XLVI.—*On Permian Entomostraca from the Fossiliferous Limestone of Durham.* By J. W. Kirkby.

[With a Plate.]

[Concluded from page 330.]

Bairdia Jonesiana, n. sp. Plate XI. figs. 1, 2, & 2 *a*.

Syn. *B. gracilis*, M'Coy, Jones, Mon. Perm. Foss. p. 63. tab. 18. fig. 7.
B. gracilis, M'Coy, Reuss, Jahres. Wetterau. Gesell. 1851–1853, p. 65.
B. gracilis, M'Coy, Richter, Zeitschr. Deutsch. Geol. Gesells. 1855, vol. vii. p. 530. tab. 26. figs. 16 & 17.

Length $\frac{1}{23}$ inch; height $\frac{1}{33}$ inch.

Carapace reniform, convex, smooth. *Dorsal margin* regularly arched; *anterior slope* gradual, convex, descending one-half of the height; *posterior slope* more abrupt, convex, descending five-sixths of the height. *Ventral margin* sinuate centrally, convex near the extremities. *Anterior extremity* bluntly rounded. *Posterior extremity* obtusely pointed. *Lateral contour* compressed oval, the posterior end the most acute; *greatest diameter* central, one-third of the length. *Flange* of left ventral margin large, being fully one-third of the length.

The chief variation of form shown by this species is in the dorsal margin, which is more prominent in some specimens than in the generality. Fig. 2. Pl. XI. illustrates this variety. In no instance have I met with examples so attenuate as the one from Byers' Quarry, figured by Jones.

It resembles in many respects the *Cythere Geinitziana** of Jones, which appears to be a closely related form. The dorsal margin of the latter, however, is more flatly convex, its posterior extremity is more acutely pointed, and it is medianly placed, and the sinus of its ventral margin is deeper than the same feature in *B. Jonesiana*; its lateral contour is peculiar also, being ovate, while that of the other is a flattened oval, with rather acute extremities. In these particulars it differs from the present species; and I allow them specific value.

There can be little doubt as to the identity of this species with Mr. Jones's specimen from Byers' Quarry, which he identified with the *Bairdia gracilis*† of M'Coy. A single cast, much worn, was the only material which Mr. Jones possessed; so that some difference might be expected between his figure and more finely preserved specimens of the same species, even had it really belonged to *B. gracilis*,—an idea, however, which is not maintainable when the Professor's description and figures are compared with perfect specimens of the Permian species. The de-

* Prof. King's Mon. Perm. Fossils, p. 62. tab. 18. fig. 4 *a*, *b*, *c*.
† Prof. M'Coy's Syn. Char. Carbon. Foss. Ireland, p. 165. pl. 23. fig. 7.

scription given by M'Coy is very short, and his figures represent only a portion of a carapace: the former would apply to many species besides the one to which it refers, so that it is not of much use in the determination of apparent affinities; but his figures show that the Carboniferous species had at least one prominent rostrated extremity, and that it was compressed and concave laterally towards the extremities,—characters which certainly distinguish it specifically from its supposed Permian representative.

Most of the specimens of this species which have occurred at Tunstall Hill are coated with a thin deposit of calcareous matter; and it is not until this is removed that their relation to *Bairdia* can be detected.

It is not rare in the fossiliferous limestone of Tunstall Hill. In Germany it is found in the Lower Zechstein of Bleichenbach, Selters, and Saalfeld.

B. Jonesiana is named after Mr. T. Rupert Jones, to whom I am indebted for several courteous communications on Permian Entomostraca.

Bairdia truncata, n. sp. Pl. XI. figs. 4 & 4 *a*.

Length $\frac{1}{23}$ inch; height $\frac{1}{60}$ inch.

Carapace subrhomboidal, inflated ventrally in anterior half, smooth (?). *Dorsal margin* almost straight, though slightly convex; *anterior slope* gradual, convex; *posterior slope* very abrupt, descending nearly the whole of the height, convex. *Ventral margin* rather convex, with a short projection near the anterior extremity. *Anterior extremity* rounded, prominent. *Posterior extremity* diagonally truncate. *Lateral contour* irregularly lenticular; *greatest diameter* in anterior half two-sevenths of the length, pointed anteriorly, bluntly rounded posteriorly, sinuate in posterior half.

The few specimens of this species which I have found are casts; consequently the above description is probably incomplete and subject to modification. That it belongs to *Bairdia* is evident by traces of an overlapping of the dorsal margin. Its marked difference from all the Permian species which have preceded it has induced me to describe it as a species, though from imperfect materials.

Rare in the fossiliferous limestone of Tunstall Hill.

Bairdia rhomboidea, n. sp. Pl. XI. figs. 3 & 3 *a*.

Length $\frac{1}{23}$ inch; height $\frac{1}{50}$ inch.

Carapace subrhomboidal, protuberant centrally, smooth. *Dorsal margin* prominently convex, sloping gradually to each extremity. *Ventral margin* very convex, more so anteriorly than

posteriorly. *Anterior extremity* subangulate. *Posterior extremity* somewhat produced, bluntly pointed. *Lateral contour* lenticular; *greatest diameter* central, rather more than one-fourth of the length. *Hinge* with the left valve overlapping the right evenly along the dorsal margin. *Flange* of left ventral margin posteriorly situate.

Very rare in the fossiliferous limestone of Tunstall Hill.

Besides the species of *Bairdia* already noticed, there appear to be one or two additional forms belonging to the fauna of the fossiliferous limestone, which may subsequently be established as species. Specimens have occurred that seem to imply this idea; but, owing to a paucity of materials, and, in some cases, to an apparent affinity to described species, I have not ventured to specialize them. There was one well-marked individual, of triangular contour, which was unfortunately lost after it had been outlined, and which I have little doubt was the *Cythere acuta* of Jones. It was minute and exceedingly globose; the ventral margin almost straight, and the dorsal margin convex; the extremities acute and similar.

Leperditia? *Permiana*, Jones. Plate XI. figs. 5–13.

Syn. *Dithyrocaris Permiana*, Jones, Mon. Perm. Foss. p. 66. tab. 18. fig. 1.
Ceratiocaris? *Permiana*, Jones, Morris's Cat. Brit. Foss. 2nd edition, 1854, p. 103.

Length $\frac{1}{20}$ inch; height $\frac{1}{43}$ inch.

Carapace oblong-ovate, ark-shaped, equivalve, very convex; valves thick. *Dorsal margin* straight, bounded laterally by flattish, slightly inclined areas formed by the depression of the upper region of the valves. *Ventral margin* straight centrally, or very slightly sinuate. *Anterior extremity* angulate at its junction with the dorsal margin, and bluntly rounded ventrally: the dorsal angle is sometimes the most prominent; at others a point midway between the margins protrudes most. *Posterior extremity* angulate dorsally, more pointed than the former, the antero-dorsal angle being more projecting, from which a convex line slopes gradually to the ventral margin. From the extreme points of the dorsal margin of each valve proceed two strongly produced rims, or marginal expansions, which become more widely separate as they approach the ventral margin. The *innermost rim* (of single valve) is elevated, and forms a raised reflexed edge round the middle portion of the valve. *The outermost or most ventral rim* is not reflexed, but projects at a right angle from the ventral portion of the valve; along the inner surface of this rim, which forms the contact-margin of the valve, extends a slightly elevated projection, on a plane with the ventral convexity of the

valve, and which appears to overlap (?) a similar longitudinal projection in the opposite valve. The outer surface of the valve within the innermost rim is deeply channeled. The *central area* of the valves is protuberant, rising abruptly from the channeled depression just mentioned; dorsally and towards the posterior extremity this area is very prominent, or slightly gibbose. Surface ornamented with irregularly-placed roundish pits, and with slender longitudinal wrinkles which occasionally bifurcate and merge into each other. *Hinge* with the dorsal margins united by ligament (?). *Lateral contour* ovate, with strongly produced extremities.

This remarkable species does not vary much in marginal outline. The posterior extremity is occasionally rather less pointed than usual, and the anterior extremity differs a little in convexity; the ventral margin also has at times a tendency to become sinuate. The variation of the posterior extremity is of most importance, as in some cases the slight modification which it undergoes causes it to assume the form of the anterior.

One of the most peculiar characters of this species is the curious marginal rims which bound its free margins and form so important a feature in its ventral aspect. I have never observed more than two rims on each valve, except in one instance, which was a perfect specimen, having three rims on the right valve, with only two on the left. These rims very much remind one of exfoliative dilatations of the margins, such as are seen in some species of Conchifera and Brachiopoda: but when the Entomostracan mode of growth is considered, the idea is found to be untenable; for we must suppose that these species, like their recent representatives, would increase in size by moulting, and not by marginal increment. The youngest specimens possess the same rims in miniature; indeed, all stages of growth are characterized by them, though the older individuals have them most produced. One very fine specimen (fig. 11) shows several fine lines between the outer and inner rims, and running parallel with them. I have not been able to prove satisfactorily that the longitudinal projection on the internal surface of the most ventral rim (see fig. 13) of one valve overlaps that of the opposite, though, from the close union of the extreme edges of these rims in some specimens, it may be inferred that it does. The free margins fit close; consequently the whole of the animal must have been enveloped by the valves.

The central area of the valves is generally very much produced, but more so in some specimens than in others. Sometimes its connexion with the marginal portion of the valves is so abrupt as to cause it to appear like a great tubercle; at others it slopes more gradually towards the margin, and wears a less gibbose

aspect: this is particularly the case in young specimens. The postero-dorsal region of this area is always the most prominent portion of the valve; and as the central portion of the dorsal region is at times rather depressed, both it and the antero-dorsal angle have then a gibbose appearance. Such specimens assimilate to the *L.* (*Cythere*) *Schrenkii** of Keyserling, whose equivalent regions are extremely gibbose. As the central area varies in prominence in different specimens, so do specimens vary in width, and that very considerably.

Although there can be little doubt of this species being characterized by a punctured surface, yet it is a character that has only been observed in two specimens, both of which are represented in Pl. XI. Usually the surface is either smooth, like that of fig. 5, or wrinkled, like that of fig. 8, and shows no traces of punctures, even when viewed with the aid of a high magnifying power. Perhaps this may result from a peculiarity of fossilization, though, from the number of specimens which have been examined, it is more likely that some individuals of the species were punctured and others were not. The punctures which have been detected are minute, and require a lens of moderately high power to resolve them. They are observed best on the central and dorsal areas; indeed I have not noticed them elsewhere. The longitudinal wrinkles are also confined to the same regions, but chiefly to the central area. They are tenuous, and trend somewhat irregularly in a direction parallel with the free margins.

L.? *Permiana* seems to be nearly related to the Russian species, *L.*? *stricta*, Keyserling†. The latter species has rounder extremities, its ventral margin more deeply sinuate, and is apparently more compressed than the former. Some difference also exists in the punctured ornamentation, which in *L. stricta* is very regularly arranged. Both agree, however, in possessing two expanded rims on the free margin of each valve. *L.*? *Roessleri*, Reuss‡, of the Lower Zechstein also corresponds in this respect, and will probably prove to be closely related.

It is not uncommon in the fossiliferous limestone of Tunstall Hill, and in the Upper Permians of Byers' Quarry.

The generic affinities of this species and of its congeners are involved in some obscurity. When first described by Mr. Jones, from specimens on the limestone slabs of Byers' Quarry, it was referred by him to the genus *Dithyrocaris* of Dr. Scouler. In placing it there, he admitted that it was questionable whether it in reality belonged to that group or not; for his own specimens

* Reise durch die Tundren der Samojeden, p. 112. taf. 4. fig. 37.

† *Loc. cit.* p. 112. taf. 4. fig. 38.

‡ Jahres. Wetterau. Gesell. 1851-1853, p. 70.

were not well preserved, nor had the characters of the genus been properly defined by its author: but from the data offered by the imperfect materials in his hands, he thought it possible that it might have some affinity to it; so he placed it in it provisionally.

Dithyrocaris was originally considered by Dr. Scouler to have a univalve carapace, like *Apus* and other single-valved Branchiopoda*. He afterwards altered his views, supposing it to be bivalve, like *Cypris*, though differing from that genus in having caudal appendages protruding from the valves. This opinion was held until 1843, when Colonel Portlock described two new species from the shales of the Lower Carboniferous rocks of Ireland†, and proved that its carapace was univalve, as Dr. Scouler had supposed at first. Colonel Portlock's description of these species, particularly of *D. Colei*, can leave no doubt of the correctness of his views in this respect, and clearly demonstrates that *Dithyrocaris* is a univalve Entomostracan—that is, supposing Dr. Scouler's species belong to the same group, which may be taken for granted until proved to the contrary.

All the examples of *L.? Permiana* which came under the notice of Mr. Jones were, as stated before, more or less imperfect; so it may naturally be supposed that great difficulty would occur in attempting to determine the generic affinities of the species to which they belonged. It is evidently owing to this cause that Mr. Jones supposed that it might be a member of *Dithyrocaris*. It is from the perfect state of preservation of my specimens that I have been enabled to offer the preceding remarks in addition to those of Mr. Jones. And as some of the specimens have the valves united and in close juxtaposition, I have also been enabled to prove that the species was a bivalve Entomostracan, like *Cythere*, or rather *Leperditia*, consequently that it has no affinity to *Dithyrocaris*—nor to *Ceratiocaris*, to which Mr. Jones afterwards referred it‡, its bivalvular character also, of course, excluding it from that genus.

German and Russian palæontologists have referred congeneric species to *Cythere*; but, with the exception of being bivalve, they possess no characters to warrant their remaining there.

The true generic affinities of *L.? Permiana* and its congeners I leave to be determined by my friend Mr. Jones, as he tells me that he has long been investigating their relations, and as I am quite sure that he is more competent to do so than I am. I am of opinion that they will be found to constitute a new group.

* Records of Science, Feb. 1835; and in a paper read before the British Association at Glasgow. See also Jones on *Dithyrocaris*, in Prof. King's Mon. Perm. Foss. p. 64.

† Report of the Geology of the County of Londonderry, pp. 313–316. pl. 12. ‡ Morris's Cat. British Fossils, 2nd edit. p. 103.

The present species is merely placed in *Leperditia* as an approximation to its true position, and not because I think it ought to remain there, though probably this genus and *Beyrichia* will prove very close neighbours to it.

Besides the species under notice, Mr. Jones has described another from Byers' Quarry—*L.? glypta.* In Germany, another has been described by Dr. Reuss under the name of *Cythere Roessleri*; and Count Keyserling has noticed three more from the Permians of Russia, terming them *Cythere Schrenkii, C. stricta,* and *C. grapta.*

The following Table gives a general view of the Permian Entomostraca, with their distribution in England, Germany, and Russia :—

		England.		Germany.	Russia.	Remarks.
		Foss. lime.	Upper lime.	Lower Zechstein.	Stratigraphical group unknown.	
1	Cythere? Morrisiana, *Jones*	..	*	..	..	Probably belonging to *Bairdia.*
2	—— elongata, *Jones*	..	*			Probably belonging to *Bairdia.*
3	——? Geinitziana, *Jones* ..	..	*	*	..	A form resembling this species occurred to me in the Permians of South Yorkshire.
4	——? Kutorgiana, *Jones* ..	..	*	..	..	Probably belonging to *Bairdia.*
5	—— bituberculata, *Reuss* ..	..	..	*		
6	Cythereis biplicata, *Jones* ..	..	*			
7	—— drupacea, *Richter*	..	..	*		
8	Cytherella inornata, *M'Coy*	..	*	*	..	A somewhat similar form occurred to Prof. King in Tullyconnel limestone, Ireland.
9	—— nuciformis, *Jones*	..	*	*		
10	Bairdia acuta, *Jones*	*?	*			
11	—— plebeia, *Reuss*	*	*	*		
12	—— Kingii, *Reuss*	*	..	*		
13	—— mucronata, *Reuss*	*	..	*		
14	—— ampla, *Reuss*	..	..	*		
15	—— frumentum, *Reuss* ..	..	..	*		
16	—— ventricosa, *Kirkby* ..	*				
17	—— Reussiana, *Kirkby*....	*				
18	—— reniformis, *Kirkby*....	*				
19	—— Schaurothiana, *Kirkby*	*				
20	——? Berniciensis, *Kirkby*	*				
21	—— Jonesiana, *Kirkby*....	*	*	*	..	Prof. King found a specimen resembling this species in the Tullyconnel limestone.
22	—— rhomboidea, *Kirkby* ..	*				
23	—— truncata, *Kirkby*	*				
24	Leperditia? Permiana, *Jones*	*	*			
25	——? glypta, *Jones*	..	*			
26	——? Roessleri, *Reuss*	..	..	*		
27	——? stricta, *Keyserling* ..	..	..	..	*	
28	——? Schrenkii, *Keyserling*	..	..	..	*	
29	——? grapta, *Keyserling* ..	..	..	..	*	As this species seems to have some affinity to the six preceding, it is placed in the same genus.
30	——? recta, *Keyserling*	..	..	..	*	
31	Cythere Pyrrhæ, *Keyserling*	..	..	..	*	
32	—— Cyclas, *Keyserling*....	..	..	..	*	