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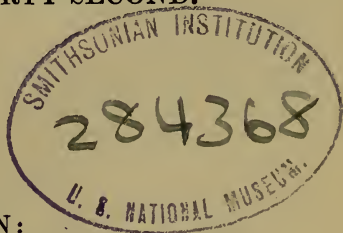
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Quod si cui mortalium cordi et curæ sit non tantum inventis hærerè, atque iis uti, sed ad ulteriora penetrare; atque non disputando adversarium, sed opere naturam vincere; denique non belle et probabiliter opinari, sed certo et ostensive scire; tales, tanquam veri scientiarum filii, nobis (si videbitur) se adjungant. —*Novum Organum, Præfatio.*

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41. *NOTES on the DISTRIBUTION of the OSTRACODA of the CARBONIFEROUS FORMATIONS of the BRITISH ISLES.* By Prof. T. RUPERT JONES, F.R.S., F.G.S., and J. W. KIRKBY, Esq. (Read May 12, 1886.)

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# I. INTRODUCTION.

THE known Ostracoda of the British Carboniferous Formations are not even yet all described, although fifty-five species have been determined or redescribed, with illustrations, since this paper was read (see page 507). There are now 177 known species and notable varieties of Carboniferous Ostracods, belonging to 33 genera of 9 families.

# II. CLASSIFICATION OF THE STRATA.

With regard to their distribution in the strata, it is necessary to premise that in Scotland the Carboniferous rocks are usually grouped as follows :—

- |  |   |  |
|--|---|--|
| 1. Coal-measures .....                 | { | (b). Upper red beds.                                   |
|  | { | (a). Coal-measures proper, with workable coals.        |
| 2. Millstone Grit.                     |   |  |
| 3. Carboniferous Limestone Series..... | { | (c). Upper beds, with limestones.                      |
|  | { | (b). Middle beds, with workable coals and iron-stones. |
|  | { | (a). Lower beds, with limestones.                      |
| 4. Calciferous Sandstones...           | { | (b). Upper or Cement-stone series.                     |
|  | { | (a). Lower or Red-sandstone series.                    |

In the North of England the same system of rocks is often classified thus :—

- |  |   |                       |
|--|---|-----------------------|
| 1. Coal-measures .....                         | { | (c). Upper measures.  |
|  |   | (b). Middle measures. |
|  |   | (a). Lower measures.  |
| 2. Millstone Grit.                             |   |                       |
| 3. Yoredale Rocks (Upper Limestone-shales).    |   |                       |
| 4. Carboniferous, Mountain, or Scar Limestone. |   |                       |
| 5. Lower Limestone-shales.                     |   |                       |

The Coal-measures and the Millstone Grit of the two countries may be regarded as equivalent, though the "Upper red beds (b)" of Scotland are absent in the N.E. of England.

The Carboniferous Limestone series of Scotland and the Yoredale Rocks of England are, in part, parallel deposits, but not wholly, for the base of the former series, when traced southwards across the border into Northumberland, has part of the Yoredales beneath it\*. Hence it follows that the lower portion of the Yoredale Rocks is parallel with the upper portion of the Calciferous Sandstones, and that the Scar Limestone and Lower Limestone-shale are more or less equivalent to the main portion of the same series.

But the term Yoredale scarcely applies in Northumberland, and the Geological Surveyors group the whole of the rocks below the Millstone Grit as the "Carboniferous Limestone Series" in the maps of that county. The upper portion of this group, occupying the position of the Yoredales, is very different in character from and much thicker than the latter, as seen in their typical development in Yorkshire; and the lower portion of the group, more or less equivalent to the Scar Limestone, is virtually a slightly modified southward extension of the Calciferous Sandstones of Scotland. This fact had been noticed by other observers before the official survey of Northumberland; perhaps first by our old friend the late Mr. George Tate, of Alnwick, who proposed the following subdivision of this portion of the series † :—

Calcareous group.  
Carbonaceous group.  
Tuedian beds.

Prof. Lebour ‡ has suggested a modification of this classification by including Tate's Calcareous and Carbonaceous groups in one division under the name "Bernician," the term Tuedian being retained by him for the lowest member of the series.

Mr. Hugh Miller, in the 'Encyclopædia Britannica,' adopts and elaborates Mr. George Tate's scheme of arrangement. We are

\* We owe this information to the officers of the Geological Survey of Scotland.

† 'History of Alnwick,' vol. ii. p. 444 (1869); Nat. Hist. Trans. Northumb. and Durham, 1876, pp. 8 & 9; and Proceed. Berwicksh. Nat. Club, vol. iv. p. 151, and vol. x. p. 315.

‡ 'Outlines of the Geology of Northumberland,' 8vo, 1878.

favoured by him with the following synopsis of the Carboniferous strata of Northumberland \*:—

#### CARBONIFEROUS LIMESTONE SERIES.

##### Northumbrian Type.

Upper Limestone Series .....	{	Felltop Division: between the Millstone Grit and the zone of the Great Limestone: Sandstones and Shales; one or more beds of Marine Limestone; some Coals. (450 to 1200 feet.)
		Calcareous Division: from the Great Limestone down to the bottom of the Dun Limestone or Redesdale Limestone. Many beds of Marine Limestone: Sandstones and Shales; some Coals. (1300 to 2500 feet.)
		Carbonaceous Division: the Scremerston beds of North Northumberland; beds prevalently Carbonaceous; Limestones, chiefly thin, many of them containing vegetable matter; Coals. (800 to 2500 feet.)
Lower Limestone Series .....	{	Tuedian Division.
		Upper Tuedian or Fell Sandstone Group. Great zone of massive grits (Larriston Fells, Bewcastle Fells, Peel Fell, Simonside and Harbottle Hills, Chillingham, &c.). Shales partly greenish and reddish; Coals few, thin, and in many districts absent. (600 to 1500 feet.)
		Lower Tuedian or Cement-limestone Group: cement-stones passing (at Rothbury and Bewcastle) into Limestones; Coals very rare; many of the Shales and Sandstones coloured. (500 to 2000 feet.)
		Basement Conglomerates (Upper Old Red Sandstone); local.

#### CARBONIFEROUS LIMESTONE SERIES.

##### Scotland—Northumberland—Yorkshire.

	<i>Scottish Type.</i>	<i>Northumbrian.</i>	<i>Yorkshire.</i>
Carboniferous Limestone Series.....	{ Upper Limestone Group. Middle or Coal and Ironstone Group. Lower Limestone Group.	{ Upper part of the Upper Limestone Series.  Lower part of the Upper Limestone Series, together with the Lower Carb. L. Series, including Basement-beds.	{ Carboniferous Limestone Series, including the beds between the Little Limestone and the Millstone Grit, the Yoredale Beds, and the Lower Limestone-shale.
Calcareous Sandstone Series .....			

We cannot go further into this matter just now, and we have, perhaps, said enough to show that, in using the term Yoredale for the whole of the North of England in the following remarks and Tables, we do so in a somewhat conventional sense, so far as it relates to Northumberland. It may be added that Ostracoda are so plentiful in these strata, and occur on so many horizons, that the

\* Encycl. Britann. 9th edit. vol. xvii. p. 574.

stratigraphical succession of their different groups of species or faunas is a subject well worth working out in detail; and this we hope some time to do with the help of our Geological-Survey friends.

In the centre and south of England,—that is, south of Derbyshire,—the Yoredales are absent, or cease to be of divisional importance in the Carboniferous series, so that the arrangement of formations there generally followed is this:—

Coal-measures.  
Millstone Grit.  
Upper Limestone-shale.  
Carboniferous Limestone.  
Lower Limestone-shale.

Unfortunately we have much less material of the Ostracodous kind from the south of England than we have from the north, and from Scotland, and most of what we have is from the Carboniferous Limestone, there being little from the Coal-measures, and nothing from the Millstone Grit or the Lower Limestone-shale. For this reason, the distribution of species in the appended Table I. (facing p. 506), is shown in two columns only—Carboniferous Limestone and Coal-measures.

For the same reason the Lower Limestone-shale is left out of the Table in “England North,” as we have nothing from localities therein. And, as we have not been able to determine any species from the Millstone Grit either in England or Scotland, that formation is not represented. See p. 514.

All our Irish specimens are from the lower portion of the series, hence the distribution in that country is given in a single column.<sup>1</sup>

In regard to the geographical divisions used in the Table, “Scotland East” includes Fife, Kinross, Linlithgow, Mid and East Lothian, Berwickshire, and Roxburghshire. “Scotland West” includes the country to the west of that area: namely, Lanarkshire, Stirlingshire, Renfrewshire, Ayrshire, &c.

“England North” takes in Lincolnshire, Notts, Derbyshire, North Staffordshire, and the counties to the north; also the Isle of Man. “England South” embraces the rest of the country southward, including South Wales.

### III. STRATIGRAPHICAL DISTRIBUTION OF THE OSTRACODA.

#### I. SCOTLAND.

§ 1. South of the Firth of Forth, the Upper Old Red is described by Dr. A. Geikie \* as passing upwards into the lowest beds of the Carboniferous Series without any signs of break or unconformity. Probably these are the lowest and oldest Carboniferous strata in Scotland; but there are no Entomostraca recorded from them.

In Fife, where the Lower Carboniferous or Calciferous Sandstone series is very thick, the basal beds are never seen, though there are

\* Geol. Survey Mem. on East Lothian, p. 27 (1866).



nearly 4000 feet of strata exposed below the Carboniferous Limestone series. In the lowest of these strata, the first Ostracod to appear is a very simple *Beyrichia*, identified with *B. subarcuata*. Fifty feet or so higher up is a shale containing *Carbonia fabulina* and *C. Rankiniana*. A few feet further up still, in a "cement-stone," *B. subarcuata* again appears along with *Leperditia Okeni* and *Bairdia nitida*. These are the earliest traces of Ostracoda in the Carboniferous Series of the east of Scotland that have come under our observation.

A few hundred feet higher up—though still from 3200 to 3500 feet below the Carboniferous Limestone series, and in a section where several thin limestones with marine fossils come in, the following species are found, and they may probably be taken as representative of the earliest important group of Carboniferous Ostracoda in Scotland :—

<i>Leperditia Okeni</i> *.	<i>Bairdia plebeia</i> .
— <i>scotoburdigalensis</i> .	— <i>Hisingeri</i> .
<i>Beyrichia subarcuata</i> ?	— <i>siliquoides</i> .
—, sp.	— <i>precisa</i> .
<i>Kirkbya spiralis</i> .	— <i>subcylindrica</i> ?
— <i>plicata</i> .	<i>Macrocypris Jonesiana</i> .
<i>Cytherella extuberata</i> .	<i>Argilloecia æqualis</i> .
— <i>attenuata</i> .	<i>Aglaia cypridiformis</i> .
<i>Carbonia subula</i> .	<i>Cythere</i> ? <i>intermedia</i> .

*Carbonia subula* occurs in this series of strata, but not associated with the other species of the list.

For the next 1000 feet or more upward, Ostracoda appear and reappear time after time, and in great individual abundance. Species, however, are not numerous. Among the commonest forms are *Leperditia scotoburdigalensis*, *Beyrichia subarcuata*, *Cytherella extuberata*, and *C. attenuata*. On some horizons they are joined by *Kirkbya spiralis* and *Cythere* ? *superba*, and perhaps one or two others. At one spot, in a "cement-stone," these species give place to *Leperditia Okeni*, *Beyrichiopsis fimbriata*, a *Cytherella*, and one or two *Bairdiæ*. Besides, at intervals, those Coal-measure Cytherids (?), *Carbonia fabulina* and *C. Rankiniana*, keep coming in along with *C. subula*. The *Leperditia* and other species generally go out as these appear, though not in all cases.

Above all this, near the middle of the Calciferous Sandstones (speaking of Fife), in a thick marine shale with Crinoids and numerous other fossils are these species :—

<i>Leperditia Okeni</i> .	<i>Bairdia plebeia</i> .
<i>Beyrichia radiata</i> .	— <i>Hisingeri</i> .
— <i>subarcuata</i> ?	— <i>brevis</i> .
<i>Cytherella</i> , 2 spp.	— <i>subelongata</i> .

Then follow more appearances of *Lep. scotoburdigalensis* and its associates before mentioned,—though not all of them, for *Kirkbya spiralis*,

\* For the authorities of species, see Table II. at the end.

*Cytherella extuberata*, and *C. attenuata* disappear,—until the Carboniferous Limestone series is approached, when in the thin limestones and associated shales begin to be seen species that are commoner in the beds above.

These remarks relate solely to what has been observed in the Lower Carboniferous of Fife. In equivalent deposits in Mid-Lothian and Linlithgowshire Ostracoda occur in great abundance in some places, notably at the classical locality of Burdiehouse; but the general sequence of the record is less complete, and no other species have been observed.

§ 2. In the south west of Scotland, Dumfriesshire and Ayrshire excepted, the Calciferous Sandstones contain few fossils of any kind, and the only Ostracods recorded from them are *Leperditia Okeni* and *L. subrecta*, from the Lower or Red Sandstone group (a) of the series. These two species are thus probably on a lower horizon than any noticed in Fife, and hence are the first occurring and oldest of known Carboniferous Ostracods.

From low down in the Calciferous Sandstones of Dumfriesshire and Ayrshire, though evidently in the Cement-stone group (b), we have the following species:—*Lep. Okeni*, *Beyr. subarcuata*?, *Argillæcia æqualis*, *Bairdia plebeia*, *B. Hisingeri*, *B. brevis*, and *B. submucronata*.

From a group of limestones higher in position, in Dumfriesshire, a more numerous suite of species occurs, including:—*Kirkbya umbonata*, *K. costata*, *Cytherella valida*, *C. Benniei*, *Macrocypris Jonesiana*, *Bythocypris bilobata*, *Cythere?* *cuneola*, *C.?* *cornigera*, *Bairdia grandis*, *B. Hisingeri*, *B. amputata*, *B. ampla*, and some others.

Lastly, in Roxburghshire, these beds become richly fossiliferous in Ostracoda. Washings of various shales and numerous mounted specimens kindly sent us by the Geological Survey of Scotland from localities in that county have given us the following list of species:—

<i>Leperditia Okeni</i> .	<i>Cytherella extuberata</i> .
— suborbiculata.	— attenuata.
<i>Beyrichia radiata</i> .	—, sp.
— subarcuata?	<i>Cythere?</i> <i>intermedia</i> .
— intermedia? *	<i>Argillæcia æqualis</i> .
— craterigera.	<i>Bythocypris bilobata</i> .
<i>Beyrichiopsis fimbriata</i> .	— sublunata.
— fortis.	<i>Bairdia Hisingeri</i> .
<i>Kirkbya plicata</i> .	— plebeia.
— spiralis.	— ampla?
— costata.	— subelongata.
— umbonata?	— submucronata.
<i>Carbonia fabulina</i> .	<i>Cythere</i> , sp.

The *Carbonia*, although apparently estuarine, curiously occurs here with several of the more decidedly marine forms.

Of the species we have mentioned as found in the Calciferous Sandstone series, the following appear to be confined to it:—*Beyrichiopsis fortis*, *Kirkbya spiralis*, *Cytherella extuberata*, *C. attenuata*, *Bythocypris sublunata*, *Argillæcia æqualis*, *Aglæa cypridiformis*,

\* A Silurian species.

*Bairdia nitida*, *B. præcisa*, and *Cythere? superba*; while *Beyrichia craterigera*, *Kirkbya costata*, *K. plicata*, and *Macrocypis Jonesiana* are almost peculiar to it, and certainly highly diagnostic of the series.

§ 3. *Carboniferous Limestone Series of South-west Scotland*.—The shales connected with the limestones of the Lower beds (*a*) of this series have yielded a great number of Ostracoda—more species, in fact, than any other portion of the Carboniferous system either in Scotland, England, or elsewhere. The following list includes the most common and characteristic forms from these limestones and shales:—

<i>Cypridina primæva</i> .	<i>Beyrichia bituberculata</i> .
— <i>Phillipsiana</i> .	— <i>ventricornis</i> .
<i>Entomoconchus Scouleri</i> .	<i>Kirkbya permiana</i> .
<i>Polycope simplex</i> .	— <i>umbonata</i> .
— <i>Youngiana</i> .	— <i>Urei</i> .
<i>Cytherella recta</i> .	— <i>spinosa</i> .
— <i>scrobiculata</i> .	— <i>oblonga</i> .
<i>Leperditia Okeni</i> .	<i>Bythocypris Phillipsiana</i> , var. <i>carbonica</i> .
— <i>suborbiculata</i> .	<i>Bairdia plebeia</i> .
— <i>oblonga</i> .	— <i>curta</i> .
— <i>compressa</i> .	— <i>Hisingeri</i> .
— <i>Armstrongiana</i> .	— <i>brevis</i> .
<i>Beyrichia fastigiata</i> .	— <i>amputata</i> .
— <i>multiloba</i> .	— <i>submucronata</i> .
— <i>radiata</i> .	— <i>subelongata</i> .
— <i>tuberculospinosa</i> .	— <i>ampla</i> .
— <i>reticosa</i> .	<i>Cythere? cuneola</i> .
— <i>Bradyana</i> .	— <i>? cornigera</i> .

As peculiar to this portion of the series may be mentioned:—*Cypridina Hunteriana*, *Cypridellina intermedia*, *Bradycinetus Rankinianus*, *Entomoconchus globosus*, *Polycope Youngiana*, *Cytherella brevis*, *C. concinna*, *C. obesa*, *C. rotundata*, *Leperditia compressa*, *L. Armstrongiana*, *L. Bosquetiana*, *Beyrichia colliculus*, *B. reticosa*, *B. varicosa*, *Bairdia amputata*, *B. grandis*, *B. ? circumcisa*, *B. legumen*, and *Bythocythere Youngiana*; several of these are rare.

The middle portion of the series (*b*), containing the workable coals and ironstones, which form the “Lower Coal-measures” of Scotch geology, yield few Ostracods; and the most common are two Upper-Coal-measure forms. These four species occur in it:—*Leperditia Youngiana*, *Beyrichia* sp., *Carbonia fabulina*, *C. Rankiniana*.

In the Upper-Limestone group of this series (*c*) many of the species belonging to the Lower group (*a*) are recurrent, and a few appear for the first time. The most common forms are:—

<i>Cypridina Youngiana</i> .	<i>Cytherella Benniei</i> .
<i>Leperditia Okeni</i> .	— <i>æqualis</i> .
— <i>suborbiculata</i> .	— <i>obliqua</i> .
<i>Beyrichia radiata</i> .	— <i>scrobiculata</i> .
— <i>bituberculata</i> .	<i>Bairdia plebeia</i> .
— <i>multiloba</i> .	— <i>Hisingeri</i> .
— <i>ventricornis</i> .	— <i>curta</i> .
<i>Kirkbya rigida</i> .	— <i>silicoides</i> .
— <i>Urei</i> .	<i>Cythere? cuneola</i> .
— <i>permiana</i> .	— <i>? cornigera</i> .
<i>Cytherella recta</i> .	



The species peculiar to these beds are:—*Cypridina Youngiana*, *C. Grossartiana*, *C. Thomsoniana*, *Cytherella obliqua*, *C. æqualis*, *Beyrichia fodicata*, *B. bicesa*, *Kirkbya rigida*, and *Youngia rectidorsalis*.

Then comes the series of sandstones, grits, shales, and fireclays, with a thin coal or two, representing the Millstone Grit. From these beds we have no Ostracoda.

Above them follow the Coal-measures proper, consisting of a Lower series (a), containing all the workable coals; and an Upper series (b) of red sandstones, shales, marls, and fireclays, with Carboniferous fossils. In the Lower series *Beyrichia arcuata*, *Carbonia fabulina*, *C. Rankiniana*, and *C. pungens* are the common Ostracoda. *Cypridina radiata* and *Carbonia? bairdioides* also occur rarely. In the Upper series (b) *C. fabulina*, *C. Rankiniana*, and *C. pungens* are found abundantly at an horizon about 400 feet from the highest beds. These are the last occurring Carboniferous Ostracods in Scotland that we have seen. The next appearance of representatives of their tribe is in the Lower Permian Limestone of Durham, where a group of seven species is found, six of which are Lower-Carboniferous forms; but these *Carboniæ* are not among them.

## 2. ENGLAND.

§ 1. In the north of England the lowest horizon from which we have Ostracoda is somewhere near the base of the Scar Limestone, as it occurs in North Lancashire and Westmoreland, and the Lower Carboniferous beds in Cumberland and Northumberland, which are probably nearly equivalent in position, though very different in character. From this or these horizons come the following more common species:—

*Cypridina brevimentum*, *Cypridinella Cummingii*, *C. superciliosa*, *Cypridellina Burrovii*, *Cyprella chrysalidea*, *C. annulata*, *Polycope Burrovii*, *Entomoconchus Scouleri*, *Entomis Burrovii*, *E. Koninekiana*, *Cytherella valida*, *C. scrobiculata*, *C. extuberata*, *Leperditia Okeni*, *L. suborbiculata*, *L. acuta*, *L. scotoburdigalensis*, *L. subrecta*, *Beyrichia craterigera*, *B. crinita*, *B. radiata*, *Beyrichiopsis subdentata*, *B. fimbriata*, *Kirkbya costata*, *K. spiralis*, *K. umbonata*, *Argillæcia æqualis*, *Macrocypris Jonesiana*, *Bairdia Hisingeri*, *B. curta*, *B. plebeia*, *B. submucronata*, *B. subelongata*, *Bernix Tatei*, &c.

Higher in the limestone are also found, somewhat plentifully, *Kirkbya permiana*, *Leperditia Armstrongiana*, *Bythocypris bilobata*, *Xestoleberis? subcorbuloides*, *Bairdia amputata*, &c.

The species peculiar to this portion of the series south of the Border are:—*Cypridina brevimentum*, *Cypridinella Cummingii*, *C. monitor*, *Cypridellina Burrovii*, *Entomoconchus Scouleri*, *Entomis Burrovii* (and other of the Cypridinidæ), *Cytherella valida*, *Leperditia subrecta*, *L. Armstrongiana*, *L. obesa*, *Beyrichia longispina*, *B. tuberculospinosa*, *B. Holliana*, *B. crinita*, *Beyrichiopsis subdentata*, *B. fimbriata*, *Kirkbya tricollina*, *K. spiralis*, *Argillæcia æqualis*, *Macrocypris Jonesiana*, *Aglæia cypridiformis*, *Bythocythere antiqua*, *Cythere? Kirkbyana*, *C.? gyripunctata*, *Darwinula berniciana*, and *Xestoleberis? subcorbuloides*.

The calcareous shales of the Yoredale rocks contain many species. In the lower beds there occur some of the more characteristic forms of the Lower Carboniferous, in the two northerly counties at least, such as *Cytherella valida*, *Beyrichia craterigera*, and *Kirkbya costata*; but these do not range very far upward.

The forms peculiar to the Yoredales are:—*Leperditia lovicensis*, *Beyrichia ventricornis*, *B. bituberculata*, *Kirkbya Urei*, *Bythocythere Youngiana*, *Bythocypris Phillipsiana*, var. *carbonica*, *Phreatura concinna*, *Cythere? cornigera*, *Bairdia legumen*, and *B. mucronata*.

We have no determinable species from the Millstone Grit.

From the Lower Coal-measures (a) have been obtained *Beyrichia arcuata*\* and *Carbonia? sp.*

From the Middle or main group of the Coal-measures (b) the last-named *Beyrichia* is a common fossil: so also is *Carbonia fabulina*. Of less common occurrence are *Philomedes elongata*, *Carbonia Rankiniana*, *C. secans*, *C. scalpellus*, and *C. Wardiana*.

Then in the Upper Coal-measures (a) reappears *Beyrichia subarcuata*, and in the "Spirorbis Limestone" of this group *Leperditia inflata*. These seem to be the last occurring Carboniferous Ostracods in England.

§ 2. Of the area of "England South" our materials are not as yet sufficient to allow anything like a complete sketch to be given of the vertical distribution of the species.

[NOTE.—Since this paper was written we have examined and described † a set of Carboniferous Ostracoda from the Gayton Boring, Northamptonshire. These Ostracods were obtained, at a depth of over 700 feet from the surface, in shaly beds, evidently identical with the Lower Limestone-shale. The shales were kindly supplied by Mr. H. J. Eunson, F.G.S. Six species were determined (one of which was new to us, and the other five were well-known Lower Carboniferous forms of Scotland and the North of England), namely, *Kirkbya variabilis*, *K. plicata*, *Cytherella extuberata*, *C. attenuata*, *Bythocypris sublunata*, and *Macrocypris Jonesiana*.

Quite recently Mr. E. Wethered, F.G.S., of Cheltenham, has favoured us with specimens from the Lower Limestone-shale of the Forest of Dean. Curiously enough these specimens are almost exactly similar in species and individual abundance to those of the Gayton Boring.

From the Forest of Dean came *Kirkbya variabilis*, *K. plicata*, *Cytherella extuberata*, *Bythocypris sublunata*, and *Darwinula berniciana* (?).]

In the Carboniferous Limestone of Shropshire, South Wales, and

\* *B. arcuata* is said to occur at Shaly Brow, in the Wigan coal-field, in the roof of one of the Gannister coals, where it is associated with *Aviculopecten papyraceus* and *Goniatites Listeri*. It would be of interest to have this corroborated, and to learn whether it occurs in other of the *Aviculopecten*-bands of the Lower Coal-measures, and just of as much interest to know if other Ostracods are found with it under these conditions.

† Geol. Mag. dec. iii. vol. iii. 1886, p. 248, pl. 7.

Somerset are found *Leperditia Okeni*, *L. parallela*, *L. acuta*, *Beyrichia arcuata* (?), *B. sp.*, *Kirkbya plicata*, *K. costata*, *Moorea tenuis*, *M. obesa*, *Bythocypris bilobata*, *Argilloecia equalis*, *Cythere? lunata*, *C.? pyrula*, *C.? Moorei*, *C.? cornigera*, *C.? thraso*, *Bairdia curta*, *B. plebeia*, *B. brevis*, and *B. Hisingeri*.

We have nothing in the south representing the large groups of species found in the Yoredale Rocks of the north of England, or of the Carboniferous Limestone series of Scotland.

From the Coal-measures of South Wales we have *Carbonia Agnes*, *C. Evelinae*, and *C. sp.*; and from the "Spirorbis Limestone" of the Midland counties *Leperditia inflata*.

#### IV. IRELAND.

The distribution of the Carboniferous Ostracoda in Ireland (see Table II.) requires further work. The Mountain-limestone near Cork and elsewhere is known to be very rich in these fossils, as are also some parts of that formation in the Isle of Man. The Lower Carboniferous Shales are rich at places in Ireland (see M'Coy's Synops. Charact. Carbonif. Fossils, Ireland, and Ann. & Mag. Nat. Hist. ser. 3, vol. xviii. pp. 40-51).

#### V. DISTRIBUTION OF OSTRACODA IN PERMIAN STRATA OF ENGLAND.

To render this sketch of the vertical distribution of Ostracoda in the Upper Palæozoic rocks more complete, we continue it up to the Permian series, into which eleven of the Carboniferous species are known to range.

In the Lower Magnesian Limestone of Durham and Yorkshire we find the following species:—*Kirkbya permiana*, *Bairdia plebeia*, *B. Hisingeri*, *B. ampla*, *Macrocypris Jonesiana*, *Cythere intermedia*, *C.? inornata* (?), and *Cytherella nuciformis*?

In the Middle Magnesian Limestone of Durham occur:—*Cypridina primæva*, *Kirkbya permiana*, *Bairdia plebeia*, *B. Hisingeri*, *B. acuta*, *B. Kingii*, *B. bernicensis*, *B. rhomboidea*, *B. amputata*, *Macrocypris Jonesiana*, *Cythere? intermedia*, *C.? Morrisiana*, and *C.? Geinitziana*.

And in the Upper Magnesian Limestone of Durham we have as the last Palæozoic representatives of the order:—*Kirkbya permiana*, *B. plebeia*, *B. grandis*, *B. ampla*, *B. acuta*, *Cythere? Morrisiana*, *C.? Kutorgiana*, *C.? Geinitziana*, *C.? biplicata*, *C.? inornata*, and *Cytherella nuciformis*:

These occurrences in the Permian series represent a range of about 400 feet. The Ostracods are always found along with the marine Mollusca and other fossils of the Magnesian Limestone; but where the last representatives of the Mollusca are seen in the highest beds of the series, no Ostracoda are found with them.

The Carboniferous species recurrent in Permian strata are:—*Cypridina primæva*, *Kirkbya permiana*, *Bairdia plebeia*, *B. ampla*, *B. Hisingeri*, *B. amputata*, *B. grandis*, *Macrocypris Jonesiana*, *Cythere? intermedia*, and (in the Zechstein of Europe) *Bairdia mucronata* and *B. subgracilis*.

## VI. RANGE OF BRITISH CARBONIFEROUS OSTRACODA IN NORTH AMERICA AND EUROPE.

§ 1. Among the British species already found in other countries, perhaps *Cytherella Benniei* and *C. concinna* enjoy the greatest range, as they are met with in the Coal-measures of Iowa in the one case, and in the Carboniferous Limestone of the same State in the other\*.

In the Carboniferous rocks (Coal-measures and Lower Coal-measures) of Nova Scotia the following species are known to occur:—*Leperditia Okeni*, *L. scotoburdigalensis*, *L. acuta*, *Carbonia fabulina*, and *C. bairdioides* (?)†.

These are all the British Ostracods whose range is as yet known to extend to the American continent. Two of them (*Leperditia scotoburdigalensis* and *Carbonia fabulina*) were essentially estuarine forms. They are the commonest species of all in the Coal-measures and Calcareous Sandstones of the North British area; and their constant occurrence in shales, ironstones, and impure limestones (intercalated with coals), associated with the remains of plants, indicates that they were anything but of deep-sea habits.

§ 2. In Europe the following species have been described from Carboniferous strata in Russia:—*Leperditia Okeni*, *Kirkbya umbo-nata*, *Beyrichia colliculus*, *B. intermedia*, *Bairdia ampla*, *B. plebeia*, and *Bythocypris bilobata*; and *Kirkbya permiana* from the Permian strata of the same country‡.

Some of the best known of the British species were discovered by Count Münster in the Carboniferous Limestone of Bavaria; these include *Leperditia Okeni*, *L. oblonga*, *L. parallela*, *L. suborbiculata*, *Cytherella inflata*, *Bairdia Hisingeri*, *Bythocypris bilobata*, and *Cythere? intermedia* §.

In Belgium, as might be expected from its comparative nearness to Britain, several species occur that are included in this list. This more particularly applies to the Cypridinidæ ||.

*Leperditia Okeni* seems to have had the greatest geographical range, being found as far east as the Russian province of Toula, and as far west as Nova Scotia.

## VII. APPENDIX.

### 1. BEYRICHIOPSIS, gen. nov.

Valves shaped and lobed much like those of some *Beyrichiæ*, but bearing longitudinal riblets, as in some *Kirkbyæ*. One of these ribs forms a dorsal crest; there is also a denticulate, spinose, or delicate fringe along the free margin. These characteristic features are well seen in *Beyrichiopsis fimbriata*.

\* Monogr. Carbonif. Bivalved Entom., Palæont. Soc. 1884, pp. 77–79.

† Geol. Mag. dec. iii. vol. i. 1884, p. 356.

‡ Ann. & Mag. Nat. Hist. ser. 4, vol. xv. 1875, p. 52; and 'Lethæa Rossica,' 1860, vii. p. 1347.

§ Ann. & Mag. Nat. Hist. ser. 3, vol. xv. 1865, p. 406.

|| Monogr. Carb. Biv. Entom., Pal. Soc. 1874, pp. 32, 38, 40.



TABLE I.—Showing the Stratigraphical Distribution of the Ostracoda in the Carboniferous Series of Scotland, and in the Permian and Carboniferous Series of the North of England.

SCOTLAND.		THE NORTH OF ENGLAND.	
COAL-MEASURES.	Upper Red beds .....	MAGNESIAN LIMESTONE.	Upper .....
	Group with workable coals .....		Middle .....
			Lower.....
			Marl-slate.....
			Lower Red Sandstone ...
MILLSTONE GRIT.		MILLSTONE GRIT.	
CARBONIFEROUS LIMESTONE SERIES.	Upper group with lime-stones.....	COAL-MEASURES.	Upper .....
	Middle group: "Lower coals and ironstones."		Middle .....
	Lower group with lime-stones.....		Lower .....
YORED ALE ROCKS .....		YORED ALE ROCKS .....	
CALCIFEROUS SANDSTONE SERIES.	Cement-stone group .....	CARBONIFEROUS OR SCAR LIMESTONE .....	Lower Limestone-shale.
	Cornstone or Red Sandstone group .....		



## 2. PHREATURA \*, gen. nov.

Valves small, subreniform in outline; seen from above or below the carapace is subcuneiform, pointed in front, truncate behind. Left valve the largest, and overlapping the other nearly all round. The surface of the valves smooth, but impressed at each end with a comparatively large and deep pit; hence the name. The only species yet known, namely, *Phreatura concinna*, J. & K., is about  $\frac{1}{10}$  inch long, and is very neat in shape. This genus approaches the Silurian *Thlipsura*.

## 3. YOUNGIA, gen. nov.

Minute, elongate, subrectangular, thick-shelled, and smooth, with a straight dorsal border that has the contact-surface of the hinge-margin denticulated along its whole length, after the manner of *Arca*.

Only one species (*Y. rectidorsalis*, J. & K.) of this genus is as yet known to us, and it was discovered by our friend Mr. John Young, of Glasgow, with whose name we associate the genus. The discovery of additional species may probably add to the generic characters. The chief feature of the genus, as now known to us, is its toothed hingement, which is certainly unique among the Carboniferous Entomostraca, though partially represented in *Cytheridea* among later forms.

NOTE.—Since this paper was read many of the species here mentioned have been described and figured in the *Annals & Mag. Nat. Hist.* for October 1886, and the *Geological Magazine* of the same date. Others in the *Proceedings of the Geologists' Association*, vol. ix. part 7. With them also the following new species have been described and have to be added to the following lists and Table, namely:—

*Cythere? obtusa*, J. & K. Yoredale series; Lowick, Northumberland. *Ann. & Mag. Nat. Hist.* October, 1886, p. 266, pl. ix. fig. 12.

*Beyrichiopsis cornuta*, J. & K. Carboniferous Limestone series; Linlithgowshire, Fifeshire, and Northumberland. *Geol. Mag.* Oct. 1886, p. 436, pl. xi. fig. 11.

*Beyrichiella cristata*, J. & K. Calciferous Sandstone series; Randerstone, Fife. *Geol. Mag.* Oct. 1886, p. 438, pl. xii. fig. 6.

We may add that *Cythere? cuneola*, *cornigera*, *pyrula*, and *thraso* are now referred to *Bythocypris* with some doubt; and *C.? lunata* more decidedly to that genus. *Beyrichia Holliana* may be a *Primitia*; and *B. reticosa* and *ventricornis* probably belong to *Beyrichiella*. *Bairdia subcylindrica?* (Münster) should have been entered under sp. 146 as belonging to the Lower Carboniferous of East Scotland (p. 500).

\* From *φρέαρ* (-*aros*), a well or pit, and *οὐρά*, a tail.

TABLE II.—The Genera and Species of Carboniferous Ostracoda, and their Occurrences in England, Scotland, and Ireland.

	ENGLAND, SOUTH.		ENGLAND, NORTH.		SCOTLAND, EAST.				SCOTLAND, WEST.				IRELAND.	EUROPE.
	Carboniferous Limestone.	Coal-measures.	Carboniferous Limestone.	Coal-measures.	Calcareous Sandstone.	Carboniferous Limestone Series.			Calcareous Sandstone.	Carboniferous Limestone Series.				
						Lower.	Middle.	Upper.		Lower.	Middle.	Upper.		
1.	..	?	..	..	..	..	..	..	..	..	..	..	..	..
2.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
3.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
5.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
6.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
7.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
8.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
9.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
10.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
11.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
12.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
13.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
14.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
15.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
16.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
17.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
18.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
19.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
20.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
21.	..	..	..	..	..	..	..	..	..	..	..	..	..	..

*Cypridina primæva (M. Coy)* .....  
*radiata, Jones, Kirkby, & Brady* .....  
*Wrightiana, J., K., & B.* .....  
*Bradyana, Jones & Kirkby* .....  
*brevimentum, J., K., & B.* .....  
*Youngiana, J., K., & B.* .....  
*Hunteriana, J., K., & B.* .....  
*pruniformis, J., K., & B.* .....  
*oblonga, J., K., & B.* .....  
*Grossartiana, J. & K.* .....  
*Phillipsiana, Jones* .....  
*Thomsoniana, J. & K.* .....  
*scoriacea, J. & K.* .....  
*Cypridinea Cummingii, J., K., & B.* .....  
*superciliosa, J., K., & B.* .....  
*clausa, J., K., & B.* .....  
[ *Bosqueti, J., K., & B. Belgium.* ]  
*Maccoyana, J., K., & B.* .....  
*monitor, J., K., & B.* .....  
*vomer, J., K., & B.* .....  
*Cypridinea clausa, J., K., & B.* .....  
*Burrovii, J., K., & B.* .....  
—, var. *longnoricensis, J., K., & B.* ...

[illegible]







TABLE II. (continued).

	ENGLAND, SOUTH.		ENGLAND, NORTH.			SCOTLAND, EAST.				SCOTLAND, WEST.				IRELAND.	EUROPE.
	Carboniferous Limestone.	Coal-measures.	Carboniferous Limestone.	Yoredale Rocks.	Coal-measures.	Calcareous Sandstone.	Carboniferous Limestone Series.			Calcareous Sandstone.	Carboniferous Limestone Series.				
							Lower.	Middle.	Upper.		Lower.	Middle.	Upper.		
116.	*	..	..	*	..	..	..	..	..	..	..	..	..	..	?
117.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
118.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
119.	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..
120.	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..
121.	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..
122.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
123.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
124.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
125.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
126.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
127.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
128.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
129.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
130.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
131.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
132.	*	..	..	*	..	..	..	?	..	..	..	..	..	..	*
133.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
134.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
135.	*	..	..	..	..	..	..	..	..	..	..	..	..	..	..
136.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
137.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
138.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

*Kirkbya spinosa, J. & K.*  
*Urei, Jones*  
*rigida, J. & K.*  
*variabilis, J. & K.*  
*Moorea tenuis, J. & K.*  
*obesa, J. & K.*  
*Carbonia fabulina, J. & K.*  
*Rankiniana, J. & K.*  
*subula, J. & K.*  
*scalpellus, J. & K.*  
*secans, J. & K.*  
*pungens, J. & K.*  
*Evelinae, Jones.*  
*Agnes, Jones.*  
*? bardoides, J. & K.*  
*Wardiana, J. & K.*  
*Bythocypris bilobata (Minster)*  
*Phillipsiana, Jones & Holl, var. carbonica, J. & K.*  
*sublunata, J. & K.*  
*Argillæcia equalis, J. & K.*  
*Macrocypris Jonesiana, Kirkby*  
*carbonica, G. S. Brady*  
*Aglaia cypridiformis, J. & K.*



NOTE.—A few weeks ago Mr. J. Ward, F.G.S., of Longton, favoured us with a specimen of impure limestone from the Millstone Grit of Danebridge, Macclesfield, containing Ostracoda. Unfortunately the matrix is so refractory and the valves are so imperfectly preserved that we cannot in any case determine either the genus or species. Mr. J. Bennie informs us also that he has incidentally noticed Ostracods, in beds holding a Millstone-Grit position, in Scotland. So it is evident that fossils of this order exist in rocks of this Middle Carboniferous age, and that only additional search is required to bring them to light.—*October 18, 1886.*

#### DISCUSSION.

Dr. Woodward congratulated the Authors on their care and patience in working up the subject. Much of this work was done under considerable discouragement, since the siliceous examples in which the structure of the appendages is preserved are not available in this country, and without these authors are dependent solely on the examination of the characters presented by the carapaces. Mr. Brady, who had examined the specimens upon which Prof. Rupert Jones's observations were founded, was satisfied that the classification adopted by the author for the fossil Ostracoda was the best that the materials afforded.