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LV.—*On the Fossil Cypridinidæ and some Allied Ostracoda.*
By Professor T. RUPERT JONES, F.R.S. &c.

[Plate XVII.]

THE generic name *Cypridina*, proposed by Professor Henry Milne-Edwards in 1838 *, and first published by him in 1840, was adopted by palæontologists more than half a century ago † as a modern representative of some small Bivalve Crustaceans found fossil in Devonian and Carboniferous strata, and others in the Cretaceous and Tertiary formations. The figure given by H. Milne-Edwards in his 'Hist. Nat. des Crustacés,' vol. iii. (1840) p. 410, pl. xxxvi. figs. 5–9, unfortunately had no indication of the antero-ventral notch. By a letter, however, dated January 11th, 1856, he definitely informed me that this notch ("l'échancrure du bord antéro-inférieure") was present, but had been inadvertently omitted in the drawing ‡. Owing to this omission of a characteristic feature

* Hist. Nat. Anim. s. Vert. édit. 2, vol. v. p. 178.

† By De Koninck in 1841; Sandberger in 1845; subsequently by Richter, Rolle, F. A. Römer, Ferd. Römer, Ludwig, von Keyserling, von Eichwald, von Reuss, Bosquet, and others.

‡ See "Monograph of the Tertiary Entomostraca of England," Palæont. Soc. 1856, p. 9; and "Monogr. British Fossil Bivalved Entomostraca from the Carboniferous Formations," Pal. Soc. 1874, p. 11.

the term "*Cypridina*" was applied to various fossils, as referred to above. The greater number of these misnamed fossils belong to *Cythere*, some to *Entomis**, others to *Cypridella* and *Cyprella*, and even to *Isochilina* and *Leperditia*. On the other hand, other fossils, more truly Cypridinal in character (such as Bosquet's *Cyprellæ* from the Cretaceous and Tertiary beds of Holland and Belgium), being possessed of the anterior notch and beak, were regarded as distinct on that account, and thus misunderstood.

One of the best authorities on the biology of this group of lowly Crustacea, Dr. G. S. Brady, F.R.S., has given the following interesting statement about them:—

"The Cypridinidæ, owing to their considerable size and frequent capture in the surface-net, have attracted more general attention from zoologists than any other division of the Ostracoda; but, compared with the Cypridæ and Cytheridæ, the number both of species and individuals is very small. They appear to be most abundant in the warm surface-waters of the tropical seas, contributing largely to the phosphorescence of those regions. The males only (at any rate of those species which have been thoroughly examined) are endowed with swimming power, the females being non-natatory and passing their lives wholly at the bottom, a condition imposed upon them by the absence of the tuft of long filaments, attached to the first pair of antennæ, which is characteristic of the males. The shape of the shell, too, is usually very different in the two sexes, the male being very long and slender in comparison with the female.

"Judging from the number of fossil species belonging to this family which have been found in the Coal-measures and other Palæozoic formations, we must suppose that the Cypridinidæ were much more abundant in old times than now. So we may perhaps likewise infer that they were chiefly inhabitants of shallow warm water, possibly of brackish and estuarine localities."

The abundance of Cypridinids in some beds of the Carboniferous or Mountain Limestone, which was formed in an open sea, indicates, however, that these bivalved Crustaceans were not confined to littoral areas†.

"Some few species have been described from Cretaceous and Tertiary strata; but it would appear that the group attained the greatest development in the Carboniferous era,

* Particularly in the case of the so-called "Cypridinen-Schiefer" of Germany.

† Some remarks on the fossil forms and their relationships were given in the 'Monthly Microscopical Journal,' vol. x. (1873) pp. 71–76.

and has been gradually losing ground since that time, until it has in our days come to be almost swamped by the smaller, hardier, and doubtless also more prolific species of the families Cypridæ and Cytheridæ, animals evidently of much more plastic organization, and more capable of adaptation to varied conditions of environment." (Zoology of the Voyage of H.M.S. 'Challenger.'—Part III. Report on the Ostracoda. By G. Stewardson Brady, M.D., F.L.S. 1880. Pp. 151, 152.)

A full catalogue of the then known thirty-two species of five genera (*Cypridina*, *Bradycinetus*, *Eurypylus*, *Philomedes*, and *Asterope*), with references and synonyms, are given at pages 152–154; and descriptions of four new species, including one of a new genus (*Crossophorus*), follow, with illustrations.

Thus we see that *Cypridina* is the type of a special group of Ostracods living in the open sea, some crawling on the sea-bed and some swimming free and coming to the surface mostly at night ("crepuscular" in habit). Their bivalve test is usually larger than those of the Cyprids and Cytherids, often globose, or, at least, oval and tumid. A few fossil forms are known in the Tertiary and Chalk formations; but in some of the Palæozoic rocks *Cypridinæ* and their relatives abound, making up the mass of the Carboniferous Limestone at some places (as in the Isle of Man, Lanarkshire, Bolland, Tenby, Cork, Belgium, and elsewhere), just as much as smaller Entomostraca constitute the mass of some Silurian limestones (Malvern, Sweden, Russia) and other limestones of Mesozoic age (at Mountfield in Sussex, Swanage in Dorset), and especially some Carboniferous Oil-shales in Lanarkshire.

Necessarily there remains to the geologist only the hard portion of the structure of these little Crustaceans, such as the bivalve carapace or its separate moieties, all the locomotive and branchial limbs and maxillary apparatus having disappeared. He cannot therefore follow the zoologist closely or decidedly in the detailed study of *Cypridina* and its allies. The shape (outlines and contours) of the carapace and its valves, and occasionally its ornamentation and its muscle-spot, become his chief guides in the discrimination of differences.

Since, however, bivalve tests recognizable as more or less closely resembling those of *Cypridina* remain in the strata, it is evident that they should subserve as far as possible in the characterization of the geological formation to which they belong. Efforts made in this direction have resulted in the recognition of numerous generic forms which can be referred to that group of the Ostracoda which is known as the

[illegible]

¹ For a tabulated catalogue of the Palæozoic Ostracoda known in 1890, see Quart. Journ. Geol. Soc. vol. xlv. p. 2.

² Numerous in fluvial and lacustrine deposits.

³ Numerous in many marine deposits.

⁴ In Australia. See Ann. & Mag. Nat. Hist. ser. 5, vol. xiv. (1884) pp. 393 and 402, pl. xv. figs. 18 a, b, c.

⁵ In Post-Tertiary deposits. See Monogr. Post-Tert. Entom. (Pal. Soc.), by Brady, Crosskey, and Robertson, 1874, p. 220, pl. xii. fgs. 18-21.

⁶ *E. Middendorffi*, Jones, from Siberia. Monogr. Foss. Esth., Pal. Soc. 1862, p. 111. pl. iv. figs. 12-22.

7 From the Cretaceous beds of Brazil, with *Estheria*. See Geol. Mag. dec. iv. vol. iv. (1897) p. 197 and p. 291.

^{8 9} These two groups of Ostracods and one of Phyllopods (¹⁰) are here introduced, the opportunity being conveniently taken to show how very persistent others of the lower Crustaceans (besides *Cypridina*) have been during long geological periods.

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MYODOCOPA, including the Cypridinidæ, Conchoeciidæ, and the Entomoconchidæ. The next allied group is the CLADOCOPA, represented by the Polycopidæ only. Another group is the PLATYCOPA, having the Cytherellidæ only. See Dr. G. S. Brady's memoir in the Trans. Linn. Soc. vol. xxvi. (1868) pp. 355 *et seq.*, for the classification by Dr. G. O. Sars.

The geological distribution of these and other Ostracods, as well as some of the Phyllopods (as far as known), is approximately shown in the Table on pp. 336 & 337.

My purpose is now to draw attention to the most noticeable of the fossil forms alluded to in the accompanying Table; beginning with those from the Lower Silurian rocks, and rising up through the Upper Silurian and Devonian to the Carboniferous and Permian formations (in the third of which Cypridinids abound), we shall have to pass by most of the Mesozoic series to reach the specimens from the Cretaceous and the Tertiary strata, of which we know something.

As a knowledge, however, of the recent forms is necessary, the student is referred to Dr. G. S. Brady's masterly expositions of the internal structure and external characters of the recent species so assiduously studied by himself, G. O. Sars, C. Claus, Fr. Müller, and others.

1. The oldest rock in which *Cypridina* first appears in unmistakable form is *C. Raisiniæ*, J., probably of Lower Silurian (Ordovician) age, as far as can be determined. It measures 9 by 5 millim. See Quart. Journ. Geol. Soc. vol. xlix. (1893) pp. 163, 164, with a woodcut. Miss Raisin discovered the fossil "in an indurated argillite," associated with the volcanic rocks of Pared-llech-y-menyn, on the south coast of the Lleyn promontory, North Wales. (Pl. XVII. fig. 18.)

"Analogous features in various degrees, and associated with other characteristics, exist in *Cypridina Reynaudii*, Milne-Edwards, *C. elongata*, Brady, *C. Bairdii*, Brady, *C. japonica*, Brady, and other hooded and apiculate members of the genus; but none of these have the hinder end tapering away to so long and strong a point. A fossil form, however, from the Carboniferous series of Sicily, described and figured by Prof. G. G. Gemmellaro (*Philomedes acanthoides*, Gemm. Mem. Soc. Ital. Sci. ser. 3, vol. viii. 1890, p. 37, pl. v. figs. 16 and 17), is very similar, but is too attenuate, and measures 6·5 by 3 millim."

2. Another specimen, also of Lower Silurian age, is *C. Grayæ*, J., Quart. Journ. Geol. Soc. vol. xlix. (1893) pp. 305, 306, pl. xiv. fig. 12. This is from the grey shales of Whitehouse Bay, near Girvan, Ayrshire. It measures 1.08 by .76 millim. In shape it nearly resembles the Carboniferous *C. Youngiana*, Jones and Kirkby. (Pl. XVII. fig. 17.)

3. Among his Silurian fossils from the River Ssrednjaja, in the New-Siberian Island of Kotelny, Baron Eduard von Toll has found a specimen which he has described and figured as "*Leperditia* (?) sp.," but which may possibly belong to the Cypridinids.

In the 'Mémoires Acad. Impér. Science St.-Pétersbourg,' sér. 7, vol. xxxvii. no. 2, 1889, p. 45, pl. iii. fig. 20, this doubtful little fossil appears to be a not well-preserved cast of a left valve that has a truncated front margin with a shallow notch. Some delicate wavy striæ, passing obliquely backwards and downwards, mark the anterior moiety of this fossil as far as the relatively large oval subcentral muscle-spot. The notch, though weak, and the muscle-spot suggest an alliance with *Cypridina*. The valve is 7 millim. long. (Pl. XVII. fig. 14.)

4. An Upper-Silurian form closely related to *Cypridina* is the *Cyprosis Haswellii*, J., Geol. Mag. dec. ii. vol. viii. (1881) p. 338, pl. ix. figs. 6 a, 6 b. It measures 10 by 7 millim.

The late Mr. G. C. Haswell found it in the Upper Silurian mudstones on the west side of the North-Esk Reservoir, in the Pentland Hills, Scotland.

The strong broad vertical sulcus crossing the hinder third of the valve is its distinguishing characteristic. (Pl. XVII. fig. 9.)

This has been referred by M. Barrande * to *Bolbozoe*, but it does not belong to that genus.

5. A bizarre form lately figured by G. Gürich, from the *Cardiola-interrupta* zone (Upper Silurian) in Poland, probably comes within the Cypridinid group. It is of a suboblong form, notched and hooded apparently in front, and impressed with two deep, transverse, curved sulci, giving the surface the appearance of being raised into three unequal lobes. An oval muscle-spot, with twelve radiate marks on each side, is visible near the middle of the valve. The notch and muscle-

* Syst. Silur. Bohême, part i. vol. i. Supplem. (1872) p. 501.

spot remind us of Cypridinal characters (as, indeed, the author himself seems to have thought); but, though some recent species are deeply sculptured, there are none just like this.

This *Cypridina* (?) has been described and figured by Dr. Georg Gürich, of Breslau, in his "Das Palæozoicum im Polonischen Mittelgebirge," in the *Verhandl. Russisch-Kaiserl. Mineralog. Gesellschaft zu St.-Petersburg*, ser. 2, vol. xxxii. (1896) p. 378, pl. xv. figs. 12 *a, b, c*, as *Bolbozoe polonica*. He found it at Niestachow, Kleczanas, Zalesic, and Brzezinki, in Poland. Specimens vary from 3 to 8 millim. in length. (Pl. XVII. fig. 16.)

6. In one of the pebbles (consisting of a quartzite doubtfully of either Silurian or Devonian age) from the Triassic Conglomerate at Budleigh-Salterton in Devonshire, the late Mr. J. W. Salter found a Cypridinal specimen, which was subsequently figured and described (but not specially named) in the *Geol. Mag.* dec. ii. vol. viii. (1881) p. 337, pl. ix. figs. 7 *a, b*. It measured 7 by 4.2 millim.

Being a mere cast in granular quartzite, with a part of its edge still imbedded, its real outline could not be determined; but it somewhat resembled certain forms of *Cypridina brevis* and *Polycope simplex*, figured in the *Monogr. Carbonif. Entom., Pal. Soc.* 1874. (Pl. XVII. fig. 15.)

7. *Cyprosina Whidbornei*, J., is a Cypridinid peculiar to the Devonian Limestone at Lummaton, near Torquay, Devonshire, as far as known at present. It was described and figured in the *Geol. Mag.* dec. ii. vol. viii. (1881) pp. 338-340, pl. ix. figs. 1-3 and 5; see also the Rev. G. F. Whidborne's *Monogr. Devon. Fauna South England*, Pal. Soc. part i. (1889) p. 53, pl. iv. figs. 1-4. Its beak is small, and it has "a short transverse (vertical) sulcus at or near the middle of the ventral region." It occurs of different sizes, the largest measuring about 18 by 12 millim. (Pl. XVII. fig. 8.)

8. In his *Monograph on the Devonian Fauna of the South of England*, vol. i. part i. (1889), the Rev. G. F. Whidborne describes and figures some rather obscure casts of carapace-valves referable in all probability to *Cypridina* (pp. 45, 46, pl. iv. figs. 6, 10, and 18); *Cypridella* (p. 47, pl. iv. fig. 5); and a new species, *Cypridinella cæca* (p. 46, pl. iv. fig. 16). These range from 3.5 to 10 millim. in length, and were all obtained from the old Lummaton quarries, near St.-Mary-Church, not far from Torquay.

9. From the extensive calcareous formation known as the Mountain-limestone, including the Lower Carboniferous series in Scotland, numerous genera and species allied to *Cypridina* were described and illustrated in 1874 and 1884 in the Palæontographical Society's Monographs, by T. Rupert Jones, J. W. Kirkby, and G. S. Brady. Thus :—

Genera.	Number of Species.	Leading Characteristics in the Fossil Forms.
<i>Cypridina</i>	13	Notch and beak, slight in some, more pronounced in others.
<i>Bradycinetus</i>	1	Beak produced and truncate.
<i>Philomedes</i> (?)	1	Notch deep and broad.
<i>Cypridinella</i>	7	Ovate, produced at each end; more or less apiculate behind; antero-ventral region projecting and prow-like.
<i>Cypridellina</i>	8	Like <i>Cypridinella</i> , but bearing a tubercle or hump above the median line.
<i>Cypridella</i>	6	Like <i>Cypridellina</i> , but having a dorsal sulcus behind the tubercle.
<i>Cyprella</i>	2	Nearly like <i>Cypridella</i> , but annulate.
<i>Sulcuna</i>	2	Subovate, with a deep and oblique sulcus modifying the dorsal region; front truncate; notch obsolete.
<i>Rhombina</i>	2	Oblique-oblong; notch obsolete on the front slope.
<i>Polycope</i>	3	Round or oval, with faint indication of the notch.
<i>Offa</i>	1	Subglobose; front edge truncate and impressed by a nearly central slight inturning of the margins of the valves.
<i>Entomoconchus</i>	3	Subglobose; front edge truncate and modified by the margins being pressed inwards, and each forming a sinuous curve, which leaves a long-oval opening below a short beak, and a narrower and shorter slit in the ventral region.

10. From the Coal-measures only a few Cypridinids have been obtained. *Cypridina radiata*, Monogr. Carb. Entom., Pal. Soc. 1874, p. 14, pl. v. figs. 6 a–6 f; and *Philomedes elongata*, Monogr. Carb. Entom. 1884, p. 81, pl. vi. figs. 1 a–1 c. The former from Scotland, and the latter from England, have both a peculiar radiate structure of the test.

11. In a memoir by Professor G. G. Gemmellaro, "On the Crustacea of the *Fusulina*-limestone of the Valley of the Sosio River, in the Province of Palermo, Sicily," Mem. Soc. Italiana delle Scienze fiss. e nat. vol. viii. ser. 3, no. 1, 40 pages, with 5 plates (4to, Naples, 1890), he refers to this limestone as being a "Permo-Carboniferous" formation;

and, besides other Crustaceans—Macrurous, Brachyurous, and of doubtful affinities—he describes (pp. 30–40) and figures (pl. v. figs 3–46) numerous Ostracoda, including:—*Cypridinella*, J. & K., 2 new species; *Cypridellina*, J. & K., 1 new species; *Cypridella*, De Koninck, 2 new species; *Cypridina*, Milne-Edwards, 2 new species; *Philomedes*, Lilljeborg, 1 new species; *Entomoconchus*, M'Coy, 1 new species; *Entomis*, Jones, 2 new species. All these have an exceedingly close resemblance to the true Carboniferous species of Britain and Belgium, and at first sight might in most instances be taken for them.

12. Two small specimens of a true Cypridinal form have been met with in the Permian Limestone of Sunderland (Monogr. Carbonif. Entom. 1874, p. 13, pl. ii. fig. 28). They closely resemble *Cypridina primæva* (*Daphnia*, M'Coy), in the Carboniferous Limestone. (Pl. XVII. fig. 5.)

13. Having nothing definite to record as to the Cypridinids that may have existed in the seas of the early Mesozoic period, we arrive at the Upper Mesozoic series, certain Cretaceous deposits of which, in Limbourg and Belgium, yielded to the researches of the late M. J. A. H. Bosquet, of Liège, some small, rare, and fragile specimens, which he referred to De Koninck's *Cyprella*, because Milne-Edwards's figure of *Cypridina Reynaudi* showed no beak and notch. See 'Mémoires de la Commission pour la Description de la Carte Géologique de la Neerlande,' vol. ii. (1854), p. 124; they had been referred to *Cypridina* in the Monogr. Cretac. Entom., Pal. Soc. 1849, pp. 3 and 36.

Cypridina ovulata (*Cyprella*, Bosquet), "Descript. Entom. foss. Craie de Maestricht," Mém. Soc. Roy. Sci. Liège, vol. iv. (1847) p. 373, pl. iv. figs. 4 *a*, *b*, *c*. Carapace gibbose, boldly pitted, and bearing a large subradiate muscle-spot. Length 2 millim., height 1·4 millim., and 1·2 in thickness. From the whitish Maestricht Chalk between Mont St. Pierre and Petit Lanaye, and at Sichen, in Belgium. Also in his "Monographie des Crustacées fossiles du Terrain Crétacé du Duché de Limbourg" (Mém. Comm. Descrip. Carte géol. Neerlande, vol. ii.), p. 124, pl. ix. figs. 11 *a*, *b*, *c*. (Pl. XVII. figs. 3 *a*, *b*.)

Cypridina Koninckiana (*Cyprella*, Bosquet), *ibid.* 1847, p. 373, pl. iv. figs. 5 *a*, *b*, *c*. Surface showing a large and partly radiate muscle-spot, and on its hinder moiety a triangular area of radiate punctation. Size 1·2 by ·7 millim. From the Maestrichian Chalk at Mont St. Pierre, Gronsveld,

Keer, and Bemelen; and in the same series at Petit Lanaye and at Sichen in Belgium. *Ibid.* 1854, p. 125, pl. ix. figs. 12 *a*, *b*, *c*. (Pl. XVII. figs. 4 *a*, *b*.)

14. M. J. Bosquet also found some specimens of a Tertiary Cypridinid in the Eocene beds of France, and he described it as a *Cyprella*, with illustrations. "Descript. Entomost. foss. Terr. Tert. France et Belgique" (Mém. cour. Acad. Roy. Belgique, 1852, p. 132, pl. vi. figs. 14 *a*, *b*, *c*, *d*). This is the neatly punctate, oval *Cypridina Edwardsiana* (*Cyprella*, Bosquet), *loc. cit.* Length 1·2, height ·75, and thickness ·7 millim. It was obtained from the "Sables Moyens" of Ver (Oise) and of Tancrou (Seine-et-Marne), also from the "Calcaire Grossier" of Chateaurouge, of Parnes and Chaumont (Oise), and of Orme and Grignon (Seine-et-Oise). (Pl. XVII. fig. 2.)

15. While sorting and examining, several years ago, some material of a friable calcareous deposit of Eocene age from Orglandes, Dép. Manche, France, procured by Sir C. Lyell in 1851, the writer met with a broken valve of a symmetrical little *Cypridina* of the not unusual broad oval shape, with a small neat hood and notch. Surface smooth, but bearing a rather obscure radiate muscle-mark. The fragment (fig. 1 *a*) is 6 millim. long, the smaller moiety of a valve probably 9 millim. long; the height of the valve is 6 millim. and the thickness of the carapace was 5 millim., the valve being 2½ millim. in depth or thickness. (Pl. XVII. figs. 1 *a*, *b*, *c*.)

EXPLANATION OF PLATE XVII.

- Fig.* 1. *Cypridina* from the Tertiary of Orglandes, France. *a*, anterior moiety of a left valve; *b*, outline of end view; *c*, outline of edge view.
- Fig.* 2. *Cypridina Edwardsiana* (Bosquet). Eocene, France.
- Fig.* 3. *Cypridina ovulata* (Bosquet). Maestricht Chalk Series. *a*, left valve; *b*, ventral aspect.
- Fig.* 4. *Cypridina Koninckiana* (Bosquet). Maestricht Chalk Series. *a*, left valve; *b*, aspect of the inside with the hinge.
- Fig.* 5. *Cypridina primæva* (M'Coy). Carboniferous Limestone (and Permian). Left valve.
- Fig.* 6. *Bradycinetus Rankinianus*, Jones and Kirkby. Carboniferous Limestone. Right valve.
- Fig.* 7. *Philomedes* (?) *Bairdiana*, Jones and Kirkby. Carboniferous Limestone. Right valve.
- Fig.* 8. *Cyprosina Whidbornei*, Jones. Devonian. Left valve.
- Fig.* 9. *Cyprosis Haswellii*, Jones. Upper Silurian. Left valve.
- Fig.* 10. *Cypridinella Maccoyiana*, Jones and Kirkby. Carboniferous Limestone. Right valve.

- Fig. 11. *Cypridellina Burrovi*, Jones and Kirkby. Carboniferous Limestone. Right valve.
 Fig. 12. *Cypridella Koninckiana*, Jones. Carboniferous Limestone. Right valve.
 Fig. 13. *Cyprilla annulata*, De Koninck. Carboniferous Limestone. Left valve.
 Fig. 14. *Cypridina*? (*Leperditia*?, von Toll). Silurian. Left valve.
 Fig. 15. *Cypridina*? Devonian or Silurian? Right valve.
 Fig. 16. *Cypridina*? *polonica* (*Bolbozoe*, Gürich). Upper Silurian. Right valve.
 Fig. 17. *Cypridina Grayæ*, Jones. Lower Silurian. Left valve.
 Fig. 18. *Cypridina Raisiniæ*, Jones. Lower Silurian. Left valve.
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LVI.—*List of the Phytophagous Coleoptera obtained by Mr. W. L. Distant in the Transvaal, with Descriptions of the new Species.* By MARTIN JACOBY, F.E.S.

SAGRINÆ.

Sagra bicolor, Lac. Barberton.

CRIOCERINÆ.

Lema crassipes, Oliv.

The single specimen obtained at Rustenburg does not differ in any way from the typical forms from Madagascar, which is interesting, as the latter island has but few species in common with Africa.

Lema hottentotta, Lac. Barberton.

Lema australis, Lac. Barberton.

Lema rufipennis, Lac. Pretoria.

Lema Dregei, Lac. Barberton.

Lema bipunctata, Baly. Natal, Durban.

Crioceris puncticollis, Lac. Barberton.

MEGALOPODINÆ.

Pæcilomorpha afra, Klug. Pretoria, Barberton.

CRYPTOCEPHALINÆ.

Cryptocephalus Distanti, sp. n.

Black, the clypeus flavous; head finely pubescent; thorax fulvous, with two black semicrescentic bands, minutely punctured; elytra rather strongly punctate-striate, the interstices finely punctured, flavous; a transverse band at the base,



Jones, T. Rupert. 1898. "LV.—On the fossil Cypridinidæ and some allied Ostracoda." *The Annals and magazine of natural history; zoology, botany, and geology* 1, 333–344. <https://doi.org/10.1080/00222939808677984>.

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