OSTRACODA FROM THE UPPER SILURIAN STONEHOUSE FORMATION, ARISAIG NOVA SCOTIA, CANADA

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ABSTRACT. Several species of ostracods of the genera *Beyrichia*, *Kloedenia*, *Leperditia*, and *Primitia* have been described from Upper Silurian strata of the Stonehouse formation near Arisaig, Nova Scotia. Previous indentifications of some of these ostracods are considered doubtful due in part to the confusion arising from their original descriptions by James Hall (1860). The present examination gives more detailed information concerning these previously described species and reveals for the first time the presence of several species previously recorded only from northern Europe. On the basis of the contained ostracod fauna, correlation of the Stonehouse formation is made with the *Beyrichia* Limestone of the Baltic region.

INTRODUCTION

NUMEROUS references have been made to ostracods from the upper part of the Silurian Arisaig group since the earliest description of this fauna by James Hall in 1860. Many specimens have been found near the middle and upper parts of the Stonehouse formation (McLearn 1924), the youngest exposed sequence of Silurian rocks in the area. Species of the genera *Beyrichia*, *Leperditia*, and *Primitia* have been reported and figured by Hall (1860), Jones (1881; 1890; 1891), and others. In the present paper previously described ostracod genera and species from this formation are evaluated and several other species are recorded for the first time.

The original description of part of this fauna by James Hall has confused subsequent workers. He described three species, *Beyrichia pustulosa*, *B. eqilatera* (*sic* = *equilatera*), and *Leperditia sinuata*, but gave no figure for *L. sinuata*. The small size of the original woodcuts of the other two species gave no adequate representations of their true morphologies. Indeed, Jones (1891, pp. 73–74) considered Hall's original figures of *B. equilatera* to be 'a small *Beyrichia tuberculata*, or one of its varieties' and he decided 'to accept the published *description* (1860) as belonging to *B. aequilatera* Hall, and to regard the little *woodcut* on the same page as belonging to the other species occurring so abundantly with *B. aequilatera*' (i.e. *B. pustulosa*). It is no wonder, therefore, that a confusing synonymy has arisen concerning these two species.

Subsequent to Hall's work, Jones recorded the presence of several other species of *Beyrichia* from these strata (*B. tuberculata* (Kloeden), *B. bronni* Reuter, *B. tuberculata strictispiralis* Jones, *B. tuberculata noetlingi* (Reuter), *B. tuberculata gibbosa* Reuter, *B. maccoyiana* Jones, and *B. wilckensiana* Jones). One of these, *B. wilckensiana*, has subsequently been referred to the genus *Kloedenia*, but the assignments of the other beyrichiid species have remained relatively unchanged. The multiplicity of these beyrichiids and the indefinite descriptions of *B. equilatera* and *B. pustulosa* have raised the problem of the possible synonymy of certain of these species. Other recorded genera from these beds include *Primitia* (*P. mundula* (Jones), *P. concinna* Jones and Holl, *P. ovata* Jones and Holl, and *P. sp.*) and *Ctenobolbina? sp.* The latter genus is not considered in this

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paper, since the identification is questioned and no specimens have been obtained during the present study.

In attempting to describe these ostracods, an examination of Hall's type specimens in the American Museum of Natural History was considered advisable. Accordingly, type specimens of *B. pustulosa* and *L. sinuata* were obtained (*B. equilatera* not being available) and comparison attempted with material available in collections of the Geological Survey of Canada.

The author gratefully acknowledges the loan of type specimens from the American Museum of Natural History. Dr. R. V. Kesling of the Museum of Paleontology, University of Michigan, kindly read the manuscript and made many helpful comments. Photographs were made by Mr. E. C. Elliot of the Geological Survey of Canada. The paper is published by permission of the Director, Geological Survey of Canada, Department of Mines and Technical Surveys, Ottawa, Ontario.

Mode of Preservation. Most ostracods from the Stonehouse formation are preserved only as internal moulds of individual valves preserved in red and pink sandy limestone or calcareous sandstone. The matrix is composed chiefly of pink calcium carbonate, which, on being weathered, leaves a residual ferruginous stain on the outcrop. This stain coats the specimens, giving them a hematite-red colour. Despite this undesirable type of preservation, sufficient surface details are generally present on most specimens to permit their specific identifications. Specimens also occur in massive grey, sandy, coquinal limestones. They are well preserved for the most part, but the beyrichiids are rarely obtained as complete valves due to the necessity of uncovering and breaking them free from the matrix. The smooth-shelled genera, however, are more easily prepared in this manner. Absence of complete carapaces may indicate the dissociation of valves due to current action prior to burial.

Stratigraphic position. The age of the Stonehouse formation has been variously considered as Middle or Late Silurian. Williams (1914) gave a detailed account of the early history of this problem and considered (p. 133) the Stonehouse as equivalent to the Ludlow of Europe. McLearn (1924, pp. 20 ff.) considered the Stonehouse fauna as equivalent to that of the Pembroke of Maine, the Upper Ludlow of Britain, and étages 9e–9g of Oslo (Christiania). Swartz *et al.* (1942) regarded the Stonehouse as equivalent to the upper part of the Wenlockian, Ludlovian, and Downtonian (emended) Series of Great Britain and equal to the upper part of the Niagaran (Guelph) and Cayugan Series of North America. Flower (1943, p. 251), basing his conclusions on fauna obtained from a drift boulder, considered that the Stonehouse cephalopod fauna 'may not be much younger, if at all, than known Middle Silurian strata of Europe and America'. More recently, Boucot (personal communication, manuscript in press), on the basis of brachiopod affinities, considers the Stonehouse formation as possibly equivalent to the Downtonian Series of Great Britain.

On the basis of ostracod fauna, correlation with rocks of the Downtonian Series is considered most probable for the Stonehouse formation. This is based on the occurrence of similar fauna from Oesel (zone K of Reuter 1885; Obere Oesel-Gruppe of von Bubnoff 1926) and Upper Silurian drift (Obersilurischen Diluvialgeschiebe) from northern Germany (Obere Beyrichien-Kalke of Krause 1891). These European faunas contain specimens of *Beyrichia tuberculata* (Kloeden), *B. salteriana* Jones, *B. buchiana* Jones,

B. maccoyiana Jones, and *Kloedenia wilckensiana* (Jones) which Kesling and Wagner (1956, p. 36) considered of Downtonian age. Moberg and Grönwall (1909), working in southern Sweden, identified among other ostracods *Primitia mundula*, *Beyrichia kochii*, *B. maccoyiana*, *Kloedenia wilckensiana*, and *Cytherellina siliqua*—species recorded from the *Beyrichia* Limestone and now found in the Stonehouse formation. The beds containing these species in Sweden were correlated with the Downtonian sandstone, Tilestones and Ledbury Shales of Great Britain—all contained within the Downtonian Series. Also, Henningsmoen (personal communication) is of the opinion that the *Beyrichia* Limestone fauna is post-9g in the Oslo region terminology and is probably of Downtonian age. From the foregoing it appears probable that the *Beyrichia* Limestone ostracods occur in beds of Downtonian age in northern Europe and that a similar age should be assigned the Stonehouse fauna. The exact stratigraphic distribution of ostracods throughout the Stonehouse formation is not at present known. This will constitute a separate study to be published at a later date.

Palaeontology. The following ostracod species have been identified from the Stonehouse formation; their distribution in northern Europe is given below.

	N. Germany (drift) Beyrichia *Ls.*	*Oesel and and Gotland*	*Southern Sweden*
Aparchites sinuatus (Hall) 1860	×		
B. kochii Boll 1862	×	×	×
B. maccoyiana Jones 1855	×	×	×
B. maccoyiana var. *sulcata* Reuter 1885	×		
B. pustulosa Hall 1860	×		
Bythocypris phillipsiana (Jones and Holl) 1869	×	×	
Kloedenia wilckensiana (Jones) 1855	×	×	×
Primitia mundula (Jones) 1855	×	×	×
Cytherellina siliqua (Jones) 1855	×	×	×

It has been demonstrated by numerous authors that the northern German 'Obersilurischen Diluvialgeschiebe' is the product of Pleistocene glaciation, probably of the Weichsel stage (Kesling and Wagner 1956, p. 39). Flow lines of this glaciation were shown (ibid., fig. 2) indicating derivation of drift boulders of this age from the islands of Gotland and Ostrov Sarema (Oesel). Both Reuter (1885, p. 666) and Kesling and Wagner (1956, p. 37) considered boulders containing an admixed ostracod fauna (*B. maccoyiana* from Gotland and *K. wilckensiana* from Oesel) as being derived from strata intermediate between the two islands cropping out beneath the Baltic Sea. It is with this fauna that the Stonehouse ostracods find their closest affinity.

B. tuberculata (Kloeden), the most representative species of the German 'Beyrichienkalk', is not present in the Stonehouse assemblage. Its place within the fauna was occupied by a somewhat similar species, *B. pustulosa* Hall. As yet, descriptions of specimens of *B. tuberculata* identified by Jones from this formation are considered as being based on specimens of *B. pustulosa*.

Little evidence is available indicating the relationship of this fauna with that of any other area in North America. *Bythocypris phillipsiana* has been reported from the Lower

Cayugan McKenzie formation of Maryland (Ulrich and Bassler 1923) and *Beyrichia equilatera*, *B. tuberculata*, and *B. kloedeni* are recorded from near Lake Temiscouata, Quebec (*Geol. Surv. Canada, Ann. Rept.*, 1888, **3**, M; &c.). These latter species may indicate possible equivalence to the Stonehouse fauna, but additional specimens are required to verify these identifications.

SYSTEMATIC DESCRIPTIONS

BEYRICHIA M'Coy

The systematic position of *Beyrichia* M'Coy 1846 has been discussed in detail by Henningsmoen (1954, pp. 18–27) and Kesling and Wagner (1956, pp. 39–43). Henningsmoen erected six sub-genera of *Beyrichia* on the bases of differing velate and surface ornamentations. These were, for the most part, accepted by Kesling, but depend on their validity to a certain extent on the designation of type species (*B. kloedeni* M'Coy 1846 or *Battus tuberculatus* Kloeden 1834). Since this question does not have definite bearing on the present discussion, Henningsmoen's classification is followed in this paper.

The *Beyrichia* species obtained from the Stonehouse formation fall within two of these subgenera—*Nodibeyrichia* and *Neobeyrichia*—the former characterized by divided anterior and posterior lobes and the latter by three simple lobes and a marginal ridge or frill. Unfortunately, the separation of species within these subgenera is somewhat difficult unless well-preserved material is available.

BEYRICHIA (NODIBEYRICHIA) Henningsmoen

Type species *Beyrichia bronni* Reuter

The description of this subgenus is as follows (Henningsmoen 1954, p. 26):

'*Beyrichia* species with L1 split into two nodes. Lp may also be split into two or more nodes. A secondary fissus may be present. Velate structure developed as a ridge. Surface granulose or smooth.'

Division of the Lp (L3 of Kesling) into two or more parts has been used as a useful criterion for division of the subgenus into species. In some species the nodes comprising L3 are fairly continuous and knoblike as in *B. tuberculata* (Kloeden), whereas in other species this lobe is distinctly disrupted and pustulose as in *B. baueri* Reuter. Numerous variations exist between these extremes, specific differentiation being based on the type, number, and orientation of the resultant nodes. It is understandable that, where specific characteristics are based on such microscopic detail and easily defaced by natural action, duplication and misunderstanding of specific designations could arise.

Beyrichia (*Nodibeyrichia*) *pustulosa* Hall

Plate 23, figs. 2–9

B. pustulosa Hall 1860, pp. 157–8, fig. 19; Dawson 1860, p. 67; Honeyman 1864, p. 344; Dawson 1868, pp. 608–9, fig. 216; Jones, *in* Honeyman 1870, p. 492; Dawson 1878, pp. 608–9, fig. 216; Jones 1881, p. 344; Jones 1881, p. 313; Jones 1890, p. 18; Jones 1891, p. 76; Dawson 1891, pp. 608–9, fig. 216; Ulrich and Bassler 1908, pp. 286, 289; Williams 1914, p. 72; Bassler 1915, p. 123; Bassler and Kellett 1934, pp. 67, 204; Henningsmoen 1954, p. 26; Kesling 1956, p. 45.

B. tuberculata (Kloeden); Jones 1870, p. 492; Jones 1881, p. 344, pl. 10, figs. 8?–10; Jones 1881, p. 313; Jones 1890, p. 552; Jones 1891, pp. 74–75, pl. 11, fig. 3; Ami 1893, p. 191; McLearn 1924, p. 20; Bassler and Kellett 1934, p. 67.

B. noetlingi Reuter 1885, p. 637, pl. 25, figs. 5A–C; Bassler and Kellett 1934, p. 67; (authors).

B. tuberculata pustulosa (Hall); Jones 1890, p. 18, pl. 2, figs. 1*a–c*; Jones 1890, p. 552; Jones 1891, p. 76, pl. 11, fig. 2; Ami 1893, p. 191.

?B. tuberculata bronni (Reuter); Jones 1890, p. 552.

?B. tuberculata gibbosa Jones 1890, p. 552.

?B. bronni Reuter; Jones 1890, p. 552.

B. tuberculata noetlingi (Reuter); Jones 1891, p. 78, pl. 11, figs. 4*a–b*, 5; Ami 1893, p. 191; Bassler 1915, p. 124.

?B. tuberculata strictispiralis Jones 1891, p. 77, pl. 11, fig. 1; Ami 1893, p. 191; Bassler 1915, p. 124; Bassler and Kellett 1934, pp. 67, 210; Henningsmoen 1954, p. 26; Kesling 1956, p. 45.

B. gedanensis pustulosa (Hall); Kiesow 1892, p. 98, pl. 24, figs. 5*a–b*, 6*a–b*.

The original description of this species is essentially adequate, but it does not appear to entirely agree with the published figures. The woodcut shown by Hall (1860) and reproduced by Dawson (1868; 1878; 1891) is too poor to be of assistance. The figures by Jones (1881; 1890; 1891), however, show additional features. These latter figures vary greatly in details. Figures 9–10 (1881, pl. 10) show the species as bearing a posterior lobe with five or six rounded tubercles aligned variously in two or possibly three rows. Figure 1 (1890, pl. 2) depicts the posterior lobe of this species as having six nodes aligned in two rows, the dorsal one being somewhat enlarged. In this figure there are four nodes in the anterior row and two in the posterior. Figures 1 to 3 (1891, pl. 11) show the posterior lobe of this species as consisting of four (?) tubercles aligned in an arcuate row. These nodes are rounded in figure 2 and elongate-oblique in figures 1 and 3, the latter being reminiscent (except in number) of *B. tuberculata* (Kloeden).

Such variation within this species may easily be explained by the type of preservation of the specimens. They are known mostly from moulds of the interiors of disarticulated valves. The preserved ornamentation of this species shows variations in size and shape that may not entirely reflect the true surface characteristics of the valves. Description must, however, be based on the preserved characteristics of the internal moulds which, it is believed, reflect the true external features of the valves as closely as possible. Such variation is depicted on the accompanying plate. A revised description based on these specimens is as follows:

Valves elongate–ovate, hinge line straight, three-quarters as long as valve, surface ornamentation unknown but presumed to be pustulose as in *B. tuberculata* (Kloeden), free border with entire marginal and velate ridges separated from each other by a smooth channel. Three main lobes are present, L1 divided into two ovate–oblique nodes, situated near and parallel with the dorsal and ventral anterior corners, the dorsal node projecting above the hinge. In the adult female the ventral anterior lobe is greatly enlarged, overhanging the free margin and extending from the mid-anterior to the mid-ventral borders. L2 separated from the other lobate areas by a deep 'U-shaped' sulcus consisting of S1 and S2. These joined sulci continue ventrally to the marginal ridge slightly anterior to L2 in the adult male valve and slightly posterior to L2 in the adult female. L2 egg-shaped, extending from beneath the hinge to the mid height of the valve. L3 large, variously lobed, consisting of six nodes arranged in two arcuate rows, the anterior row with four and the posterior row with two nodes. The nodes of the anterior row are separated by three shallow furrows, the dorsal and ventral nodes largest. The smaller

posterior nodes are situated posterior and opposite to the two upper furrows of the anterior row.

Remarks. This species is considered synonymous with *B. noetlingi* Reuter, *B. gedanensis* (Kiesow), and their varieties. The close resemblance of *B. bronni* Reuter and *B. pustulosa* Hall indicate them to be closely allied forms, differing specifically in the shape and number of nodes on the posterior lobe. The division of the posterior lobe into three or four major elements appears to be a feature common to these species and is indicated in a more elemental form by *B. tuberculata* (Kloeden).

BEYRICHIA (NEOBEYRICHIA) Henningsmoen

Type species *Beyrichia buchiana* Jones 1855

The description of this subgenus is as follows (Henningsmoen 1954, p. 25):

'*Beyrichia* species with L1 isolated from L2 and Lp. L2 and Lp may be united or not. Velate structure developed as a ridge, or a narrow ridge-like frill. Surface granulose or smooth.'

This subgenus is distinguished from others of the genus by the tumid outline of the lobes. In many species (e.g. *B. maccoyiana*) the three lobes are without intermediate furrows, whereas some (e.g. *B. kochii*) have L3 divided variously into nodes or tubercles.

Beyrichia? (Neobeyrichia) equilatera Hall

B. equilatera Hall 1860, p. 158, fig. 20?; Dawson 1860, p. 67; Honeyman 1864, p. 344; Dawson 1868, p. 609, fig. 217; Dawson 1878, p. 609, fig. 217; Jones 1881, p. 344; Jones 1881, p. 313; Jones 1890, p. 18, pl. 2, fig. 6; ibid., p. 552; Jones 1891, p. 72; Dawson 1891, p. 609, fig. 217; Ami 1893, p. 191; Williams 1914, p. 72; McLearn 1924, p. 20; Bassler and Kellett 1934, pp. 67, 191.

This species, if it exists, is very incompletely known. The original woodcut is very indistinct, does not agree with the written description, and may indeed represent an individual of *B. pustulosa* Hall as suggested by Jones. The figure by Jones (1890) only questionably agrees with the original description but may portray a more reliable representation of the species. Unfortunately, no type material is available on which to base an adequate redescription of the species. The original description could equally well apply to a defrilled male specimen of *B. maccoyiana*, *B. salteriana*, or *B. reuteri*, but this should have been immediately evident to Jones and so is not considered probable. It is hoped that further investigation will uncover additional specimens.

Beyrichia (Neobeyrichia) kochii Boll

Plate 23, fig. 23

B. kochii Boll 1862, p. 121, pl. 1, fig. 2; (authors).

This species is distinguished from other species of the subgenus by having a nearly confluent L2–L3, an oblique groove crossing L3 and both dimorphs with a narrow velar frill and a small tubercle in the dorsal part of S2. Only L3 is tuberculate, the remaining parts of the valve are smooth.

Beyrichia (*Neobeyrichia*) *maccoyiana* Jones

Plate 23, figs. 12, 13

B. maccoyiana Jones 1855, p. 88, pl. 5, fig. 14; Jones *in* Honeyman 1870, p. 492; Jones 1881, p. 313; (authors).
B. spp. (part) Honeyman 1864, p. 344; Jones 1881, p. 344; Jones 1881, p. 313.

This species is represented in the Stonehouse collections by several incomplete valves, two of which are figured. They are entirely representative of the species as described from Europe and no new description is necessary. All the valves obtained are of male specimens.

Beyrichia (*Neobeyrichia*) *maccoyiana* var. *sulcata* Reuter 1885

Plate 23, figs. 14–16

B. maccoyiana sulcata Reuter 1885, p. 644, &c., pl. 26, figs. 17*a*, *b*; (authors).

The variety as originally described is entirely representative of the Stonehouse specimens. The diagnostic characteristics of this variety appear to be the division of L3 into two nodes by an angulated furrow and the presence of a notch or furrow on the ventral surface of the adult female brood pouch. The male frill (fig. 14) does not appear to be as striated as that of *B. maccoyiana* but this may be due to preservation.

KLOEDENIA Jones and Holl

Type species *Beyrichia wilckensiana* Jones 1855

A revised description of this genus has been given by Kesling (*in* Kesling and Wagner 1956, p. 63).

Kloedenia wilckensiana (Jones)

Plate 23, figs. 17, 18

Beyrichia wilckensiana Jones 1855, p. 89, pl. 5, figs. 17, 18; Jones *in* Honeyman 1870, p. 492; Jones 1881, p. 313; (authors).
Kloedenia wilckensiana (Jones); Jones and Holl 1886, p. 347; (authors).
Kloedenia sp. McLearn 1924, p. 20.
Beyrichia spp. (part) Honeyman 1864, p. 344; Jones 1881, p. 344; Jones 1881, p. 313.

Kesling (*in* Kesling and Wagner 1956, pp. 61 ff.) is the latest author to discuss fully the relationships of this species. His work has shown the existence of ontogenetic variation and has more clearly defined the characteristics of sexual dimorphism within the species. Most of these characteristics demonstrated in Kesling's work have been observed in the Arisaig specimens. The ontogenetic variation is shown by the relative decrease in size of L2, the forward shift of S2, and the narrowing of the marginal area in progressive instars. Sexual dimorphism is manifest in the 'convexity of the ventral lobe, the number and spacing of crests on the ventral lobe, the prominence of L2, and the presence of a low, humplike ridge behind S2' (Kesling, ibid., p. 64).

Numerous specimens of several instars have been observed during preparation of this material. No attempt has been made to graphically portray the instar variation due to the difficulty of preparation of perfect valves for measurement.

Remarks. Specimens of this species are well preserved in the Stonehouse strata. They occur as single valves of a brown-black colour, mostly in grey coquinal limestones, few specimens being observed in the red sandy limestone strata.

APARCHITES Jones

Type species *A. whiteavesi* Jones 1889

Aparchites sinuatus (Hall)

Plate 23, figs. 19, 20

Leperditia sinuata Hall 1860, p. 158; Dawson 1860, p. 67; Honeyman 1864, p. 344; Dawson 1868, p. 609; Dawson 1878, p. 609; Jones 1881, p. 344; Jones 1881, p. 313; Jones 1890, p. 24, pl. 1, figs. 12*a–c*; McLearn 1924, p. 20; Bassler and Kellett 1934, pp. 67, 400.
Aparchites sinuatus (Hall); Bassler and Kellett 1934, p. 161.
Primitia ovata Jones and Holl 1865, p. 423, pl. 13, figs. 13*a*, *b*, *c*; Jones 1881, p. 344; Jones 1881, p. 314; Jones 1890, p. 552; Jones 1891, p. 72; Ami 1893, p. 191; (authors).
Aparchites ovatus (Jones and Holl); Jones 1889, p. 384; (authors).

Revised description. Valves ovate in lateral view, hinge line short, surface punctate. Anterior and posterior ends of the valves thickened, slightly reflexed, flattened, mid area of valves convex, supporting a dorsal ridge parallel to the hinge and elevated above it.

Remarks. This is the most common species observed in the Stonehouse material. The original description mentions the presence of a small tubercle near the anterior end and the sinuous nature of the posterior ventral margin. As is typical of the genus, no tubercle is present on any of the specimens examined. The posteroventral sinuosity is believed to indicate the slight flexure of the valve surface where it contacts the ventral margin rather than a distinct indentation as mentioned by Hall (p. 158).

EXPLANATION OF PLATE 23

Fig. 1. *Primitia mundula* (Jones), lateral view; ×17; hypotype, G.S.C. No. 14497.
Figs. 2–9. *Beyrichia* (*Nodibeyrichia*) *pustulosa* Hall. 2, male right valve; ×9; hypotype, G.S.C. No. 14498. 3, male right valve; ×9; hypotype, G.S.C. No. 14499. 4, male left valve; ×9; hypotype, G.S.C. No. 14500. 5, male left valve; ×9; hypotype, G.S.C. No. 14501. 6, male left valve; ×9; hypotype, G.S.C. No. 14502. 7, female right valve; ×9; hypotype, G.S.C. No. 14503. 8, male left valve; ×9; hypotype, G.S.C. No. 14504. 9*a*, *b*, ventral and dorsal views of male specimen; ×9; hypotype, G.S.C. No. 14504.
Figs. 10, 11. *Cytherellina siliqua* (Jones), lateral views of two specimens; ×17; hypotypes, G.S.C. Nos. 14505–6.
Figs. 12, 13. *Beyrichia* (*Neobeyrichia*) *maccoyiana* Jones. 12, part of male right valve; ×17; hypotype, G.S.C. No. 14508. 13, part of male left valve; ×17; hypotype, G.S.C. No. 14509.
Figs. 14–16. *Beyrichia* (*Neobeyrichia*) *maccoyiana* Jones var. *sulcata* Reuter. 14, male right valve; ×17; hypotype G.S.C. No. 14510. 15, female right valve; ×17; hypotype G.S.C. No. 14511. 16, female left valve; ×17; hypotype G.S.C. No. 14512.
Figs. 17, 18. *Kloedenia wilckensiana* (Jones). 17, lateral view of female left valve; ×9; hypotype, G.S.C. No. 14513. 18, lateral view of male right valve; ×17; hypotype, G.S.C. No. 14514.
Figs. 19, 20. *Aparchites sinuatus* Hall, lateral and dorsal views; ×17; hypotype, G.S.C. No. 14515.
Figs. 21, 22. *Bythocypris phillipsiana* (Jones and Holl), lateral views of two specimens; ×17; hypotypes, G.S.C. Nos. 14516, 14517.
Fig. 23. *Beyrichia kochii* Boll, lateral view of male left valve; ×17; hypotype, G.S.C. No. 14507.

BYTHOCYPRIS Brady

Type species *Bairdia bosquetiana* Brady 1866 = *Bythocypris reniformis* Brady 1880

Bythocypris phillipsiana (Jones and Holl)

Plate 23, figs. 21, 22

Primitia concinna Jones and Holl 1865, p. 424; Jones *in* Honeyman 1870, p. 492; Jones 1881, p. 313.
?Leperditia minuta (Eichwald); Jones and Holl 1865, p. 424.
Bairdia phillipsiana Jones and Holl 1869, p. 213, pl. 14, figs. 7*a–c*.
?Leperditia sinuata Hall; Jones 1870, p. 492.
Bythocypris phillipsiana (Jones and Holl); Jones and Kirkby 1886, p. 250; Krause 1891, p. 510, pl. 33, figs. 4*a–c*; (authors).

Specimens of this species are common in the Arisaig strata. They are preserved as individual valves showing only the external surface, no hinge structures or muscle scars being visible. They agree with the original description by Jones and Holl.

PRIMITIA Jones and Holl

Type species *see* Warthin 1948, pp. 645–6

Primitia mundula (Jones)

Plate 23, fig. 1

Primitia mundula (Jones); Jones *in* Honeyman 1870, p. 492; Jones 1890, p. 552; Jones 1891, p. 72; Ami 1893, p. 191; (authors).

The revised description of this species by Jones and Holl 1865 (pp. 419–20) agrees very closely with the specimen figured here. The species was emended by Swartz (1936, *J. Paleont.* **10**, p. 565), type figures published at that time differing slightly from the original description. It is not known whether the dorsal angles are present on the specimen figured in this report, because their positions are obscured.

CYTHERELLINA Jones

Type species *Beyrichia siliqua* Jones 1855

Cytherellina siliqua (Jones)

Plate 23, figs. 10, 11

Beyrichia siliqua Jones 1855, p. 90, pl. 5, fig. 22; (authors).
Cytherellina siliqua (Jones); Jones and Holl 1869, p. 216, pl. 14, figs. 2, 5, 6; (authors).
Bythocypris siliqua (Jones); Bassler and Kellett 1934, p. 233.

Specimens similar to those figured here have been reported from northern Europe and Great Britain. Exfoliated specimens are trilobate, the lobes apparently increasing in size anteriorly. According to Jones (1869, pp. 215–16) no external evidence is visible of the internal lobes. This cannot be substantiated since, as yet, no perfect specimens have been obtained from Arisaig.

REFERENCES

AMI, H. M. 1893. Catalogue of Silurian fossils from Arisaig, Nova Scotia. *Proc. Trans. Nova Scotia Inst. Sci.* (1895), **8**, 185–92.

BASSLER, R. S. and KELLETT, B. 1934. Bibliographic index of Paleozoic Ostracoda. *Geol. Soc. Amer., Spec. Pap.* **1**.

DAWSON, J. W. 1860. Supplementary chapter to *Acadian geology*. Edinburgh.

—— 1868; 1878; 1891. *The geology of Nova Scotia, New Brunswick, and Prince Edward Island, or Acadian geology*. London.

FLOWER, R. H. 1943. Cephalopods from the Silurian of Arisaig, Nova Scotia. *J. Paleont.* **17**, 248–57.

HALL, J. 1860. Description of new species of fossils from the Silurian rocks of Nova Scotia. *Can. Nat. Geol.* **5**, 144–59.

HENNINGSMOEN, G. 1953. Classification of Paleozoic straight-hinged ostracods. *Norsk. Geol. Tidsskr.* **31**, 185–288.

—— 1954. Silurian ostracods from the Oslo region, Norway. *Norsk. Geol. Tidsskr.* **34** (1), 15–71.

HONEYMAN, D. 1859. Abstract of a paper on the fossiliferous rocks of Arisaig. *Trans. Nova-Scotia Lit. and Sci. Soc.* 19–29.

—— 1864. On the geology of Arisaig, Nova Scotia. *Quart. J. Geol. Soc. London*, **20**, 333–45.

JONES, T. R. 1855. Notes on Palaeozoic bivalved Entomostraca. No. 1. Some species of *Beyrichia* from the Upper Silurian limestones of Scandinavia. *Ann. Mag. Hist.* (2), **16**, 81–92.

—— 1855. Notes on Palaeozoic bivalved Entomostraca. No. II. Some British and foreign species of *Beyrichia*. Ibid. 163–76.

—— 1858. Notes on the Palaeozoic bivalved Entomostraca. No. IV. Some North American species. *Ann. Mag. Nat. Hist.* (3), **1**, 241–57.

—— 1858. On some additional Palaeozoic bivalved Entomostraca from Canada. Ibid. 340–2.

—— 1869. Notes on the Palaeozoic bivalved Entomostraca. No. IX. Some Silurian species. *Ann. Mag. Nat. Hist.* (4), **3**, 211–29.

—— 1870. Notes on some Entomostraca from Arisaig. *In* Honeyman, D. Notes on the geology of Arisaig, Nova Scotia. *Quart. J. Geol. Soc. London*, **26**, 492.

—— 1881. Notes on some Palaeozoic Entomostraca. *Nova Scotian Inst. Nat. Sci., Proc. and Trans.* **5** (3), 313–14.

—— 1881. Notes on some Palaeozoic bivalved Entomostraca. *Geol. Mag.*, dec. 2, **8**, 337–47, pl. 9–10.

—— 1889. Notes on the Palaeozoic bivalved Entomostraca. No. XXVII. On some North-American (Canadian) species. *Ann. Mag. Nat. Hist.* (6), **3**, 373–87.

—— 1890. On some Palaeozoic Ostracoda from North America, Wales, and Ireland. *Quart. J. Geol. Soc. London*, **46**, 1–31.

—— 1890. On some Devonian and Silurian Ostracoda from North America, France, and the Bosphorus. Ibid. 534–56.

—— 1891. On some Ostracoda from the Cambro-Silurian, Silurian, and Devonian rocks. *Contributions to Canadian Micro-Palaeontology, III, Geol. and Nat. Hist. Survey, Canada*, 59–99.

JONES, T. R. and HOLL, H. B. 1865. Notes on the Palaeozoic bivalved Entomostraca. No. VI. Some Silurian species (*Primitia*). *Ann. Mag. Nat. Hist.* (3), **16**, 414–25.

—— —— 1886. Notes on the Palaeozoic bivalved Entomostraca. No. XX. On the genus *Beyrichia* and some new species. *Ann. Mag. Nat. Hist.* (5), **17**, 337–63.

—— —— 1886. Notes on the Palaeozoic bivalved Entomostraca. No. XXI. On some Silurian genera and species. Ibid. 403–14.

KESLING, R. V. and WAGNER, P. L. 1956. Silurian ostracods collected by Dr. Carl Ludwig Rominger from glacial deposits in Germany. *Contrib. Mus. Pal., Univ. Michigan*, **13** (2), 33–79.

KIESOW, J. 1892. Beitrag zur Kenntnis der in westpreussischen Silurgeschiebengefundenen Ostracoden. *Jahrb. Kön. Preuss. Geol. Landes. und Berg. zu Berlin, Abh.* (1889), 80–103.

KRAUSE, A. 1877. Die Fauna der sogen. Beyrichien- oder Choneten-Kalke des norddeutschen Diluviums. *Zeit. Deutsch. Geol. Gesell.* **29**, 1–49.

—— 1891. Beitrag zur Kenntniss der Ostrakoden-Fauna in silurischen Diluvialgeschieben. *Zeit. Deutsch. Geol. Gesell.* **43**, 488–521.

—— 1892. Neue Ostrakoden aus märkischen Silurgeschieben. *Zeit. Deutsch. Geol. Gesell.* **44**, 383–99.

KUMMEROW, E. 1924. Beiträge zur Kenntnis der Ostracoden und Phyllocariden aus nordischen Diluvialgeschieben. *Jahrb. Preuss. Geol. Landes. zu Berlin*, **44**, 405–48.

MCLEARN, F. H. 1924. Palaeontology of the Silurian rocks of Arisaig, Nova Scotia. *Geol. Surv., Canada, Mem.* **137**.

MOBERG, J. C. and GRÖNWALL, K. A. 1909. Om Fyledalens Gotlandium; *Lunds Univ. Årsskrift*, N.F., Afd. 2, **5** (1).

REUTER, G. 1885. Die Beyrichien der obersilurischen Diluvialgeschiebe Ostpreussens. *Zeit. Deutsch. Geol. Gesell.* **37**, 621–79.

SWARTZ, C. K. *et al.* 1942. Correlation of the Silurian formations of North America. *Bull. Geol. Soc. Amer.* **53**, 533–8.

WARTHIN, A. S. 1948. Ostracode genotypes designated by S. A. Miller. *J. Paleont.* **22**, 645–6.

WILLIAMS, H. S. 1900. The Silurian-Devonian boundary in North America. I. The Chapman Sandstone fauna. *Amer. J. Sci.* **9**, 203–13.

WILLIAMS, M. Y. 1914. Arisaig-Antigonish district, Nova Scotia. *Geol. Surv., Canada, Mem.* **60**.

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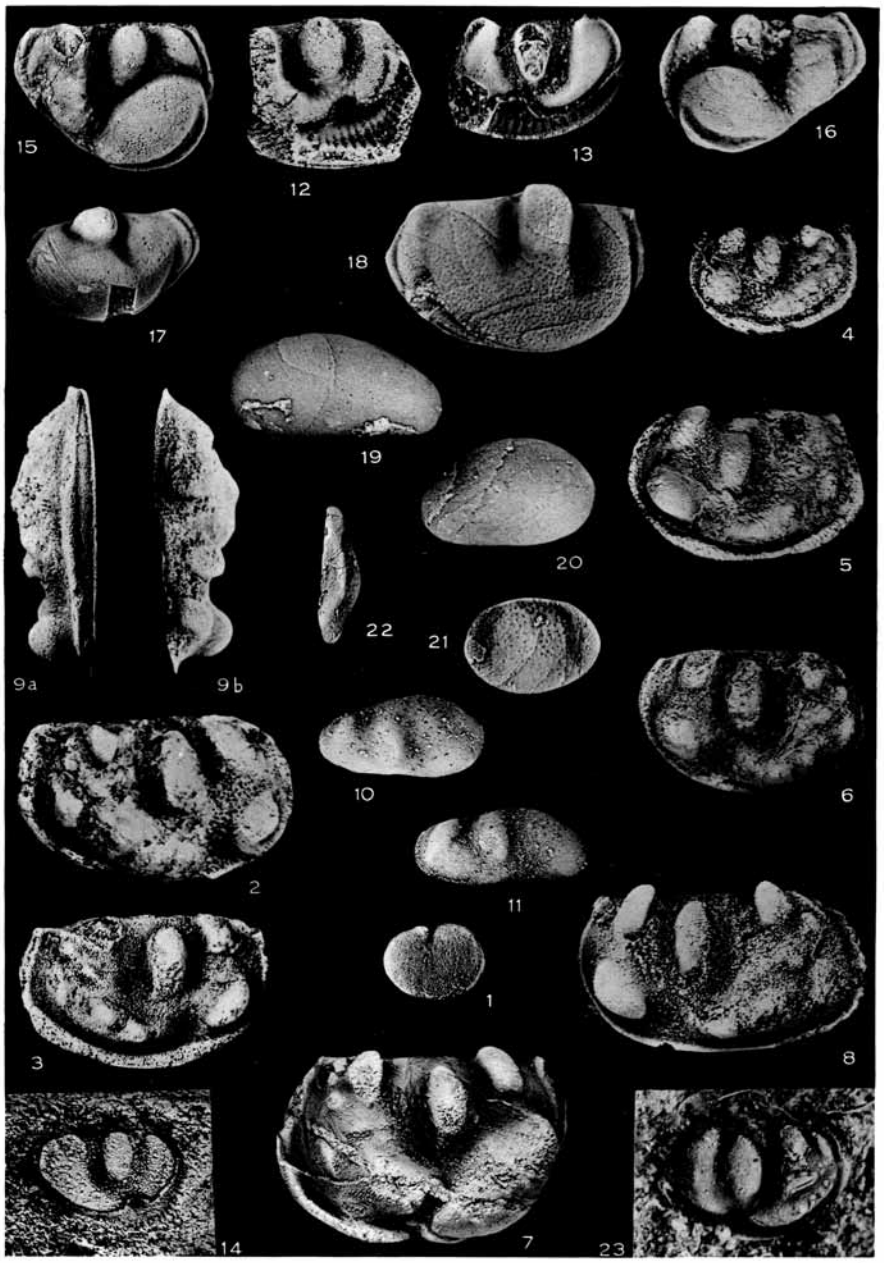

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