

A REVIEW OF THE EVIDENCE FOR A 'NEBRASKAN' FAUNA IN THE SCOTTISH CARBONIFEROUS

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ABSTRACT. W. Hind claimed that a lamellibranch and gastropod fauna from the lower part of the Passage Group, Upper Carboniferous of Scotland, had strong North American affinities. The specimens on which this claim was based have been re-examined and it is now thought that this fauna is indigenous to Britain. Those specimens which can be identified specifically belong to species unrecorded from America. Two new lamellibranch species, *Euchondria bilstonensis* and *Schizodus taiti*, are described.

ABOUT the start of this century, palaeontological zoning of the Scottish Carboniferous succession was being attempted, based on plant and fish remains. The researches of Kidston and Traquair appeared to reveal a division into Lower and Upper Carboniferous, the break in the flora occurring about one-third of the way up the Scottish 'Millstone Grit'. D. Tait, a Geological Survey collector, while engaged in collecting plant specimens for Kidston, discovered several marine bands containing a rich molluscan fauna near the base of the 'Millstone Grit'. When the specimens were examined by Hind (1908, p. 332), he claimed that quite 50 per cent. of the lamellibranch species were new to Europe but bore a close resemblance to those found in the Coal Measures of Nebraska and Illinois. This conclusion had a profound effect on subsequent work on the zoning of the Scottish Carboniferous and has been quoted in most works on the subject. Confusion arose because, although Hind (op. cit.) stated that the fauna came from beds below the break between Lower and Upper Carboniferous floras, he also said that some members of the fauna resembled American Upper Carboniferous species and showed a marked approach to Permian types. The study of the goniatites by Currie (1954) has now placed the zoning of the Scottish Carboniferous on a much sounder footing. The present work is an attempt to re-examine the evidence which led Hind to describe what has become known as the 'Nebraskan Fauna' in Scottish Carboniferous literature.

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STRATIGRAPHY

When Hind (1908) described the Scottish fauna which he thought had close affinities with North American forms, only meagre knowledge existed of the strata from which the specimens had been collected. Several localities were involved, all of them in the Central Coalfield area except one in the Bilston Burn, Midlothian. For detailed accounts of the successions concerned, reference should be made to Francis (1956), Tulloch and Walton (1958), Read (1959), and Forsyth (1961). It is now known that the Limestone Coal Group is the lowest Upper Carboniferous formation in the Scottish Midland

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Valley, as Currie (1954, p. 535) assigned a Lower *Eumorphoceras*, E₁ (basal Namurian) age to the Group. It is succeeded by the Upper Limestone Group, of Upper *Eumorphoceras*, E₂, age, and Currie (op. cit.) also recorded E₂ goniatites from the basal marine band of the succeeding group, which was formerly called the Millstone Grit (of Scotland) but is now known as the Passage Group (MacGregor 1960). This latter formation is transitional between the Upper Limestone Group, which contains numerous marine bands, and the Coal Measures, which is mainly of non-marine origin. In the lower part of the Passage Group, rich marine faunas occur in limestones and mudstones but the upper and major part is mainly composed of sandstones and seat-clays with a few poorly fossiliferous shales usually containing only *Lingula*. The fauna under discussion came from the marine bands in the lower part of the Passage Group. Although goniatite evidence of an E₂ age has only been obtained so far from the lowest of these bands, the same molluscan fauna occurs throughout, and there is no reason to suppose that any great time interval separated the deposition of the lowest and highest bands. The maximum vertical distance separating them is 400 feet and there is no evidence of a major break within the strata containing the marine bands. The age of the fauna then is E₂ in the goniatite zonal scheme of the Namurian.

SPECIMENS FIGURED BY HIND

The Scottish specimens figured by Hind (1908, pls. 1, 2, figs. 1-58) have all been examined and the present writer's determinations and comments on the specimens are given below, the order being that in which Hind illustrated the material. Hind's identification is given first followed by the reference to his illustration. The specimens are housed in the Geological Survey Office, Edinburgh.

Lamellibranchs. Palaeolima retifera (Shumard), pl. 1, fig. 1. The specimen Hind figured, GSE 6436, was from a bed of shale in the pit shaft, Fireclay Works, Castlecary. It is an internal mould of a right valve with the anterior ear preserved, but the posterior ear is missing and the whole posterior end of the shell is crumpled and incomplete, giving a false outline. The specimen is refigured (Plate 66, fig. 1) but the orientation differs from that adopted by Hind. It is claimed that in Hind's illustration the hinge-line is turned through about 30 degrees in a clockwise direction from horizontal, giving the valve the appearance of having a produced posterior end.

This fossil is known from marine bands near the base of the Passage Group from several localities in the Central Coalfield and Midlothian. No well-preserved specimens have been found, but they bear a strong resemblance to *Palaeolima simplex* (Phillips) and, for the present, are best referred to as *P. cf. simplex*. The valve shape is quite different from that of *P. retifera*, the American species as illustrated by Meek (*in* Hayden 1872, pl. 9, fig. 5a). The most obvious difference is the absence of the markedly produced posterior end.

Aviculopecten regularis Hind, pl. 1, figs. 2, 3. Hind had two specimens available when he described this species, GSE 6420 (fig. 2) and GSE 6419 (fig. 3). They came from the marine band, found by D. Tait, 27 to 30 feet above the Castlecary Limestone (top of the Upper Limestone Group) on the right bank of the Bilston Burn, Midlothian. The exact locality is 220 yards S. 30° W. of the south-west corner of Bilston Lodge, near

Polton, and for convenience of reference it is here called the Polton Marine Band. Neither of the two syntypes quoted above is well preserved, but the left valve, GSE 6419, refigured on Plate 66, fig. 3, is here designated the lectotype. Subsequent collections made from the locality have yielded further specimens, but none is well preserved. Three of these are figured (Plate 66, figs. 5-7) to illustrate the species. The original description (Hind 1908, p. 341) is confirmed. The better material now available shows that the valves are acline or slightly prosocline, the costae on the almost flat right valve are more prominent than they appear on the poorly preserved right valve available to Hind, and the anterior ear of the right valve is quadrate in outline with a deep byssal notch separating it from the body of the valve. Hind did not claim American affinities for this species.

? *Aviculopecten neglectus* (Geinitz), pl. 1, figs. 4-7. Hind (1908, pp. 341-2) doubtfully referred some shells from the Polton Marine Band, Bilston Burn, to *Aviculopecten neglectus*. This is an American form which was designated the type species of the genus *Euchondria* Meek 1874 by Newell (1938, p. 104). Newell (op. cit., pl. 19, figs. 1, 4) illustrated the left valve of *Euchondria neglecta* showing that it is different from the Scottish form which is also a *Euchondria* and is described below as *Euchondria bilstonensis* sp. nov. (Plate 66, figs. 8-10).

Aviculopecten obliquus Hind, pl. 1, fig. 8. Hind (1908, p. 340) described this species from the previous locality. Confusion exists as to which specimen Hind actually illustrated. He stated that the figured specimen was numbered T4507b and was a right valve. The specimen numbered thus, now GSE 6417 (Plate 66, fig. 12), is the counterpart of GSE 6418 (Plate 66, fig. 11) which is a left valve, and Hind in fact shows a left valve although he stated that only right valves were present. GSE 6418 is almost certainly the specimen he used to illustrate the species and it is here designated the lectotype.

Subsequent collections from the locality have yielded eleven more specimens of this species, all left valves but one, none of which is complete. These specimens have confirmed Hind's diagnosis but to his description of the costae as nodulose should be added the fact that the nodes bear spines. These spines are seldom preserved, but they have been seen on several specimens, small ones being present on GSE 11892 (Plate 66, fig. 14) on the anterior margin. Also, a few costae are present on both anterior and posterior ears. This species is now placed in the genus *Pterinopectinella* Newell 1938 because of the presence of the spinose costae. It is much smaller and more prosocline than other described British species of *Pterinopectinella*. Hind did not claim American affinities for this form.

Limatulina alternata (M'Coy), pl. 1, figs. 9, 10. The specimens figured by Hind, GSE 6428-9, are poorly preserved, the latter having been crushed laterally, giving it a gibbose, narrow appearance. Newell (1938, p. 63) considered the generic name *Limatulina* to be a junior synonym of *Aviculopecten*. These specimens are not *Aviculopecten* and for the present are identified as '*Limatulina*' *alternata*. As Hind did not claim American affinities for this species it can be ignored here.

Pterinopecten whitei (Meek), pl. 1, figs. 11-13. Of the three specimens Hind figured, GSE 6450-2, only the last one is worth commenting on, as the other two are very poorly preserved and indeterminate. The specimen GSE 6452, now refigured (Plate 66, fig. 15), is from 40 feet above the Castlecary Limestone in the River Avon on the east side of the railway viaduct, 2 miles north of Linlithgow. It is an acline right valve with the margin

of the posterior ear markedly falcate. The anterior ear is not so well preserved as depicted by Hind. This specimen was referred to the American species *Aviculopecten whitei* Meek which is now the type species of *Dunbarella* (Newell 1938, p. 38). Good illustrations of *Dunbarella whitei* were given by Newell (op. cit., pl. 2, figs. 12–18) showing a general resemblance to the Scottish form but differing radically in the outline of the posterior ear. Also the ears of *D. whitei* lack costae, whereas the posterior ear of the Scottish specimen possesses numerous fine costae. The shape of the Scottish specimen's posterior ear is not typical of the genus *Dunbarella* and the form is best referred to for the present as *Dunbarella*?

Posidoniella laevis (Brown), pl. 1, fig. 15. Hind's illustration of the specimen GSE 6437, from the foregoing locality, is misleading. It portrays what is probably a left valve, showing the upper part of the anterior margin present. This gives the impression that the umbo is terminal, thus justifying his placing this specimen in the genus *Posidoniella*. The shell (Plate 66, fig. 16) does in fact possess a small anterior ear but the remainder

EXPLANATION OF PLATE 66

All illustrations are unretouched photographs. The specimens are in the Geological Survey Collection, Edinburgh.

- Figs. 1, 2. *Palaeolima* cf. *simplex* (Phillips). 1, From Pit Shaft, Fireclay Works, Castlecary, GSE 6436, $\times 1.5$. 2, From No. 1 Marine Band, Passage Group, Gartarry Borehole, Clackmannanshire, GSE 11488, $\times 2$.
- Figs. 3–7. *Aviculopecten regularis* Hind, all from Polton Marine Band, Bilston Burn, Midlothian. 3, GSE 6419, lectotype, left valve, $\times 1.5$. 4, GSE 6420, syntype, right valve, $\times 2$. 5, GSE 11641, right valve, $\times 1.5$. 6, GSE 11639, left valve, $\times 1.5$. 7, GSE 11610, left valve, $\times 1.5$.
- Figs. 8–10. *Euchondria bilstonensis* sp. nov., same locality. 8, GSE 11611, holotype, left valve, $\times 2$. 9, GSE 11605, paratype, right valve, $\times 2$. 10, GSE 11617, right valve, $\times 2$.
- Figs. 11–14. *Pterinopectinella obliqua* Hind, same locality. 11, GSE 6418, lectotype, left valve, $\times 1.5$. 12, GSE 6417, counterpart of previous specimen, internal view of left valve, $\times 1.5$. 13, GSE 11891, right valve, $\times 1.5$. 14, GSE 11892, part of left valve showing spines on antero-ventral margin, $\times 1.5$.
- Fig. 15. *Dunbarella*?, Passage Group, River Avon, 2 miles north of Linlithgow, GSE 6452, right valve, $\times 1.5$.
- Fig. 16. *Posidonia corrugata*? (Etheridge jun.), same locality, GSE 6437, probably a left valve, $\times 2.5$.
- Fig. 17. *Promytilus*? cf. *emaciatius* (de Koninck), Passage Group, Torwood Glen, Stirlingshire, GSE 6430, left valve, $\times 2$.
- Fig. 18. *Parallelodon semicostatus* (M'Coy), Passage Group, River Avon, 2 miles north of Linlithgow, GSE 6427, right valve, $\times 1.5$.
- Fig. 19. *Schizodus* aff. *obliquus* (M'Coy), Passage Group, Greenfoot Quarry, Glenboig, Lanarkshire, GSE 6447, left valve, $\times 1.5$.
- Figs. 20–22. *Schizodus taiti* sp. nov. 20, No. 2 Marine Band, Passage Group, Kincardine Bridge Borehole, Stirlingshire, GSE 11334, holotype, left valve, $\times 1.5$. 21, Same locality and horizon, GSE 11335, paratype, left valve, $\times 1.5$. 21a, Same specimen, showing dentition, $\times 2$. 22, No. 2 Marine Band, Passage Group, Mossneuk Borehole, Stirlingshire, GSE 2666, hinge of left valve showing dentition, specimen fluoritized in hydrofluoric acid, $\times 2$.
- Fig. 23. *Sanguinolites* aff. *abdenensis* Etheridge jun., Passage Group, Torwood Glen, Stirlingshire, GSE 6455, right valve, $\times 1$.
- Fig. 24. *Sanguinolites tricostatus*? (Portlock), Passage Group, River Avon, 2 miles north of Linlithgow, GSE 6456, left valve, poorly preserved, $\times 1$.
- Fig. 25. *Sanguinolites argutus*? (Phillips), Gain Quarry, Glenboig, Lanarkshire, GSE 6474, right valve, $\times 2$.
- Fig. 26. *Prothyris* sp. nov., same locality, GSE 6442, right valve, $\times 1.5$.

of the anterior and ventral margins are absent. It is here determined as *Posidonia corrugata*? (Etheridge jun.).

Myalina verneuili (M'Coy), pl. 1, fig. 16. The figured specimen, GSE 6433, is from a horizon 9 to 10 feet above the Castlecary Limestone in Torwood Glen, Stirlingshire. It is a large, badly crushed, incomplete specimen of *Myalina* but it is specifically indeterminate.

Nuculana laevistriata (Meek and Worthen), pl. 1, fig. 17. The figured specimen, GSE 6433, is from a bed of shale in the River Avon, between the outcrop of the Castlecary Limestone and the railway viaduct, 2 miles north of Linlithgow. It is poorly preserved but can be doubtfully referred to the form commonly occurring in the Upper Limestone Group and known as '*Nuculana*' *levistriata*. It could also be referred to *Nuculana intermedia* Etheridge jun., but in a recent study of the Scottish lamellibranch species erected by Etheridge jun. (Wilson, in press), no type material of this species could be found, so that it is not an entirely satisfactory name. Meek and Worthen's species, *levistriata*, is from the Lower Carboniferous of North America and even if the similar form in the Scottish Upper Limestone Group proves to be conspecific with it, its presence in the Passage Group is not really important to the main discussion.

Nucula gibbosa Fleming, pl. 1, figs. 18, 19. The figured specimen, GSE 6434, from Gain Quarry, Glenboig, Lanarkshire, is a poorly preserved internal mould of *Nuculopsis gibbosa* (Fleming). This species occurs through much of the Lower Carboniferous of Scotland and need not be further considered.

Modiola subelliptica (Meek), pl. 1, fig. 20. The specimen illustrated, GSE 6430, from a horizon 9 to 10 feet above the Castlecary Limestone, Torwood Glen, is refigured (Plate 66, fig. 17). Hind referred it to Meek's American species *subelliptica* which Newell (1942, pp. 42, 43) designated as the type species of *Volsellina* Newell. The Scottish specimen is unlike *V. subelliptica*, lacking the angular umbonal ridge, and its hinge line is relatively much shorter. It is a slightly crushed left valve, approximately 7.5 mm. long and 3.7 mm. high. The umbo is terminal or subterminal, raised slightly above the hinge-line and is crushed. British Carboniferous Modiolids are in need of revision, and for the present this form is doubtfully referred to *Promytilus*? *emaciatum* (de Koninck).

Parallelodon [*Grammatodon*] *tenuistriata* (Meek and Worthen), pl. 1, fig. 21. The figured specimen, GSE 6427, is from the right bank of the River Avon, between the outcrop of the Castlecary Limestone and the railway viaduct. It is a poorly preserved internal mould (Plate 66, fig. 18), with two postero-lateral teeth present, but the outline is incomplete in places and the anterior end is crushed. It is clear, however, that it is not so relatively elongate as the American species *tenuistriata*. It is here referred to *Parallelodon semicostatus* (M'Coy) on the evidence of the general valve shape. This latter species is of common occurrence at some horizons in the Scottish Upper Limestone Group. Hind also claimed to have recognized the American species in the Polton Marine Band at Bilston Burn, but this record has already been changed to *P. semicostatus* (Wilson in Tulloch and Walton 1958, p. 89).

Protoschizodus curtus (Meek and Worthen), pl. 1, figs. 22, 23. Of the specimens figured, GSE 4506, represented by fig. 23, is crushed, incomplete, and can only be identified as *Schizodus* sp. The other specimen, GSE 6447, illustrated as fig. 22, preserved in ironstone and uncrushed, is from Greenfoot Quarry near Gain Farm, Glenboig,

Lanarkshire. It is refigured (Plate 66, fig. 19) and is different in valve outline from *Schizodus curtus* as shown by Meek (*in* Hayden 1872, pl. 10, fig. 13), particularly at the anterior end. The Scottish specimen has a straight upper antero-dorsal margin whereas the American species appears to have a symmetrically curved anterior border and an anterior umbonal ridge. The Scottish form is here determined as *Schizodus* aff. *obliquus* (M'Coy) but it probably represents an undescribed species.

Schizodus wheeleri (Swallow), pl. 1, figs. 24–28. Of the specimens figured by Hind, GSE 8517 (fig. 24) is incomplete at the posterior end, GSE 8518 (fig. 25) has decayed in storage, GSE 6458 (fig. 26) is poorly preserved and only shows the hinge, GSE 6457 (fig. 27) is crushed and incomplete, and GSE 6459 (fig. 28) has the posterior end and umbo missing. These specimens were presumably in better condition when Hind examined them. The form he described and illustrated is easily recognized in modern collections from the marine bands near the base of the Passage Group in Stirlingshire and Clackmannanshire. The present writer regards this form as different from other described British species of *Schizodus* and different from the American species *S. wheeleri*. It is described below as *Schizodus taiti* sp. nov.

? *Anthracomya truncata* Hind, pl. 1, figs. 29, 30. The specimens GSE 11381, 2, represented by figs. 29 and 30 respectively, are poor but are here determined as *Curvirimula* aff. *belgica* (Hind). They are in a dark shale from a drain in the bottom of Greenfoot Quarry near Gain Farm, Glenboig, and the horizon is probably near the top of the Upper Limestone Group. *C. belgica* has been figured by Weir (1960, pl. 32, fig. 47) from about this horizon.

Edmondia excentrica Hind, pl. 2, figs. 31, 32. Of the figured specimens, GSE 6422 (fig. 31) is poorly preserved and the margins are incomplete and GSE 6421 (fig. 32) is a young shell with the postero-dorsal margin missing so that the outline shown by Hind is not a true one. Both specimens are here identified as *Edmondia unioniformis*? (Phillips).

Edmondia sulcata (Phillips), pl. 2, fig. 33. The figured specimen, GSE 6426, is a poorly preserved internal mould and the margin is incomplete except at the posterior end. It is here identified as *Wilkingia elliptica*? (Phillips). Hind did not claim American affinities for these last three species.

Edmondia nebrascensis (Geinitz), pl. 2, fig. 34. The figured specimen, GSE 6424, is from No. 3 Marine Band, Passage Group, in the Rosehill Diamond Bore, Plean, Stirlingshire. It is preserved in shale and is crushed and incomplete, but it is here identified as *Edmondia* cf. *maccoyi* Hind. Hind (1908, p. 358) stated that *E. maccoyi* is closely related to the American species *E. nebrascensis* and that the Scottish specimens he had available were poorly preserved. He said that the former was more gibbose and that the ornament was different. The specimens he examined are all crushed and the true gibbosity cannot be seen; also their preservation is such that the shell markings are too poor to justify reference to an American species. Subsequent collections from the same strata in the area have yielded specimens which have been determined as *E. cf. maccoyi* (Wilson *in* Read 1959, pp. 67, 68).

Edmondia lyelli Hind, pl. 2, fig. 35. The figured specimen, GSE 6423, is crushed and incomplete but Hind's determination is confirmed. No American affinities were claimed for this species.

Sanguinolites occidentalis Meek and Hayden, pl. 2, figs. 36–38. Hind used three

specimens from different localities to illustrate this form. GSE 6455 is from a horizon 9 to 10 feet above the Castlecary Limestone in Torwood Glen, Stirlingshire. It is crushed and incomplete with a well-defined umbonal ridge, and the postero-dorsal region is concave. It probably represents an undescribed species but has affinities with *Sanguinolites abdenensis* Etheridge jun. (Plate 66, fig. 23). GSE 7563 (fig. 37) is incomplete and so poorly preserved as to be indeterminate. GSE 6456 (fig. 38) is an internal mould preserved in a weathered ironstone from above the Castlecary Limestone from the right bank of the River Avon between the outcrop of that Limestone and the railway viaduct, near Linlithgow. It is poorly preserved but is here determined as *Sanguinolites tricostatus?* (Portlock) (Plate 66, fig. 24). The illustration by Meek (*in* Hayden 1872, pl. 10, fig. 12) of *Pleurophorus occidentalis* shows a valve with a prosogyrous umbo placed almost at the anterior end and the shell expands rapidly in height towards the posterior. None of the Scottish specimens has these characters.

?*Allorisma reflexa* Meek, pl. 2, fig. 39. The figured specimen, GSE 6410, is a fragment of an internal mould of a right valve of a lamellibranch with concentric markings. The only part of the margin of the shell present is a small length of the venter. The specimen is extremely poorly preserved but is most likely to be a part of *Sanguinolites* cf. *clavatus* (Etheridge jun.).

Tellinomorpha hindii Bolton, pl. 2, figs. 40–42. Hind illustrated three specimens of this form, all preserved as internal moulds in ironstone, from Gain Quarry, 1 mile NNE. of Glenboig, Lanarkshire. GSE 6475 (fig. 40) is an almost complete right valve. GSE 6476 (fig. 41) is a left valve with the posterior end missing, although Hind portrayed it as complete. GSE 6474 (fig. 42) is a right valve and the venter has now been cleared of matrix. Hind did not claim American affinities for this form but compared it with a species described from a marine band near the base of the Coal Measures of Bristol by Bolton (1907, p. 460, pl. 30, fig. 8a, b). The Scottish specimens, however, have a tapering posterior end and a relatively longer anterior end than Bolton's species and the writer regards them as distinct. Hind (1900, p. 431) distinguished *Tellinomorpha* from *Sanguinolites* by the absence of an oblique ridge in the former, but the valves under discussion have a distinct umbonal ridge (Plate 66, fig. 25). Hind (1908, p. 350) claimed to have seen tubercles on these Scottish specimens but these are not visible now. The specimens bear a close resemblance to *Sanguinolites argutus* (Phillips) but are only doubtfully referred to that species which itself is based on poor material.

Solenomorpha cylindrica Hind, pl. 2, figs. 43, 44. Hind (1908, pp. 350–1) described this species from two specimens from Greenfoot Quarry, Gain Farm, Glenboig. The syntypes, GSE 6445 and 6460, are extremely poor internal moulds preserved in ironstone and it is thought that Hind's drawings are restorations based on insufficient evidence. These specimens are here determined as *Solenomorpha* sp.

Solenomya brevis Hind, pl. 2, figs. 45–47. This species was described from three specimens, GSE 6461–3, all poorly preserved internal moulds in ironstone, from the foregoing locality. Two are young individuals and the third is incomplete; GSE 6463 (fig. 45) is the only valve with the outline complete. The only character which differentiates these specimens from *Solemya excisa* de Koninck, as figured by Hind (1900, pl. 50, figs. 11, 12, 14–16), is the lack of radial striae. It is possible that such striae would not be seen on poorly preserved internal moulds, and the specimens are here identified as *S. excisa?*

Prothyris elegans Meek, pl. 2, figs. 48–50. Hind used three specimens to illustrate this form, GSE 6442–4. All are internal moulds preserved in ironstone from the same locality as before. The best specimen, GSE 6442 (fig. 50), is refigured (Plate 66, fig. 26). Hind (1908, p. 353) claimed that these Scottish specimens of *Prothyris* were conspecific with the American species *P. elegans* and laid great stress on this occurrence when he concluded that a fauna with strong American affinities was present in the Passage Group. *P. elegans* is stated by Meek (*in* Hayden 1872, p. 223) to have the length about three times the height. The Scottish specimens have the length slightly less than three times the height. This ratio is similar to that in *P. soleniformis* Elias, but judging by the illustration of the holotype of that species (Elias 1957, pl. 90, fig. 3), the Scottish form differs in valve outline, especially at the posterior end. The present writer thinks that these Scottish specimens belong to an undescribed species, and as he is engaged at present in reviewing the occurrence of *Prothyris* in Britain, the form under discussion is here referred to as *Prothyris* sp. nov.

Solenomya cylindrica Hind, pl. 2, figs. 60, 61. Two specimens, GSE 6464–5, were figured and both are internal moulds in ironstone from the same locality. Hind (1908, pp. 351–2) described the species on the evidence of these two specimens, pointing out that it was closely related to *Solemya costellata* (M'Coy). The writer claims that the specimens are too poorly preserved to be distinguished from the latter species and they are here doubtfully referred to it.

Gastropods. Loxonema nanum de Koninck, pl. 2, fig. 51. The figured specimen GSE 6263 is the internal mould of a small, high-spined gastropod, but only two whorls remain. It is now indeterminate, and as it is an internal mould, it probably was also indeterminate when Hind examined it.

Naticopsis brevispira de Ryckholt, pl. 2, figs. 52, 53. The figured specimens, GSE 6279 and 6285, are small, incomplete, and poorly preserved and are here determined as *Naticopsis*?

Ptychomphalus marcouianus (Geinitz), pl. 2, fig. 55. The specimen figured, GSE 6286, was referred to the Scottish species *Glabrocingulum armstrongi* Thomas by Thomas (1940, p. 42).

Bellerophon marcouianus Geinitz, pl. 2, fig. 56. The figured specimen, GSE 6266, was redescribed as *Bellerophon torwoodensis* Weir by Weir (1931, p. 812), who rejected Hind's claim that the specimen belonged to the American species of Geinitz.

Euphemus d'orbignyi (Portlock), pl. 2, figs. 57, 58. The figured specimen, GSE 6265, was cited by Weir (1931, p. 849) as *Euphemus urei* (Fleming) mut. *hindi* Weir. This name was changed by Wilson (*in* Read 1959, p. 64) to *Euphemites hindi* (Weir).

Macrocheilina sp., pl. 2, fig. 59. The figured specimen is missing but as Hind did not claim American affinities for it, it can be ignored.

Scaphopod. Entalis meekianum (Geinitz), pl. 2, fig. 54. The figured specimen, GSE 6795, is 23 mm. long, slightly curved, but both ends are broken. The exposed surface is smooth but the removal of some matrix revealed faint oblique striae, suggesting that the specimen may be determined as *Dentalium (Plagioglypta)* sp., but it is too poor to be compared with American species.

The revised names of the specimens figured by Hind are listed below together with Hind's names.

HIND'S NAME AND FIGURE NO.	REVISED NAME
1. <i>Palaeolima retifera</i> (Shumard)	<i>Palaeolima</i> cf. <i>simplex</i> (Phillips)
2, 3. <i>Aviculopecten regularis</i> Hind	<i>Aviculopecten regularis</i> Hind
4-7. ? <i>Aviculopecten neglectus</i> (Geinitz)	<i>Euchondria bilstonensis</i> sp. nov.
8. <i>Aviculopecten obliquus</i> Hind	<i>Pterinopectinella obliqua</i> (Hind)
9, 10. <i>Limatulina alternata</i> (M'Coy)	' <i>Limatulina</i> ' <i>alternata</i> (M'Coy)
11-13. <i>Pterinopecten whitei</i> (Meek)	<i>Dunbarella</i> ?
15. <i>Posidoniella laevis</i> (Brown)	<i>Posidonia corrugata</i> ? (Etheridge jun.)
16. <i>Myalina verneuili</i> (M'Coy)	<i>Myalina</i> sp.
17. <i>Nuculana laevistriata</i> (Meek and Worthen)	? <i>Nuculana intermedia</i> (Etheridge jun.)
18, 19. <i>Nucula gibbosa</i> Fleming	<i>Nuculopsis gibbosa</i> (Fleming)
20. <i>Modiola subelliptica</i> (Meek)	<i>Promytilus</i> ? cf. <i>emaciatum</i> (de Koninck)
21. <i>Grammatodon tenuistriata</i> (Meek and Worthen)	<i>Parallelodon semicostatus</i> (M'Coy)
22, 23. <i>Protoschizodus curtus</i> (Meek and Worthen)	<i>Schizodus</i> aff. <i>obliquus</i> (M'Coy)
24-28. <i>Schizodus wheeleri</i> (Swallow)	<i>Schizodus taiti</i> sp. nov.
29-30. ? <i>Anthraco-myia truncata</i> Hind	<i>Curvirimula</i> aff. <i>belgica</i> (Hind)
31, 32. <i>Edmondia excentrica</i> Hind	<i>Edmondia unioniformis</i> ? (Phillips)
33. <i>Edmondia sulcata</i> (Phillips)	<i>Wilkingia elliptica</i> ? (Phillips)
34. <i>Edmondia nebrascensis</i> (Geinitz)	<i>Edmondia</i> cf. <i>maccoyi</i> Hind
35. <i>Edmondia lyelli</i> Hind	<i>Edmondia lyelli</i> Hind
36. <i>Sanguinolites occidentalis</i> (Meek and Hayden)	<i>Sanguinolites</i> aff. <i>abdenensis</i> Etheridge jun.
38. <i>Sanguinolites occidentalis</i> (Meek and Hayden)	<i>Sanguinolites tricostatus</i> ? (Portlock)
39. ? <i>Allorisma reflexa</i> Meek	<i>Sanguinolites</i> cf. <i>clavatus</i> (Etheridge jun.)
40-42. <i>Tellinomorpha hindii</i> Bolton	<i>Sanguinolites argutus</i> ? (Phillips)
43, 44. <i>Solenomorpha cylindrica</i> Hind	<i>Solenomorpha</i> sp.
45-47. <i>Solenomya brevis</i> Hind	<i>Solemya excisa</i> de Koninck
48-50. <i>Prothyris elegans</i> Meek	<i>Prothyris</i> sp. nov.
50, 51. <i>Solenomya cylindrica</i> Hind	<i>Solemya costellata</i> ? (M'Coy)
51. <i>Loxonema nanum</i> de Koninck	Indeterminate
52, 53. <i>Naticopsis brevispira</i> de Ryckholt	<i>Naticopsis</i> ?
54. <i>Entalis meekianum</i> (Geinitz)	<i>Dentalium (Plagioglypta?)</i> sp.
55. <i>Ptychomphalus marcouianus</i> (Geinitz)	<i>Glabrocingulum armstrongi</i> Thomas
56. <i>Bellerophon marcouianus</i> Geinitz	<i>Bellerophon torwoodensis</i> Weir
57, 58. <i>Euphemus d'orbignyi</i> (Portlock)	<i>Euphemites hindi</i> (Weir)
59. <i>Macrocheilina</i> sp.	missing

SYSTEMATIC PALAEOLOGY

Genus EUCHONDRIA Meek 1874

Euchondria bilstonensis sp. nov.

Plate 66, figs. 8-10

?Aviculopecten neglectus Hind 1908, pp. 341-2, pl. 1, figs. 4-7.*Euchondria* sp. nov. Wilson in Tulloch and Walton 1958, p. 89.

Material. Holotype: GSE 11611, a left valve. Paratype: GSE 11605, a right valve.

Locality. The species is only known from one locality, the Polton Marine Band, on the right bank of the Bilston Burn, 220 yards S. 30° W. of south-west corner of Bilston Lodge, Polton, near Edinburgh. The horizon is 27 to 30 feet above the Castlecary Limestone, of Namurian (E₂) age, Upper Carboniferous. There are numerous examples of the species in the Geological Survey Collection, Edinburgh, but none is well preserved.

Description. Left valve: moderately convex, maximum convexity is in sub-umbonal region, markedly prosocline. Length is approximately equal to height. Hinge-line straight, 7 mm. long in a valve approximately 11 mm. long. Umbonal folds are moderately well developed and there is an outward angular fold on the posterior ear, running from the umbo to half-way down the posterior margin of the ear. Ears are equal in length, anterior one triangular with fine costae, posterior one also has fine costae and its posterior margin forms an obtuse angle about the termination of the angular fold. Body of valve has numerous, regularly spaced, fine, intercalate costae with irregularly spaced fine fila present, seen in the ventral region of the holotype. Preservation is not good but some specimens appear to show small pits on the ligament area, a characteristic feature of *Euchondria*. Umbonal angle is approximately 90 degrees.

Right valve: almost as convex as left valve, with maximum convexity in sub-umbonal area. The outline is the mirror image of the left valve except for the byssal sinus under the anterior ear. The inner margin of the posterior ear is marked by a straight, sharp, indented fold corresponding to the outward fold in the left valve. An angular ridge runs from the umbo to half-way down the posterior margin. Anterior umbonal fold is moderately well developed. Valve marked by obscure growth-lines only. Anterior ear bears irregularly spaced costae, maximum number seen is five, crossed by close-spaced fila. Posterior ear appears to have fine costae only. Poorly preserved small ligament pits are present on some of the specimens.

Discussion. Hind (1908, p. 342), with only a few poorly preserved specimens available, deduced that the costate left valves and almost smooth right valves of the form just described belonged to the same species. The writer, having examined numerous specimens of the Pectinid shells from the locality, confirms this view. Although no attached valves have yet been seen, there are cases where left and right valves are very closely associated. Hind referred the form to *Pecten neglectus* Geinitz, a Pennsylvanian species from Nebraska which is now the type species of the genus *Euchondria* Meek and was redescribed by Newell (1938, pp. 104-5). Hind also suggested that the costate left valve figured by Meek (*in* Hayden 1872, pl. 9, fig. 2a) as *Aviculopecten coxanus* (Meek and Worthen) was the left valve of *A. neglectus*, an opinion also expressed by Newell (1938, p. 104). The costae of the left valve of *E. bilstonensis* are much more closely spaced and the valves are much more prosocline than in *E. neglectus*. Although of common occurrence at the type locality, *E. bilstonensis* has not yet been recorded elsewhere.

Genus SCHIZODUS de Verneuil 1844

Schizodus taiti sp. nov.

Plate 66, figs. 20-22

Schizodus wheeleri, Hind 1908, pp. 345-6, pl. 1, figs. 24-28.

Material. Holotype: GSE 11334, a left valve. Paratype: GSE 11335, a left valve. Both specimens from No. 2 Marine Band, Passage Group, Upper Carboniferous, in Kincardine Bridge Borehole, Stirlingshire.

Description. A medium-sized species of *Schizodus*, elongate, inequilateral, subtrigonal, posterior end produced. Umbones situated in anterior quarter, small, incurved, slightly prosogyrous. Sub-umbonal region convex, remainder only slightly convex except for a pronounced subangular umbonal ridge, running to postero-ventral extremity. Anterior and posterior cardinal margins make an obtuse angle of about 125 degrees about the umbo. Anterior border is symmetrically curved, ventral margin gently convex and meets the almost straight, truncate posterior margin in an acute angle of about 60 degrees. The dentition has only been seen in the left valve in which it consists of a large central tooth, which is bifid when traced under the umbo, and a small one to the anterior. Their notation in the system used by Cox (1951, p. 363) is 2, 4a, and the cavity which separates them presumably accommodated the large central tooth 3a of the right valve. In the left valve a slight thickening of the postero-cardinal margin may be a poor expression of tooth 4b. Shell about 1 mm. thick in large specimens. Exterior marked by fine growth-lines only. Interior has not been seen. Dimensions of holotype—length 28 mm., height 21 mm., width (of one valve) 8 mm.

Discussion. *Schizodus taiti* has a distinctive shape and can be distinguished from other British described species by its produced posterior end and the long, almost straight, ventral margin. Hind (1908, p. 346) referred the Scottish specimens to *S. wheeleri* (Swallow) as depicted by Meek (*in* Hayden 1872, pl. 10, figs. 1a-f) claiming that the range of variation shown by the American forms could be matched by the Scottish material. An examination of the specimens used by Hind has shown that none is complete and many are crushed so that he had not adequate material to make this claim. Only the specimen GSE 8517 (Hind 1908, pl. 1, fig. 24) is good enough to show the general shape of the valve and it is incomplete posteriorly. The illustrations of *S. wheeleri* by Meek (*op. cit.*) show a great range of variation in shape suggesting that more than one species is involved. Judging by the plate explanation, only fig. 1b, a drawing of a specimen in the possession of Swallow, can be taken to depict the characters of *S. wheeleri*. This shows a left valve with the ventral margin markedly upturned posteriorly, a relatively large postero-dorsal area and a poorly inflated subumbonal region, features absent in the Scottish specimens. Indeed the shape of *S. taiti* is quite different from all the variable shapes ascribed to *S. wheeleri* by Meek.

Elias (1958, p. 26) referred the Scottish specimens to *S. cf. batesvillensis* Weller but this latter species is much more elongate than *S. taiti*. *S. taiti* is of common occurrence in Namurian (E₂) beds of the Scottish Central Coalfield, ranging from the Calmy Limestone, in the Upper Limestone Group, up to No. 3 Marine Band in the Passage Group.

CONCLUSIONS

The re-examination of the specimens which Hind figured to illustrate the Scottish fauna which he claimed had strong North American Upper Carboniferous affinities, has shown two things. The first is that many of the specimens are poorly preserved and, in the writer's opinion, are not good enough to base such far-reaching conclusions upon. Secondly, the specimens which can be identified specifically are now referred to species which were first described from British material, many from the Lower Carboniferous. What Hind (1908, p. 332) said regarding the lamellibranch fauna was: 'Quite 50 per cent. of the species were, as far as I could discover, new to Europe, but which resembled very closely the lamellibranch fauna of the Coal Measures of Nebraska and Illinois of North America. The most striking member of the fauna was the shell *Prothyris elegans* Meek, this being the first occurrence of the genus in the Carboniferous rocks of Great Britain.' It must be remembered that Hind was confronted with these specimens from the Passage Group just after he had finished his monograph of the British Carboniferous Lamellibranchiata. The presence of *Prothyris*, a genus he had not met with in the preparation of his monograph, turned his attention to American works, particularly to that of Meek (*in* Hayden 1872) on the Upper Carboniferous fossils of Nebraska, a profusely illustrated work. The writer thinks that Hind, having convinced himself that he had one member of Meek's Nebraskan fauna, hitherto unrecorded from Britain, referred a few poorly preserved specimens of other genera to American species.

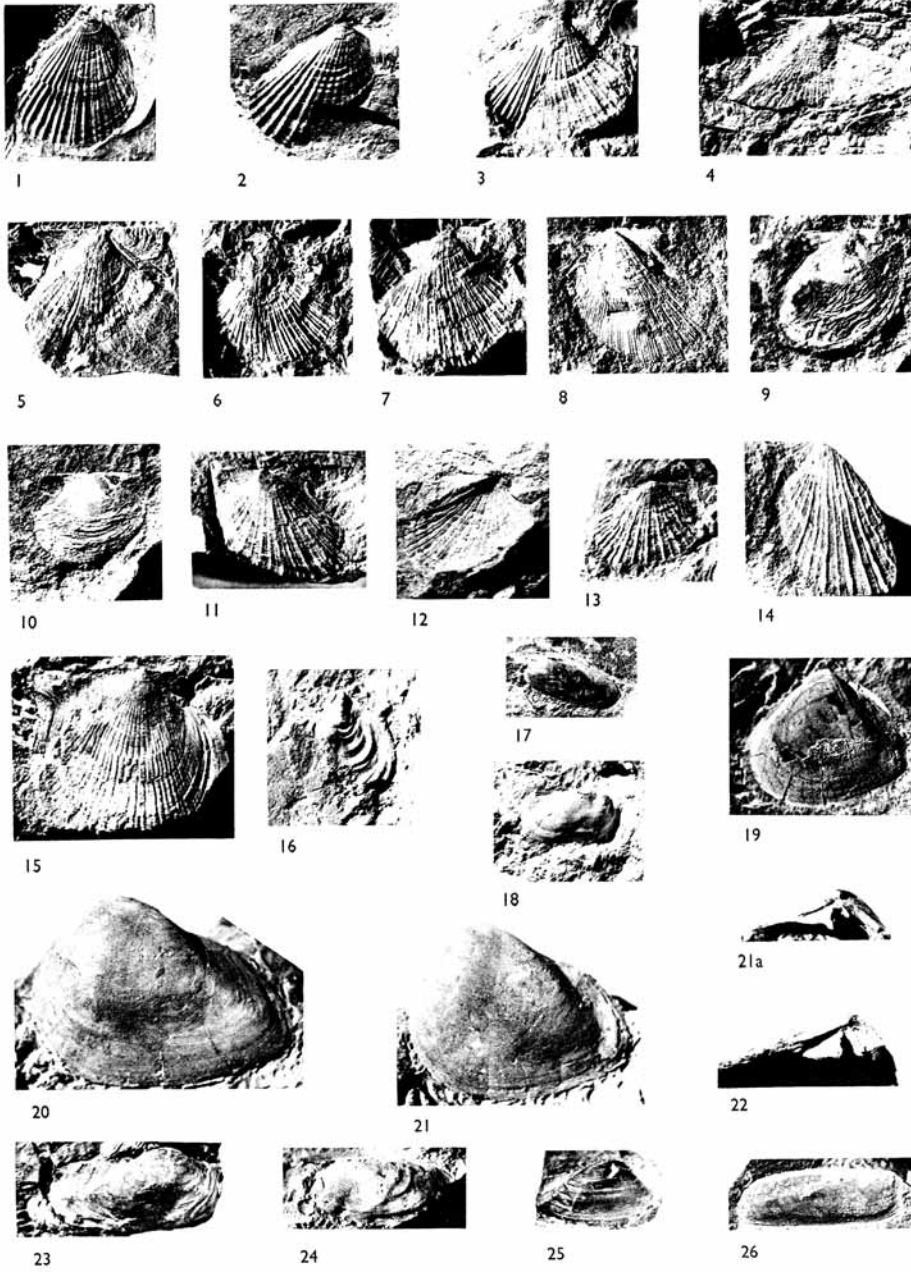
It is unfortunate that so much stress was laid on the presence of *Prothyris*. This genus is now known to occur in the Midland Valley in the Limestone Coal Group, Namurian E₁ (Pringle *in* Allan and Knox 1934, p. 121), and in Dumfriesshire two species have been recognized about 2,000 feet below the base of the Upper Carboniferous (Wilson 1961, *in press*).

The writer claims that Hind was mistaken in his reference of approximately half the molluscan species found in the marine bands in the lower part of the Passage Group to American forms. The conclusion now drawn is that in the upper part of the Arnsbergian (E₂) Stage of the British Namurian, while the goniatite and thin-shelled lamellibranch faunas flourished in the Pennine area, a rich fauna of molluscs and calcareous brachiopods lived in the Scottish Midland Valley area. Also, the composition of this fauna suggests that it is a continuation of the type of faunas found in earlier Scottish Carboniferous strata, since many of the species and all of the genera are present in Scottish Lower Carboniferous rocks. Thus there is no need to invoke a migration of species from North America to Scotland in Lower Carboniferous times as suggested by Elias (1958, p. 27). Elias (*op. cit.*, p. 26) revised Hind's identifications of the figured specimens, and although he changed some of the American names to British ones, he referred some forms to American species described after Hind's paper was published. Unfortunately, Elias was under the impression that the figured specimens were well preserved and the illustrations were accurate. For example, these assumptions led Elias to refer the four illustrations by Hind (1908, pl. 1, figs. 4-7) of the species now named *Euchondria bilstonensis* sp. nov., to three species of *Aviculopecten* and one of *Deltopecten*?. The revised identifications suggested by Elias have not been ignored, but the present list of revised determinations is based on a study of the actual specimens used by Hind together with numerous other specimens from the same localities and horizons.

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WILSON, Scottish Namurian (E₂) lamellibranchs