in Europe.

S. (ACUTIROSTRATUS) species group

Female (Fig. 35). Frons pointed. Ventral head margin concave. Rostrum long. Setules on inner side of posterior valve margin thick. Dorso-posterior valve angle without prominence or with rounded prominence. Two supra-anal angles. Basal pecten of postabdominal claw of 10–15 large, close-set spines, which increase in size distally. Male. Unknown.

S. acutirostratus (King, 1853)

Fig. 35

Daphnia Elizabethae var. *acuti-rostrata* King, 1853b: 254; *Simocephalus acutirostratus*: Sars, 1896: 12; *S. paradoxus* Schödler, 1877; *S. vidyae* Rane, 1983: 154; *S. vidyae gajareae* Rane, 1986: 168.

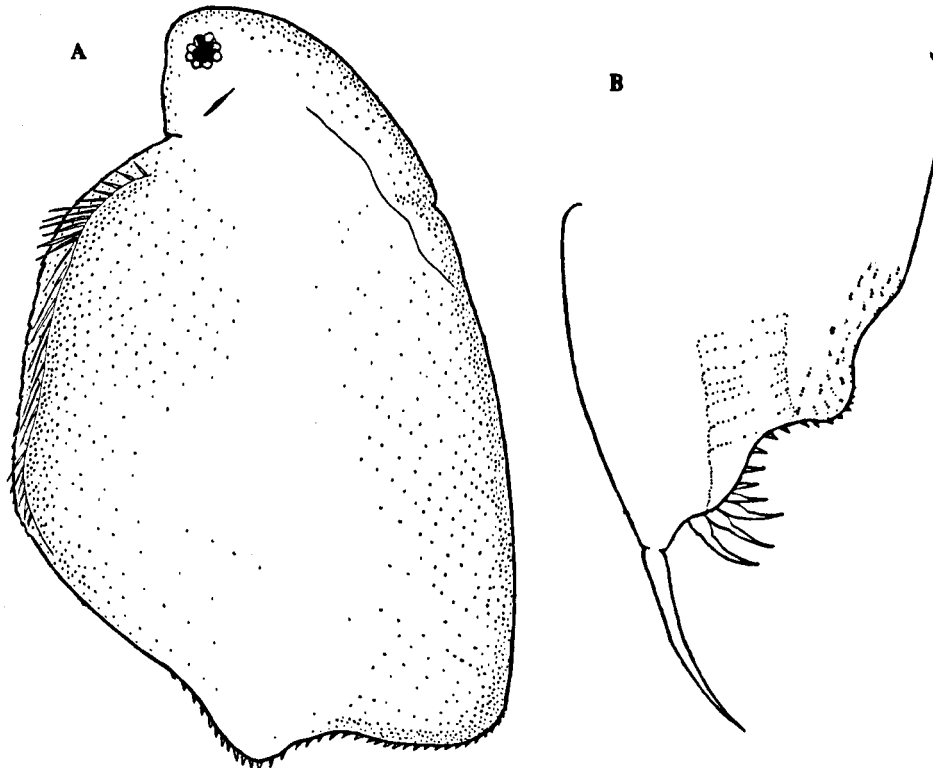


Fig. 26 *S. gibbosus*, lectotype, parthenogenetic female. A, lateral view, B, postabdomen.

TYPE MATERIAL. Type probably not indicated by King. Type locality: Australia, New South Wales, ponds in Denham Court.

MATERIAL EXAMINED. (Fig. 32) Australia, New South Wales, swamp 26km east of Cobar, 31°30'S 146°7'E, 12. 12. 1973, leg. Timms: more than 20 ♀ ♀ ad., 20 ♀ ♀ juv. New South Wales, Casino, 28°52'S 153°3'E, leg. Henry: ♀ ad. New Caledonia, dam near La Foa, 21°50'S 166°53'E, 8. 8. 1981, leg. De Deckker: ♀ juv. Queensland, pool at the road side, 30. 6. 1974: 2 ♀ ♀ ad., 5 ♀ ♀ juv. Queensland, Lake Lalilee, 22°19'S 145°51'E, 22. 4. 1984, leg. Timms: ♀ ad. Material in AM and AC.

DIAGNOSIS. Measurements. ♀ ♀ ad.: 1.0–3.0mm.

FEMALE. General body shape ovoid (Fig. 35). Frons with large sharp prominence. Dorso-posterior valve prominence distinct, separated above and below with shallow, wide depressions. Diameter of circle inscribed in it large. Dorsal margin with denticles. Proximal and distal supra-anal angles large, embayments of postabdomen deep, proximal angle rounded.

DISTRIBUTION. (Fig. 32) This species is reported from Australia (King, 1853b), Philippines (Mamaril & Fernando, 1978), India (Michael & Sharma, 1988), Sri-Lanka (Rajapaksa, 1981), China (Chiang & Du, 1979), Lake Tanganyika and Venezuela (Zoppi De Roa & Vasquez, 1991), but the name *S. acutirostratus* has been so often misused for other species that its range needs to be redefined. It occurs with certainty in Australia and South-East Asia.

REMARKS. This species was originally described as a variety of *S. elizabethae*. The types are obviously lost. The original description and illustration (King, 1853b), allow identification of this remarkable species with certainty. Sars (1896) gives *S. acutirostartus* the rank of a species.

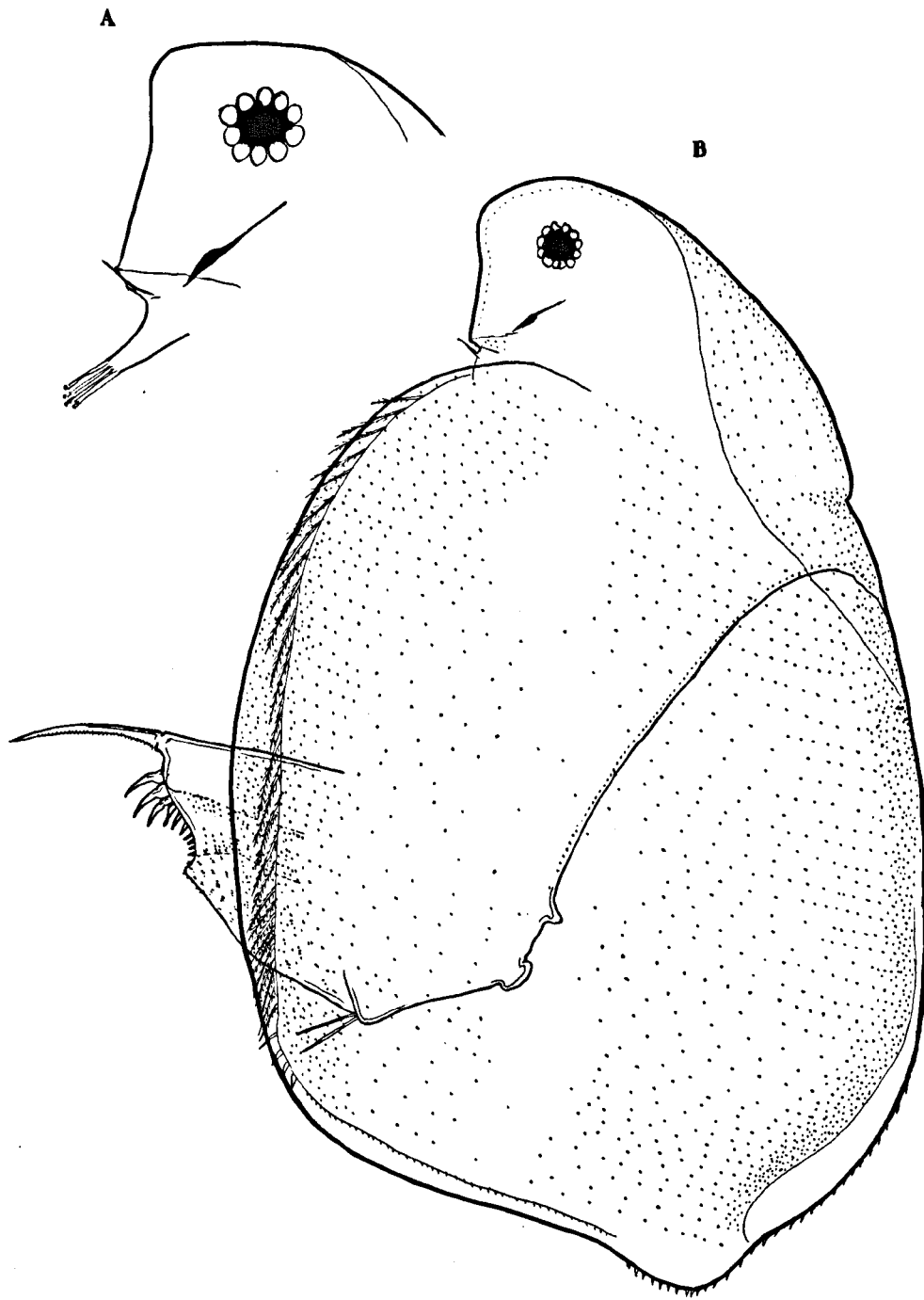


Fig. 27 *S. elizabethae*, parthenogenetic female. A, head, B, lateral view.

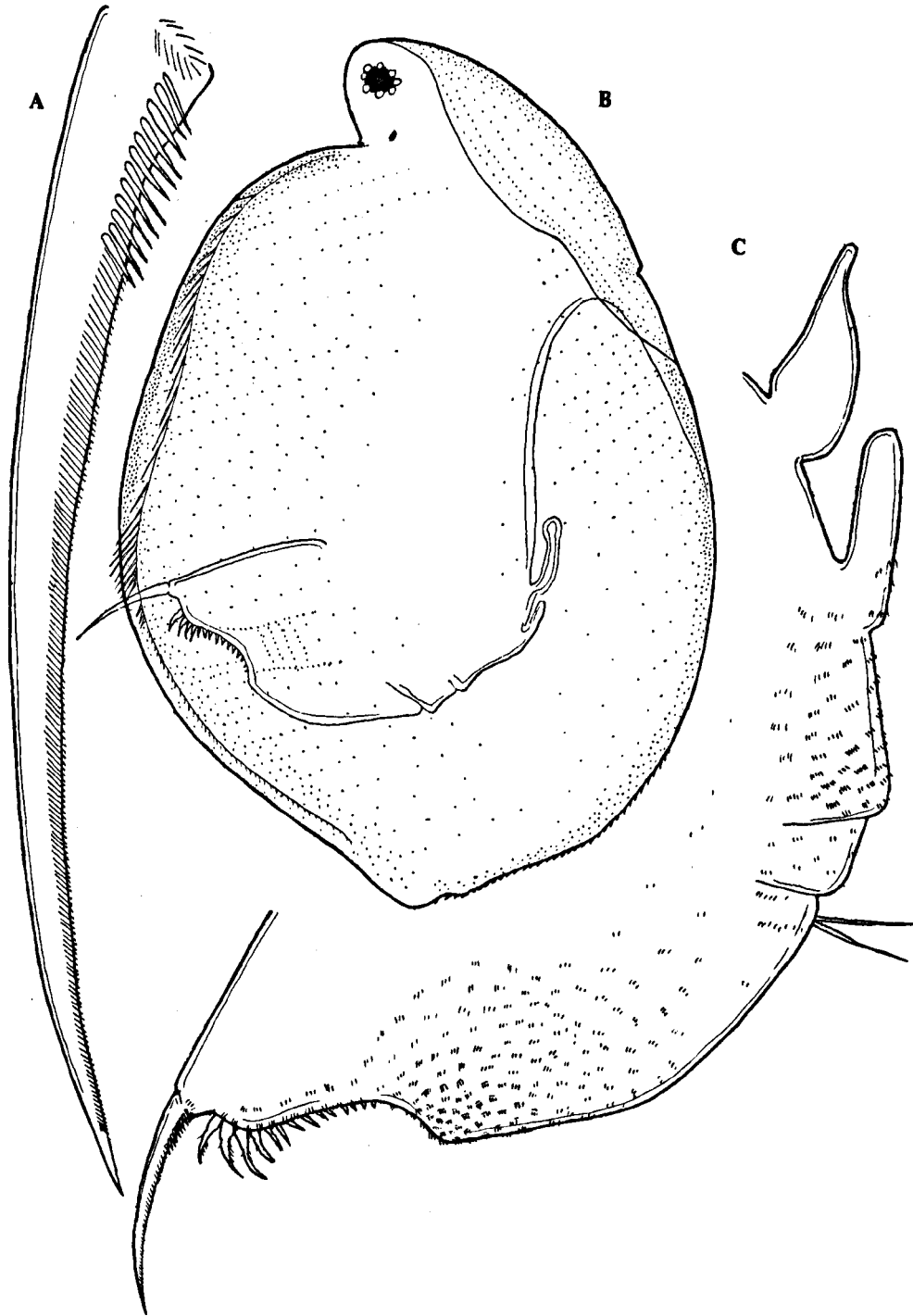


Fig. 28 *S. exspinosus*, parthenogenetic female. A, postabdominal claw, B, lateral view, C, postabdomen.

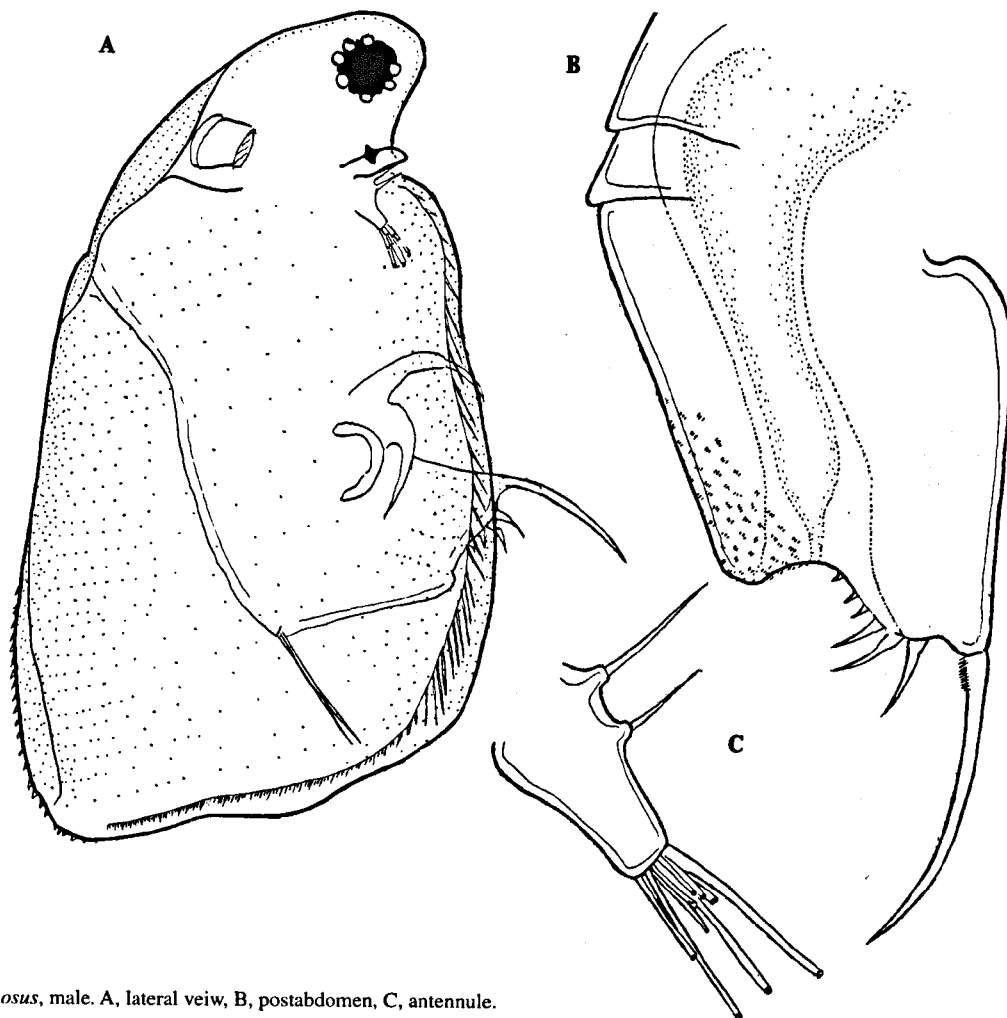


Fig. 29 *S. exspinosus*, male. A, lateral view, B, postabdomen, C, antennule.

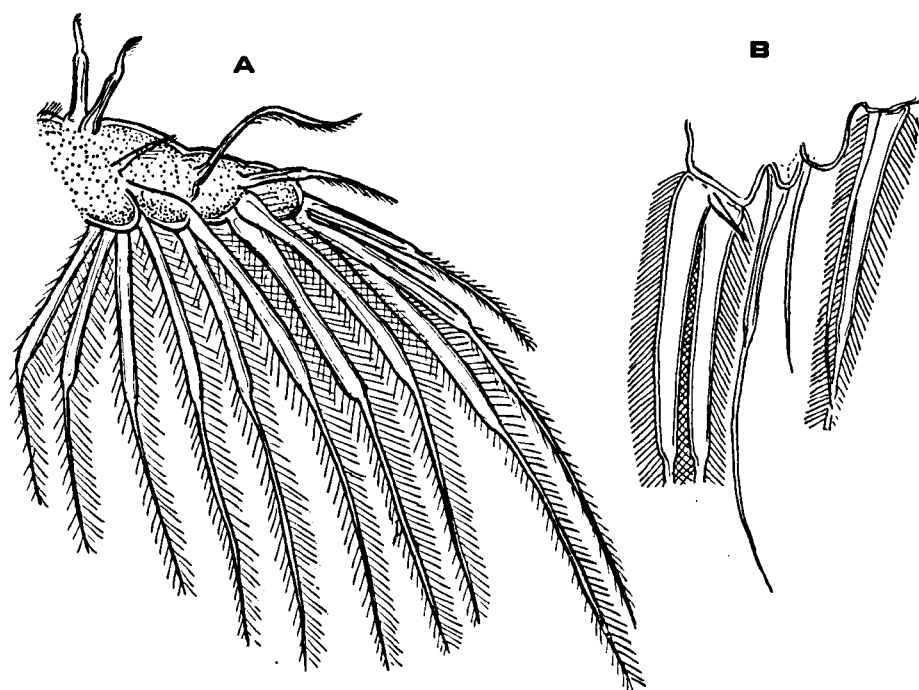


Fig. 30 *S. exspinosus* female, trunk limbs. A, 1st limb, B, endite of 2nd limb.

Schödler (1877) renamed *S. acutirostratus* as *S. paradoxus*. Consequently, the latter name is an objective junior synonym of the former.

S. vidyae Rane and *S. vidyae gajareae* Rane were described from Jabalpur (India). The descriptions (Rane, 1983, 1986) are very detailed and provided with excellent illustrations, but do not contain any characters which differentiate these taxa from *S. acutirostratus*. The types are deposited in the National collection of the Zoological Survey of India (Calcutta). Sharma & Sharma (1990) sink both names into the synonymy of *S. acutirostratus* on the basis of investigation of these types.

S. victoriensis Dumont, 1983

Fig. 36

Simocephalus acutirostratus: Haase, 1903: 150 (partim); *S. victoriensis* Dumont, 1983: 105.

TYPE MATERIAL. Holotype: Australia, Victoria, temporary pool 7km W of Edenkope, 37°2'S 141°17'E, 19. 10. 1978, leg. Morton: PVAS: ♀ ad. (AM, P31316).

MATERIAL EXAMINED. (Fig. 32) Holotype and other specimens:

Australia, New South Wales, a lake near Cooma, 12. 5. 1975: 4 ♀ ♀ ad., 12 ♀ ♀ juv. Lake Maffa, 13. 5. 1975: 3 ♀ ♀ ad., 10 ♀ ♀ juv. South Australia, Tatiara, 4km N of Bordertown, 6. 11. 1979, leg. Zeidler: 5 ♀ ♀ ad., ♀ juv. A lake on Nimakel-Bumbala road, 14. 5. 1975: 8 ♀ ♀ ad., 2 ♀ ♀ juv. The material is in SAM and AC.

DIAGNOSIS. Measurements. ♀ ♀ ad.: 1.0–3.0mm.

Female (Fig. 36). General body shape rounded. Frons with small rounde prominence separated above and below with depressions. Dorso-posterior valve prominence absent. Diameter of circle inscribed in dorso-posterior valve angle very large. Dorsal margin without denticles. Proximal and distal supra-anal angles small, embayments of postabdomen shallow, proximal angle rounded.

DISTRIBUTION. (Fig. 32) Australia: New South Wales, South Australia, Victoria.

REMARKS. There is no doubt that *S. victoriensis* and *S. acutirostratus* are separate species because they are sympatric and differ markedly from each other.

Judging from illustration made by Haase (1903), the author examined specimens of *S. victoriensis* but erroneously identified them as *S. acutirostratus*.

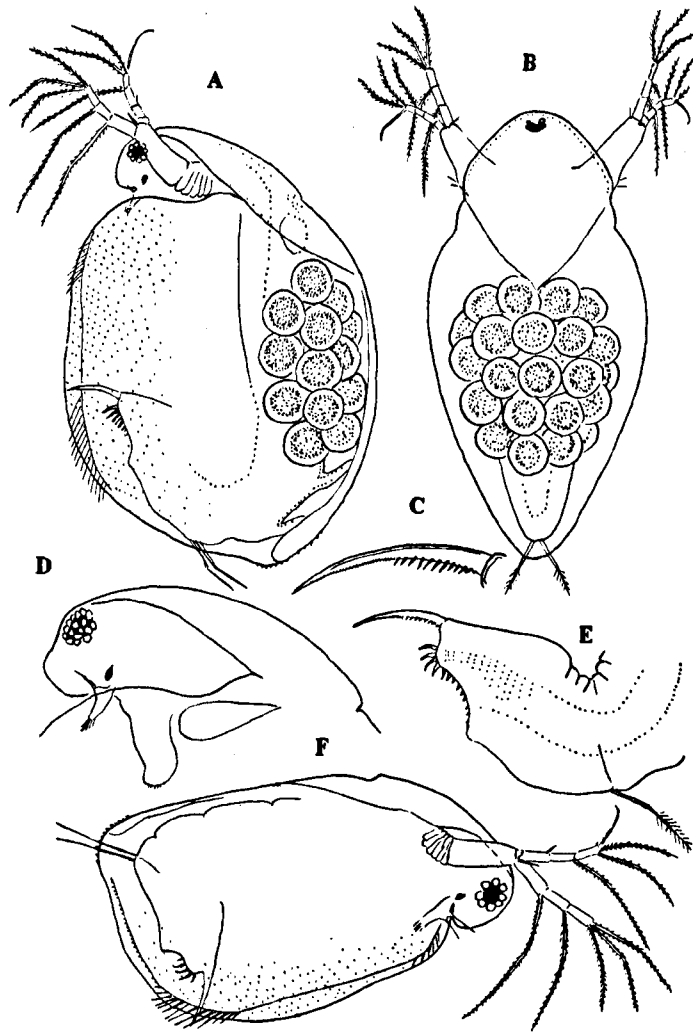


Fig. 31 *S. obtusatus* (after Sars, 1894). A, parthenogenetic female, lateral view, B, parthenogenetic female, dorsal view, C, postabdominal claw, D, head, E, postabdomen, F, male.

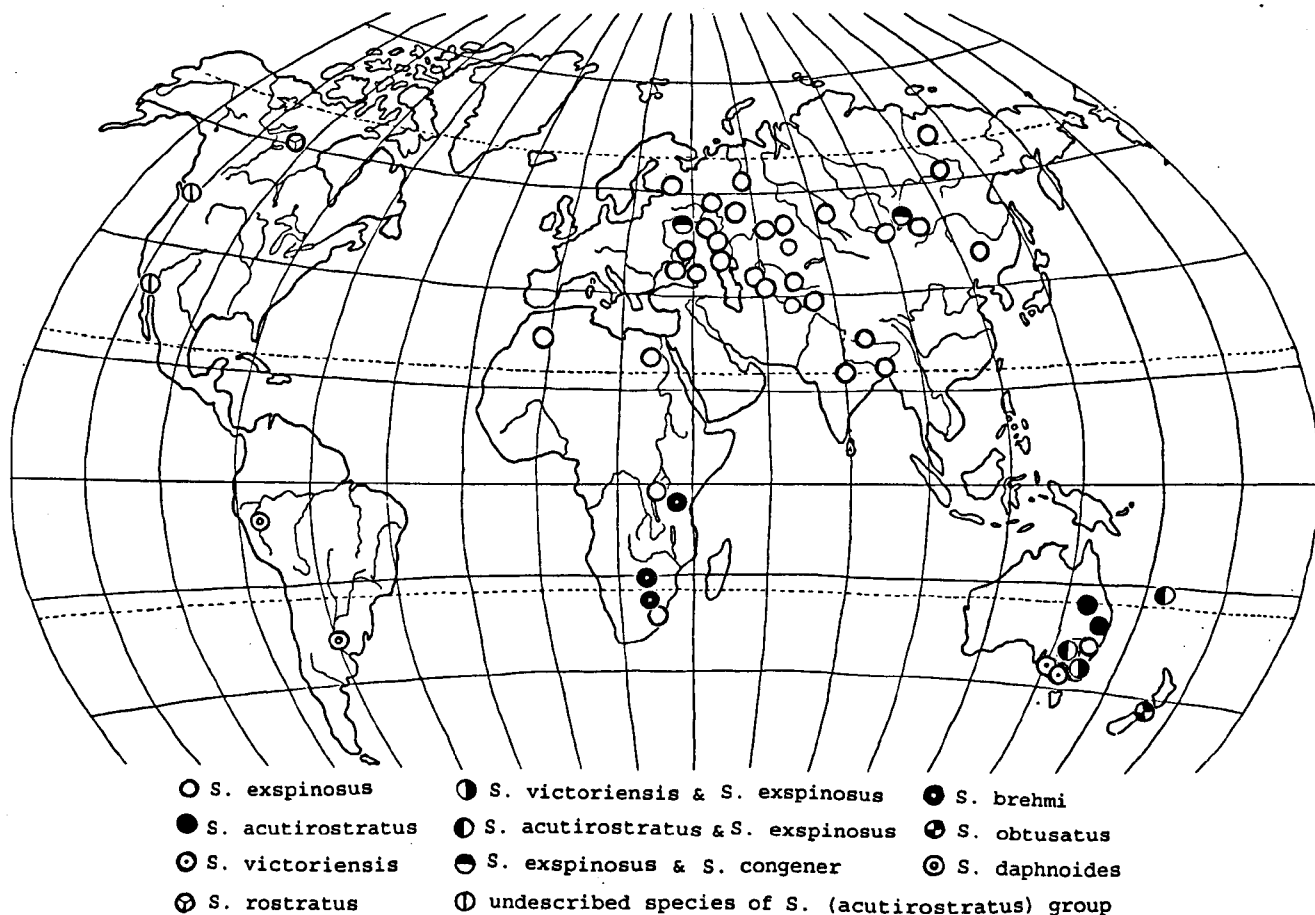


Fig. 32 Locations, where studied material of *S. (Echinocaudus)* was collected.

S. brehmi Gauthier, 1939 stat. nov.

Fig. 37

Simosa acutirostrata brehmi Gauthier, 1939: 144; *Simocephalus acutifrons* Johnson, 1954: 954 syn. nov.

TYPE MATERIAL. Types (5 ♀ ad.) were in Gauthier's collection before it was nationalized by the Algerian government. There is no information about the place, where this collection is now (Hudec, 1993).

MATERIAL EXAMINED. (Fig. 32) Type material of junior synonym *S. acutifrons* Johnson. Holotype: South Africa, Kempton Park, Johannesburg: MPA: ♀ ad. (BMNH). Paratype collected with holotype: MPA: ♀ ad. (BMNH). Other specimens: Tanzania, Mt Hanang: 23 ♀ ad., 2 ♀ juv. (MCA). Southern Rhodesia, Plumtree, 7. 2. 1954: 4 ♀ ad., ♀ e., 2 ♀ juv. (ZICC).

DIAGNOSIS. Measurements. ♀ ad.: 1.0–3.0mm. Female (Fig. 37). General body shape ovoid. Frons with small obtuse prominence not separated above and below by depressions. Dorso-posterior valve prominence distinct, separated above and below by deep, wide depressions. Diameter of circle inscribed in it moderate. Dorsal margin with denticles. Proximal and distal supra-anal angles large, embayments of postabdomen deep, proximal angle sharp.

DISTRIBUTION. (Fig. 32) Vicinity of Lake Chad, Southern Rhode-

sia, Tanzania, South Africa. This species is also reported from Brasil by Brehm (Gauthier, 1939). Unfortunately, no specimen of this species group from South America is available and it is impossible to confirm or to disprove this report.

REMARKS. *S. brehmi* differs from *S. acutirostratus* in the shape of the valves and postabdomen. These forms are allopatric, so the question of specific or subspecific rank of *S. brehmi* is difficult, but I take *S. brehmi* to be a separate species because the differences between it and *S. acutirostratus* are not less than those between other species in this group.

S. acutifrons, described from Johannesburg (South Africa), is identical to *S. brehmi*, judging by the examined type material. Johnson (1954) does not point out any characters which distinguish his species from *S. brehmi* and *S. acutirostratus*.

S. rostratus Herrick, 1884

Fig. 38

Simocephalus rostratus Herrick, 1884.

TYPE MATERIAL. The type is probably lost, like those of other species described by Herrick (D. Frey, personal communication through N.N. Smirnov).

MATERIAL EXAMINED. (Fig. 32) Canada, Waterloo National Park, 15. 9. 1972, leg. Smirnov: 10 ♀ ad., 10 ♀ juv. (AC).

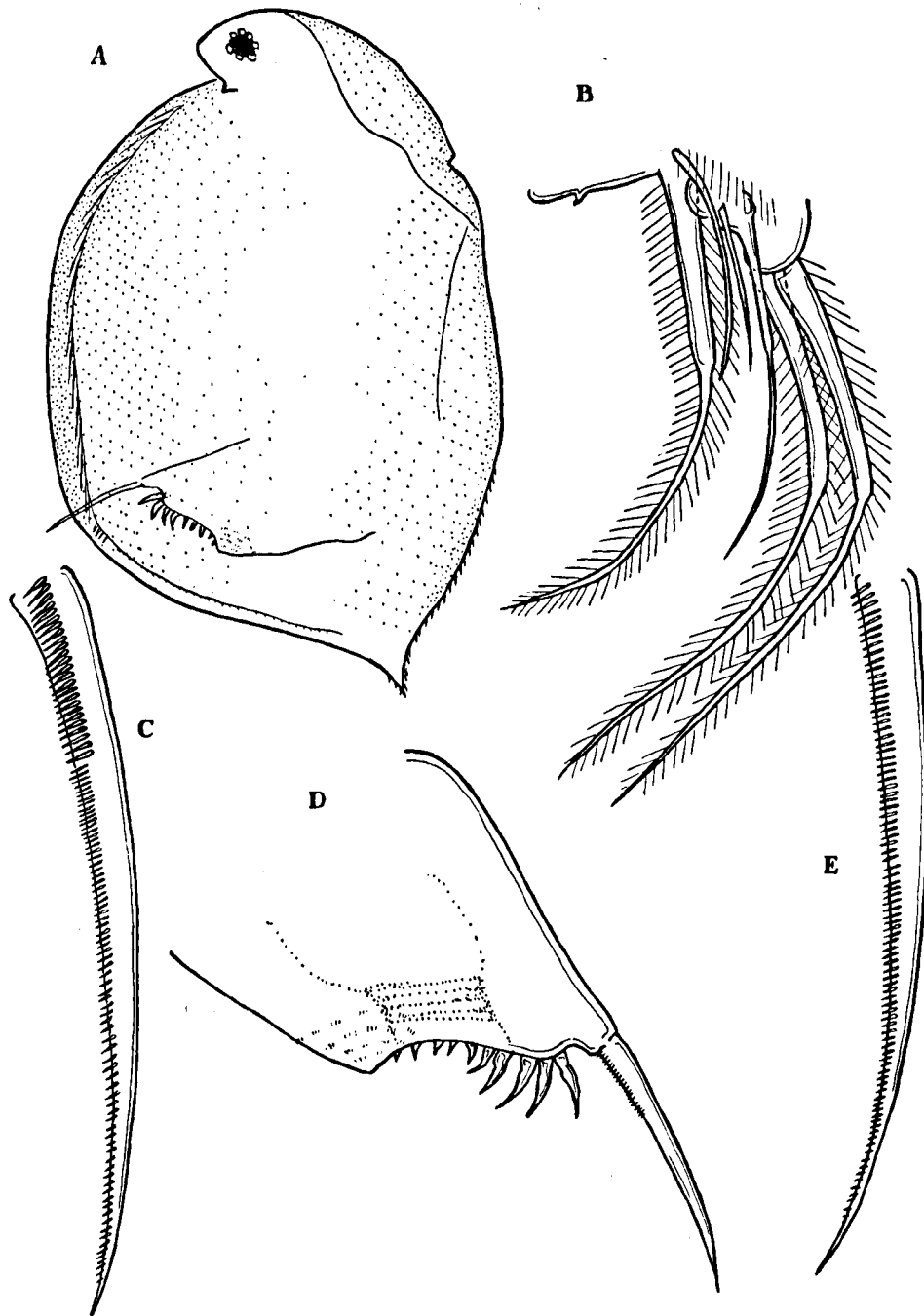


Fig. 33 *S. daphnoides*, parthenogenetic female. A, lateral view, B, endite of 2nd trunk limb, C, outer side of postabdominal claw, D, postabdomen, E, inner side of postabdominal claw.

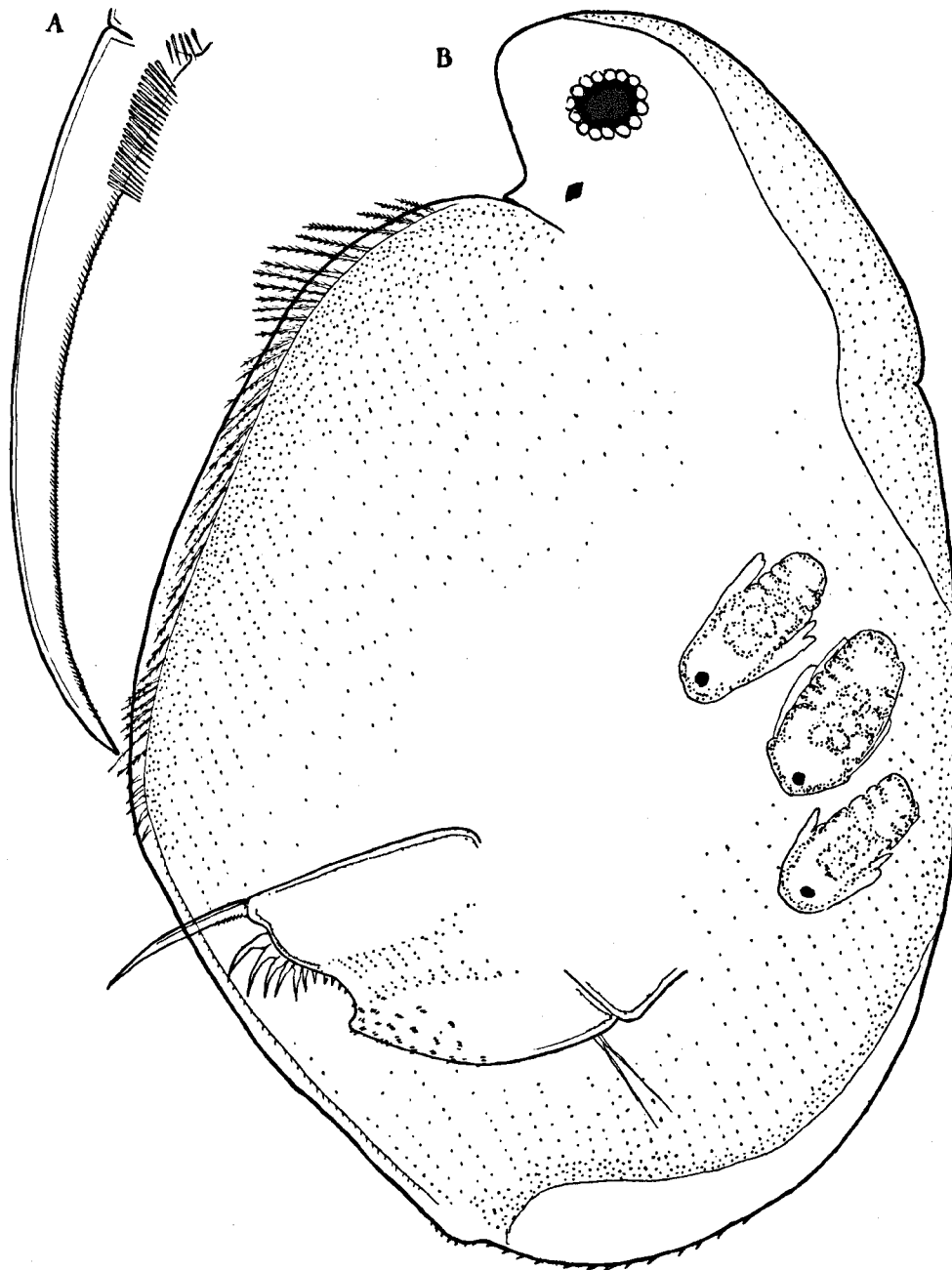


Fig. 34 *S. congener*, parthenogenetic female. A, postabdominal claw, B, lateral view.

DIAGNOSIS. Measurements. ♀♀ ad.: 1.0–3.0mm. Female (Fig. 38). General body shape ovoid. Frons with small obtuse prominence not separated above and below by depressions. Dorso-posterior valve prominence distinct, separated above and below by deep depressions. Dorsal margin with denticles. Diameter of circle inscribed in it small. Proximal and distal supra-anal angles small, embayments of postabdomen shallow, proximal angle rounded.

DISTRIBUTION. (Fig. 32) U.S.A., Canada.

REMARKS. The original description of this species is not provided with an illustration (Herrick, 1884). It is evident from the description that it is closely related with *S. acutirostratus*. 'The spine is as

in *S. americanus*' (*S. serrulatus*) and 'the head is produced below the eyes in an angle, like a right angle, which is not spiny'. I had serious doubt about the taxonomical state of this taxon (Orlova-Bienkowskaja, 1993), because there were no other records of *S. (acutirostratus)* species group from North America. The examination of specimens from Canada has shown that they belong to this group and differ from *S. acutirostratus*, *S. victoriensis* and *S. brehmi* in the shape of the dorso-posterior valve angle. Obviously, they belong to *S. rostratus*.

There is one undescribed species of *S. (acutirostratus)* group in North America. I have about forty specimens of this species from California and Washington, but I do not name this new species

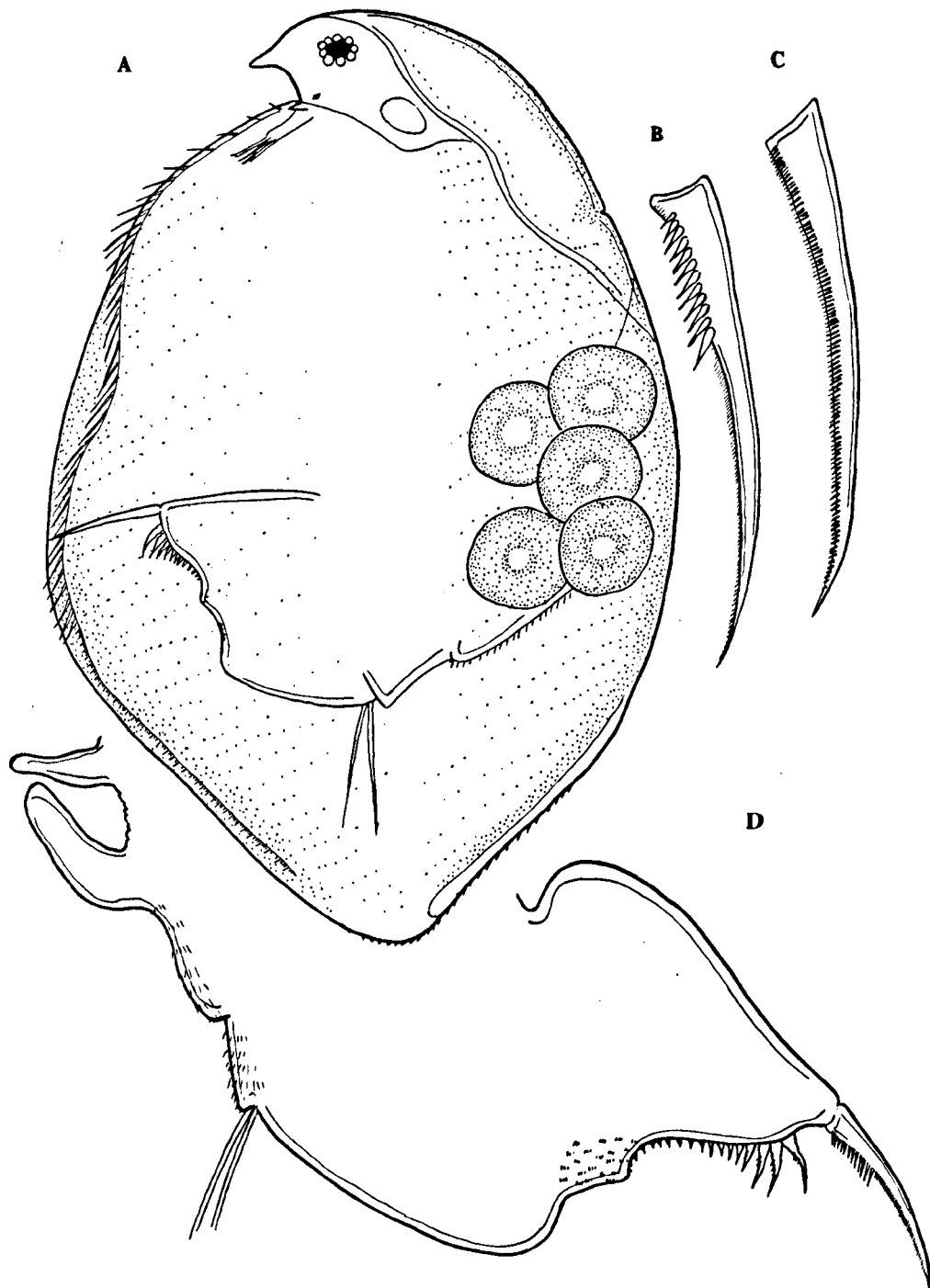


Fig. 35 *S. acutirostratus*, parthenogenetic female. A, lateral view, B, outer side of postabdominal claw, C, inner side of postabdominal claw, D, postabdomen and abdomen.

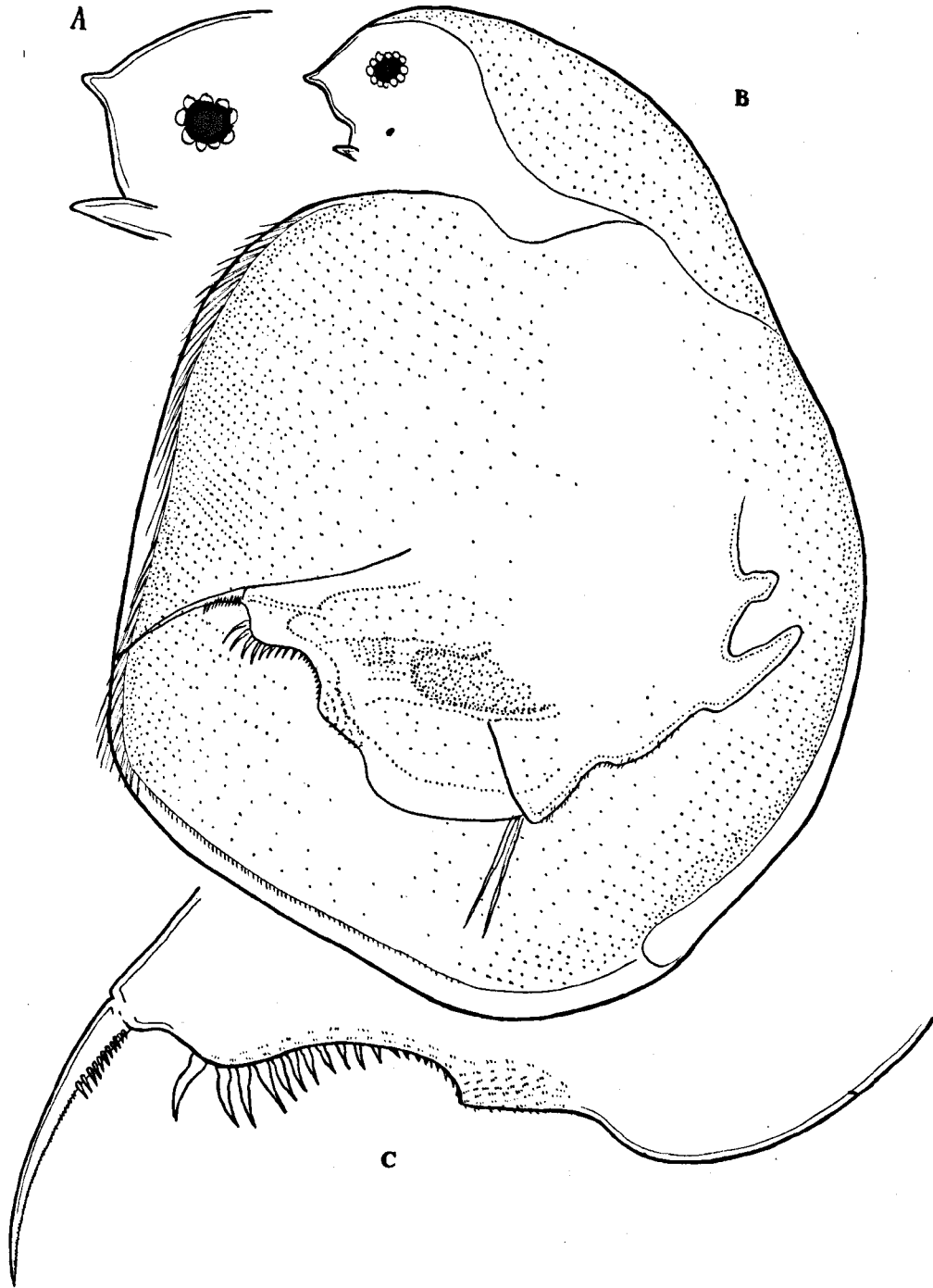


Fig. 36 *S. victoriensis*, parthenogenetic female. A, head, B, lateral view, C, postabdomen.

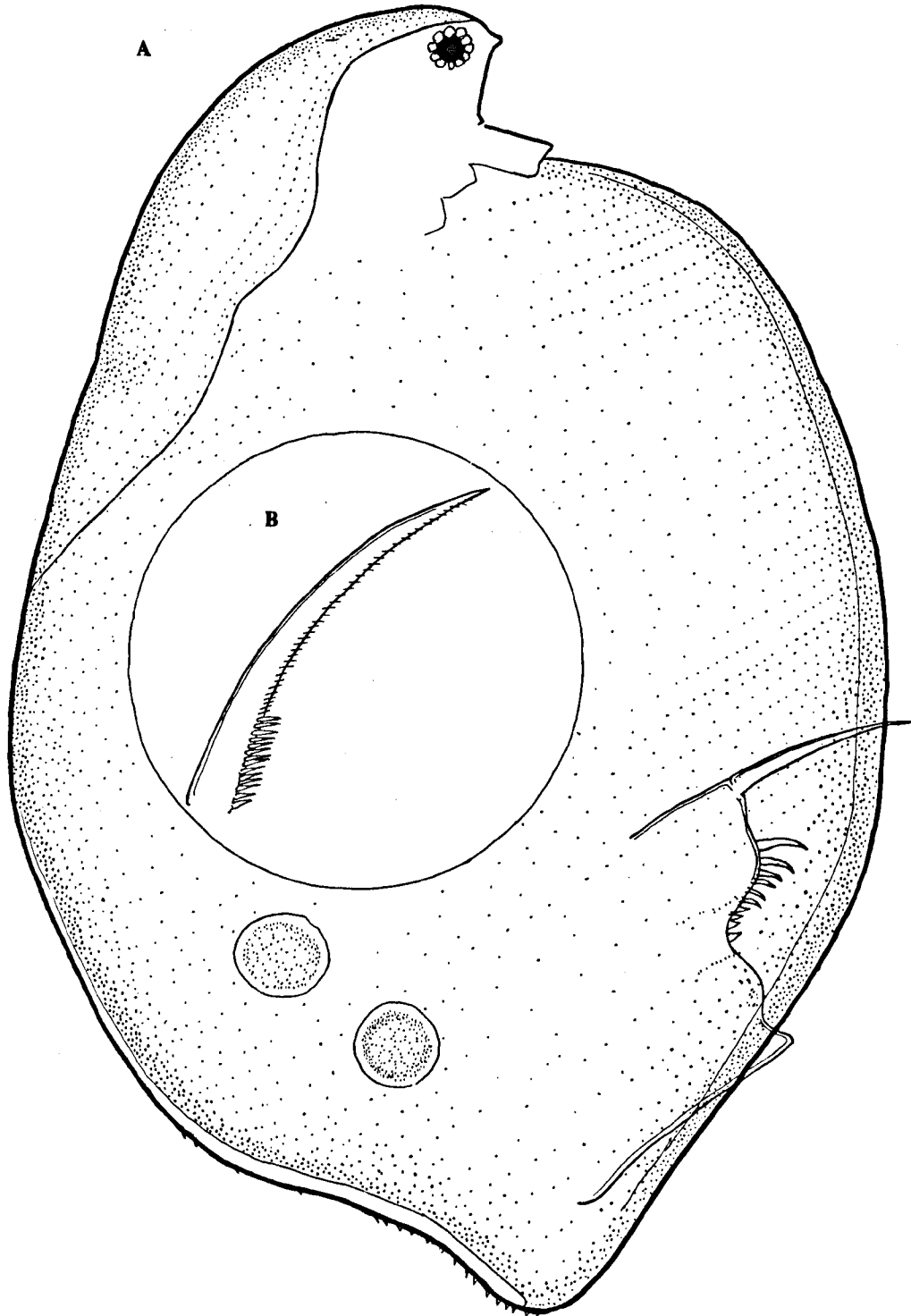


Fig. 37 *S. brehmi*, parthenogenetic female. Holotype of *S. acutifrons* = *S. brehmi*. A, lateral view, B, postabdominal claw.

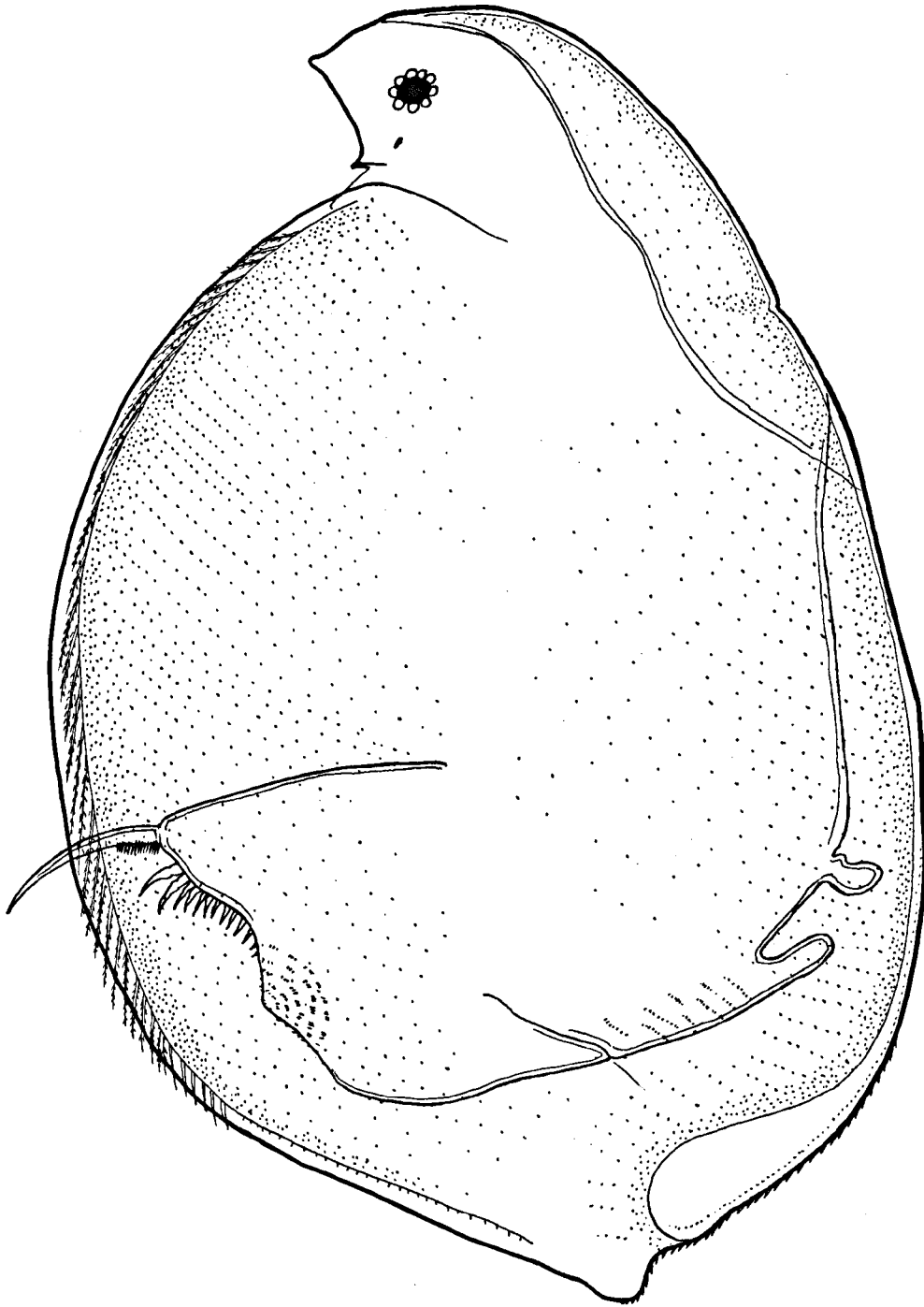


Fig. 38 *S. rostratus*, parthenogenetic female.

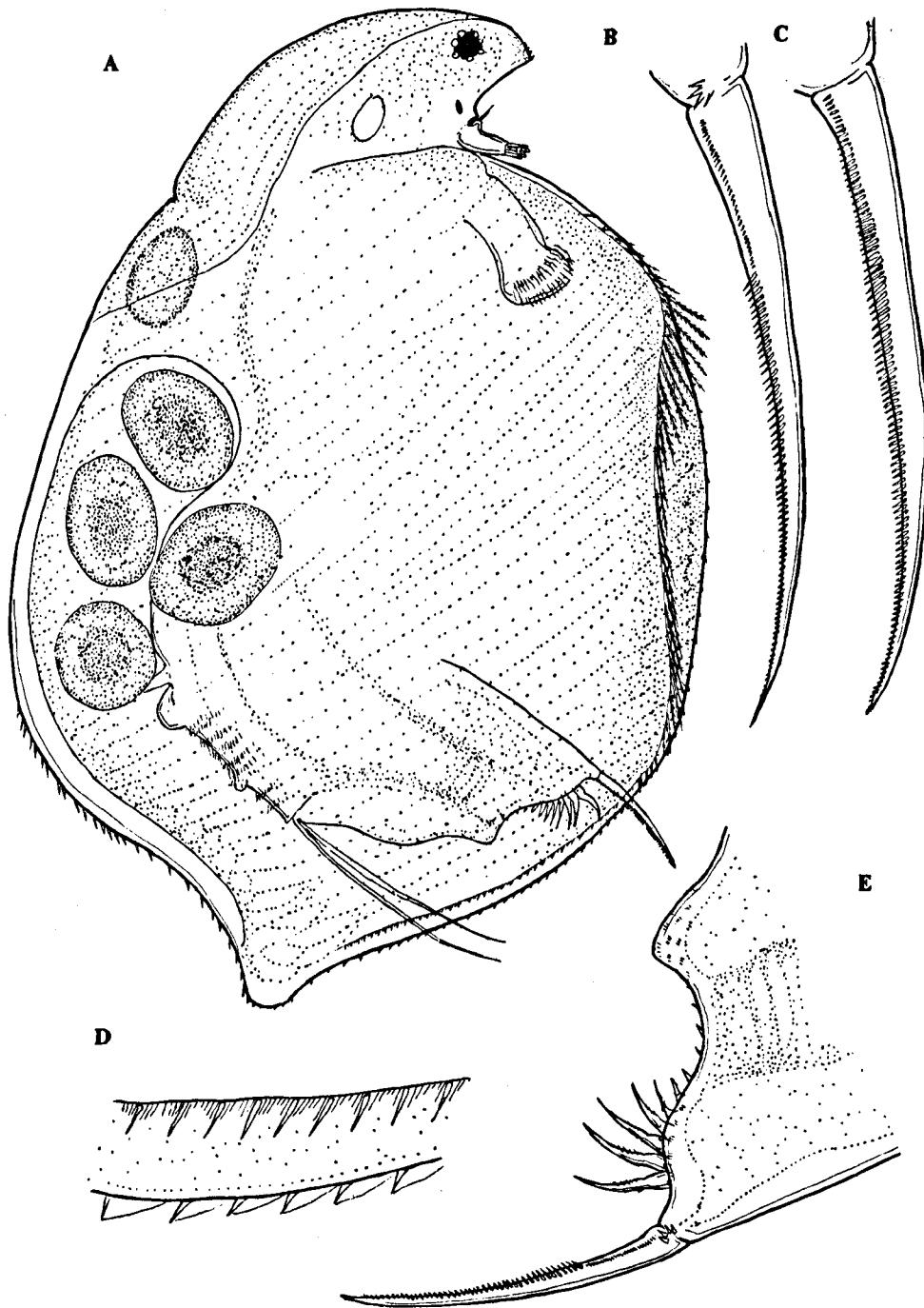


Fig. 39 *S. serrulatus*, parthenogenetic female. A, lateral view, B, outer side of postabdominal claw, C, inner side of postabdominal claw, D, setules of posterior valve margin, E, distal part of postabdomen.

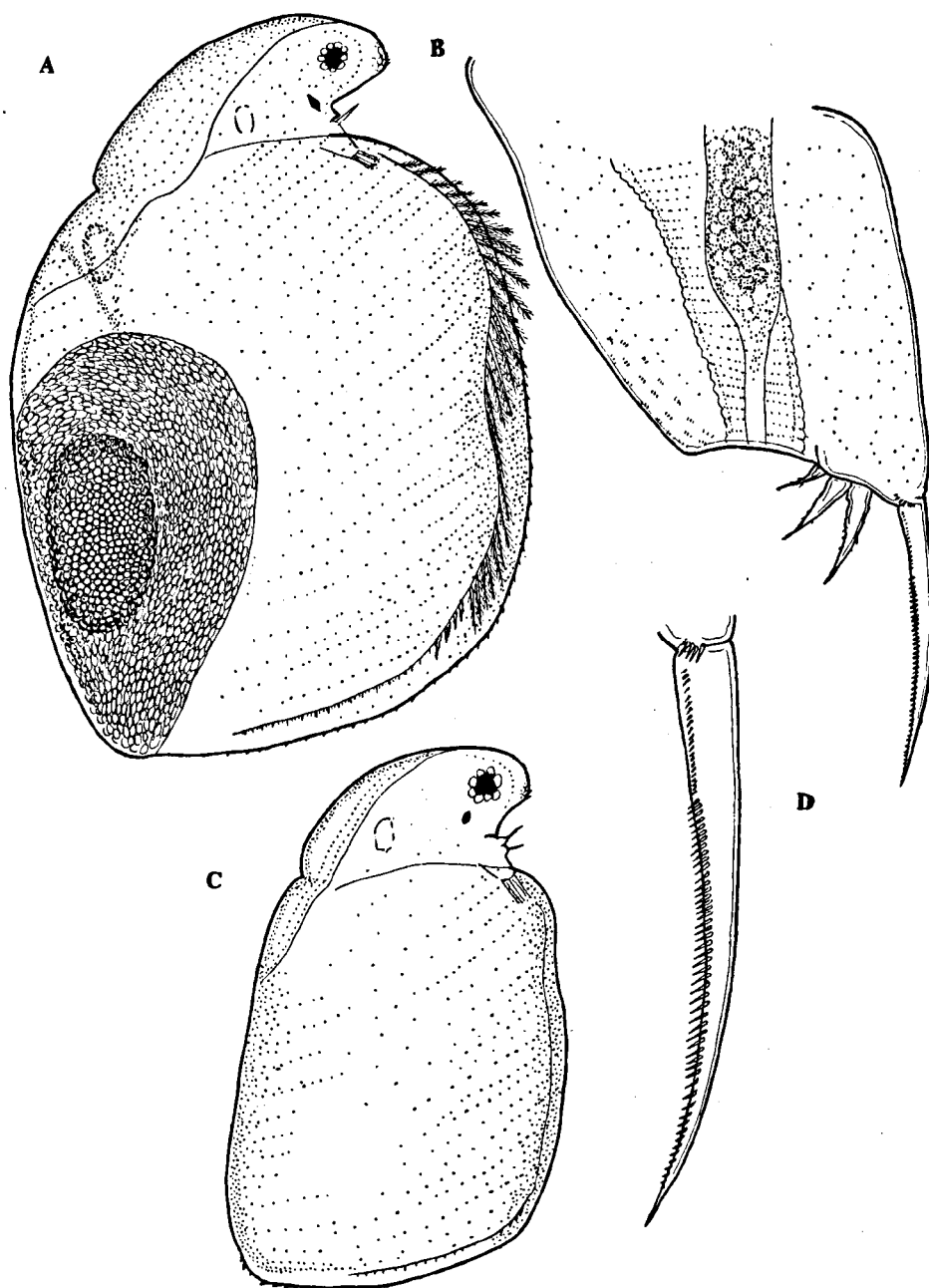


Fig. 40 *S. serrulatus*. A, ehippial female, B, postabdomen, male, C, male, D, outer side of male postabdominal claw.

because it was originally discovered by B. Hann (D. Berner, personal communication) and she has already started working on its description.

This species undoubtedly belongs to the *S. (acutirostratus)* species group because its frons is pointed, without denticles, and its postabdomen has two supra-anal angles. It differs from *S. acutirostratus*, *S. brehmi* and *S. rostratus* in the absence of a dorso-posterior valve prominence and from *S. victoriensis* in the shape of the postabdomen and head.

Subgenus *S. (Coronocephalus)* Orlova-Bienkowskaja, 1995

TYPE SPECIES. *Simocephalus serrulatus* (Koch, 1841).

DIAGNOSIS. Both sexes (Figs 39–42). Frons right-angled, with denticles (*S. serrulatus*, *S. semiserratus*) or without them (*S. mirabilis*). Head shield without depression. Head pores absent. Insertion of antennules at end of rostrum. Antennule short in correspondence with short rostrum, with transversal ridges covered with denticles on inner side. Aesthetes shorter than base of antennule. Postabdominal claw with spines on proximal part of outer side and on inner side. Basal part of outer side with fine setules. Anal bay of postabdomen narrow, rounded, with anal teeth. Female. Dorso-posterior valve angle with rounded prominence. Valves without dorsal keel. Posterior corner of ehippium without protuberance. Ocellus short (*S. serrulatus* and *S. semiserratus*), or elongate (*S. mirabilis*). Setae of 2nd and 3rd endite prominence of

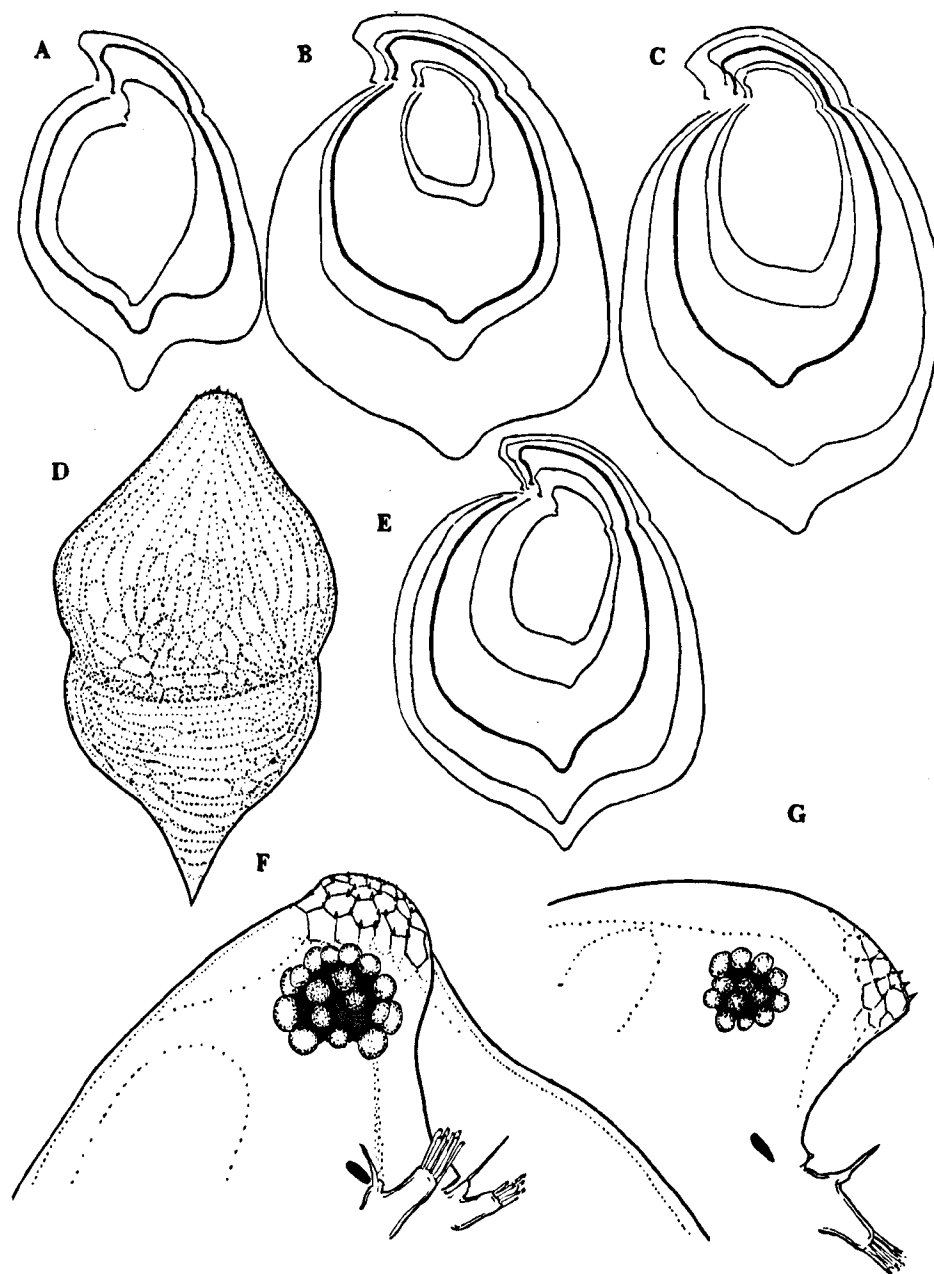


Fig. 41 *S. serrulatus*, parthenogenetic female. A – C, E, interpopulational and age variability, A, type series of *S. serrulatus* var. *montenegrinus* (Montenegro), B, series from the vicinity of Vladivostok, C, type series of *S. capensis*, E, series from Taimyr, D, head shield, dorsal, F – head, ventral, G, head, lateral.

2nd trunk limb as long as 0.3 and 0.9 or 0.6 and 0.4 of basal segment of plumose seta of 1st prominence respectively. Postabdomen with 9–15 anal teeth on each side. Supra-anal angle rounded. Male. Supra-anal angle rounded. Vas deferens opening in middle of anal bay. Postabdomen with 3–5 anal teeth on each side. Dorsoposterior valve angle with small rounded prominence. There is no morphological hiatus between males of *S. serrulatus* and *S. semiserratus*. The male of *S. mirabilis* is unknown, so only the females of these species are described.

ETYMOLOGY. The name '*Coronocephalus*' is derived from the words '*corona*' – 'crown' and '*cephalon*' – 'head' and refers to spines on the head that are typical of this subgenus.

REMARKS. The subgenus consists of three species: *S. serrulatus*, *S. semiserratus* and *S. mirabilis* sp.nov. The first is distributed world-wide. Statistical analysis of its variation (Orlova-Bienkowskaja, 1995a) has revealed that it has no geographical races and that there is a morphological hiatus between *S. serrulatus* and *S. semiserratus* in two pairs of independent metric characters. In addition, these species differ from each other in the number of denticles on the valve margin. *S. serrulatus* and *S. semiserratus* are sympatric in South America. Therefore, they are not subspecies but separate species. *S. mirabilis* differ from *S. serrulatus* and *S. semiserratus* in having an elongate ocellus and in the absence of denticles on the frons.

S. serrulatus (Koch, 1841)

Figs 39–42

Daphnia serrulata Koch, 1841: 35; *D. brandtii* Fischer, 1848: 177; *D. intermedia* Lievin, 1848: 29; *Simocephalus serrulatus*: Schödler, 1858; *Simocephalus americanus* Birge, 1878; *S. capensis* Sars, 1895: 15; *S. inflatus* Vávra, 1900: 12; *S. serrulatus* var. *productifrons* Stingelin, 1904: 57; *S. serrulatus* var. *montenegrinus* Werestchagin, 1912: 7; *S. serrulatus* var. *mixta* Grochmalicki, 1915: 220 (nec *S. mixtus* Sars, 1903); *S. serrulatus* var. *rotundifrons* Brehm, 1933: 54; *S. kerhervei* Bergamin, 1939: 63; *S. aqua-brankai* Bergamin, 1939: 64; *S. serrulatus* var. *armata* Brehm, 1956: 221; *S. serrulatus* var. *pelagicus* Brehm, 1959; *S. surekhae* Rane, 1985a: 159.

TYPE MATERIAL. The types appear to be lost. No type locality is indicated in the original description. Probably it is in Germany.

MATERIAL EXAMINED. (Fig. 43) Type material of junior synonyms: *S. serrulatus montenegrinus* Werestchagin, 1912: Lectotype (designated by Orlova-Bienkowskaja (1995a)): Montenegro, Lake Scutari, 15. 6. 1911, leg. Werestchagin: MPA: ♀ ad. (ZICC, 7085). Paralectotypes collected with lectotype: MPA: 3 ♀ ad., ♀ juv (ZICC, 7085, 7086), Montenegro, vicinity of Rijeka, leg. Werestchagin: CBS: 2 ♀ ad., 2 ♀ juv. (ZICW). *S. capensis* Sars, 1895: Lectotype (designated by Orlova-Bienkowskaja (1995a)):

South Africa, Knysna, hatched from dry ephippia: MPA: ♀ ad. (ZMO, F 18357). Paralectotypes collected with lectotype: MPA: 15 ♀ ad., 10 ♀ juv., 8 ♀ e. (ZMO, F 18357), 16 ♂♂ (ZMO, F 183578). Other specimens: about 1500 specimens (♀ ad., ♀ juv., ♀ e. and ♂♂) from Russia, Kazakhstan, China, India, Bangladesh, Vietnam, Burkina Faso, Central Africa, Niger, Nigeria, Mauritania, Sudan, Canada, U.S.A., Guatemala, Nicaragua, Argentina, Brasil, Australia (ZICW, ZIPD, AM, AC). More precise geographical data have been published previously (Orlova-Bienkowskaja, 1995a).

DIAGNOSIS. Measurements. ♀ ad.: 1.0–2.0mm, ♀ e. 1.0–1.5mm, ♂♂: 0.7–1.0mm.

Female. Dorso-posterior valve prominence large, separated from the rest of valves by deep embayment. Its length exceeds the diameter of a circle inscribed in its contour. Denticles cover the ventral, posterior and more than 1/3 of the dorsal margin. Ocellus short. Frons with denticles. Setae of 2nd and 3rd endite prominence of 2nd trunk limb as long as 0.3 and 0.9 of the basal segment of plumose seta of 1st prominence respectively.

DISTRIBUTION. (Fig. 43) Europe, Asia, Africa, North America, South America, Australia.

REMARKS. Fig. 41 shows the interpopulational variability of head height, and size and shape of the dorso-posterior valve angle. A number of subspecies and even separate species have been described

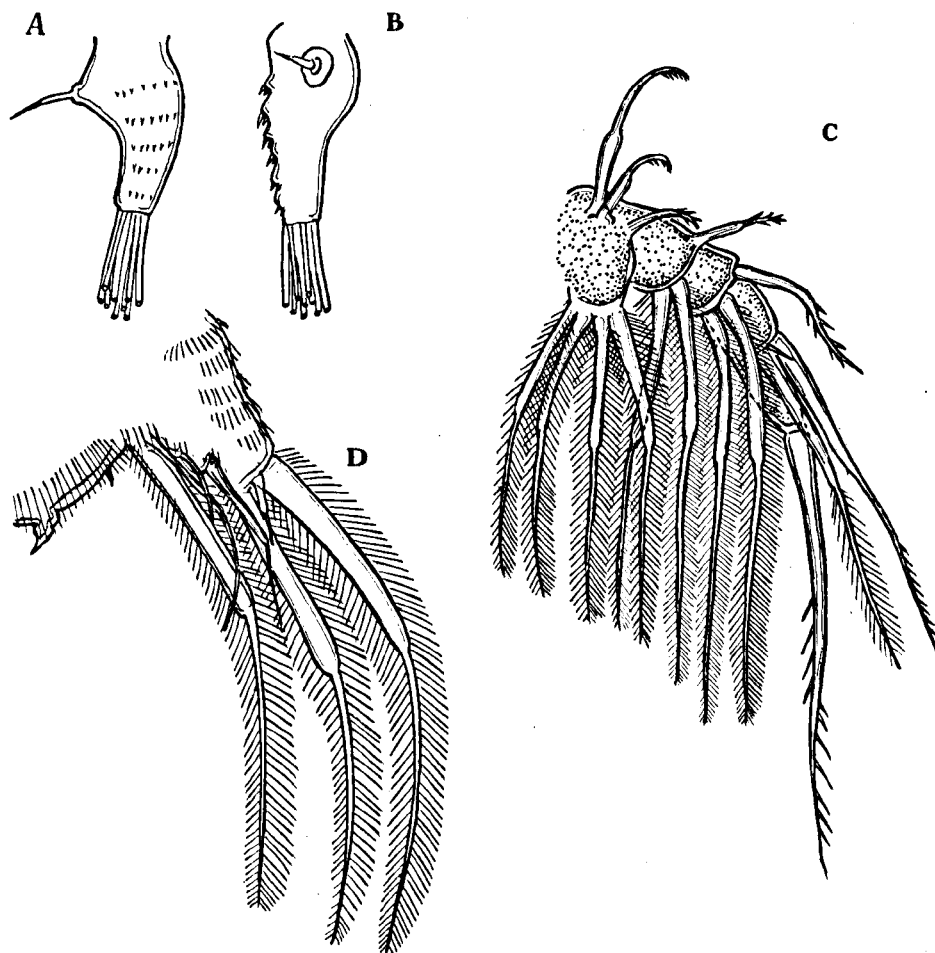


Fig. 42 *S. serrulatus*, female. A, antennule, lateral, B, antennule, dorsal, C, 1st trunk limb, D, endite of 2nd trunk limb.

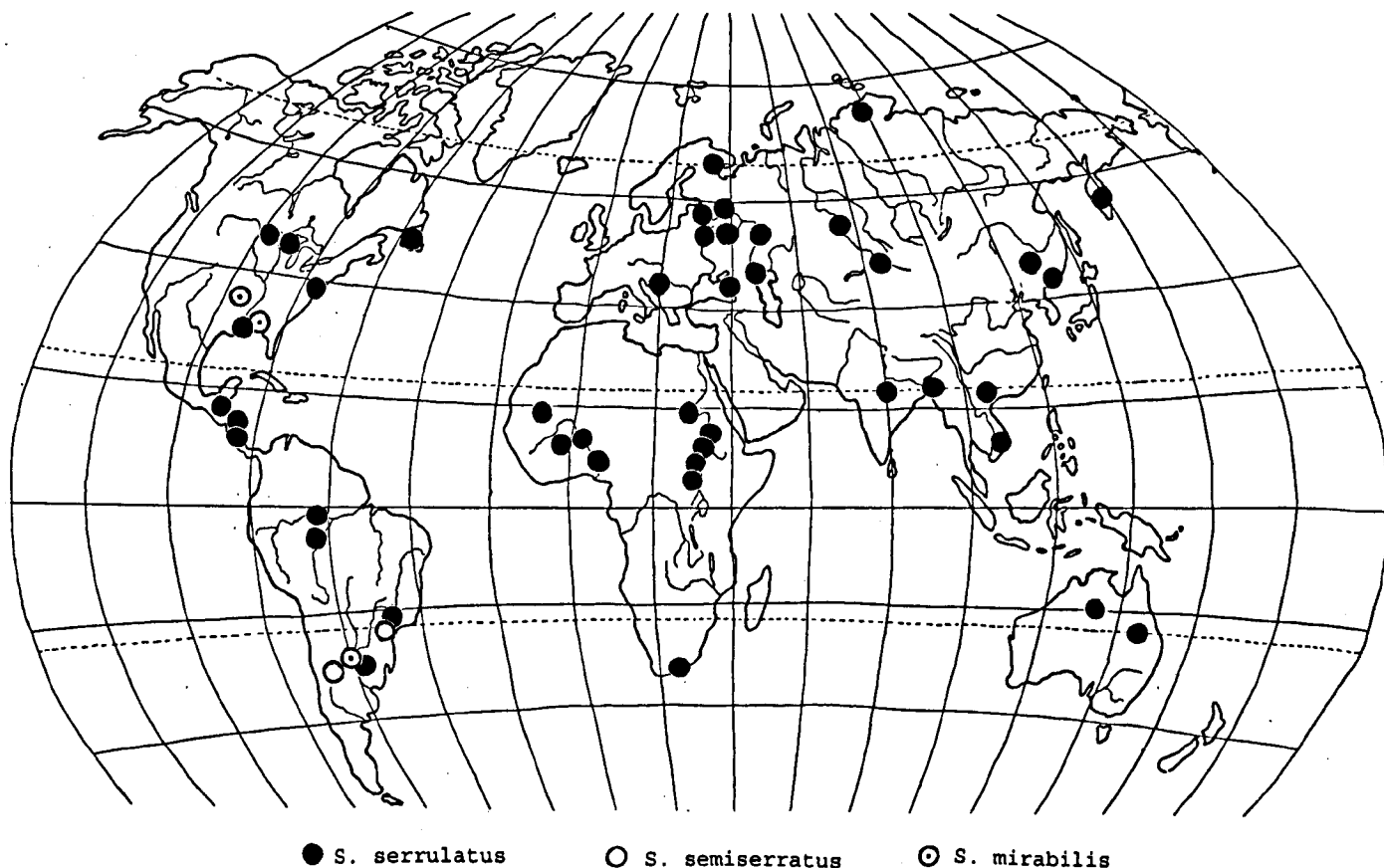


Fig. 43 Locations, where the studied material of *S. (Coronocephalus)* was collected.

because of these variations. However, I believe, that *S. serrulatus* has no subspecies. First, there is no morphological hiatus between populations. There are always some specimens with intermediate characters (Orlova-Bienkowskaja, 1995a). Second, the variability is not geographical and sometimes neighbouring populations differ more strongly than populations from different continents.

This interpopulational variability is probably the consequence of the founder-effect, which is strong in Cladocera because of parthenogenesis. It conforms with the data of Hann & Hebert (1986), who studied the genetic structure of North American *Simocephalus* populations. Based on a study of enzymes, these authors came to the conclusion that the genetic diversity within populations is less than between populations. They supposed it to be a consequence of the founder-effect.

The original description of *S. serrulatus* was supported by good illustration and contains most of the characters which differentiate this species from others (Koch, 1841).

S. brandtii and *S. intermedius*, described from Europe, are traditionally regarded as synonyms of *S. serrulatus*. The types are probably lost, but the original descriptions (Fischer, 1848; Lievin, 1848) show that this opinion is correct. The name *S. vetulus* var. *brandtii* Cosmovici, 1900 is the junior secondary homonym of *S. brandtii* (*Daphnia brandtii* Fischer, 1848). According to Article 59a of the International Code of Zoological Nomenclature (1988), it is invalid. It is not necessary to propose the replacement name (Art. 60a), because *S. vetulus* var. *brandtii* is the junior synonym of *S. vetulus*. The name *S. intermedius* Studer is not the secondary homonym of *S. intermedius* (Lievin) (*Daphnia intermedia* Lievin,

1848) (Art. 60c), because the species described by Studer (1878) is assigned to the genus *Simocephalus* erroneously and belongs to the genus *Daphnia*.

S. serrulatus var. *montenegrinus* Werestchagin, 1912 was described from Montenegro (Fig. 41A). It is regarded as a subspecies (Behning, 1941), or as a synonym of *S. serrulatus* (Šrámek-Hušek *et al.*, 1962; Negrea, 1983). Werestchagin (1912) writes that this variety differs from the typical form in the higher head and the longer dorso-posterior valve prominence. Statistical analysis of these metric characters in type specimens shows that there is no morphological hiatus between this variety and *S. serrulatus* (Orlova-Bienkowskaja, 1995a).

S. surekhae Rane is described from Jabalpur (India) (Rane, 1985a). The author does not point out any differences between this species and *S. serrulatus*. Sharma & Sharma (1990) have studied the types and sunk *S. surekhae* into the synonymy of *S. serrulatus*. This conforms with my data, because the available specimens from Jabalpur belong to the latter species.

S. serrulatus var. *rotundifrons* Brehm is also a synonym of *S. serrulatus* (Šrámek-Hušek *et al.*, 1962; Flössner, 1972). In the opinion of Brehm (1933) this variety described from Gao (Mali) differs from the typical *S. serrulatus* in its rounded head and the shorter dorso-posterior valve prominence. The types are lost (Smirnov N.N., personal communication). Statistical analysis shows that specimens available from Niger do not differ from those from Europe in these characters (Orlova-Bienkowskaja, 1995a).

S. capensis Sars was described from the vicinity of Knysna (South Africa) (Fig. 41C). Sars (1895) writes that this species is closely

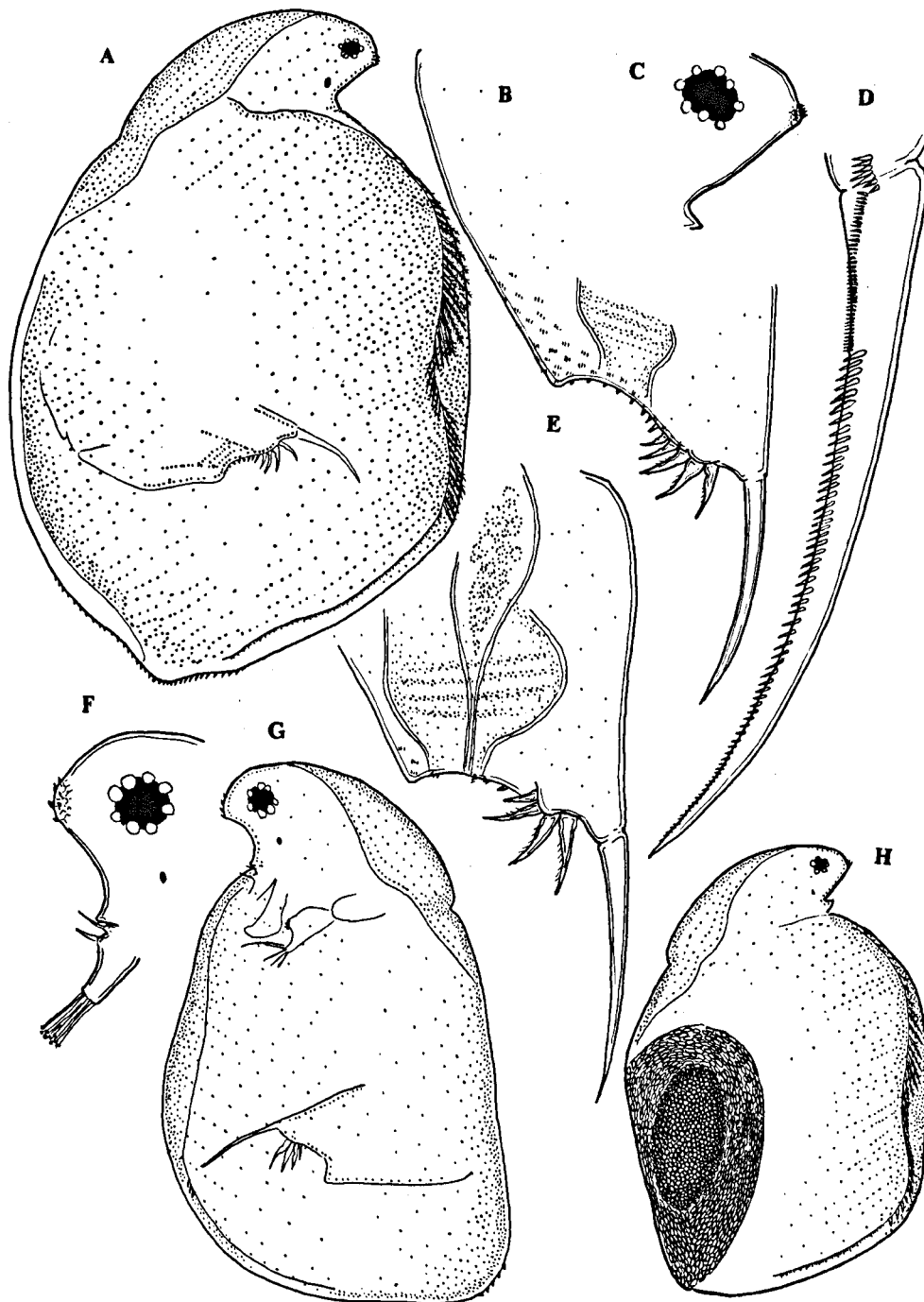


Fig. 44 *S. semiserratus*. A, parthenogenetic female, B, postabdomen, female, C, distal head part, female, D, outer side postabdominal claw, female, E, postabdomen, male, F, distal part of head, male, G, male, H, ehippial female.

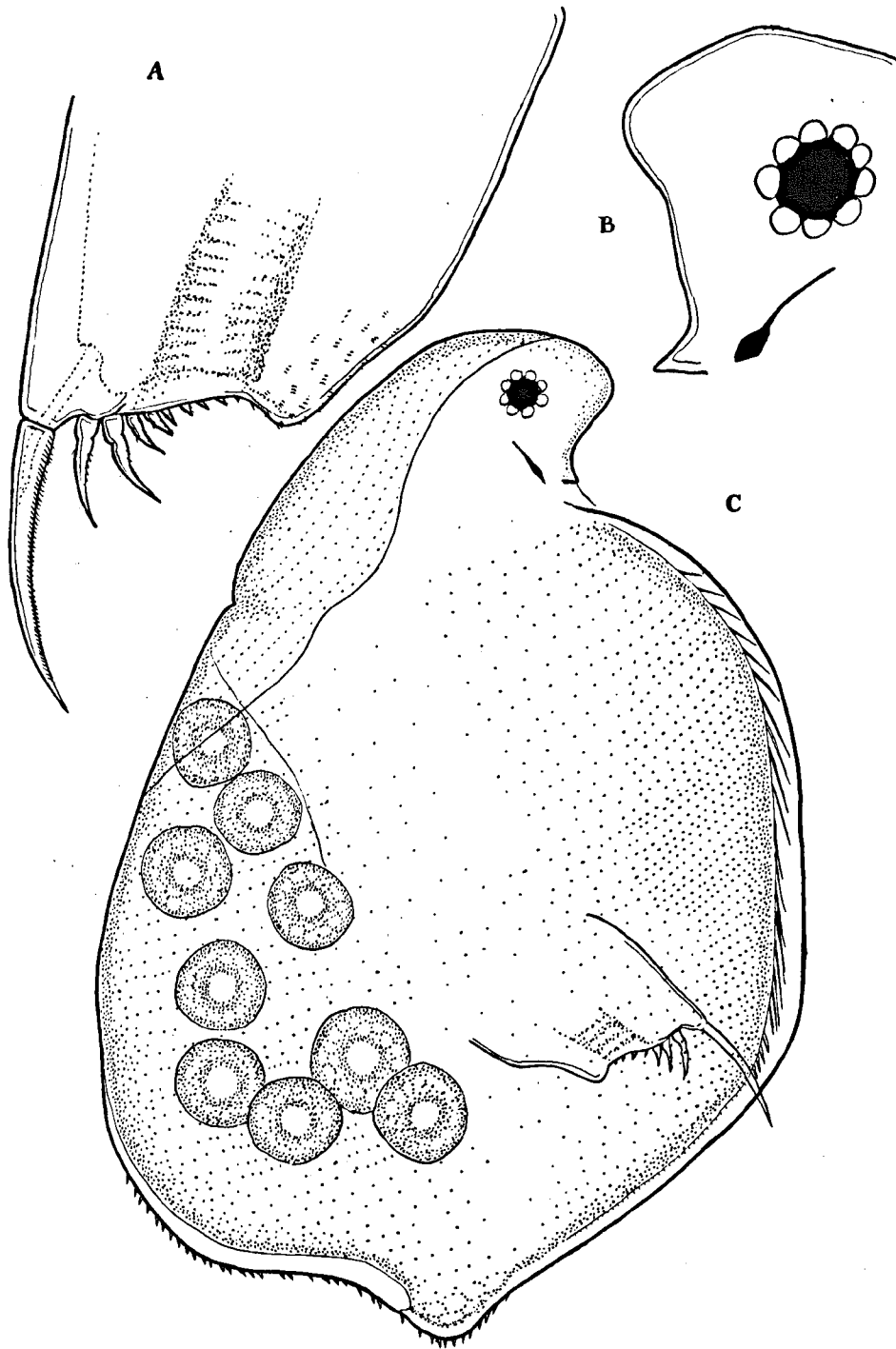


Fig. 45 *S. mirabilis* sp. nov., female. A, postabdomen, B, head, C, lateral view of holotype.



Fig. 46 *S. mirabilis* sp. nov., female. A, endite of 2nd trunk limb, B, postabdominal claw, C, 1st trunk limb, D, antennule.

related with *S. serrulatus* but differs from it in head shape and the absence of denticles on the posterior valve margin below the prominence. Analysis of the head height in the type specimens reveals that it does not differ in this respect from European specimens of *S. serrulatus* (Orlova-Bienkowskaja, 1995a). The denticles of the posterior margin are present in the types, but they are covered with a semitransparent substance. I agree with the opinion of Fryer (1957) that *S. capensis* is a synonym of *S. serrulatus*.

S. americanus Birge is described from North America. There is no information about the types and type locality. The original description (Birge, 1878) reveals that this species is closely related with *S. serrulatus*. In the opinion of Birge, it differs from the latter because it has a rhomb-like ocellus and the postabdominal claw is covered with denticles. Obviously, this is a misunderstanding because *S. serrulatus* has the same characters.

S. serrulatus var. *armata* Brehm was described from Venezuela. According to Brehm (1956), it differs from the typical form because its antennules have ridges covered with denticles. But the typical form has the same ridges and denticles, so this variety is a synonym of *S. serrulatus* (Flössner, 1972; Negrea, 1983). The illustration in the original description has the caption '*S. serrulatus* var. *barbata*'. Obviously, this is an inadvertent error.

S. inflatus Vávra was described from Valdivia (Chile) (Vávra,

1900). There is no information about the types. Vávra does not point out any differences between *S. inflatus* and *S. serrulatus*. He writes that *S. inflatus* differs from *S. capensis* in the head shape, small ocellus and general body shape. Daday (1905) supposes this name to be a synonym of *S. capensis*, because he found some specimens with intermediate characters in Paraguay. Michael & Sharma (1988) believe it to be a synonym of *S. serrulatus*. I agree with them because the original description, provided with a good illustration, contains all the important characters of the latter species.

S. kerhervei and *S. aguabrankai*, described from São Paulo (Brasil), are not mentioned in recent literature. There is no information about the types. The illustrations in the original description (Bergamin, 1939), suggest that both types are juveniles with denticles on the head and a row of denticles along the postabdominal claw. The differences between these species and *S. serrulatus* are not indicated. The available material from São Paulo does not differ from the latter species (Orlova-Bienkowskaja, 1995a). Therefore *S. kerhervei* and *S. aguabrankai* are the junior synonyms of *S. serrulatus*.

S. serrulatus var. *productifrons*, described from Sumatra (Stingelin, 1904), is also synonym of *S. serrulatus* (Šrámek-Hušek *et al.*, 1962; Negrea, 1983). The type material is lost (Frenzel, 1987). According to Stingelin (1904), this variety differs from *S. serrulatus*, *S. inflatus* and *S. americanus* by the elongate, pointed head and the large

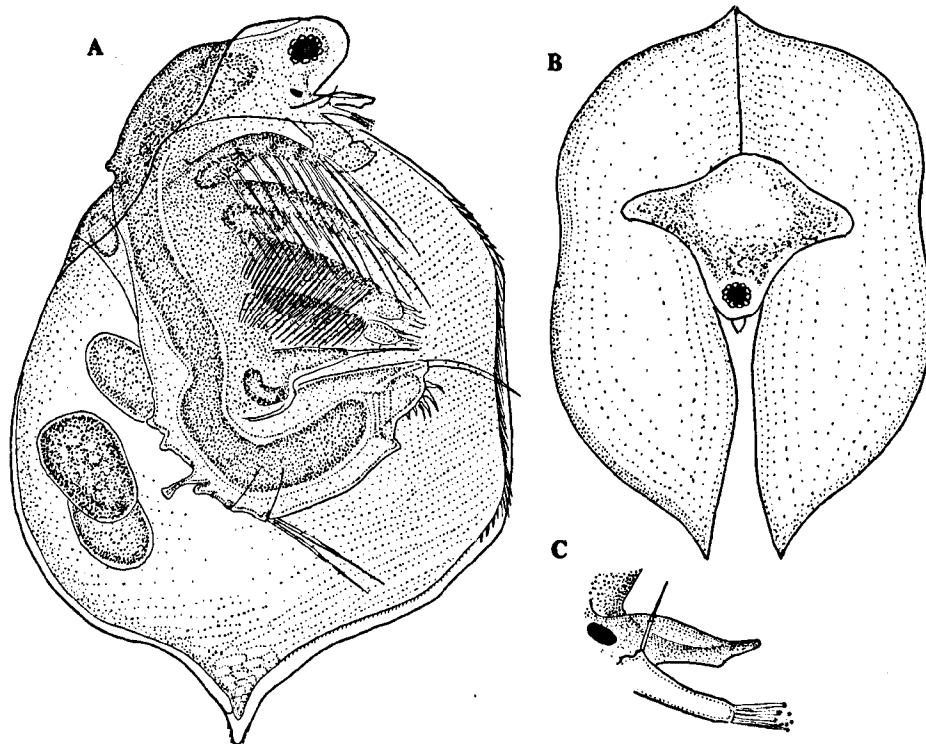


Fig. 47 *S. latirostris*, parthenogenetic female. A, lateral view, B, anterior view, C, rostrum and antennule.

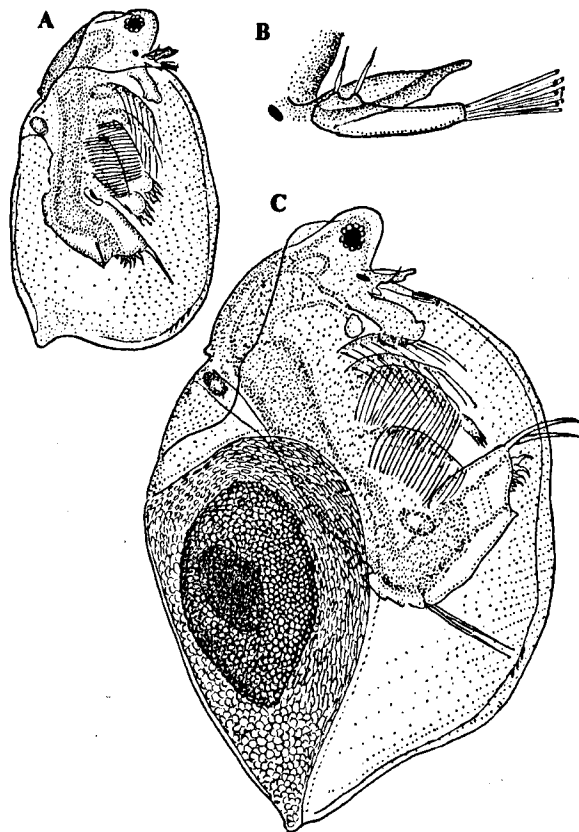


Fig. 48 *S. latirostris*. A, male, B, rostrum and antennule, male, C, ephippial female.

number of denticles. I believe that both features vary within populations and cannot be diagnostic characters.

S. serrulatus var. *mixta*, described from Java, differs from the typical *S. serrulatus* by the high head, large eye and elongate ocellus (Grochmalicki, 1915). I have no material from Java, but specimens from South-East Asia and Australia do not differ from European *S. serrulatus*. Furthermore, the diagnostic characters of this form varies within populations. I suppose this variety to be a synonym of *S. serrulatus*. In addition, *S. serrulatus* var. *mixtus* is the primary junior homonym of *S. mixtus* Sars, 1903.

S. serrulatus var. *pelagicus* Brehm was described from the pelagial zone of a small lake in New Guinea (Brehm, 1959). The type material, consisting of juvenile females, is probably lost (N.N. Smirnov, personal communication). The author does not point out any other differences between *S. serrulatus* var. *pelagicus* and typical *S. serrulatus* except the head shape. I take *S. serrulatus* var. *pelagicus* to be a synonym of *S. serrulatus*, because this character varies within populations.

'*S. serrulatus* var. *spinosulus* Stingelin, 1904' mentioned by Flössner (1972) as a synonym of *S. serrulatus*, does not exist. The variety *S. vetulus* var. *spinosulus* Stingelin belongs to the subgenus *Simocephalus* s. str.

S. semiserratus Sars, 1901

Fig. 44

Simocephalus semiserratus Sars, 1901: 23; *S. capensis* (*S. semiserratus* Sars, 1901): Daday, 1905: 209; *S. serrulatus* (*S. semiserratus* Sars, 1901): Kanduru, 1981: 72; Michael & Sharma, 1988: 83.

TYPE MATERIAL. Lectotype (designated by Orlova-Bienkowskaja (1995a)): Brasil, São Paulo, Itatiba: CBS: ♀ ad. (ZMO, F 9176).

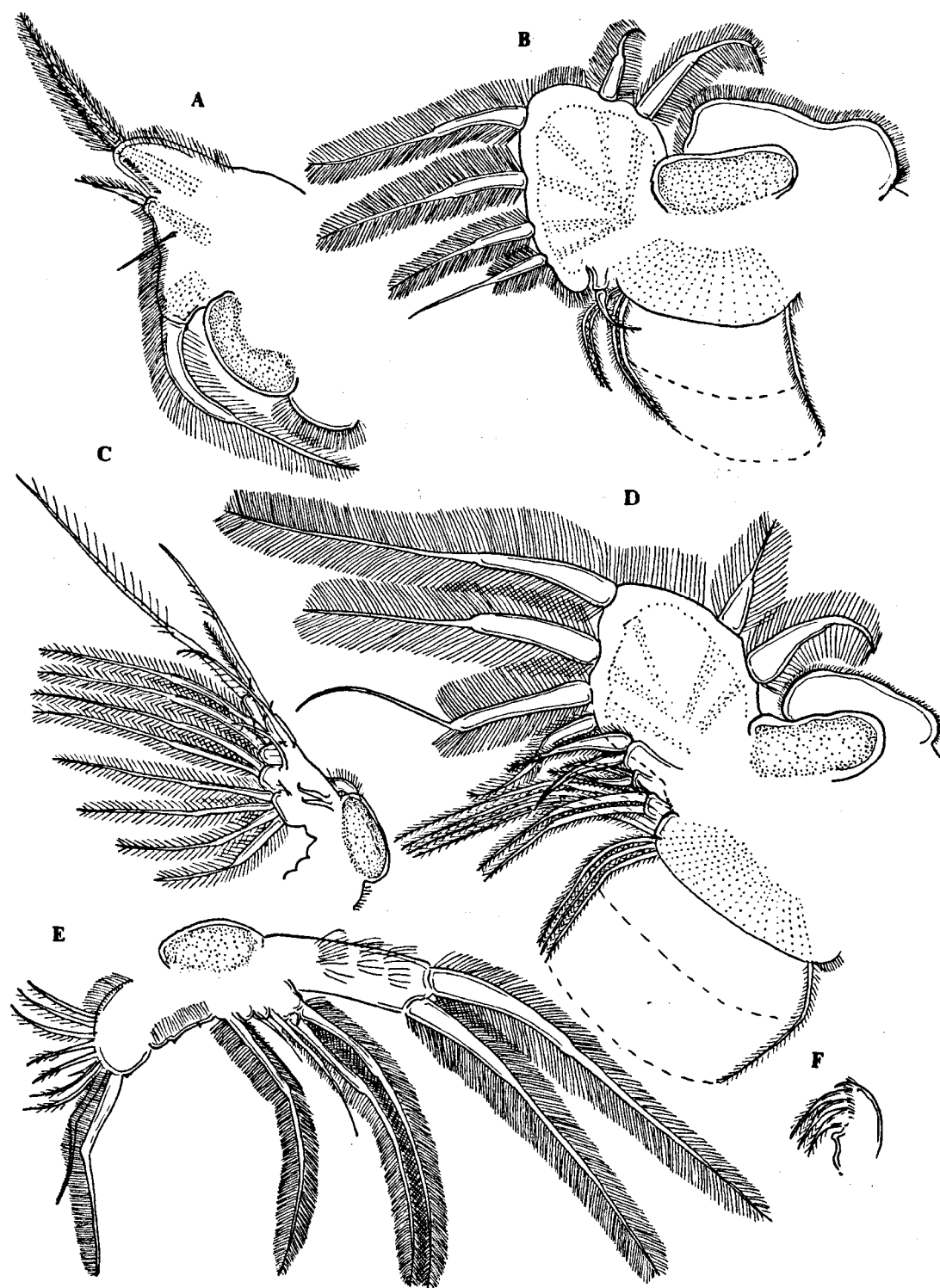


Fig. 49 *S. latirostris* appendages, female. A, 5th trunk limb, B, 4th trunk limb, C, 1st trunk limb, D, 3rd trunk limb, E, 2nd trunk limb, F, maxillule.

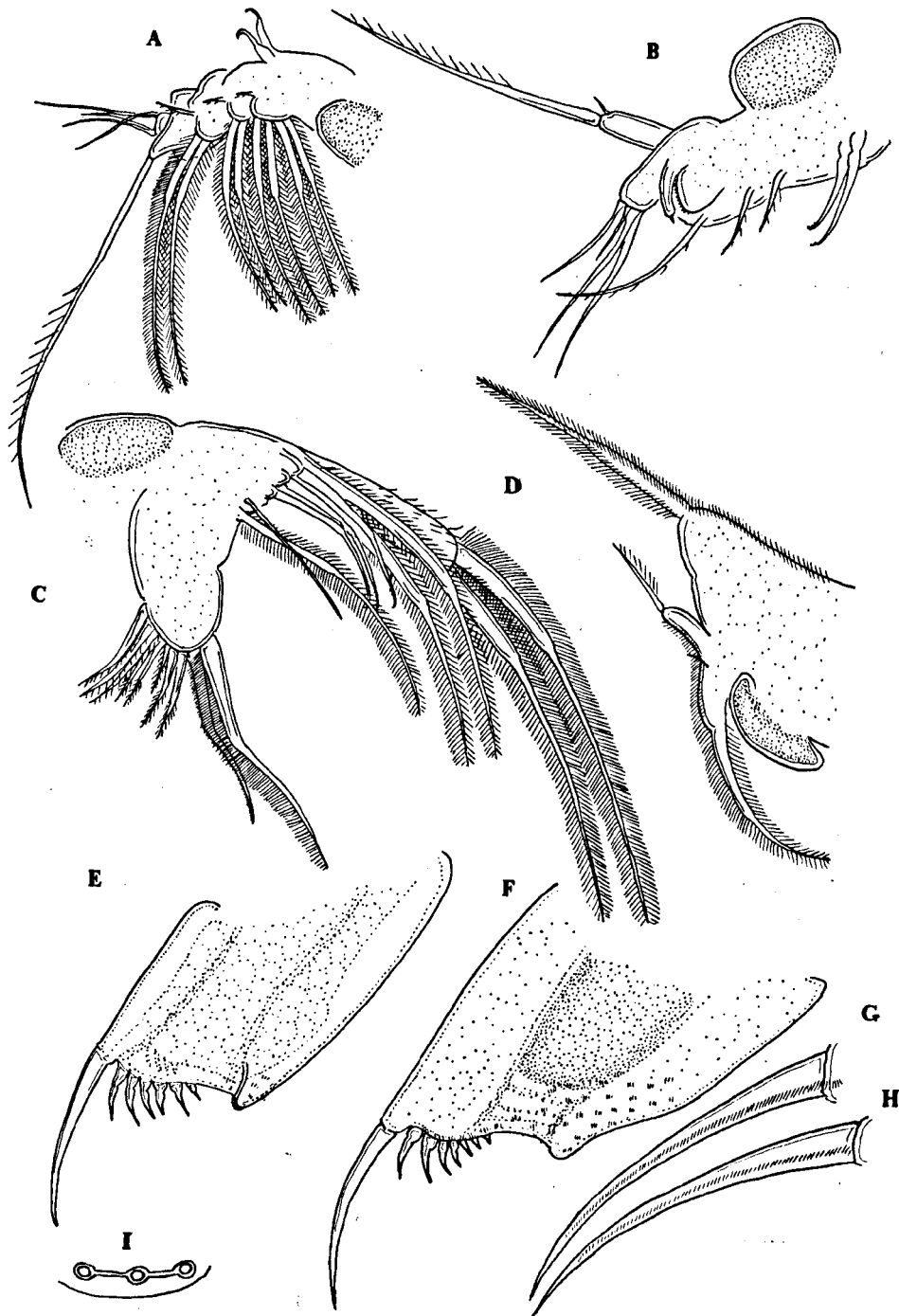


Fig. 50 *S. latirostris*. A, lateral view of 1st trunk limb, male, B, frontal view of 1st trunk limb, male, C, 2nd trunk limb, male, E, postabdomen, male, F, postabdomen, female, G, outer side of postabdominal claw, H, inner side of postabdominal claw, I, head pores.

Paralectotypes collected with lectotype: CBS: 9 ♀ ♀ ad., 2 ♀ ♀ juv. (ZMO, F 9176, F 9177), Argentina: MPA: 15 ♀ ♀ ad., 10 ♀ ♀ juv., 6 ♀ ♀ e., ♂ (ZMO, F 18438); MPA: 27 ♀ ♀ ad., 2 ♀ ♀ juv., 3 ♀ ♀ e. (BMNH, 1901. 12. 12. 251–261).

MATERIAL EXAMINED (Fig. 43). Lectotype, paralectotypes.

DIAGNOSIS. Measurements. ♀ ♀ ad.: 1.0–2.0mm, ♀ ♀ e. 1.0–1.5mm, ♂ ♂: 0.7–1.0mm.

Female (Fig. 44). Dorso-posterior valve prominence small, separated from the rest part of valves by shallow embayments. Its length less than the diameter of circle inscribed in its contour. Denticles cover less than 1/2 of posterior and less than 1/3 of dorsal margin. No denticles on ventral margin. Ocellus short. Frons with denticles. Morphology of trunk limbs unstudied, because it was impossible to dissect the type material.

DISTRIBUTION. (Fig. 43) Argentina, Brasil (São Paulo).

REMARKS. Daday (1905) believes *S. semiserratus* and *S. capensis* to be one species. Kanduru (1981) and Michael & Sharma (1988) sink *S. semiserratus* into the synonymy of *S. serrulatus*. Sars (1901) writes: 'I am enabled to state with full certainty its [*S. semiserratus*] distinctness from the European species [*S. serrulatus*]. In addition to its somewhat larger size, it is easily distinguished by the far less prominent posterior projection of the carapace, and somewhat different shape of the head. The marginal denticles, moreover, which in *S. serrulatus* extend throughout the whole length of the hind margin,

are in this species always limited to their uppermost part only'. It is my belief that *S. semiserratus* is a separate species. First, statistical analysis shows that it is separated from *S. serrulatus* in two pairs of independent metric characters (Orlova-Bienkowskaja, 1995a). Second, it differs from it in the marginal denticles of the valves. Third, it occurs in South America sympatrically with *S. serrulatus* and cannot be a geographical subspecies of this species.

S. mirabilis sp.nov.

Figs 45; 46

ETYMOLOGY. The name '*Mirabilis*' means '*Surprising*'.

TYPE MATERIAL. Holotype: U.S.A., Alabama, Mobil Co., lower part of Langan Park lake, 24. 5. 1987, leg. Fitzpatrick: MPA: ♀ ad. (BMNH 1997. 1709). Paratypes: collected with holotype: MPA: 11 ♀ ♀ ad., 9 ♀ ♀ juv. (BMNH 1997. 1710–1719); U.S.A., Oklahoma, Tulsa, Oxley Nature Center, Mallard lake, 36°10'N, 98°W, 12. 6. 1991, leg. Berner: MPA: 10 ♀ ♀ ad., 2 ♀ ♀ juv. (AC); Argentina, Rio Parana, Catay pond, leg. Frutos: MPA: 4 ♀ ♀ ad., 7 ♀ ♀ juv. (AC).

MATERIAL EXAMINED. (Fig. 43) Holotype, paratypes.

DIAGNOSIS. Measurements. ♀ ♀ ad. 1.0–1.2mm. Female (Figs 45; 46). Dorso-posterior valve prominence moderate, separated from the rest part of valves by moderate embayments. Its length less than the diameter of circle inscribed in its contour. Denticles cover less than 1/2 of posterior and less than 1/3 of dorsal

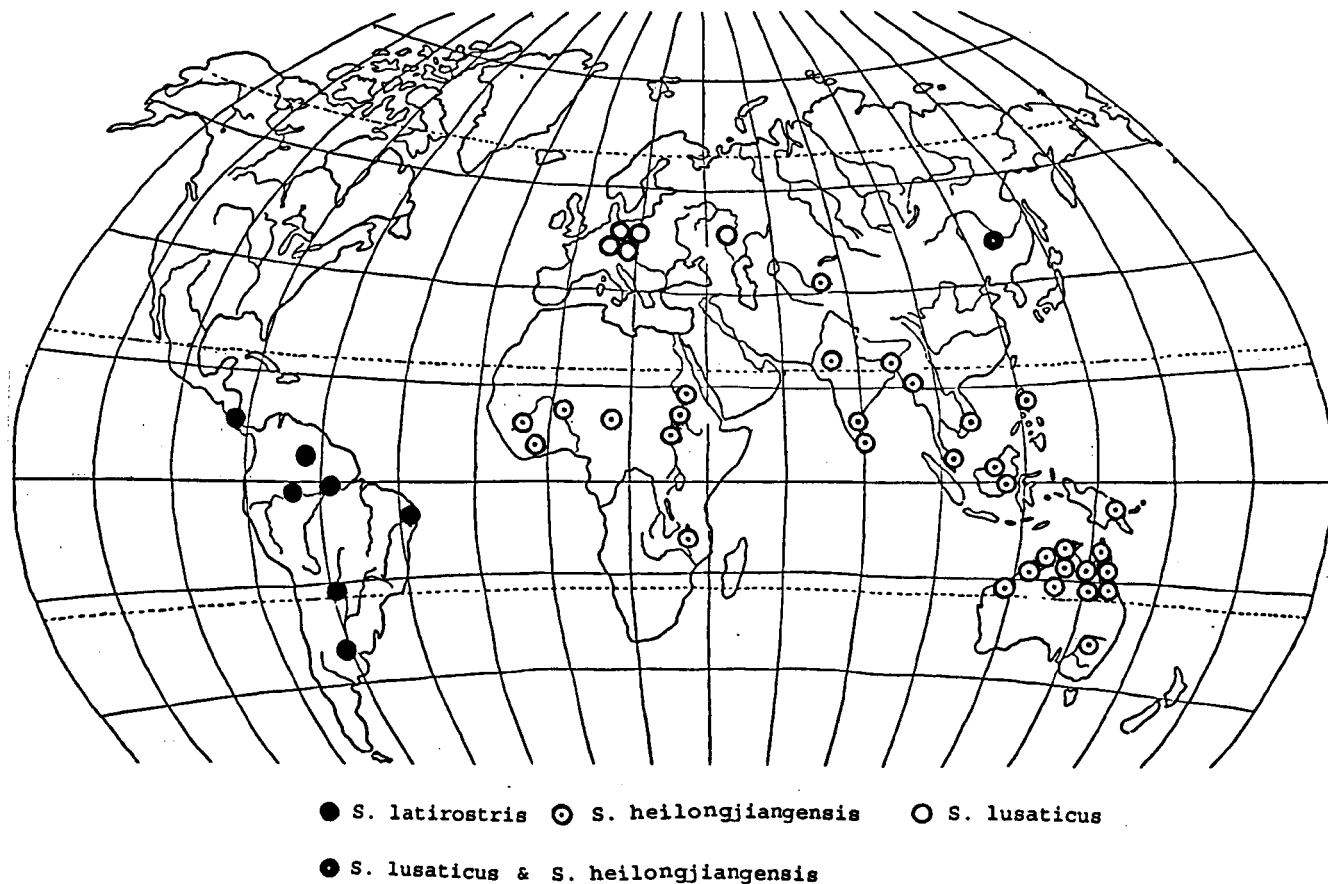


Fig. 51 Locations where the species of *S. (Aquipiculus)* were collected for this study or reported in literature.

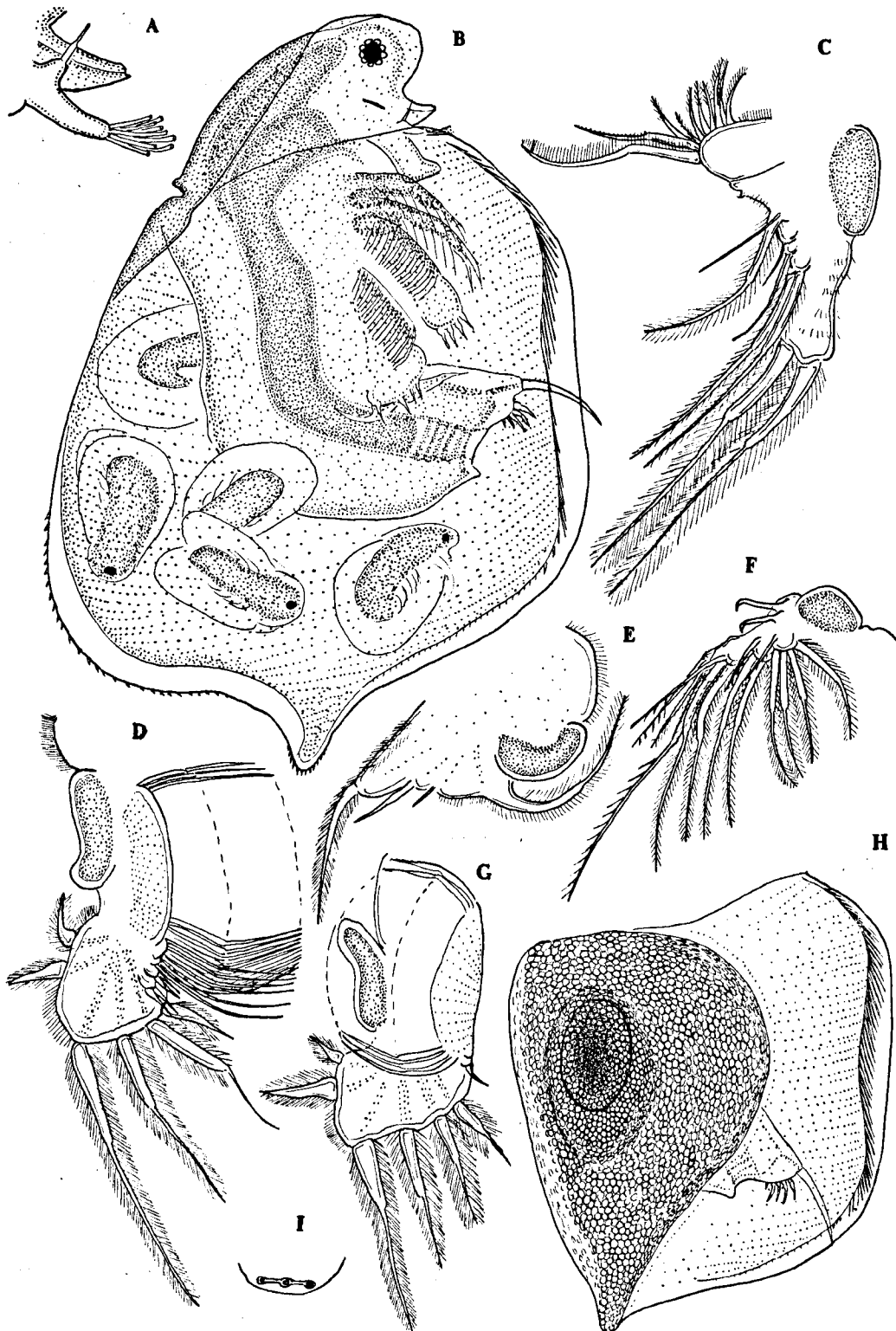


Fig. 52 *S. heilongjiangensis*, female. A, rostrum and antennule, B, parthenogenetic female, C, 2nd trunk limb, D, 3rd trunk limb, E, 5th trunk limb, F, 1st trunk limb, G, 4th trunk limb, H, ephippial female (head omitted), I, head pores.

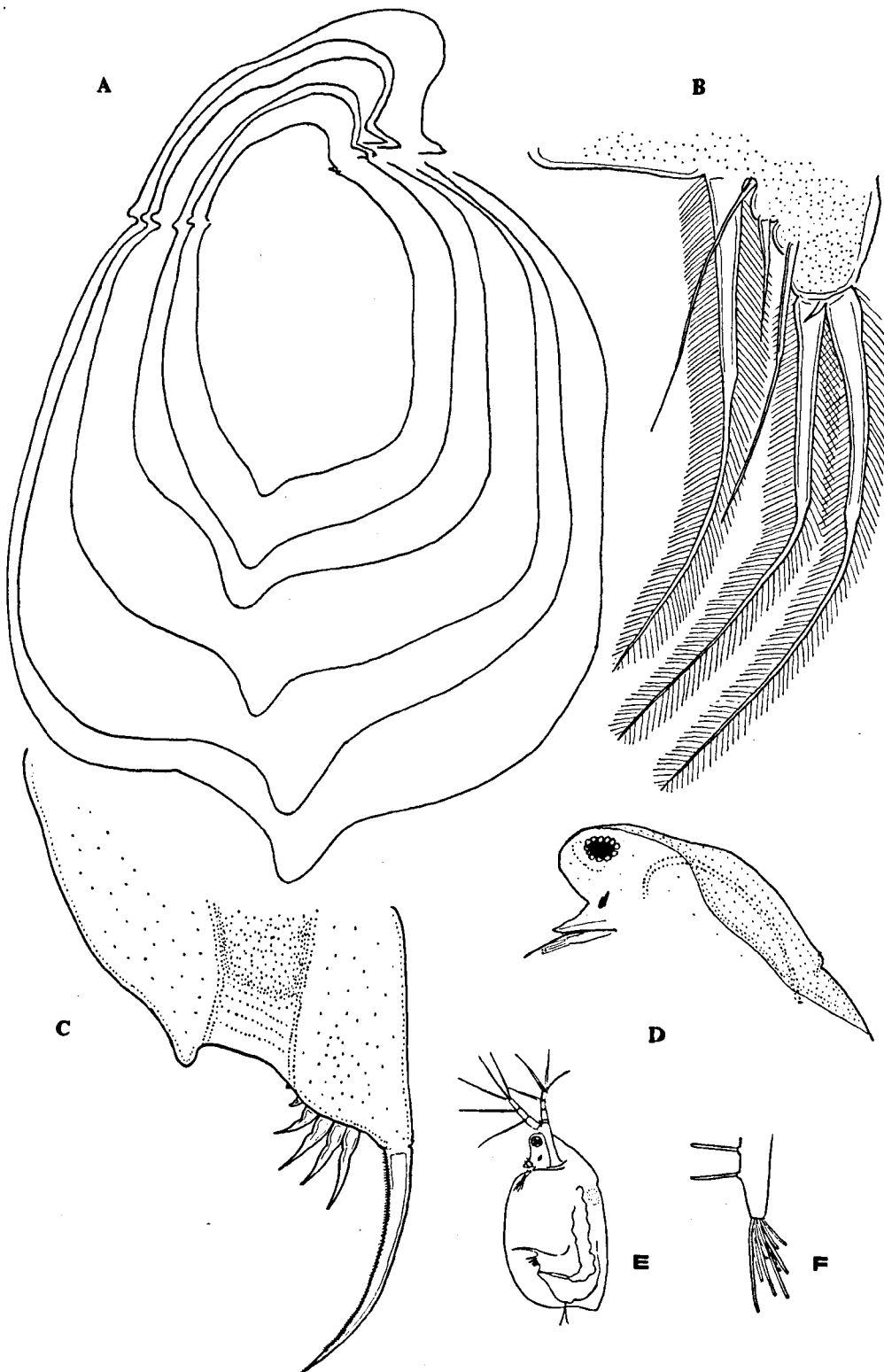


Fig. 53 *S. heilongjiangensis*. A, female, age variability, B, female, endite of 2nd trunk limb, C, female, postabdomen, D, female, head, E, male, lateral view, F, male, antennule (E, F – after Shi & Shi, 1994).



Fig. 54 *S. lusaticus*. A, parthenogenetic female, B, parthenogenetic female ventral, C, ehippial female, D, male, E, parthenogenetic female, F, parthenogenetic female, G, postabdomen, female, H, antennule, female, I, distal part of postabdomen, male, J, parthenogenetic female, K, parthenogenetic female, L, 5th trunk limb, female, M, 2nd trunk limb, female. A-C, G, H, L, M after Herr, 1925, D, I, J, K after Herr, 1917, E, F after Šrámek-Hušek *et al.*, 1962. edge. No denticles on ventral edge. Ocellus elongate. Frons without denticles. Setae of 2nd and 3rd endite prominence of 2nd trunk limbs as long as 0.6 and 0.4 of basal segment of plumose seta of 1st prominence respectively.

DISTRIBUTION. (Fig. 43) North and South America.

REMARKS. *S. mirabilis* differs from *S. serrulatus* and *S. semiserratus* in the elongate ocellus and the absence of denticles on the frons. However, I assign it to the subgenus *S. (Coronocephalus)*, because of the following characters: frons right-angled; antennule short, with transversal ridges covered with denticles on inner side; postabdominal claw with spines on proximal part of outer side and on inner side.

Subgenus *S. (Aquipiculus)* Orlova-Bienkowskaja, 1995

TYPE SPECIES. *Simocephalus latirostris* Stingelin, 1906

DIAGNOSIS. Both sexes (Figs 47–50). Frons rounded, without denticles. Head shield depressed or flattened in middle. Head pores

present. Insertion of antennules at base of rostrum. Antennule long in correspondence with long rostrum, with neither ridges nor denticles on inner side. Aesthetes shorter than base of antennule. Postabdominal claws without pecten of spines. Inner and outer side of claw with fine setules. Anal bay of postabdomen straightened in the middle, its proximal part without anal teeth.

Female. Dorso-posterior valve angle with large prominence. Valves with dorsal keel. Posterior corner of ehippium with protuberance. Ocellus short or slightly elongate, but always shorter than in *S. vetulus*. Setae of 2nd and 3rd endite prominence of 2nd trunk limb as long as 0.6–0.7 and 1.4–1.6 of basal segment of plumose seta of 1st prominence respectively. Postabdomen with 5–10 anal teeth on each side. Supra-anal angle pointed.

Male. Supra-anal angle pointed. Vas deferens opening in middle of anal bay or at base of supra-anal angle. Postabdomen with 5–7 anal

teeth on each side. Dorso-posterior valve angle with more or less pointed prominence.

ETYMOLOGY. The subgenus is named *Aquipiculus* or 'small water woodpecker' because all its representatives have a long rostrum resembling a beak.

S. latirostris Stingelin, 1906

Figs 47–50

S. latirostris Stingelin, 1906: 187; Brandorff *et al.*, 1982: 92; Orlova-Bienkowskaja, 1995b: 46.

TYPE MATERIAL. Lectotype (designated by Orlova-Bienkowskaja (1995b)): Paraguay, Riacho Negro, 3. 1894., leg. Ternetz, CBS in poor condition: ♀ ad., (MNO, III/24). Paralectotype: ♀ juv., mentioned in the original description, has probably been lost.

MATERIAL EXAMINED. (Fig. 51) Lectotype and other specimens: Argentina, Santa Fe, 23. 5. 1981: 21 ♀ ♀ ad., more than 50 ♀ ♀ juv., 31 ♀ ♀ e., 8 ♂ ♂ (BMNH and AC). Brasil, Rio Negro, Anavilanas Margen, 14. 9. 1979: ♀ ad.

DIAGNOSIS. Measurements. ♀ ♀ ad.: 1.0–1.8mm, ♂ ♂: 0.6–0.9mm. Both sexes (Figs 47–50). Rostrum very long, rostrum length 6.4–9.1% of body length in ♀ ♀ ad., 5.4–7.7% in ♂ ♂. Lateral margins of rostrum elevated above central part. Antennule long, in correspondence with long rostrum; about as long as rostrum. Head shield deeply depressed in middle.

Female. Height 65–74% of length. Ehippium length 47–67% of body length. Aesthetes shorter than antennule. Dorso-posterior valve prominence in ♀ ad. pointed. Denticles of valves very small, located only on dorso-posterior prominence. No lateral prominences of valves. Postabdomen with 5–9 (usually 7) anal teeth on each side. Anal teeth gradually decreasing in size proximally, 5th tooth more than half length of 4th.

Male. Vas deferens opening at base of supra-anal angle.

DISTRIBUTION. (Fig. 51) The tropics and subtropics of South and Central America. Numerous records of *S. latirostris* from Australia, Malay Archipelago, South-East Asia and Africa are available. Johnson (1963) supposes this species to be pantropical. However, according to the descriptions and figures, the authors misuse the name *S. latirostris* for *S. heilongjiangensis*.

REMARKS. *S. latirostris* was originally described at the beginning of the 20th century (Stingelin, 1906) and was poorly known up to now (Orlova-Bienkowskaja, 1995b). It was confused with next species by several authors (see below).

Dumont (1983) supposes *S. iheringi*, described from Brasil, to be a synonym of *S. latirostris*. The general body shape is rather similar in these two species, and the valves of females are produced into a sharp prominence in both species. But according to our data, *S. iheringi* is the junior synonym of *S. daphnoides* and clearly differs from *S. latirostris* in the pecten of the spines on the postabdominal claw.

S. heilongjiangensis Shi, Shi, 1994

Figs 52–53

Simocephalus latirostris: Fryer, 1957: 225; Johnson, 1963: 160; Biswas, 1971: 115; Dumont & Van De Velde, 1977a: 81; Mamaril & Fernando, 1978: 134; Kanduru, 1981: 65; Rajapaksa, 1981: 98; Hossain, 1982: 112; Dumont, 1983: 103; Michael & Sharma, 1988: 80; *S. heilongjiangensis* Shi, Shi, 1994: 403; *S. mesorostris* Orlova-Bienkowskaja, 1995b: 51.

TYPE MATERIAL. Holotype. Moershan Town (45°15'N, 127°30'E), Shangzhi County, Heilongjiang Province, 6.8.1990., leg. Shi Xinlu. ♀ ad. Allotype ♂ and paratypes 30 ♀ ♀ and 10 ♂ ♂ collected with holotype (deposited in the Laboratory of Hydrobiology, Harbin Normal University, China).

MATERIAL EXAMINED. Type material of junior synonym *S. mesorostris*: Holotype. The Philippines, Luzon, Bulacan near Chemical Plant, pond, 1.1976: CBS: ♀ ad. (BMNH, 1995.753). Paratypes: 110 specimens (♀ ♀ ad., ♀ ♀ juv. and ♀ ♀ e.) from The Philippines, Indonesia, Malaysia, New Guinea, Australia, Viet-Nam, Sri Lanka and India (BMNH, AC). More precise geographical data are published elsewhere (Orlova-Bienkowskaja, 1995b). Other specimens: 139 specimens (♀ ♀ ad. and ♀ ♀ juv.) from Sudan (AC).

DIAGNOSIS. Measurements. ♀ ♀ ad.: 1.2–1.9mm.

Female. (Figs 52; 53). Height 59–75% of length. Rostrum shorter than in *S. latirostris*; length 3.3–5.7% of body length. Lateral margins of rostrum below central part. Antennule shorter than in *S. latirostris*, in correspondence with moderate size of rostrum, its length about as long as rostrum. Aesthetes longer than antennule. Depression of head shield shallow. Dorso-posterior valve prominence in ♀ rounded. Denticles of valves of moderate size, located both on dorso-posterior prominence and on dorsal valve margin. No lateral prominences of valves. Postabdomen with 5–8 (usually 6) anal teeth on each side. Four distal teeth large, the rest extremely small, 5th tooth less than half as long as 4th.

Male. Vas deferens opening at base of supra-anal angle.

DISTRIBUTION. The tropics of Australia, Malay Archipelago, Asia and Africa (Fig. 51).

REMARKS. The specimens from Africa differ from others in shorter rostrum. However I believe that the African *S. heilongjiangensis* does not belong to another subspecies because there is a considerable overlapping in this character (more than 25%) and there are no other differences.

S. heilongjiangensis was confused with the closely related *S. latirostris* by many authors (Fryer, 1957; Dumont & Van De Velde, 1977a; Rajapaksa, 1981; Kanduru, 1981; Hossain, 1982; Dumont, 1983; Michael & Sharma, 1988). I discovered that it is a separate species (Orlova-Bienkowskaja, 1995b) and described it as *S. mesorostris*. Shi & Shi (1994) came to the same conclusion independently and named this species *S. heilongjiangensis*. This name has the priority.

S. lusaticus Herr, 1917

Fig. 54

Simocephalus lusaticus: Herr, 1917: 58; Behning, 1923: 5; 1925: 526; Šrámek-Hušek *et al.*, 1962: 259; Flössner, 1972: 182; Kamiński, 1975: 89.

TYPE MATERIAL. Syntypes: East Europe, Silesia, ponds near Werda, 27. 7. 1913 (12 specimens), 5. 9. 1913 (3 specimens), 'false ponds', 10. 8. 1913 (6 specimens). I do not know in what museum these syntypes were deposited, or whether they still exist.

MATERIAL EXAMINED. None.

DISTRIBUTION. (Fig. 51) East Europe: Silesia, Czech Republic, Slovakia, Poland, Russia: Wolga basin. Chiha: Heilong Province. Manujlova (1964) reports this species from the Caucasus. Obviously, this is a misunderstanding, because she refers to a book (Behning, 1941) which contains no such information.

DIAGNOSIS. Measurements. ♀ ♀ ad.: 1.5–3mm, ♂ ♂ about 1mm.

Both sexes (Fig. 54). Rostrum shorter than in *S. latirostris*; its lateral margins below central part. Antennule shorter than in *S. latirostris*, about as long as or a little longer than rostrum. Depression of head shield shallow.

Female. Aesthetes about as long as antennule. Dorso-posterior valve prominence rounded or pointed. Denticles of valves very small, located only on dorso-posterior prominence. 2–8 pairs of lateral prominences on valves. Postabdomen with 7–10 anal teeth on each side. Anal teeth gradually decreasing in size proximally.

Male. Vas deferens opening in middle of anal bay.

REMARKS. Judging from the available descriptions (Herr, 1917; Behning, 1925; Šrámek-Hušek *et al.*, 1962; Flössner, 1972; Kamiński, 1975), *S. lusaticus* has all the diagnostic characters of the subgenus *Aquipiculus*. It differs from all other species of the genus in having lateral prominences on the valves.

NOMINA DUBIA AND SPECIES TRANSFERRED TO THE GENUS *DAPHNIA*

S. aegyptiacus (Fischer, 1860) has been described from the vicinity of Alexandria (Egypt). There is no information about the type material. The original description (Fischer, 1860) is rather detailed and allows us to attribute this species to *Simocephalus* s. str. I think that contrary to the opinion of Richard (1894) and Šrámek-Hušek *et al.* (1962), it is not a synonym of *S. vetulus* because it has a large dorso-posterior valve prominence. Behning (1941) supposes this species to be a synonym of *S. elizabethae*, but I believe that the latter differs from all species including *S. aegyptiacus* in the shape of the ventral head margin. Unfortunately, it is impossible to conclude whether *S. aegyptiacus* is a separate species or a synonym of *S. mixtus* or *S. vetuloides*.

S. cacticus Moniez, 1889 has been described from Lake Titicaca. There is no information about the type material. To judge from the original description (Moniez, 1889), this species belongs to *Simocephalus* s. str. But it is difficult to say whether it is in fact a separate species.

S. vetulus spinosulus Stingelin, 1904 has been described from the Hawaiian Islands. Stingelin (1904) points out that this variety differs from the typical form because 'es zeigt sich die Tendenz zur Bildung einer schwachen Shalenprominenz'. No illustration is given. The type material has been lost (Frenzel, 1987). Some authors regard *S. vetulus* var. *spinosulus* as a synonym of *S. vetulus* (Flössner, 1972; Frenzel, 1987). The original description shows that this variety belongs to *Simocephalus* s. str., but it does not contain any characters important for the identification of species within this subgenus. Material from the Hawaiian Islands is necessary to decide this question.

S. serrulatus var. *nudifrons* Delachaux, 1918 has been described from the Andes (Peru). The type was probably not indicated. The original description (Delachaux, 1918) is without an illustration and contains only one character: the absence of denticles at the head in all specimens. That means that it is not *S. serrulatus* because the denticles are the main character of this species. But this information is not enough to permit identification.

S. postidelivis Lai & Li, 1987 was described on the base of fossil ephippia from the Tertiary of China (Lai & Li, 1987). Referring to the photographs, these ephippia do not differ from ephippia of recent species. It is impossible to identify either the species or even the subgenus.

Two species assigned to the genus *Simocephalus* belong, in fact, to the genus *Daphnia*, as is evident from their original descriptions

(Studer, 1878; Brady, 1918). This is *S. gelidus* Brady, 1918 = *Daphnia gelida* comb. nov. and *S. intermedius* Studer, 1878 = *D. intermedia* comb. non.

KEY TO THE SUBGENERA AND SPECIES OF *SIMOCEPHALUS*

Figs 55–59 (picture numbers correspond with couplets in the key)

1. Fig. 55. ♀ & ♂: Postabdominal claw without spines. Inner and outer side of claw with fine setules (A). Frons rounded, without denticle (B) 2
- Fig. 55. ♀ & ♂: Postabdominal claw with basal pecten of spines at outer side. Inner side and distal part of outer side with fine setules (C). Frons rounded (D) or pointed (E), without denticles. *S. (Echinocaudus) subgen. nov.* 10
- Fig. 55. ♀ & ♂: Postabdominal claw with spines on inner side and in proximal part of outer side. Basal part of outer side with fine setules (F). Frons right-angled, with denticles, or very rarely without denticles (G) (American species *S. mirabilis*) *S. (Coronocephalus)* Orlova-Bienkowskaja, 1995 16
2. Fig. 55. ♀: Ocellus elongate (H) (exception: North American species *S. punctatus*). Anal bay with small anal teeth (I). Dorso-posterior valve angle without prominence (J) or with comparatively small prominence (K). ♂: Vas deferens opening on top of supra-anal angle (L). *Simocephalus* s. str. 3
- Fig. 55. ♀: Ocellus short (M). Anal bay without anal teeth (N). Dorso-posterior valve angle with large prominence (O). ♂: Vas deferens opening in middle of anal bay or at base of supra-anal angle (P) *S. (Aquipiculus)* Orlova-Bienkowskaja, 1995 8
3. Fig. 56. ♀: Ocellus point-like (B). Dorso-posterior valve angle rounded, without prominence (A). Occurs in North America *S. punctatus* sp. nov.
- Fig. 56. ♀: Ocellus elongate (C). Dorso-posterior valve angle of different shape 4
4. Fig. 56. ♀: Dorso-posterior valve angle with very small prominence (D). The most common European species. Occurs also in North Africa *S. vetulus* (O.F. Müller, 1776)
- Fig. 56. ♀: Dorso-posterior valve angle with larger prominence (E) 5
5. Fig. 56. ♀: Depression of ventral head margin near rostrum deep (F) 6
- Fig. 56. ♀: Depression of ventral head margin near rostrum shallow, sometimes absent (G). Species occur in Australia, Tasmania and New Guinea 7
6. Fig. 56. ♀: Diameter of dorso-posterior valve prominence exceeds its length (H). Dorsal valve margin protruding backward (I) *S. mixtus* Sars, 1903
- Fig. 56. ♀: Diameter of dorso-posterior valve prominence less than its length (J). Dorsal valve margin not protruding backward (K). Occurs in Eastern Siberia *S. vetuloides* Sars, 1898
7. Fig. 56. ♀: Dorsal valve margin protruding backward strongly (L) *S. gibbosus* Sars, 1896
- Fig. 56. ♀: Dorsal valve margin not protruding backward (M) *S. elizabethae* (King, 1853)
8. Fig. 57. ♀ & ♂: lateral prominences on valves present (A). Rare species. Occurs in East Europe and China. *S. lusaticus* Herr, 1917

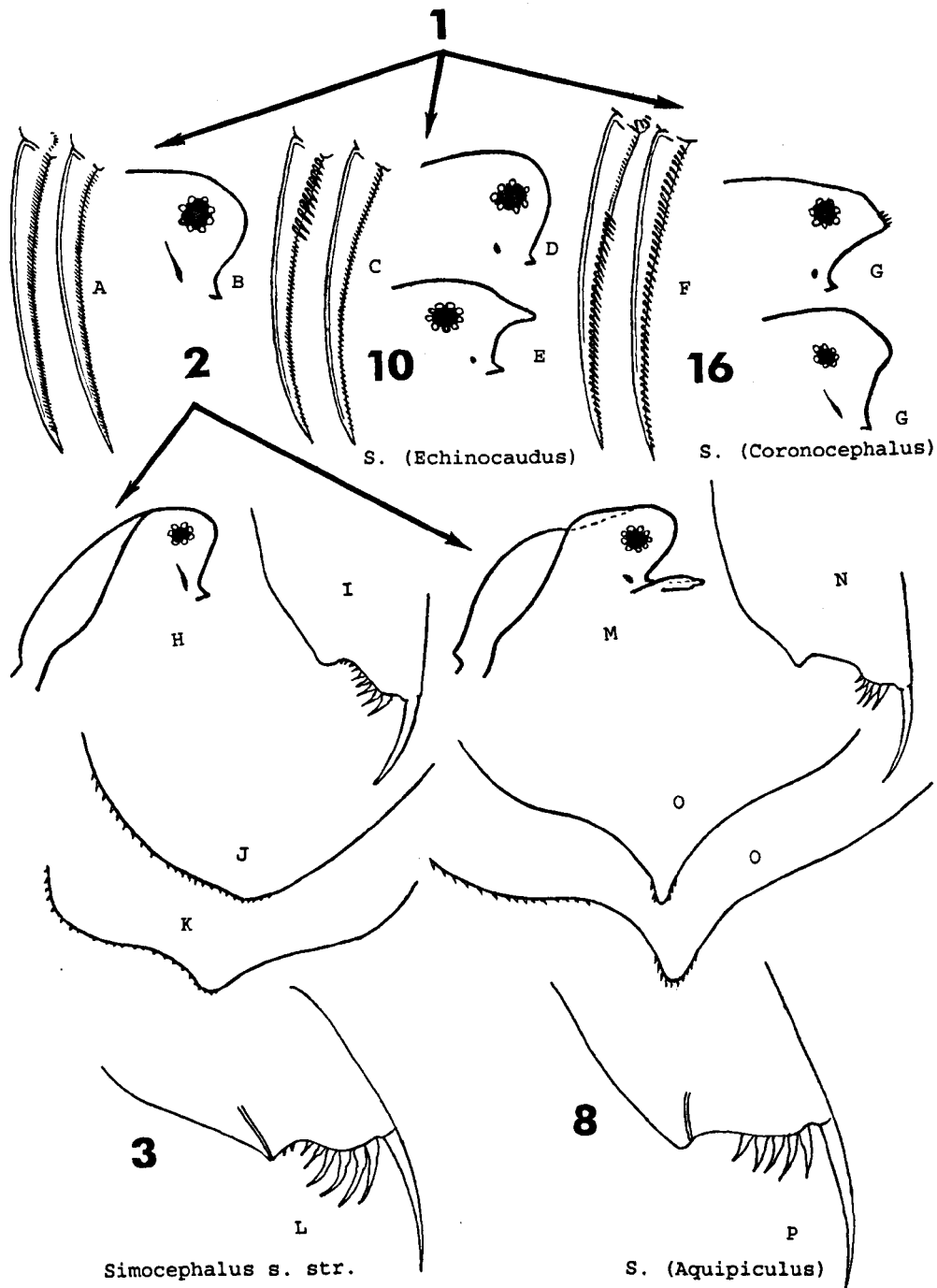


Fig. 55 Key to subgenera. Numbers correspond with couplets in the key.

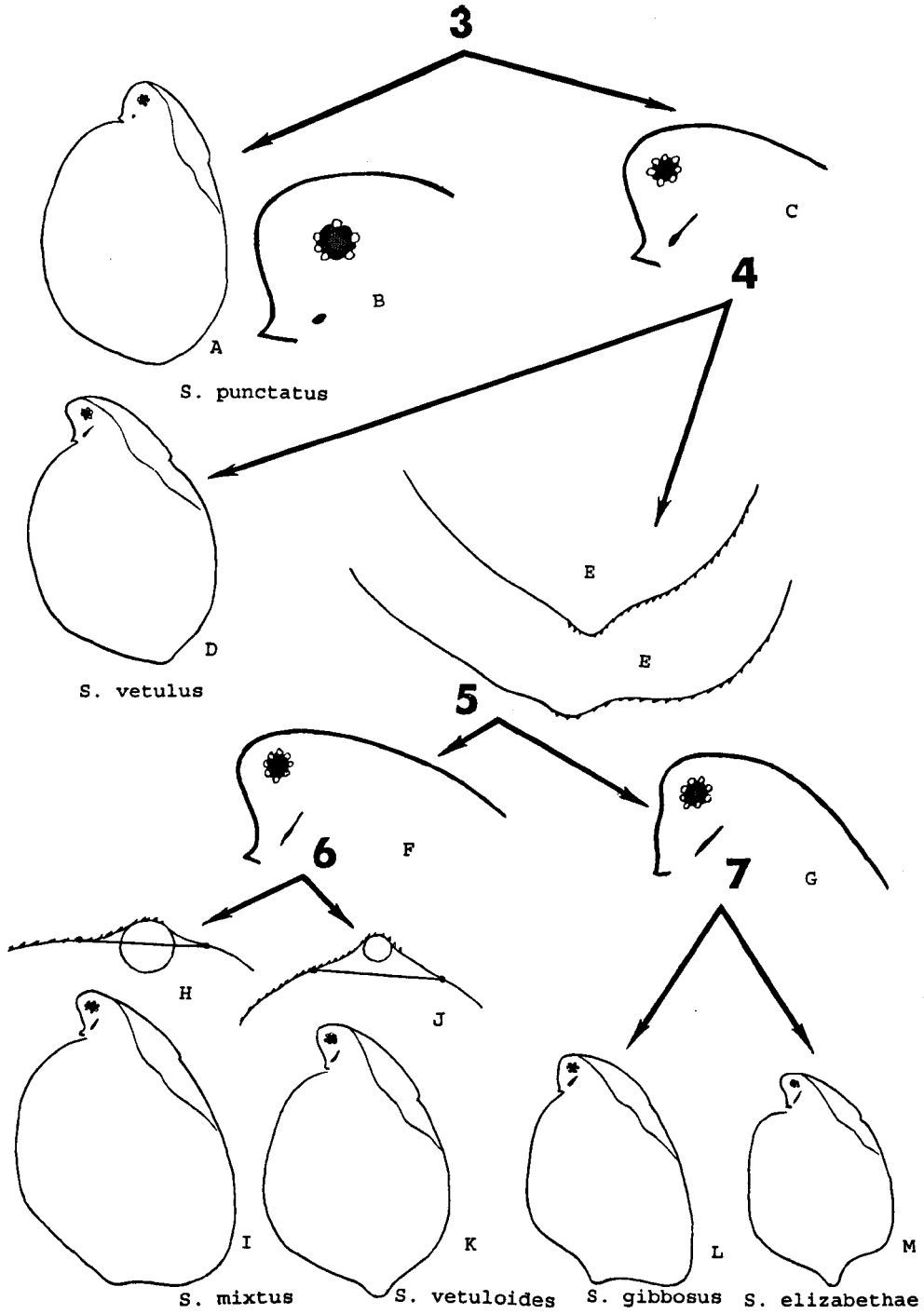


Fig. 56 Key to *Simocephalus* s. str. Numbers correspond with couplets in the key.

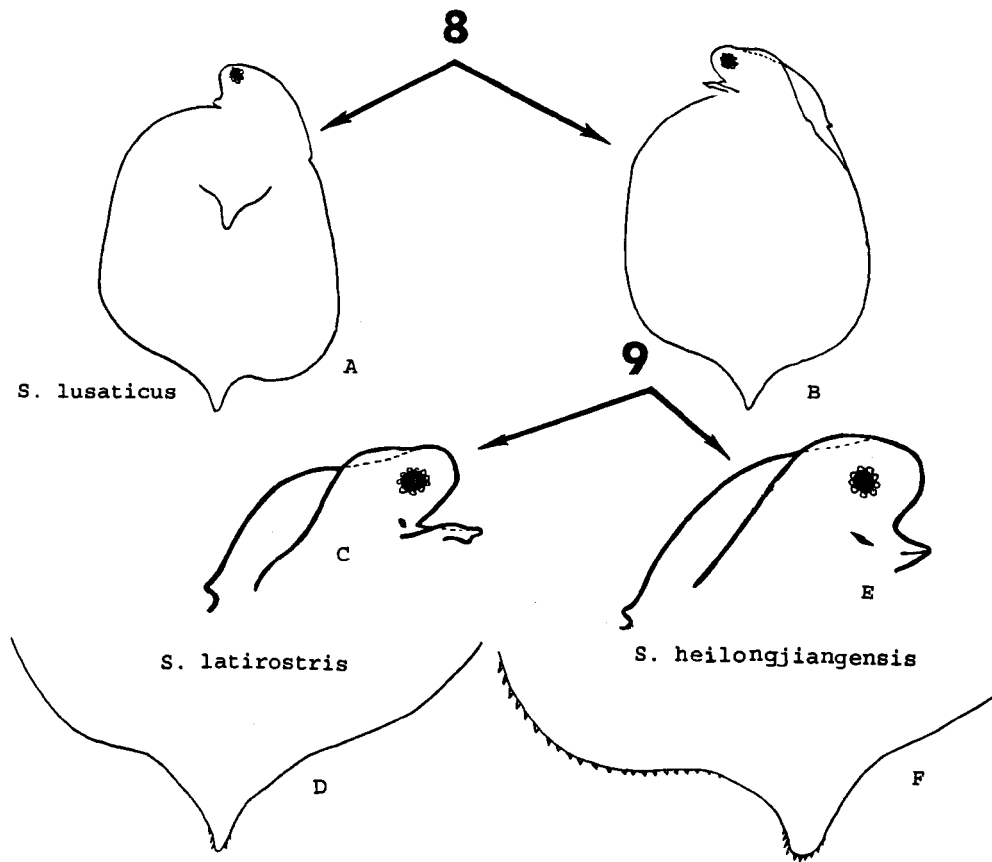


Fig. 57 Key to *S. (Aquipiculus)*. Numbers correspond with couplets in the key.

- Fig. 57. ♀ & ♂: No lateral prominences on valves (B) 9
- 9. Fig. 57. ♀: Rostrum very long, its lateral margin elevated above central part (C). Dorso-posterior valve prominence pointed (D). Occurs in South America *S. latirostris* Stingelin, 1906
- Fig. 57. ♀: Rostrum of moderate size, its lateral margin below central part (E). Dorso-posterior valve prominence rounded (F). Occurs in Australia, Malay Archipelago, Asia and Africa. *S. heilongjiangensis* Shi, Shi, 1994
- 10. Fig. 58. ♀: Frons rounded (A). One supra-anal angle (B) 11
- Fig. 58. ♀: Frons pointed (C). Two supra-anal angles (D) *S. (acutirostratus)* species group 14
- 11. Fig. 58. ♀: Ventral head margin very convex (E). Spines of basal pecten of postabdominal claw well-spaced (F). Occurs in New-Zealand *S. obtusatus* (Thomson, 1878)
- Fig. 58. ♀: Ventral head margin almost straight (G). Spines of basal pecten of postabdominal claw close-set (H) 12
- 12. Fig. 58. ♀: Dorso-posterior valve angle with large pointed prominence (I). Occurs in America *S. daphnoides* Herrick, 1883
- Fig. 58. ♀: Dorso-posterior valve angle with rounded prominence or without prominence (J) 13
- 13. Fig. 58. ♀: Basal pecten of postabdominal claw of 8–12 spines of moderate size (K) *S. expinosus* (De Geer, 1778)
- Fig. 58. ♀: Basal pecten of postabdominal claw of 20–25 small spines (L). Occur in Europe and Asia *S. congener*(Koch, 1841)
- 14. Fig. 58. ♀: Dorso-posterior valve angle smooth, rounded, without prominence (M). Occurs in Australia *S. victoriensis* Dumont, 1983
- Fig. 58. ♀: Dorso-posterior valve angle with distinct prominence covered with denticles (N) 15
- 15. Fig. 58. ♀: Dorso-posterior valve prominence separated above and below by deep, wide depressions. Diameter of circle inscribed in it moderate (O). Occurs in Africa *S. brehmi* Gauthier, 1939
- Fig. 58. ♀: Dorso-posterior valve prominence separated above and below by shallow, wide depressions. Diameter of circle inscribed in it large (P). Occurs in Australia and Asia *S. acutirostratus* (King, 1853)
- Fig. 58. ♀: Dorso-posterior valve prominence separated above and below by deep, narrow depressions. Diameter of circle inscribed in it small (Q). Occurs in North America *S. rostratus* Herrick, 1884
- 16. Fig. 59. ♀: Ocellus elongate. Frons without denticles (A). Occurs in America *S. mirabilis* sp. nov.
- Fig. 59. ♀: Ocellus short. Frons with denticles (B) 17
- 17. Fig. 59. ♀: Dorso-posterior valve prominence large, separated from rest of valves by deep embayments (C). Its length exceeds diameter of circle inscribed in its contour (D). Denticles cover ventral, posterior and more than 1/3 of dorsal margin. *S. serrulatus* (Koch, 1841)
- Fig. 59. ♀: Dorso-posterior valve prominence small, separated from rest of valves by shallow embayments (E). Its length less than diameter of circle inscribed in its contour (F). No denticles on ventral margin. Denticles cover less than 1/2 of posterior and less than 1/3 of dorsal margin. Occurs in South America *S. semiserratus* Sars, 1901

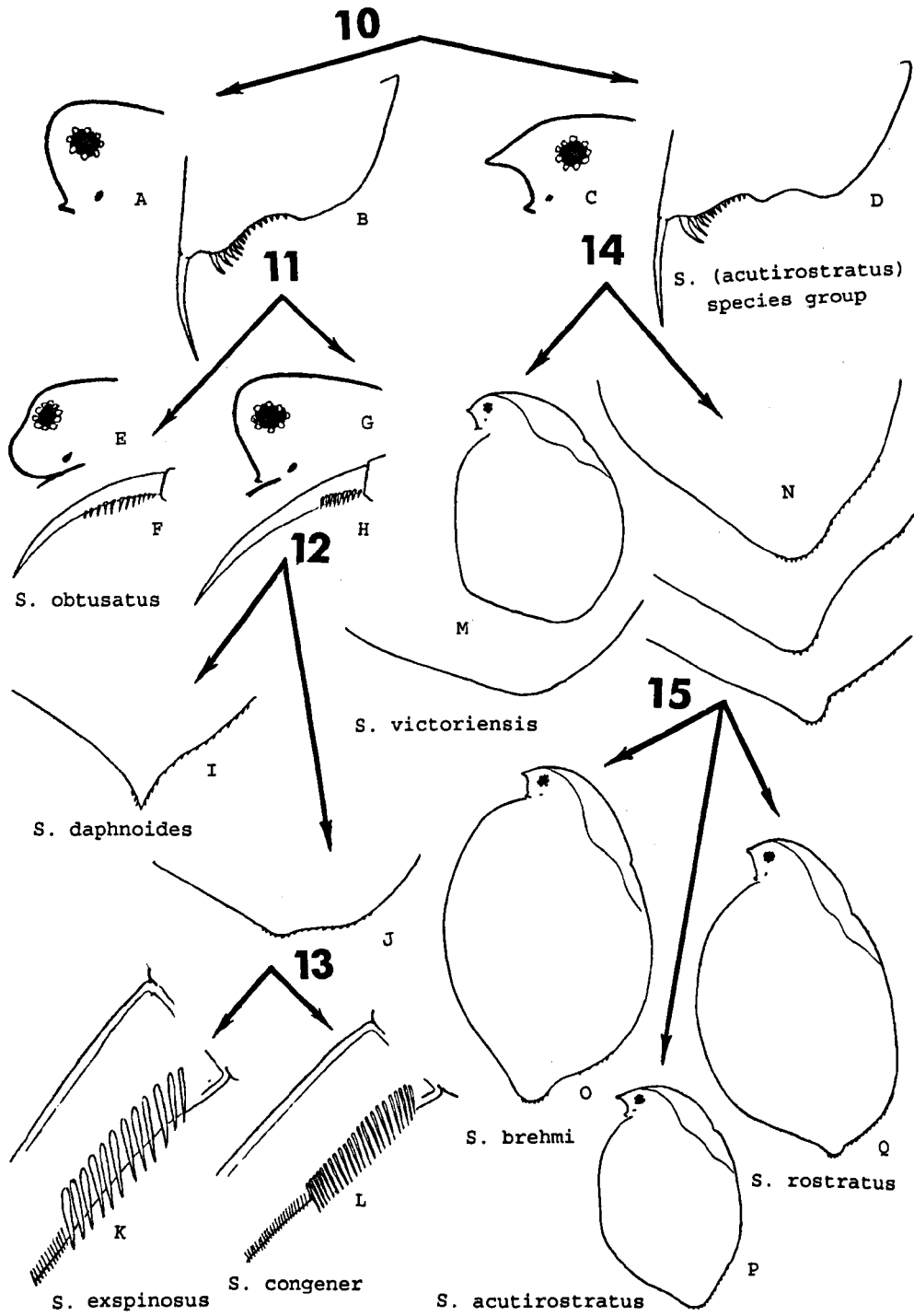


Fig. 58 Key to *S. (Echinocaudus)*. Numbers correspond with couplets in the key.

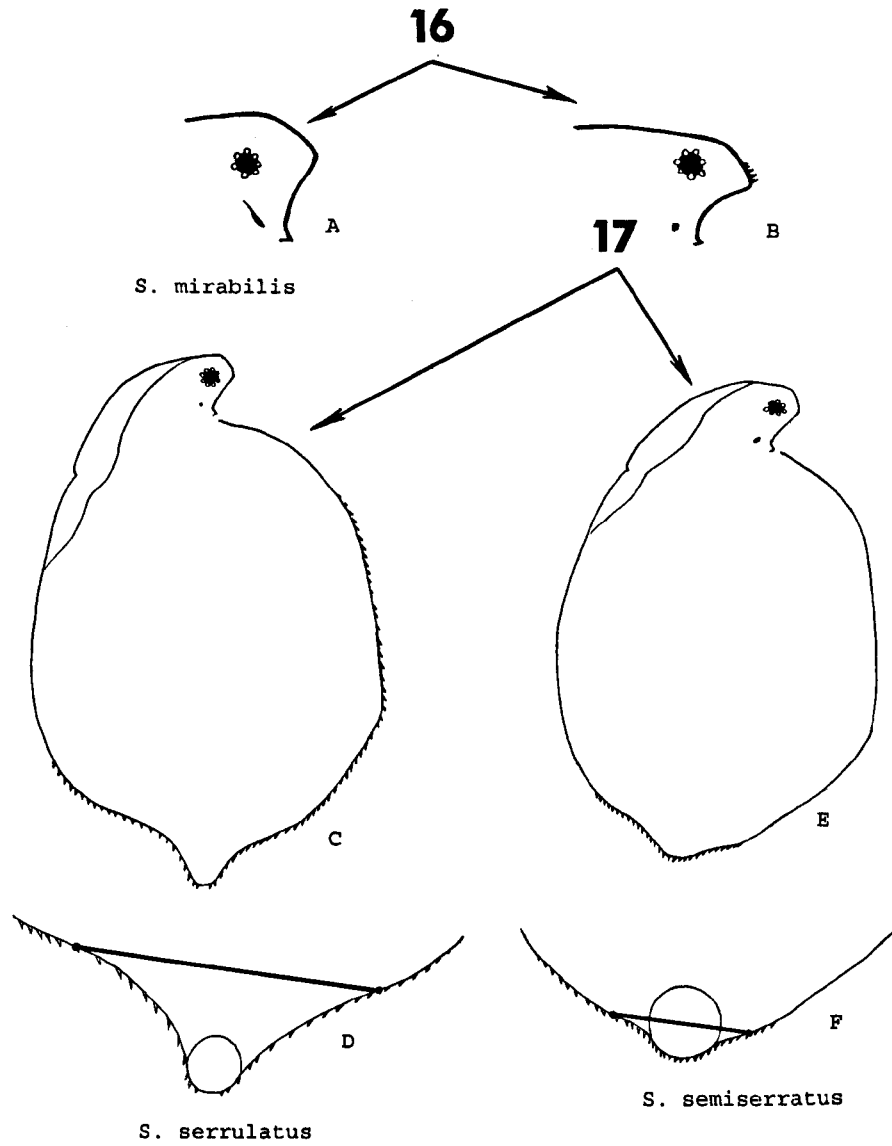


Fig. 59 Key to *S. (Coronocephalus)*. Numbers correspond with couplets in the key.

CHECK LIST OF SIMOCEPHALUS

Subgenus *Simocephalus* s. str.

1. *S. vetulus* (O.F. Müller, 1776) (*Daphne vetula*)
Daphnia sima O.F. Müller, 1785
Monoculus nasutus Jurine, 1820
S. vetulus var. *angustifrons* Lilljeborg, 1900
S. vetulus var. *brandtii* Cosmovici, 1900 syn. nov.
S. vetulus gebhardti Ponyi, 1955
S. mixtus hungaricus Ponyi, 1956
2. *S. elizabethae* (King, 1853) (*Daphnia Elizabethae*)
S. dulvertonensis Smith, 1909
3. *S. gibbosus* Sars, 1896
4. *S. vetuloides* Sars, 1898
5. *S. mixtus* Sars, 1903
S. corniger Methuen, 1910 syn. nov.
S. beianensis Shi, Sbi, 1994 syn. nov.
6. *S. punctatus* sp. nov.

Subgenus *S. (Echinocaudus)* subgen. nov.

7. *S. obtusatus* (Thomson, 1878) (*Daphnia obtusata*)
8. *S. daphnoides* Herrick, 1883
S. lheringi Richard, 1897 syn. nov.
S. fonsecai Bergamin, 1939 syn. nov.
S. fonsecai var. *sinucristatus* Bergamin, 1939 syn. nov.

S. (exspinosus) species group

9. *S. exspinosus* (De Geer, 1778) (*Monoculus exspinosus*)
Daphnia australiensis Dana, 1852
S. sibiricus Sars, 1898 syn. nov.
S. productus Sars, 1903
S. himalayensis Chiang & Chen, 1974 syn. nov.
S. vamani Rane, 1985
10. *S. congener* (Koch, 1841) (*Daphnia congener*)

S. (acutirostratus) species group

11. *S. acutirostratus* (King, 1853) (*Daphnia Elizabethae* var. *acuti-rostrata*)
S. paradoxus Schödler, 1877
S. vidyae Rane, 1983
S. vidyae gajareae Rane, 1986
12. *S. victoriensis* Dumont, 1983
13. *S. brehmi* Gauthier, 1939 stat. nov. (*Simosa acutirostrata brehmi*)
S. acutifrons Johnson, 1954 syn. nov.
14. *S. rostratus* Herrick, 1884

Subgenus *S. (Coronocephalus)* Orlova-Bienkowskaja, 1995

15. *S. serrulatus* (Koch, 1841) (*Daphnia serrulata*)
D. brandtii Fischer, 1848
D. intermedia Lievin, 1848
S. americanus Birge, 1878
S. capensis Sars, 1895
S. inflatus Vávra, 1900
S. serrulatus var. *productifrons* Stingelin, 1904
S. serrulatus var. *montenegrinus* Werestchagin, 1912
S. serrulatus var. *mixta* Grochmalicki, 1915
S. serrulatus var. *rotundifrons* Brehm, 1933
S. kerhervei Bergamin, 1939
S. aqua-brankai Bergamin, 1939
S. serrulatus var. *armata* Brehm, 1956
S. serrulatus var. *pelagicus* Brehm, 1959
S. surekhae Rane, 1985

16. *S. semiserratus* Sars, 190117. *S. mirabilis* sp. nov.Subgenus *S. (Aquipiculus)* Orlova-Bienkowskaja, 1995

18. *S. latirostris* Stingelin, 1906
19. *S. lusaticus* Herr, 1917
20. *S. heilongjiangensis* Shi, Shi, 1994
S. mesorostris Orlova-Bienkowskaja, 1995

Nomina dubia

- Daphnia aegyptiaca* Fischer, 1860
S. cacticus Moniez, 1889
S. vetulus spinosulus Stingelin, 1904
S. serrulatus var. *nudifrons* Delachaux, 1918
S. postidelivis Lai & Li, 1987

Species transferred to the genus *Daphnia*

- S. gelidus* Brady, 1918 = *Daphnia gelida* comb. nov.
S. intermedius Studer, 1878 = *D. intermedia* comb. nov.

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