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TWO NEW SPECIES OF TROGLOBITIC AMPHIPOD CRUSTACEANS (GAMMARIDAE) FROM HUBEI PROVINCE, CHINA

Zhong-E Hou and **Shuqiang Li**
Institute of Zoology, Chinese Academy of Sciences, Beijing 100080, P.R. China
Email: lisq@panda.ioz.ac.cn (All correspondence to Shuqiang Li)

ABSTRACT. - Two new species of troglobitic amphipod collected from Hubei Province, China: *Gammarus xianfengensis*, new species, and *Gammarus lichuanensis*, new species, are described. Descriptions of taxonomic characters of these blind amphipods are given and differences from related species are discussed.

KEY WORDS. - troglobitic amphipod, *Gammarus*, new species, China.

INTRODUCTION

Although there are many caves in southern China, especially in the provinces of Guizhou, Yunnan, Guangxi, Sichuan and Hubei, research on speleobiota in this region is not yet sufficiently developed. With regard to the troglobitic invertebrate fauna, only a few species of diplopods, spiders, freshwater shrimps (Cai & Li, 1997) and troglobitic amphipods (Karaman & Sket, 1990; Karaman & Ruffo, 1995) have been reported (Zhang, 1992). To improve our knowledge of the Chinese troglobitic invertebrate fauna and its biogeographic significance, intensive studies on this topic have recently begun by several research groups of the Chinese Academy of Sciences. In this paper, two new troglobitic species of freshwater Amphipoda are described, including detailed drawings of taxonomic characters. Type specimens of the new species are deposited at the Institute of Zoology, Chinese Academy of Sciences (IZCAS) in Beijing.

TAXONOMY

FAMILY GAMMARIDAE

Gammarus xianfengensis, new species
(Figs. 1-4)

Material examined. - Holotype - male 12.7mm (IZCAS-I-A0001), A cave (no name) in Qingping Town, Xianfeng County (29.40°N, 109.09°E), Hubei Province, coll. S.-Q. Li, 4 Jun.1989.

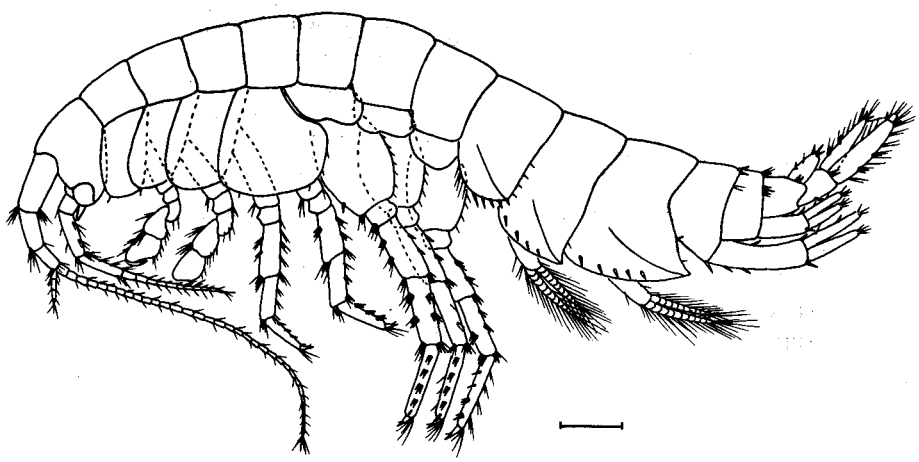

Fig. 1. *Gammarus xianfengensis*, new species, paratype, female, 12.5mm (IZCAS). Scale = 1mm.

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Paratypes - 5 males, 3 females, same data as holotype.

Description. - Male, body 12.7mm in size. Eyes (Fig. 2A) absent. Antenna 1 (Fig. 2A) about 41% of body length, peduncular articles 1-3 in length ratio 1 : 0.82 : 0.55, only with distal setae; primary flagellum 34-articulate, accessory flagellum 4-articulate. Antenna 2 (Figs. 2A, B) about half the length of antenna 1, gland cone reaching beyond peduncular article 3, peduncular articles 4 and 5 and flagellum in length ratio 1 : 1 : 2.1, flagellum 16-articulate, calceoli present on proximal 10 articles, both peduncular articles with 3 groups of short setae, setae length attain the article's width.

Upper lip (Fig. 2J) convex, with minute setae. Incisor of left mandible (Fig. 2H) 5-dentate; lacinia mobilis with 4 weak dentitions; molar triturative, with 1 stout seta; article 2 of palp with 14 marginal setae, article 3 with 2 groups of A-setae on outer face, two groups of B-setae on inner face, about 30 D-setae and 6 E-setae (cf. Cole, 1980). Incisor of right mandible (Fig. 2K) 4-dentate, lacinia mobilis with 6 weak dentitions at edge. Lower lip concave (Fig. 2L), lacking inner lobes, with long apical setules. Maxilla 1 (Figs. 2C, E), inner plate with 12 plumose setae on lateral margin; outer plate armed with 11 serrated spines apically; palp 2-articulate, with 7 slender spines and 3 stiff setae. Maxilla 2 (Fig. 2I), inner plate armed with a diagonal row of 13 plumose setae, outer plate with apical setae. Maxilliped (Figs. 2D, F, G), inner plate with 3 stout apical spines; outer plate with 10-15 medial spines and 4 apical pectinate setae; palp 4-articulate, article 3 truncated distally, article 4 unguiform.

Coxal plates 1-3 (Figs. 3D, 4C, E) approximately twice as long as wide, distally rounded, with 3-6 short setae on anterior and posterior parts of distal margins. Coxal plate 4 (Fig. 3E) concave, hardly longer than wide, with 5 anterodistal and 7 posteromarginal setae. Coxal plates 5-7 (Figs. 3A-C) shallow, with 3 setae on posterior margin. Coxal gills of pereopods 2-7 sac-like.

Gnathopod 1 (Fig. 4E), carpus much smaller than propodus; propodus pyriform, with 1 medial palmar spine and 5 blunt spines posteriorly, 4 facial spines and 3 small crenulations; dactylus slender. Gnathopod 2 (Fig. 4C), carpus about half as long as propodus, anterior and posterior margins subparallel; palm of propodus with 1 medial palmar spine and 4 posterodistal spines; dactylus fitting palm.

Pereopods 3-4 with few long setae. Pereopod 3 (Fig. 3D), basis slender with long setae, article 4 with 5 anterior and 3 posterior spines in tandem, accompanied by a few setae, article 5 with 1 anterior spine distally and 1-1-2 posterior spines, article 6 with 2-2-1-1 lateral spines, dactylus with 1 seta. Pereopod 4 (Fig. 3E), article 4 with 1-2 spines anteriorly and I-1-1-1 posterior spines, article 5 with 1 anterior spine distally and 2-2-2 posterior spines, article 6 with 1-1-1-1 lateral spines.

Pereopods 5-7 (Figs. 3A-C) in length ratio 1 : 1.17 : 1.05, the pereopod 7 about 34% of body length. Bases with slightly convex anterior margin, bearing about 5 short single spines and some setae; posterior margin nearly straight in pereopod 6, convex in pereopod 7, with a row of about 15 short setae; the posterodistal lobe weak. Articles 4-5 mainly with 3 groups of 1-3 spines and some setae along their anterior and posterior sides; setae are shorter than article diameters. Dactylus short and curved, about 20% of article 6.

Epimeral plates 1-3 (Fig. 4B) progressively acuminate posterodistally. Epimeral plate 1 ventrally rounded; anteroventral margin with 2 clusters of setae and 1 spine, followed by 2 ventral marginal setae; posterior margin with 2 small setae. Epimeral plate 2 with 5 ventral marginal spines and 1 facial spine, posterior margin with 3 small setae. Epimeral plate 3 with 5 ventral spines and 2 posterior lateral setae.

Pleopods 1-3 (Figs. 4M-O) similar and well developed. Peduncles of pleopods progressively shorter, with 2 distal retinaculae accompanied by 2-3 long setae, and several long setae dorsally; both rami fringed with plumose setae.

Urosomites 1-3 with some dorsal spines and setae. Urosomite 1 with 1 seta- 2 spines-1 spine accompanied by setae from left to right, urosomite 2 with 3-2-3 dorsal spines, urosomite 3 with 3-2 spines.

Uropod 1 (Fig. 4G), peduncle longer than rami, with 1 basofacial spine, outer margin with 1-1-2 spines, inner margin with 1 lateral and 1 distal spines; outer ramus a little shorter than inner ramus, with no lateral but 4 distal spines; inner ramus with 1 mid-marginal and 4 distal spines. Uropod 2 (Fig. 4I), peduncle longer than inner ramus but shorter than outer ramus, with 1 marginal and 2 distal spines, both rami with 1 outer mid-lateral and 5 distal spines. Uropod 3 (Fig. 4K), peduncle with 3 paired distal spines and some facial setae, inner ramus a little shorter than outer ramus, inner ramus with 1 distal spine and fringed with plumose setae, article 1 of outer ramus with 2-2 lateral and 4 distal spines, article 2 small, fused with article 1.

Telson (Fig. 4A) deeply cleft; each lobe bearing 5-6 setae on dorsal surface and 3 distal spines accompanied by 2 long setae.

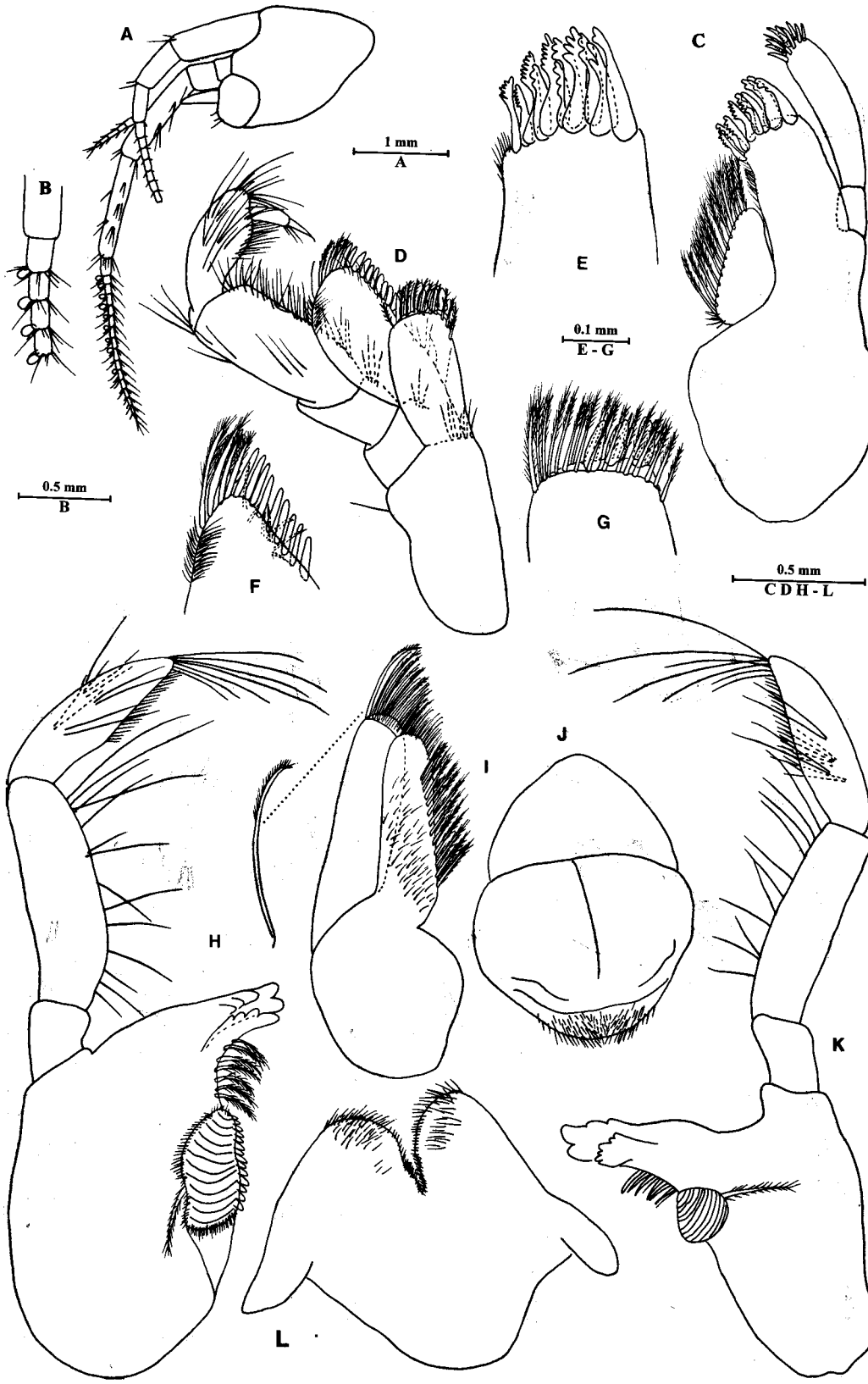

Fig. 2. *Gammarus xianfengensis*, new species, holotype, male (IZCAS). A. head; B. antenna 2; C. maxilla l; D. maxilliped; E. outer plate of maxilla 1; F. outer plate of maxilliped; G. inner plate of maxilliped; H. left mandible; I. maxilla 2; J. upper lip; L. lower lip; K. right mandible.

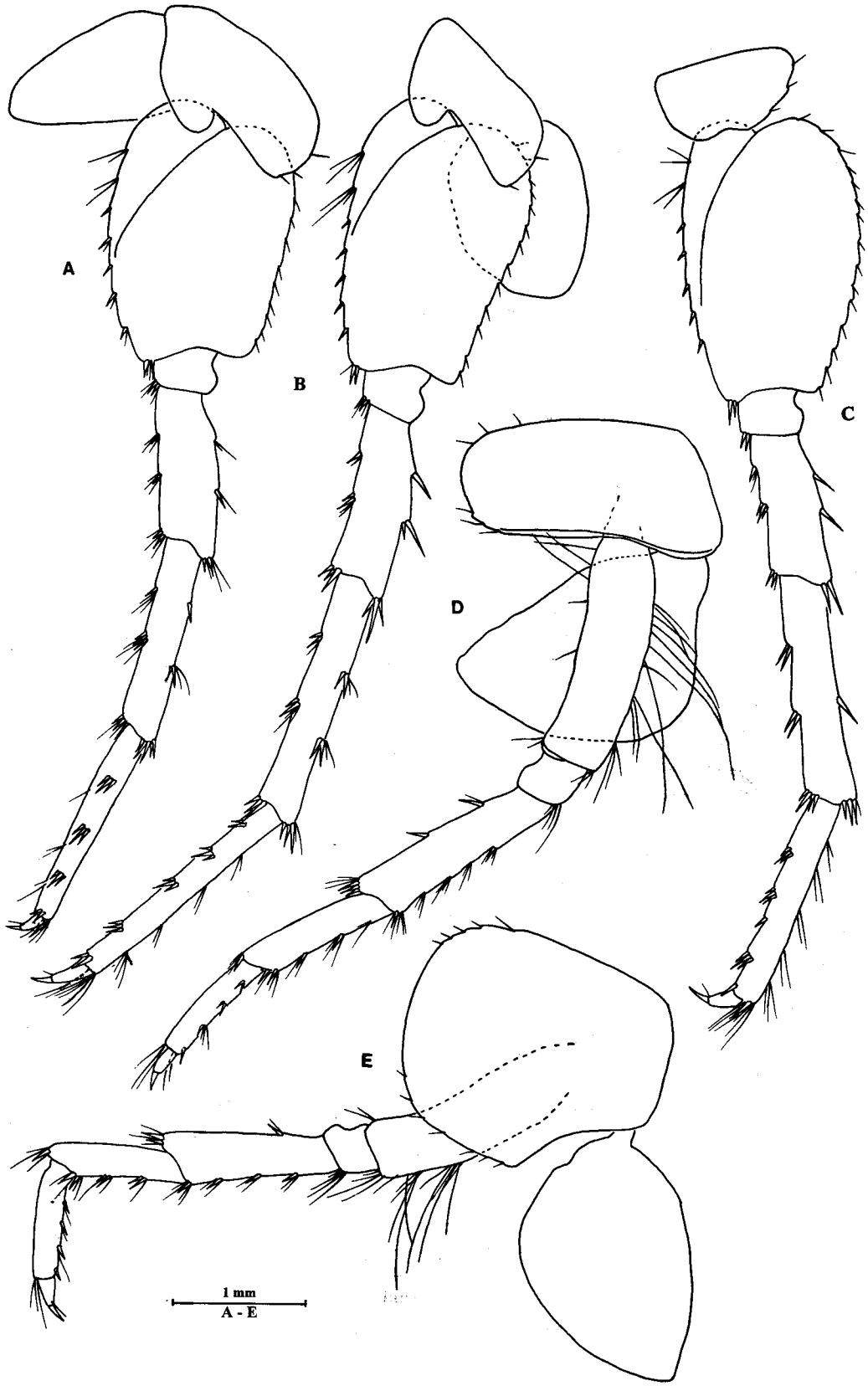

Fig. 3. *Gammarus xianfengensis,* new species, holotype, male (IZCAS). A. pereopod 5; B. pereopod 6; C. pereopod 7; D. pereopod 3; E. pereopod 4.

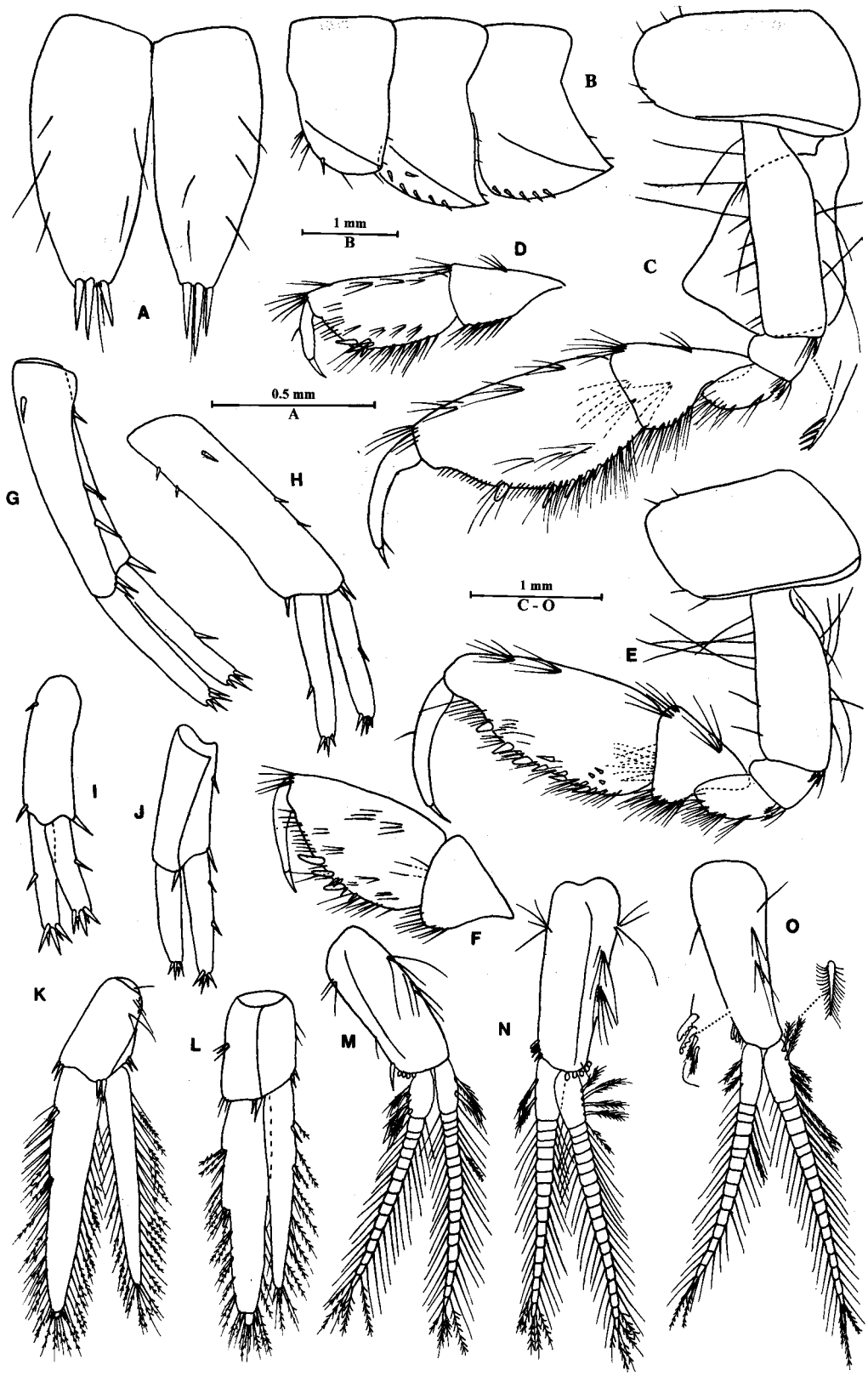

Fig. 4. *Gammarus xianfengensis*, new species, holotype, male (IZCAS). A. telson; B. epimeral plates 1-3; C. gnathopod 2; D. gnathopod 2 (female, paratype); E. gathopod l; F. gnathopod 1 (female, paratype); G. uropod 1; H. uropod 1 (female, paratype); I. uropod 2; J. uropod 2 (female, paratype); K. uropod 3; L. uropod 3 (female, paratype); M. pleopod 1; N. pleopod 2; O. pleopod 3.

Dimorphism. - Female 12.5mm. Antenna 2 slightly shorter than that of male, calceoli absent. Propodus of gnathopods dissimilar. Gnathopod 1 (Fig. 4F), propodus palm oblique with 7 posterodistal spines. Gnathopod 2 (Fig. 4D), propodus palm slanted, with 5 blunt spines at posterior corner. Outer ramus of uropod 2 with no marginal spines. Each lobe of telson with 1 dorsal spine.

Oostegites present on pereopods 2-5, paddle-shaped and bearing many long setae along lateral margins.

Etymology. - The new species is named after its type locality, Xianfeng County.

Habitat. - The cave, which the species inhabits, has a small entrance on the side of a country road in Qingping Town, Xianfeng County. This opening is just large enough to allow a collector armed with a net to enter. No other entrance was discovered.

Remarks. - The first Chinese troglobite of the family Gammaridae, *Sinogammarus troglodytes*, was found in Sichuan province by Karaman & Ruffo (1995). Although some difference was found between *Sinogammarus* and *Gammarus*, our research revealed that *Sinogammarus* is not a separate genus and a detailed discussion on this topic will be given in another paper. *Gammarus xianfengensis*, new species, is the second troglobitic gammarid reported from China. The latter is morphologically similar to the former in the absence of eyes; in the shape of male gnathopods 1-2; in the inner ramus of uropod 3 which is more than three-fourths of length of segment 1 of outer ramus and segment 2 of outer ramus is small and fused with article 1; in the presence of plumose setae on both rami. However, *G. xianfengensis* differs from *S. troglodytes* by the bases of pereopods 6-7 which are not elongate and with weakly concave posterodistal margin in pereopod 6 but posteriorly rounded margin in pereopod 7 and by epimeral plates 2-3 bearing 5-6 ventral spines.

This new taxon differs from other Chinese freshwater gammarids (Barnard & Dai, 1988) mainly by pereopods 3-4 with fewer long setae on posterior margin, rami of uropods 1-2 with fewer spines and article 2 of outer ramus of uropod 3 very small and shorter than adjacent spines.

Gammaus lichuanensis, new species
(Figs. 5-7)

Material examined. - Holotype - female (15.8mm) (IZCAS-I-A0002), Tenglong Cave (about 10km apart from Chengguan Town), Lichuan City (30.18°N, 108.56°E), coll. S.-W. Wang, 24 Dec.1987.

Description. - Female (Fig. 5A), body 15.8mm in size and blue color in alcohol. Appendages slender. Eyes absent. Antenna 1 about 70% of body length, peduncular articles 1-3 slender, in length ratio 1 : 0.69 : 0.54, with some distal setae; primary flagellum 43-articulate, accessory flagellum 5-articulate. Antenna 2 less than half the length of antenna 1, peduncular articles 4 and 5 and flagellum in length ratio 1 : 1 : 1.36, flagellum 9-articulate; both long peduncular articles with 4 groups of setae along ventral side, setae length attain the article's diameter; gland cone reaching beyond peduncular article 3.

Upper lip subrounded (Fig. 6A), with minute setae. Mandible (Fig. 6E), incisor 4-dentate, lacinia mobilis with 4 weak dentitions, molar triturative; article 2 of palp with many marginal setae, article 3 with 2 groups of A-setae, about 10 on outer face, 6 B-setae on inner face, about 32 D-setae and 6 E-setae. Lower lip (Fig. 6B) concave with marginal setae. Maxilla 1 (Figs. 6F, G), inner plate with 12 plumose setae, outer plate with 11 serrated spines, palp article 2 with 7 slender spines. Maxilla 2 (Fig. 6D), inner plate with a diagonal row of 23 setae on inner face, outer plate with apical setae. Maxilliped (Fig. 6C), inner plate with 3 apical spines and some setae, outer plate with 16 lateral spines and some setae, palp article 2 stout, article 3 truncated distally and article 4 unguiform.

Coxal plates 1-4 subrectangular (Figs. 7D-H), with 3-8 setae on anterior and posterior margins. Coxal plates 5-7 bilobate (Figs. 7A-C). Coxal gills 2-4 sac-like, gills 5-7 missing. Oostegites of pereopods 2-5 (Figs. 7A, D, G, H) progressively attenuated, with long marginal setae.

Gnathopod 1 (Figs. 7E, F), basis with 3 distal spinulate spines, article 3 with 2 distal spines, carpus shorter than propodus, propodus palm oblique with 1-1-1-3-1-2-2-2-2 posterior spines in tandem. Gnathopod 2 (Figs. 7D, I), carpus elongated, as long as propodus in length, propodus palm transverse with 2 posterodistal spines.

Pereopod 3 (Fig. 7H), basis slender, article 4 with 1-1-1 anterior and 1-1 posterior marginal spines, article 5 with 1 anterodistal and 1-1-1-1 posterior spines, article 6 with 2-2-1-1-2 facial spines. Pereopod 4 (Fig. 7G), article 4 with 1 anterior distal and 1-1-1 posterior spines, article 5 with 1 anterior distal and 1-1-1-2 posterior spines, article 6 with 6 spines on posterior margin.

Pereopods 5-7 (Figs. 7A-C) similar and slender. Anterior margin of bases bearing about 10 short single spines and some setae; posterior margin convex in

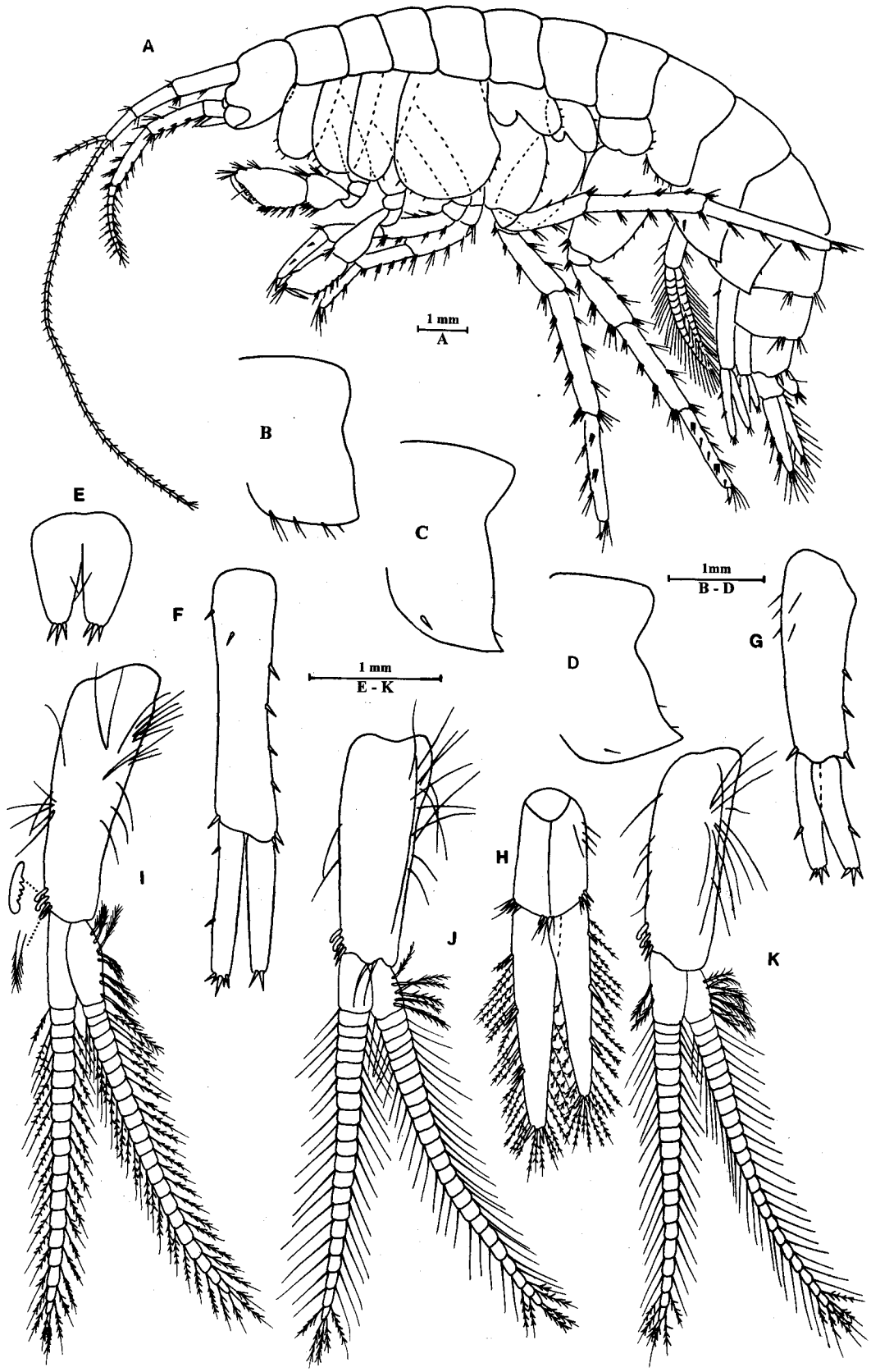

Fig. 5. *Gammarus lichuanensis,* new species, holotype, female 15.8mm (IZCAS). A. body; B-D. epimeral plates 1-3; E. telson; F. uropod 1; G. uropod 2; H. uropod 3; I. pleopod 1; J. pleopod 2; K. pleopod 3.

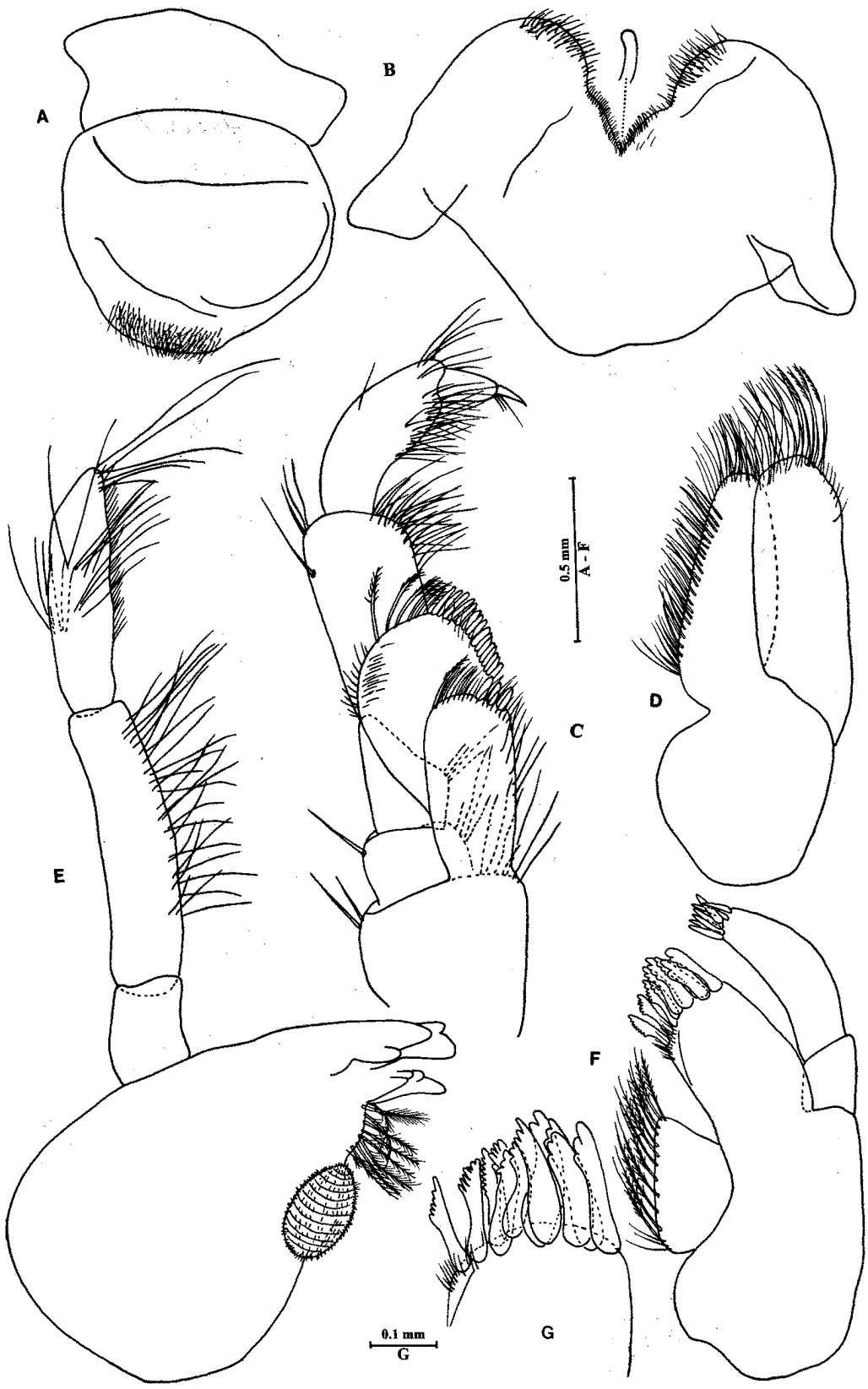

Fig. 6. *Gammarus lichuanensis*, new species, holotype, female 15.8mm (IZCAS). A. upper lip; B. lower lip; C. maxilliped; D. maxilla 2; E. mandible; F. maxilla 1; G. outer plate of maxilla 1.

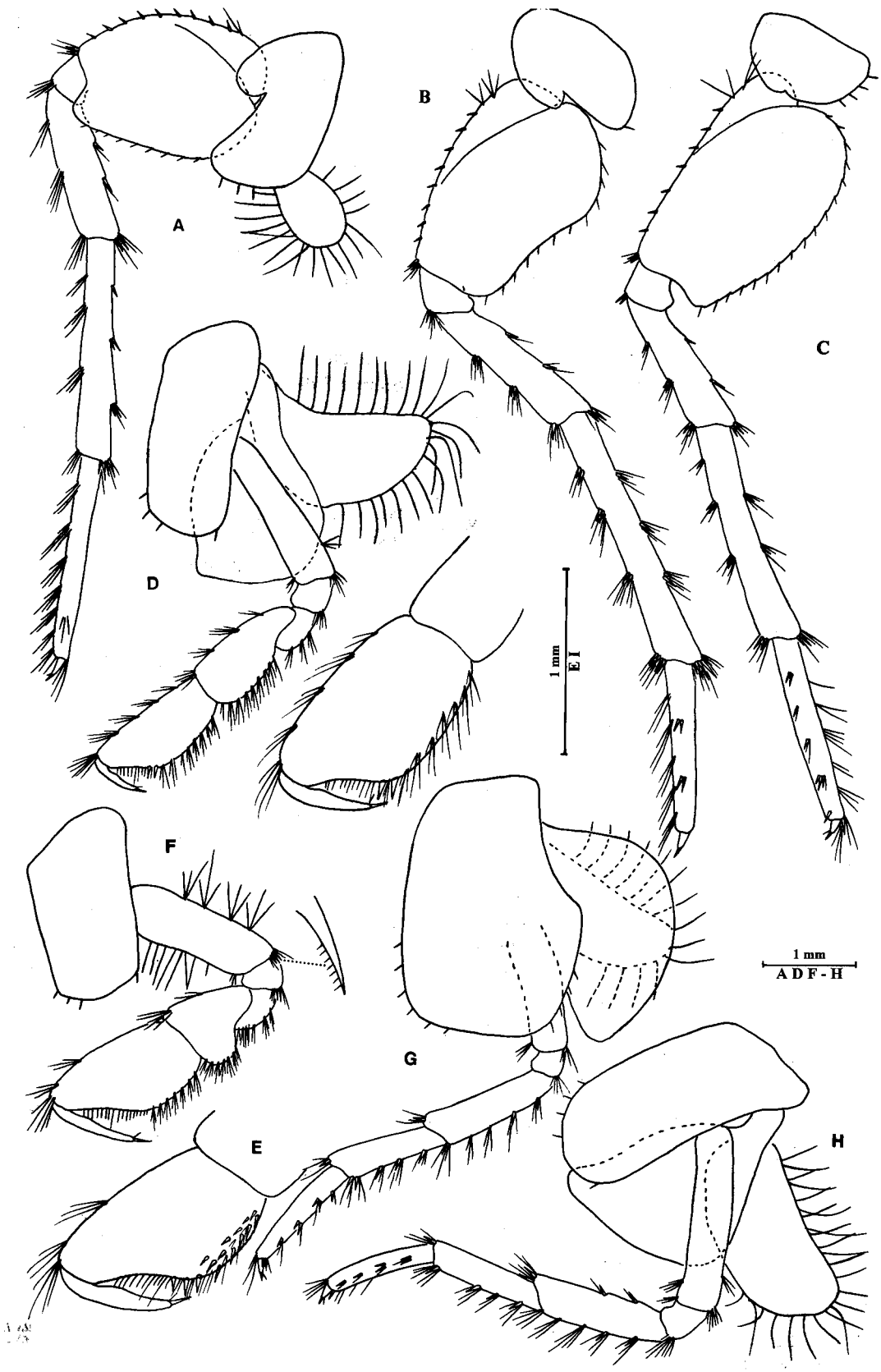

Fig. 7. *Gammarus lichuanensis*, new species, holotype, female 15.8mm (IZCAS). A. pereopod 5; B. pereopod 6; C. pereopod 7; D. gnathopod 2; E. propodus of gnathopod 1; F. gnathopod l; G. pereopod 4; H. pereopod 3; I. propodus of gnathopod 2.

Pereopod 6, with about 13 short setae. Articles 4-5 mainly with 3 groups of spines and some setae along their anterior and posterior sides; setae longer than spines. Article 6 with 5 clusters of marginal setae, setae a little longer than article diameters. Dactylus short and curved, about 18% of article 6 in length.

Epimeral plates 1-3 (Figs. 5B-D) progressively more acuminate on posterior corner, epimeral plate 1 ventral margin rounded with marginal setae, epimeral plate 2 with 1 ventral spine, epimeral plate 3 with ventral setae and posterior short setae.

Pleopods (Figs. 5I-K) well developed, similar. Peduncle of pleopods 1-3 progressively shorter, with 2 distal retinaculae accompanied by 2 long setae, and some long setae in proximal portion; both rami fringed with plumose setae.

Urosomites 1-3 with dorsal spines accompanied by setae, urosomite 1 with 1 spine on both sides and a cluster of dorsal setae, urosomite 2 with 2 spines on each side and some dorsal setae, urosomite 3 with 2 spines on each side.

Uropod 1 (Fig. 5F), peduncle longer than rami, with 1-1 outer and 1-1-1-1-2 inner marginal spines and 1 basofacial spine; inner ramus missing, outer ramus with 1-1 outer marginal and 5 distal spines. Uropod 2 (Fig. 5G), peduncle with dorsal setae and 1 outer distal and 1-1-1 inner marginal spines, inner ramus with 1 mid-lateral and 3 distal spines, outer ramus with 1 mid-lateral and 4 distal spines. Uropod 3 (Fig. 5H), peduncle with 9 distal spines and some dorsal setae; inner ramus a little shorter than outer ramus, with 1-1 lateral and 2 distal spines; outer ramus 1-articulate, with 1-2-2 spines on outer margin and 2 distal spines; both rami armed with long plumose setae.

Telson (Fig. 5E) deeply cleft, each lobe with 3 distal spines and 1 facial seta.

Male unknown.

Etymology. - The new species named after its type locality, Lichuan City (Hubei Province, China).

Habitat. - The species was found in Tenglong Cave. Tenglong Cave is one of the biggest caves in China, with about 52.8 km in length and more than 2,000,000 m^2. The temperature varies between 14-18°C during the year. The entrance of the cave is 74m high and 64m wide. The stream from which the type specimen was collected about 14 years ago is more than 16.8 km long.

Remarks. - *Gammarus lichuanensis,* new species, differs from *G. xianfengensis,* new species, in the following ways: (1) antennal sinus sharp; (2) pereopods 3-7 slender; (3) outer ramus of uropod 3 1-articulate; (4) epimeral plates 1-3 with few spines or setae; (5) basis of pereopod 6 posteriorly lobate.

The new species also resembles *Gammarus vignai* (Karaman & Pinkster, 1977), which is found in Asia Minor, but differs from that species by: (1) article 2 of gnathopod 1 with 3 distal spinulate spines, article 3 with 2 distal spines; (2) pereopods 3 and 4 armed with a few long setae; (3) outer ramus of uropod 3 is 1-articulate; (4) telson longer than wide, each lobe bearing 3 distal spines and 1 dorsal seta.

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