ARJAMANNIA, A NEW UPPER ORDOVICIAN–SILURIAN PLEUROTOMARIACEAN GASTROPOD FROM BRITAIN AND NORTH AMERICA

by JOHN S. PEEL

ABSTRACT. A new genus, *Arjamannia*, is proposed to accommodate five pleurotomariacean gastropod species from the Upper Ordovician–Silurian of Britain and North America. *A. aulangonensis* sp. nov. is described.

PLEUROTOMARIACEAN gastropods of the extinct family Lophospiridae Wenz, 1938 commonly form a conspicuous element in Lower Palaeozoic gastropod faunas. The occurrence of three lophospirid species with a distinctive reticulate ornamentation, in the Arisaig Group of Nova Scotia, has prompted the description of a new genus, *Arjamannia*, to include these, and other species from the Upper Ordovician and Silurian of Britain and North America.

The type species, *Arjamannia cancellatula* (M'Coy *in* Sedgwick and M'Coy 1852), was originally described from the Lower Llandovery Mulloch Sandstone of Girvan, Ayrshire, but Longstaff (1924) subsequently reported the species also from the Middle Llandovery of near by Newlands. In addition, *A. cancellatula* is currently recorded from the Lower Llandovery Beechhill Cove Formation of Arisaig, Nova Scotia.

Arjamannia thraivensis (Longstaff, 1924) from the Upper Ordovician (Ashgill) Drummock Group of Girvan appears to be the earliest species of *Arjamannia*. In the Silurian (Llandovery), *Arjamannia* is represented by *A. cancellatula*, *A. woodlandi* (Longstaff, 1924) from Britain and Nova Scotia, and *A. inexpectans* (Hall and Whitfield, 1875) from the Brassfield Limestone of Ohio, U.S.A. *A. aulangonensis* sp. nov., from the Doctors Brook Formation (Wenlock) of Arisaig, Nova Scotia, is the youngest known representative of the genus.

SYSTEMATIC PALAEONTOLOGY

The following abbreviations are used in the text: Sedgwick Museum, Cambridge (SM); U.S. National Museum of Natural History, Washington D.C., U.S.A. (USNM).

Class GASTROPODA Cuvier, 1797
Superfamily PLEUROTOMARIACEA Swainson, 1840
Family LOPHOSPIRIDAE Wenz, 1938
Subfamily RUEDEMANNIINAE Knight, 1956
Genus ARJAMANNIA gen. nov.

Type species. Murchisonia cancellatula M'Coy *in* Sedgwick and M'Coy 1852.

Derivation of name. For Arja, arbitrarily combined in the style of the related *Ruedemannia* Foerste, 1914. Feminine.

[Palaeontology, Vol. 18, Part 2, 1975, pp. 385–390, pl. 53.]

Diagnosis. Ruedemanniinid gastropods with reticulate ornamentation and a tendency to develop a conical or subconical spire.

Description. The shell is turbiniform, commonly with a conical spire and adpressed whorls. The base is convex and globose such that the apertural height in many species may constitute more than half of the total height, though in the type species it is rather less. There is no umbilicus but the curvature of the base may produce a shallow pseudo-umbilicus. A true slit is present generating a convex selenizone which typically carries a strong median cord. Ornamentation is reticulate with many sharply defined, closely spaced, spiral lirae and transverse growth lines. A prominent spiral cord is commonly developed on the upper whorl surface but is often reduced or absent in late growth stages. The shell is usually thick, its structure unknown.

Discussion. Arjamannia most closely resembles *Ruedemannia* Foerste, 1914 from which, however, it is readily distinguished by its reticulate ornamentation. *Lophospira* Whitfield, 1886 similarly lacks reticulate ornamentation and is further delimited by the absence of a well-developed selenizone of the type seen in *Arjamannia* and *Ruedemannia*.

Arjamannia cancellatula (M'Coy *in* Sedgwick and M'Coy 1852)

Plate 53, figs. 1–5, 7

1852 *Murchisonia cancellatula* M'Coy *in* Sedgwick and M'Coy, pp. 292–293, pl. 1L, fig. 20, 20*a*.
1924 *Lophospira cancellatula*; Longstaff, pp. 419–420, pl. XXXIII, figs. 1, 2.

Holotype. SM A34829, Mulloch Sandstone, Lower Llandovery (Silurian), Mulloch Quarry, Dalquorhan, Girvan, Ayrshire.

Other figured material. SM A34830, same locality as holotype. USNM 169484, Beechhill Cove Formation, Lower Llandovery, from USNM Collection 10114, shore 2050 ft north-east of McGillivray Brook, Arisaig, Nova Scotia (Boucot, *et al.* 1974, pl. 3). USNM 169480, USNM 169483, and USNM 188523, Beechhill Cove Formation, Lower Llandovery, from USNM Collection 10115, McGillivray Brook, 50 ft upstream of contact with underlying Bears Brook Volcanic Group, Arisaig, Nova Scotia (Boucot *et al.*, 1974, pl. 3).

Description. Type species of *Arjamannia* gen. nov. with about five whorls. Spire

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EXPLANATION OF PLATE 53

Figs. 1–5, 7. *Arjamannia cancellatula* (M'Coy *in* Sedgwick and M'Coy 1852). 1–4, Beechhill Cove Formation, Arisaig, Nova Scotia, silicon rubber impressions. 5, 7, Mulloch Sandstone, Girvan. 1, USNM 169480, upper whorl surface of gerontic adult, ×2. 2, USNM 169483, ×2. 3, USNM 169484, lateral view showing selenizone, ×3. 4, USNM 188523, juvenile, ×2·5. 5, SM A34830, paratype, ×1·5. 7, SM A34829, holotype, ×1·5.

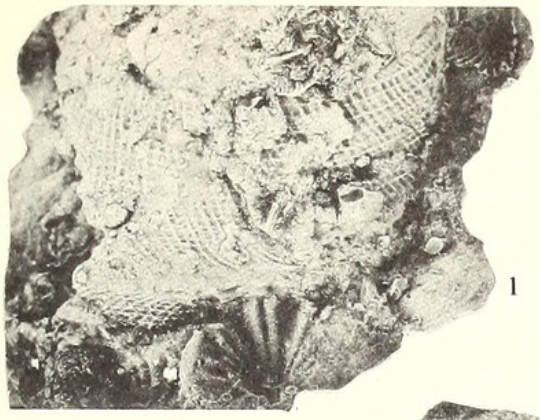
Figs. 6, 8. *Arjamannia thraivensis* (Longstaff, 1924). USNM 208893, Drummock Group, Girvan, silicon rubber impression, ×1.

Figs. 9–11, 16. *Arjamannia inexpectans* (Hall and Whitfield, 1875). USNM 85063, Brassfield Limestone, Ohio, ×1·5.

Figs. 12, 13. *Arjamannia aulangonensis* sp. nov. USNM 169469, holotype, Doctors Brook Formation, Arisaig, Nova Scotia, ×2. 12, silicon rubber impression showing selenizone. 13, internal mould.

Figs. 14, 15. *Arjamannia woodlandi* (Longstaff, 1924). USNM 188521, Beechhill Cove Formation, Arisaig, Nova Scotia, silicon rubber impression, ×1·5.

Specimens coated with ammonium chloride.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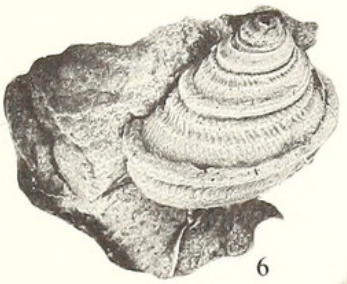
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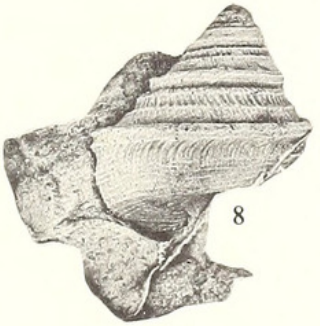
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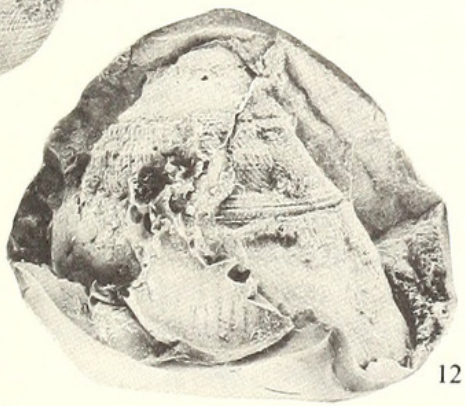
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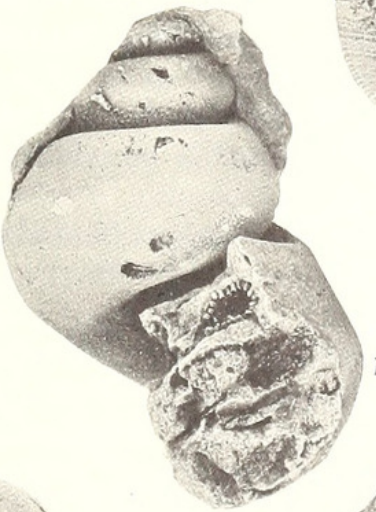
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PEEL, *Arjamannia*

conical with adpressed whorls; whorl embracement at periphery of previous whorl, commonly covering the peripheral selenizone. Peripheral angulation at midwhorl dividing whorl profile into upper whorl surface, above, and convex base, below. Upper whorl surface steeply inclined; divided into two shallowly concave surfaces in early growth stages by a prominent spiral cord half-way between selenizone and suture; reduction in relief of cord in later growth stages producing a flattening of the surface as a whole. Whorl initially vertical below selenizone but increasing in curvature to form inflated base; pseudo-umbilicus shallow. Aperture subquadrate; growth lines prosocline on upper whorl surface at about sixty degrees to the suture before curving backwards into the slit of unknown depth; growth lines curving forwards on vertical whorl surface below selenizone prior to passing radially, with slight forward concavity, across base and into pseudo-umbilicus. Selenizone convex between bordering cords; ornamentation of numerous concave lunulae crossed by a median spiral cord. Shell ornamentation of spiral lirae and growth elements of equal size intersecting to form a fine reticulation with small nodes at the intersections; a prominent spiral cord is commonly present on the upper whorl surface. Shell seemingly thick; structure unknown.

Discussion. The holotype of *A. cancellatula* (Pl. 53, fig. 7) is a rather poor internal mould with parts of four whorls preserved. The earlier whorls have a rounded profile but a strong peripheral angulation at midheight of the final whorl delimits the convex base from the flat, inclined, upper whorl surface. A paratype (SM A34830, Pl. 53, fig. 5) preserves the reticulate ornamentation. No stronger spiral element is seen on the final whorl in this paratype but at least one stronger cord is present on the upper surface of the penultimate whorl.

One of the major sources of variation in *A. cancellatula* is the exact position of whorl embracement. This may vary from below, to just above, the whorl periphery. In the former case the perfection of the conical spire is lost but all details of the selenizone in early whorls may be seen. In the latter, linear sutures and a conical spire are produced and the selenizone may be partly or completely covered by the following whorl.

A fragment from the Lower Llandovery Gasworks Mudstone of Pembrokeshire, SM A32393, can possibly be referred to *A. cancellatula*.

Arjamannia thraivensis (Longstaff, 1924)

Plate 53, figs. 6, 8

1924 *Lophospira thraivensis* Longstaff, pp. 420–421, pl. XXXIII, figs. 5, 6.

Figured material. USNM 208893 from the Drummock Group, 'Starfish Bed', Ashgill (Ordovician), South Threave, Girvan, Ayrshire.

Discussion. This species, figured and described by Longstaff (1924), is characterized by the presence of well-developed reticulate ornamentation only on the base of the whorls. Longstaff (1924) noted that the upper whorl surface has only two strong, and one fine, spiral elements. Other species of *Arjamannia* develop many fine spiral threads on the upper whorl surface although a strong spiral element is also typically present.

A. thraivensis is apparently the earliest species of the genus but the poorly known

Pleurotomaria turrita Portlock, 1843, from the Ordovician of Tyrone, N. Ireland, may belong here.

Arjamannia inexpectans (Hall and Whitfield, 1875)

Plate 53, figs. 9–11, 16

1875 *Pleurotomaria inexpectans* Hall and Whitfield, p. 117, pl. 5, fig. 12.
1923 *Lophospira* (*Ruedemannia*?) *inexpectans*; Foerste, pp. 96–99.

Figured material. USNM 85063 from the Brassfield Limestone, Middle–Upper Llandovery (Silurian), Whippoorwill Church, north-east of West Union, Ohio, U.S.A.

Discussion. A full description of this species was given by Foerste (1923) but the only published figure is the inadequate original illustration of Hall and Whitfield (1875). The figure and accompanying description were based on two specimens in the collection of U. P. James of Cincinnati. Dr. K. E. Caster (University of Cincinnati; written communication, 1970) believes that this collection was probably donated to the Cincinnati Society of Natural History, whose collections are now located at the University of Cincinnati. However, the specimens have not been found in the relevant collection and are apparently lost. The figured specimen is from collections made by A. F. Foerste, now located in the U.S. National Museum, and is labelled 'typical'.

Arjamannia inexpectans is distinguished from *A. cancellatula* by its greater incremental angle of eighty degrees, compared to the sixty degrees of the latter species, and by its shorter spire and more inflated base.

Arjamannia aulangonensis sp. nov.

Plate 53, figs. 12, 13

Holotype. USNM 169469 from the Doctors Brook Formation, Wenlock (Silurian), in USNM Collection 10919, Doctors Brook, Arisaig, Nova Scotia (Station U64 of Boucot *et al.* 1974, pl. 5).

Description. Species of *Arjamannia* gen. nov. with at least four whorls. Spire conical with adpressed whorls covering the peripheral selenizone of earlier whorls and the lower margin of the selenizone of the penultimate whorl. Upper whorl surface steeply inclined with strong spiral cord at just above midheight. Lower whorl surface uniformly convex, external features unknown. Aperture subquadrate; inner and basal lips unknown; growth lines prosocline on upper whorl surface before curving backwards into a slit of unknown depth. Selenizone relatively wide, shallowly convex between two bordering threads; ornamentation of regularly spaced concave lunulae crossed by a median groove, the edges of which are marked by fine spiral striae. Shell ornamentation composed of a reticulation of equally developed spiral lirae and growth elements with small nodes at intersections. Shell seemingly thin but thickened at the sutures due to the whorl adpression; structure unknown.

Discussion. Arjamannia aulangonensis is distinguished from *A. cancellatula* and *A. inexpectans* by its wider selenizone with a median groove. In the latter two species, from the Llandovery, the selenizone is narrow with a strong spiral cord. *A. thraivensis*, from the Upper Ordovician, lacks the well-developed reticulate ornamentation on the upper whorl surface, characteristic of all the Silurian species of *Arjamannia*, and

also has a strong spiral cord on the selenizone. The subsutural thickening of the shell associated with the adpressed whorls in *A. aulangonensis* is well illustrated by comparing the silicon rubber impression of the external mould of the holotype (Pl. 53, fig. 12) with the natural internal mould of the same specimen (Pl. 53, fig. 13). The angulation at midwhorl height in the internal mould indicates the position of the selenizone which occurs at just above the suture with the following whorl in the rubber impression.

In addition to the holotype, *A. aulangonensis* is known only from a few poor fragments in the same collection.

Arjamannia woodlandi (Longstaff, 1924)

Plate 53, figs. 14, 15

1924 *Lophospira woodlandi* Longstaff, p. 418, pl. XXXIII, fig. 7*a*, *b*.
1939 *Lophospira woodlandi*; Pitcher, pp. 88–89, pl. II, figs. 1–4.

Figured material. USNM 188521, from the Beechhill Cove Formation, Lower Llandovery (Silurian), in USNM Collection 10819 from Wallace Brook, Pictou County, Nova Scotia (Geological Survey of Canada 'open file' locality map after Harper 1973).

Discussion. Arjamannia woodlandi is distinguished from other species of *Arjamannia* by its greater sutural indentation and lack of adpressed whorls. In this respect, there is similarity in form with many species of *Lophospira* Whitfield, 1886 but the well-developed selenizone and reticulate ornamentation justify placement within *Arjamannia*. The figured specimen from Nova Scotia (Pl. 53, figs. 14, 15) has a more shallowly inclined upper surface than specimens illustrated by Pitcher (1939) from the Upper Llandovery of Shropshire, and is a little taller than wide. The Shropshire specimens, and the original specimens of Longstaff (1924) from the Middle Llandovery of Girvan, are reportedly slightly wider than tall. Ornamentation is poorly preserved in the figured specimen from Nova Scotia due to abrasion.

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