THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 11. NOVEMBER 1858.

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

[With a Plate.]

Mr. Rupert Jones first noticed the occurrence of Entomostraca in the Permian System of England. In Prof. King's Monograph of the Permian Fossils of England, he (Mr. Jones) describes several species, which were principally obtained from the upper beds of the Durham Permians*. With the exception of the notice of a single species by Prof. King, from a Permian deposit near Tullyconnel in the county of Tyrone, Ireland†, no additional observations have been published on Permian Entomostraca in Britain.

In 1851–53 Dr. Reuss described ten species from the Permians of Germany, which were found in the Unter Zechstein of Bleichenbach and Selters, in the Wetterau‡. Some of the species he considered to be new, others to be identical with forms found in the upper beds of Durham.

From the Permian rocks of Russia, six new species were described by Alex. Graf Keyserling, in 1854§.

In 1855, M. Richter noticed the occurrence of eight species in the Unter Zechstein of Saalfeld. Among them was one new form; the rest were referred to species that had been previously described by Jones and Reuss||.

* Monograph of Perm. Foss. of England, pp. 58–66.

† Journal of the Geological Society of Dublin, vol. vii. p. 78.

‡ Jahresbericht der Wetterauer Gesellschaft, 1851–1853, pp. 65–70.

§ Reise durch die Tundren der Samojeden, Dorpat, 1854, pp. 111–113. pl. 4. Permian Entomostraca were observed in Russia previous to this date; but the notices of them merely mention the fact of their occurrence, without specific details. See Table of Formations of the Government of Simbirsk of Jaaykow, 1844, Petersb. Miner. Gesellsch.

|| Zeitschr. der Deutsch. Geol. Gesells. vol. vii. pp. 526–533.

These, I believe, comprise all the Permian Entomostraca which have been noticed up to the present time.

The following remarks refer to the Entomostraca belonging to the fossiliferous or shell-limestone of the Permian System of Durham. This deposit lies below the beds whence the species described by Mr. Jones were procured. It occupies a central position in the calcareous beds of the system, being situated between the lower or compact limestone and the various beds of the upper members. Consequently the Entomostraca of this deposit belong to a period antecedent to that of the previously described Durham species. In Britain they have not yet been observed in Permian rocks of an earlier date; but in Germany they occur, as before stated, in the Lower Zechstein, which is equivalent to our compact limestone. This proves their existence during the deposition of the first calcareous beds of the Permian series of Western Europe, and gives them a place in the fauna of each of the three members into which this series of rocks has been divided. Although they appear to have existed throughout the period during which the whole of the calcareous beds were accumulated, it is evident that their distribution was not at all general: otherwise their absence in the compact limestone of Durham, in the Zechstein Dolomit, Stinkstein, and Rauchwacke of Germany, would not have been observed; nor would they have been so rare, in respect to localities, in those members in which they do occur. In the upper beds of Durham they are only found in one locality (Byers' Quarry)*. In the fossiliferous limestone they are only found at Tunstall, with the exception of a stray example occasionally met with at Humbleton Hill. At Tunstall Hill they are not generally dispersed throughout the locality; it is only at one particular spot that they occur in any abundance,—or rather, in which they have occurred, for the spot seems already exhausted. In this place they were very plentiful, some hundreds of specimens having been obtained from a few cubic feet of matrix.

In the limestone of Tunstall Hill, there occur cavities which are filled with brown or yellow calcareous dust. Sometimes they contain yellow or brown dust, and nothing more; at others, groups of very finely preserved fossils are mixed with the dust. These cavities have already been noticed by Mr. Howse, who long ago detected the richness of their contents†. It was in one of these that I found the various forms of Entomostraca to be noticed in this paper. It is questionable whether a better matrix

* See Jones in Mon. Perm. Foss. p. 60.

† Catalogue of Fossils of Perm. Syst. of Northumb. and Durham, p. 9. Mr. Howse has also observed similar cavities in the fossiliferous limestone of Silksworth.

for the preservation, and subsequent extraction, of microscopic organisms, than this in which these Entomostraca occurred, can be conceived. It has preserved the specimens which it encloses so perfectly, that they almost rival the productions of recent zoology. In some instances a brush will remove the investing matrix, without the use of other tools. Occasionally the dust occurs in a state of semi-coherency, with nodules or fragments of limestone intermixed. In this state the imbedded fossils are also easily extracted without much assistance from palæontological instruments. Some of the finest specimens ever taken from the Durham Permians have been got from these cavities; and they have also yielded some of the rarest species. An analytical examination of the contents of some show very curious results. For instance, in one I found about one hundred and fifty perfect and imperfect spines of *Archæocidaris Verneuiliana*, King, and with them but one or two fragments of the plates of the same species. In another I got more than four hundred dorsal valves of young individuals of *Strophalosia Goldfussi*, Münst., which were accompanied by only fifteen ventral valves. Of course, in both cases other species were associated; but those mentioned were the most prevalent, and by their abundance and peculiar mode of occurrence formed the characteristic feature of the contents of each cavity. Such facts are very puzzling, and would almost seem indicative of a drifting of specimens prior to fossilization,—an idea which is scarcely tenable when the general evidence of the whole fauna is considered.

The majority of the specimens of Entomostraca which were found belong to species of *Bairdia*, with scarce, but good, examples of a *Leperditia*-like species, previously noticed in the upper members by Jones, and provisionally referred by him to the genus *Dithyrocaris* of Scouler*. The *Bairdiæ* generally occurred with united valves, though single valves were not uncommon. Specimens of the latter species were nearly always in a detached state, only three or four per cent. occurring with valves connected. The valves of *Bairdia* possess a stronger hinge than the latter, one valve overlapping the other along the dorsal margin, while the valves of the other appear to have been merely united by membrane. This difference in the mode of hingement seems to explain their manner of occurrence. None of the specimens are worn, nor show indications of drifting. The acute extremities of several of the species, and the delicate margins of the detached valves, never present traces of attrition; so that it may be inferred that these Entomostraca were original residents in the area where they have become imbedded and fossilized.

* Mon. Perm. Foss. of England, p. 64, and the remarks on this species in the present paper.

In the calcareous dust which contained the Entomostraca were also a number of specimens of a curious Foraminifer, apparently a species of *Miliolina**. Several species of Mollusca also occurred, as *Productus horridus, Spiriferina multiplicata, Camarophoria Schlotheimi, Crania Kirkbyi, Monotis speluncaria, Pleurotomaria nodulosa*, &c. The convex valve of the conchifer appears to have been a popular place of resort with the *Bairdiæ*. Out of one I procured some dozens of individuals.

It is also worthy of remark, that in close vicinity to the Entomostraca there occurred some of the rarest Permian fossils, and others that were previously unknown; also an abundance of specimens belonging to species hitherto rare in the limestone of Tunstall: so that the evidence deducible from the fossils associated with the Entomostraca, and from those in their immediate neighbourhood, may imply some peculiarity of conditions pertaining to this particular area during the deposition of the fossiliferous limestone.

During the Permian period, the prevailing forms of Entomostraca seem to have belonged to two groups,—to *Bairdia*, and to an undetermined genus, of which *Dithyrocaris*? *Permiana*, Jones†, and *Cythere*? *Roessleri*, Reuss‡, are members. *Bairdia* is the most characteristic of the Permians of Western Europe; in fact, it is unknown as yet in the Permian rocks of Russia. In Germany it is represented by several species, and by a greater number in Durham; a single species occurs in the Yorkshire Permians; and Prof. King has observed another (?) in the Permian deposit of Tullyconnel. In the fossiliferous limestone of Durham the Entomostraca almost exclusively consist of species of this genus, from which it may be inferred that the conditions prevailing during the accumulation of that deposit were highly suitable for their development. *Bairdia* seems to represent the Mesozoic element in this section of the Permian fauna, it being more properly a Mesozoic group, although it is first met with in Palæozoic beds. As a connecting link with the older rocks, the generic form typified by the above species, *D. Permiana* and *C. Roessleri*, may be noticed as a representative of its more ancient prototypes, the *Beyrichia* and *Leperditia* of the early Palæozoics. This form predominates in Russia; three species occur there§. Another is found in Germany, and two in Durham. According to our present knowledge, these species are all that belong to this genus, no similar forms having, as yet, been found in other rocks; con-

* It is the same fossil as Geinitz's *Serpula pusilla* and the *Spirillina pusilla* of Jones.

† Mon. Perm. Foss. p. 66.

‡ Jahres. Wetter. Gesell. 1851–1853, p. 70.

§ Reise durch die Tundren der Samojeden, 1854, p. 112.

sequently it is pre-eminently characteristic of Permian deposits. Associated with the species belonging to the above groups are a few forms which have been referred to *Cythere, Cythereis,* and *Cytherella,* all of which, with one exception, are found in the upper Permian beds of Byers' Quarry, and some of which also occur in the Lower Zechstein of Germany. In the former beds these forms are in the ascendant, being seven in a list of twelve species found therein. The difference in generic affinity observed in the species of these beds from those found in the fossiliferous limestone, which almost occupies the same area of distribution, may be indicative of peculiar conditions. It is generally assumed by geologists of Permian repute, that the upper beds of Durham originated in comparatively shallow water; nor is it an unwarrantable assumption, as some of the beds are ripple-marked*, and in others there are found occasionally the remains of Algæ†, —facts which certainly do not imply any great depth of water. So, supposing littoral conditions to have prevailed during their period of deposition, the differences observed in the generic relations of the species may, in some measure, be due to them; and the Byers' Quarry group of Entomostraca may represent some of those species which loved a habitat of shallow depths in this Permian age; while in those found in the fossiliferous limestone, which belong so exclusively to *Bairdia,* we may possess a group of pelagic species which dwelt in the waters of a Permian ocean. Although this is advanced as a mere suggestion, so far as evidence is derivable from the species in question, yet it is an idea which is supported by many collateral facts that may be deduced from the general fauna of this deposit.

The list of Permian Entomostraca is now rather extensive. Twelve species were described by Jones in 1850. In this paper six new forms will be noticed, besides three previously discovered in Germany, but new to Durham; so that, in all, the Permians of Durham will possess a list of twenty-one species, thirteen of which are peculiar to them. Eight species appear to be common to the deposits of Germany and Durham, some of which have existed from the deposition of the Lower Zechstein, the equivalent of our compact limestone, until the last of the Permian beds were accumulating. Five species are peculiar to Germany; and six have been found in Russia, which are as yet unknown in the West. These, with the British species, make thirty-two species of Entomostraca belonging to the Permian strata of Europe.

* Prof. King observed ripple-marks in the upper yellow limestone on the site of the South Docks, Sunderland; and I have also seen slabs marked with them in the Fulwell Quarries.

† From the upper limestone beds between Hawthorne Hive and Black Hall Rocks on the Durham coast.

For the convenience of those who may find fossil Entomostraca, or other small organisms, in a similar matrix to that in which the Tunstall specimens occurred, it may be well to add a word or two as to the mode I adopted for extracting the Permian specimens from the calcareous dust. I first sifted the dust of all the coarser particles—of everything larger than the tenth of an inch; and from what was left I took all the very fine dust with another sieve, leaving a residue among which everything organic could easily be distinguished. In picking out the organisms, a piece of polished slate—a common school slate, for instance—is a good area on which to strew a portion of the residue for examination. It is much better to adopt this method than to pick the specimens out of a mass of material; for by sprinkling a small portion over the slab, every individual particle can be recognized, and the organic forms separated from the inorganic with very little trouble. A pair of blunt forceps with broad points are exceedingly useful for picking up the specimens. Some care is necessary, or injury may result to the specimens; but, with caution and a little skill, the forceps can be used with a great delicacy of touch, and with less risk than the fingers. Dr. Carpenter recommends the use of the moistened tip of a camel's-hair pencil in similar cases; and in instances where the objects sought are extremely delicate, it will be the more preferable instrument: but when the specimens, like the Permian Entomostraca, possess a moderate degree of firmness, they may be extracted with greater ease and celerity as above indicated; and when an extensive series of examples is needed, expedition is of some value. With the assistance of a common lens and a pair of moderately good eyes, nothing more is required. It is perhaps best to pick out a quantity of specimens "in rough," and separate the specific forms afterwards.

Genus **Cythere**, Müller.

Subgenus Bairdia [M'Coy], Jones, Entomostraca of the Cretaceous Formation of England.

Syn. Genus *Bairdia*, M'Coy, 1844, Syn. Char. Carb. Foss. of Ireland.

This group was instituted by Prof. M'Coy in 1844 for the reception of two species of Entomostraca from the carboniferous rocks of Ireland, which he considered to differ generically from any existing genus*.

Mr. Rupert Jones, in his Monograph of the Entomostraca of the Cretaceous Formation of England, 1848, proposed its adoption as a subgenus of *Cythere*, giving a good definition of its

* Synopsis of the Characters of the Carboniferous Fossils of Ireland, page 164.

subgeneric characters, which had scarcely been done by M'Coy*. I attach to it a similar value in these remarks.

Dr. Baird has placed it, as modified by Jones, among his synonyms of *Cythere*. He states that no anatomical difference exists in the animal of those recent species referred to it by Jones, from the animal of *Cythere proper*†. This is certainly a strong point in support of its near affinity with *Cythere*; but still, with its marked peculiarity of carapace, I think it may be fairly entitled to a distinctive term to distinguish it from the typical forms of *Cythere*. At least, whether it really be a natural subgenus or not—supposing such to exist—it is a very convenient group in palæontology, as it serves to mark a number of fossil Entomostraca of peculiar character, which have repeatedly held no unimportant position in the economy of ancient faunas.

The subgeneric characters of *Bairdia* have already been given by Mr. Jones. The Permian species add little that is new to them, though I will recapitulate the generic features of these forms. They are all smooth. The general form of the majority is somewhat triangular or subpentagonal, though species of a different contour occur. The posterior extremity of all is more pointed than the anterior, and it is generally rostrated. The anterior extremity is usually rounded, but in one or two instances it is subangulated; it is also much wider than the former. The ventral margin is always the straightest, though often somewhat sinuated. The dorsal margin is more or less convex centrally, and generally sinuated towards the posterior extremity. In lateral contour‡ they are lenticular, variously modified, being sometimes almost exactly lenticular, at others, by the extreme position of greatest diameter, subcuneiform. Perhaps the most important generic character of *Bairdia* is its hingement, which is a lapping of the left valve over the right along the dorsal margin, and which was first noticed by Mr. Jones. In some Permian species the folding of the valves is great (*B. plebeia* and *B. ventricosa* may be cited as examples); and in most cases the folding is much greater in the centre than near the extremities. In general this character does not vary much in Permian species. A central third of the ventral margin of the left valve overlaps an equivalent portion of the right, giving the contact-line of the ventral margins a sinuated appearance. The mode of its overlapping is this:—from each extremity, until approaching the central por-

* Entomostraca of the Cretaceous Formation of England, p. 22.

† Natural History of the British Entomostraca, p. 163.

‡ The term "lateral contour" is used for the outline which is seen by viewing the carapace ventrally. "Ventral aspect" is used in similar instances by others; but as it is chiefly the contour of the sides of each valve of the carapace that is referred to when using the term, I think the former better expresses the meaning attached to it.

tion of the ventral margin, the extreme edges of each valve are somewhat produced, and lie against each other in close juxtaposition, like the valves of a conchifer; towards the centre, however, the edges become flattened and bent inwards, forming slight horizontal ledges or flanges, that of the right valve being rather smaller than the other which overlaps it. In no instance does the whole margin of one valve overlap that of the other; in no species is more than a third overlapped, sometimes less. The length of margin overlapped, and its width, are of use as specific characters, as is also its position, which is not constant, being sometimes nearer one extremity than the other.

Although nearly all the species of *Bairdia* possess a contour more or less resembling those species which may be considered typical of the group, such as *B. curta* (Carboniferous), *B. plebeia* (Permian), and *B. subdeltoidea* (Cretaceous), there are others which show a great aberration in outline from these types, and, so far as their general form is concerned, have a much nearer resemblance to *Cythere* than to *Bairdia*; their hingement, however, being that of *Bairdia*, leaves no doubt of their true affinity. Among the Permian species, *B. reniformis*, *B. Berniciensis*, and *B. Jonesiana* are the most aberrant in this respect.

1. *Bairdia plebeia*, Reuss. Pl. X. figs. 1, 2, & 2 *a*.

B. plebeia, Reuss, Jahresbericht der Wetterau. Gesell. 1851–1853, p. 67.
Syn. *B. curta*, M'Coy, Jones, Mon. Perm. Foss. of England, p. 61. tab. 18. fig. 3.

Length $\frac{1}{15}$ inch; height $\frac{1}{30}$ inch.

Carapace subtrigonal, somewhat inflated centrally, surface smooth. *Dorsal margin* prominently convex, sometimes rather flatly convex; *posterior slope* abrupt, slightly concave; *anterior slope* less abrupt, straight, or slightly concave. *Ventral margin* straight centrally, more or less convex towards each extremity. *Anterior extremity* rounded, and rather produced. *Posterior extremity* acute, rostrated. *Lateral contour* regularly lenticular; *greatest diameter* (of lateral contour, or width of carapace) two-thirds of the height. *The flange*, or overlapping portion of the ventral margin of left valve, short, subcentral. *Hinge* with the left dorsal margin overlapping the right extensively.

Mr. R. Jones has identified a very similar form, found in the upper members of the Durham Permians at Byers' Quarry and in the fossiliferous limestone of Humbleton Hill, with the *B. curta* of M'Coy. I think it very probable that the former is identical with the present species, although the figure and description of Jones are somewhat different,—a difference, however, which is most likely due to the state of preservation in which his specimens occurred, being casts. His figure represents the

posterior extremity much shorter, and not so acute as the same member in perfect examples of *B. plebeia*; the anterior extremity is also angulate dorsally,—a character unknown to the latter species, whose anterior extremity, though sometimes a little produced, is always more or less rounded. These characters, with a slight sinuosity in the ventral margin, are the only points in which it differs from the present species; and as the specimens from which they were obtained were, as above stated, casts, I think they may be assumed to be accidental, and of little specific value. This being the case, the identification with *B. curta* is probably erroneous; for, according to M'Coy's description and figure of that species, its general form is more elongate, and its extremities are more acutely rostrated, especially the anterior, than those of *plebeia*; it also possesses a deep sinus in its ventral margin, and shows a marked difference in lateral contour, being subcuneiform, while the other is lenticular. It has other peculiarities; but those mentioned appear sufficient to demonstrate its being specifically distinct from *B. plebeia.*

B. plebeia occurred very plentifully along with the other Entomostraca found in the fossiliferous limestone at Tunstall Hill, also rarely at Humbleton Hill, and not unfrequently in the upper beds at Byers' Quarry.

It is found in the Lower Zechstein at Bleichenbach, Selters, and probably at Saalfeld in Germany.

Var. *elongata.* Plate X. figs. 4 & 4 *a.*

Length $\frac{1}{13}$ inch; height $\frac{1}{33}$ inch.

This is a more elongate form than the preceding. Its posterior and anterior slopes are more gradual, and its anterior extremity is more produced and more compressed laterally than in that form.

Var. *compressa.* Pl. X. figs. 7 & 7 *a.*

Convexity of dorsal margin regular; sinus of posterior slope nearly obsolete; posterior extremity less acute than the typical form. Valves compressed laterally, the greatest diameter being only a little more than half the height; position of greatest diameter in posterior half.

Var. *Neptuni.* Pl. X. figs. 5 & 5 *a.*

The form to which I have attached the name *Neptuni* shows several peculiarities, which might almost be considered of specific importance had they been constant; but when a series of specimens is examined, it is seen to approach, by gradations, the typical forms of *B. plebeia,* so that it seems necessary to include it along with other varieties of that species.

It differs in having the greatest convexity of the dorsal margin posteriorly situate, consequently in possessing an abrupt posterior slope and a very gentle anterior depression; in the blunt but beaked posterior extremity, and in its more compressed lateral contour.

2. *Bairdia ventricosa*, n. sp. Plate X. figs. 3 & 3 *a*.

Length $\frac{1}{20}$ inch; height $\frac{1}{40}$ inch.

Carapace subrhomboidal, ventricose, smooth, rather protuberant ventrally in anterior half. *Dorsal margin* flatly convex; *posterior slope* abrupt, descending three-fourths of the height, deeply sinuate close to posterior extremity; *anterior slope* steep. *Ventral margin* slightly sinuous, rising rapidly anteriorly. *Anterior extremity* rather acute, the dorsal and ventral margins almost forming a right angle at their juncture. *Posterior extremity* prolonged into a narrow bluntish point. *Lateral contour* almost lenticular, ventricose, sinuated anteriorly. Dorsal margin of left valve strongly overlapping that of the right, especially in the centre. The *flange* of left ventral margin short, situate a little beyond the centre and in posterior half.

The principal characteristics of this species are its ventricosity, its blunt produced posterior extremity, its angulated anterior extremity, and its slightly sinuous ventral margin.

It frequently occurred in the fossiliferous limestone of Tunstall Hill.

3. *Bairdia Reussiana*, n. sp. Pl. X. figs. 6 & 6 *a*.

Length $\frac{1}{22}$ inch; height $\frac{1}{45}$ inch.

Carapace somewhat reniform, flatly convex, smooth. *Dorsal margin* flatly convex; *posterior slope* abrupt, deeply sinuate near its juncture with the ventral margin; *anterior slope* gentle. *Ventral margin* with a deep sinus near the centre, becoming rapidly convex posteriorly; towards posterior extremity margins of valves produced. *Anterior extremity* rounded. *Posterior extremity* beaked. *Lateral contour* sublenticular, with a flat central region, slightly concave and produced posteriorly; *greatest diameter* one-fourth of length. *Flange* of left ventral margin anteriorly situate. *Hinge* with the left dorsal margin overlapping the right, more so centrally than towards extremities.

B. Reussiana rather resembles some of the forms of *B. plebeia*. I have been induced to separate it from that species on account of its having a sinuate ventral margin, a comparatively blunt and high beak, a less prominent dorsal margin, consequently a greater length compared with its height, and a compressed lenticular lateral contour.

It is dedicated to Dr. Reuss, who has contributed a valuable paper on the Entomostraca of the Permians of Germany.

Found rarely in the fossiliferous limestone of Tunstall Hill.

4. *Bairdia Kingii*, Reuss. Pl. X. figs. 8 & 8 *a*.

B. Kingii, Reuss, Jahresbericht der Wetterau. Gesell. 1851–1853, p. 67.

Length $\frac{1}{22}$ inch; height $\frac{1}{43}$ inch.

Carapace subpentagonal, smooth. *Dorsal margin* arched. *Ventral margin* sinuate, becoming rapidly convex at each extremity. *Anterior* and *posterior extremities* almost alike, subangulate, the posterior a little less pointed than the anterior. *Lateral contour* lenticular, slightly concave posteriorly; greatest diameter one-fourth the length, centrally situate.

Although I have identified the form just described with *B. Kingii*, Reuss, there exists a little difference in the general outline. Reuss's figure represents the anterior extremity more pointed, and the posterior wider and rounder, than the same features in the Durham form. In other respects they agree; so that it is perhaps better to consider those slight variations to be of little importance, than to risk creating a synonym.

B. Kingii was first observed by Dr. Reuss in the Lower Zechstein of Bleichenbach. It is a rare species in the fossiliferous limestone of Tunstall Hill.

5. *Bairdia mucronata*, Reuss. Pl. X. figs. 9, 10, & 11 ?

B. mucronata, Reuss, Jahresbericht der Wetterau. Gesell. 1851–53, p. 67.

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

Carapace subcuneiform, smooth, ventricose centrally, compressed towards extremities. *Dorsal margin* convex centrally; *anterior slope* slight, only one-fourth of height, somewhat concave, joining the ventral margin almost at a right angle; *posterior slope* deeply sinuate, falling three-fourths of height, more or less abruptly. *Ventral margin* almost straight, or slightly sinuate. *Anterior extremity* wide, subangular, sometimes angular. *Posterior extremity* acutely rostrated, very much produced, and occasionally curved upwards. *Lateral contour* nearly lenticular, slightly concave at each extremity; *greatest diameter* rather more than one-fourth of length, centrally situate. *Flange* of left ventral margin long, but narrow, posteriorly situate. *Hinge* with left dorsal margin rather largely overlapping the right.

This fine species is subject to modifications of outline. Figs. 9, 10, and 11 ? represent the most common forms. Its sharp, produced posterior extremity, which is the characteristic feature of the species, varies in length; fig. 10 gives the most produced form. Some individuals have the anterior extremity

angulated; others more rounded, though of a subangulated outline. The sinus of the ventral margin is scarcely indicated in some specimens. The contour of the dorsal margin undergoes slight variations.

In identifying this species with *B. mucronata* of Dr. Reuss, I have allowed a little for probable imperfection in his material, or for slight modification of form which may have been induced by some unknown causes. It is the first reason, however, that has influenced me most; for all the specimens of Entomostraca which I have seen from the locality whence Dr. Reuss procured this species are in a very unsatisfactory state, and not at all to be relied on for exactness of original form; so that it is not unlikely that the specimen or specimens from which he described, and which he figured, were in some measure imperfect. Should this not be the case, and should his figure represent a perfect individual, then our Durham form, with which I have identified it, must be made a distinct species.

Found rather commonly in the fossiliferous limestone of Tunstall Hill. It is rare in the Lower Zechstein of Bleichenbach, and occurs in the same deposit at Saalfeld, Germany.

6. *Bairdia* ——— ? Pl. X. figs. 12 & 12 *a*.

Length $\frac{1}{20}$ inch; height $\frac{1}{30}$ inch.

Carapace subrhomboidal, attenuate, smooth. *Dorsal margin* arched; *anterior slope* moderately steep, descending one-third of height; *posterior slope* gradual, descending two-thirds of height. *Ventral margin* with a central sinus, convex near extremities. *Anterior extremity* angulate at the juncture of dorsal and ventral margins, which almost form a right angle; ventral curve of extremity rather convex. *Posterior extremity* pointed, convex ventrally, somewhat concave dorsally. *Lateral contour* very attenuate; *greatest diameter* central, less than one-fifth of the length.

I have only found a single example of this form, and it is scarcely so well preserved as I could wish: and there exist some doubts in my mind as to the propriety of describing it as a species; for it may be but a variety of *B. mucronata*, and the somewhat imperfect condition of the specimen rather invalidates the authenticity of the specific characters which appear to distinguish it. Of this, however, there can be no certainty until other and better specimens are procured. The evidence deducible from this single example seems to favour the idea of its being a species. Its attenuate form, and other peculiarities already noticed, seem to point to specific distinction; and, relying in some measure on these characters, I have thought it advisable to keep it separate from any of the preceding species, and to

describe it provisionally as one that is new, to which, however, I forbear adding a name, which may be attached when its specific identity is more firmly established.

7. *Bairdia reniformis*, n. sp. Pl. X. figs. 13 & 13 *a*.

Length $\frac{1}{33}$ inch; height $\frac{1}{73}$ inch.

Carapace subreniform, flatly convex, obtuse marginally, smooth. *Dorsal margin* almost straight centrally, but slightly inclined towards the anterior extremity; *anterior slope* short, convex; *posterior slope* abrupt, convex, falling two-thirds of height. *Ventral margin* sinuous, convex towards extremities, with a rather deep sinus anteriorly situate. *Anterior extremity* rounded. *Posterior extremity* obtusely pointed. *Lateral contour* sublenticular, compressed, convex towards extremities, more so posteriorly than anteriorly; *greatest diameter* central, rather more than one-fourth of length. *Hinge* with left dorsal margin moderately and regularly overlapping the right.

B. reniformis has some resemblance to *B. Reussiana*, and also to *B. Schaurothiana*. It may be distinguished from the former by its more *Cythere*-like form, by its more depressed dorsal margin, its convex posterior slope, its unrostrated posterior, and the greater width of the anterior extremity; it also differs in lateral contour, its extremities being convex and comparatively blunt. *B. Schaurothiana* has straighter dorsal and ventral margins than the present species; it is more produced anteriorly, and its posterior extremity is angulate; in lateral contour it differs in the acuteness of its extremities and in the position of its greatest diameter.

At first I was inclined to refer this species to *Cythere**, its general resemblance to that genus causing me to consider it to belong to it rather than to *Bairdia*; but I found its mode of hingement like that of *Bairdia*, so that there can be little doubt of its belonging to the same group.

Bairdia Schaurothiana, n. sp. Pl. X. figs. 14 & 14 *a*.

Length $\frac{1}{18}$ inch; height $\frac{1}{40}$ inch.

Carapace subhexagonal; dorsal half convex, ventral less so, protuberant about one-third from posterior extremity. *Dorsal margin* straight centrally; *anterior slope* convex, gradually descending rather more than one-third of height; *posterior slope* very abrupt, descending two-thirds of height in a right line. *Ventral margin* straight, rising abruptly to meet dorsal margin posteriorly, and very convex anteriorly. *Anterior extremity* regularly rounded, prominent. *Posterior extremity* angulate,

* To the recent forms *C. reniformis* and *C. albo-maculata*, for instance.

the dorsal and ventral margins forming a right angle. *Lateral contour* irregularly lenticular; greatest diameter one-fourth of height, posteriorly situate. *Hinge* strong. *Flange* of left ventral margin small, subcentral.

It is with great pleasure that I name this species after Baron von Schauroth of Coburg, to whose assiduous researches in the Permian rocks of Germany palæontologists are greatly indebted.

Found rarely in the fossiliferous limestone of Tunstall Hill.

Bairdia? *Berniciensis*, n. sp. Pl. X. figs. 15 & 15 *a*.

Length $\frac{1}{25}$ inch; height $\frac{1}{33}$ inch.

Carapace subrhomboidal, moderately convex, smooth. *Dorsal margin* convex; *anterior slope* descending rather more than one-third of height; *posterior slope* rather abrupt, descending about half of height, very convex. *Ventral margin* convex. *Anterior extremity* obliquely truncate. *Posterior extremity* rounded or bluntly pointed. *Lateral contour* sublenticular; *greatest diameter* posteriorly placed, more than two-sevenths of length.

This scarce form rather resembles the recent *Cythere acuta* in marginal outline.

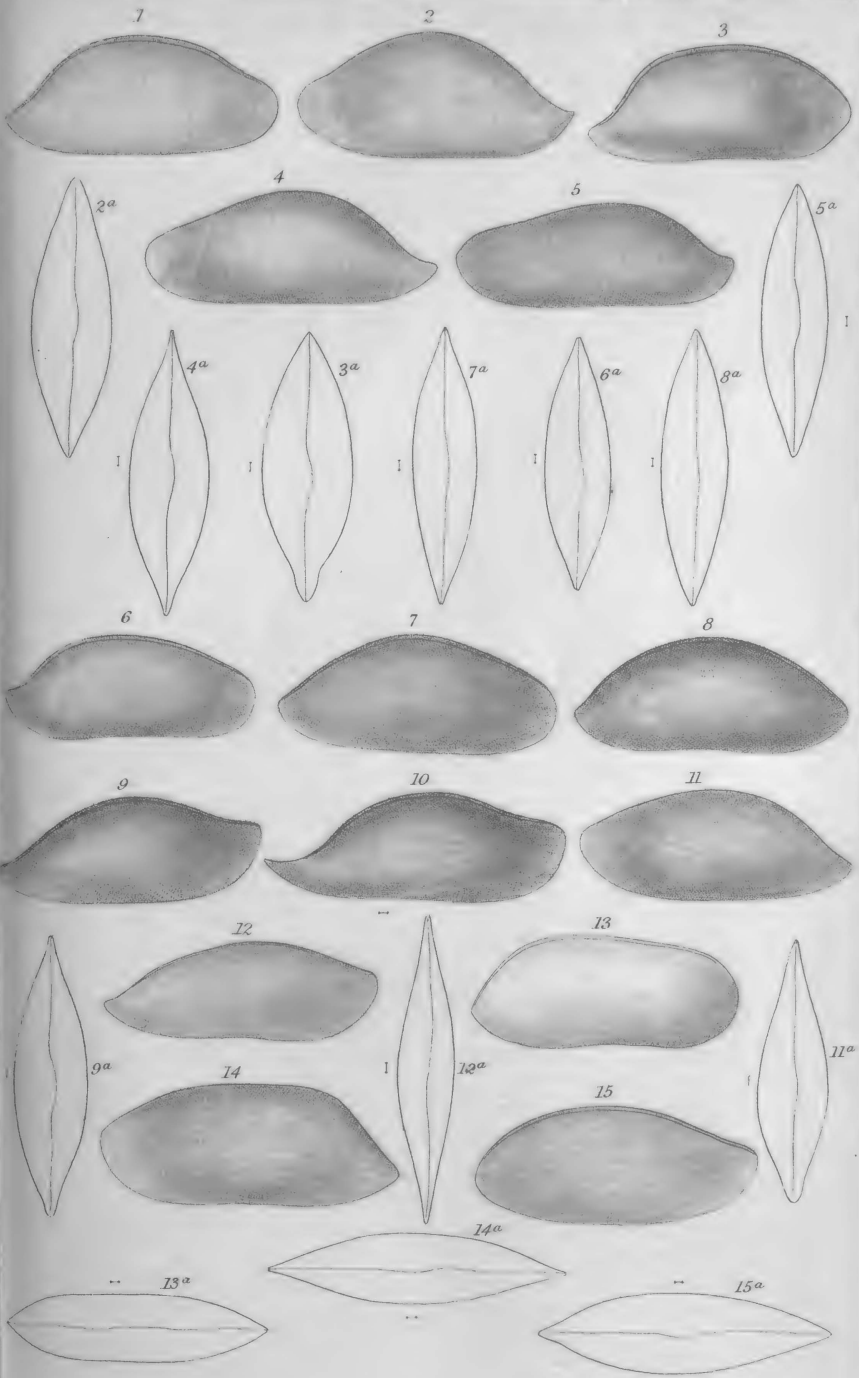
Not being able to make out the hingement of this species, some doubts may exist as to its really belonging to *Bairdia*; but I place it in that group provisionally, until its true affinities be determined.

EXPLANATION OF PLATE X.

Fig. 1. *Bairdia plebeia*, Reuss: right valve; magnified 23 times.
Fig. 2. Ditto: left valve of another variety; magnified 23 times: 2 *a*, lateral contour, with contact-line of ventral margins.
Figs. 4 & 4 *a*. Ditto, var. *elongata*: left valve; magnified 23 times.
Figs. 5 & 5 *a*. Ditto, var. *Neptuni*: left valve; magnified 30 times.
Figs. 7 & 7 *a*. Ditto, var. *compressa*: right valve; magnified 25 times.
Figs. 3 & 3 *a*. *Bairdia ventricosa*, n. sp.: right valve; magnified 28 times.
Figs. 6 & 6 *a*. *Bairdia Reussiana*, n. sp.: right valve; magnified 26 times.
Figs. 8 & 8 *a*. *Bairdia Kingii*, Reuss: right valve; magnified 34 times.
Figs. 9, 10, & 9 *a*. *Bairdia mucronata*, Reuss: right valves; magnified 28 times.
Figs. 11 & 11 *a*. *Bairdia mucronata*?: left valve; magnified 28 times.
Figs. 12 & 12 *a*. *Bairdia* ———, n. sp.?: right valve; magnified 29 times.
Figs. 13 & 13 *a*. *Bairdia reniformis*, n. sp.: right valve; magnified 40 times.
Figs. 14 & 14 *a*. *Bairdia Schaurothiana*, n. sp.: left valve; magnified 28 times.
Figs. 15 & 15 *a*. *Bairdia Berniciensis*, n. sp.: right valve; magnified 33 times.

[The whole of these are from the fossiliferous limestone of Tunstall Hill.]

[To be continued.]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