HOLOTHURIAN SPICULES FROM THE LOWER CARBONIFEROUS NEAR WATERHOUSES, NORTH STAFFORDSHIRE

by

Paul G. Morris

Summary

New composite spicules composed of associations of anchor-like units which together form a "wheel" are recorded from the Lower Carboniferous of North Staffordshire. The spicules are attributed to a holothuroid echinoderm and are described under the name *Hampsancora brownendensis* gen. and sp. nov. Other spicules occurring as perforate plates are also regarded as holothurian and are compared with *Eocaudina*.

Introduction

Although complete holothuroids are rare as fossils, records of isolated skeletal elements known as spicules or sclerites, are numerous. The first important study of the group was by Etheridge (1881) who described in detail the spicules which he had earlier (1873) recorded from the Carboniferous Limestone Series of Scotland. Slightly later Schlumberger (1888) described a series of French Eocene sclerite assemblages. American Carboniferous spicules were described by Croneis and McCormack (1932) but it was not until 1956 that the first monographic treatment of these fossils was made by Frizzell and Exline, who were also responsible for the section on fossil Holothuroidea in Part U of the Treatise on Invertebrate Paleontology (1966).

Records of British occurrences of holothurian spicules are few, most being made from Jurassic rocks. Apart from the records of Etheridge, passing reference has been made to Carboniferous spicules in Scotland by Peach (1900) and Smith (1901). A review of other records of British holothurian remains appears in the paper by Hodson, Harris and Lawson (1956). Since their review several papers by J.S. Hampton relating to holothuroid spicules have been published. These are quoted in the reference list at the end of this text in order to bring the bibliography of British records up to date.

Locality and horizons

During investigations of Lower Carboniferous microfaunas in the southern Pennines, holothurian spicules have been noted in residues from several limestone bands in Brownend Quarry (SK 090502), near Waterhouses, north Staffordshire. For the purpose of location, limestone bands in the quarry have been numbered upwards from the base of the succession. This is taken as the limestone containing quartz pebbles outcropping high up on the quarry face which parallels the main road. Specimens described below as *Hampsancora brownendensis* gen and sp. nov. were collected from band 220 only. This band occurs in the face at the north-western end of the quarry; it is some 0.13m. thick and lies 0.30m. above a massive (4.88m.) band of

coarse-grained limestone. A total of 7.25 kgs. of limestone from this band have been processed and a total of 23 sclerites have been isolated. Specimens described below as "Probable holothurian spicules" occur at several levels in the Brownend Quarry succession but they are particularly common in bands 20, 86 and 90.

The age of the Brownend Quarry beds is somewhat doubtful in terms of the coral-brachiopod zonal scheme. Prentice (1951, pp. 175-176) has referred these beds to the lower part of his Cementstone Series, regarding them as of Lower Caninia (C_1) age. Ludford (1951, p. 219) refers these strata to his Weaver Beds, which he regards as of C_2 age. More recently Parkinson and Ludford (1964, p. 171) state that earlier suggestions concerning the presence of C_1 strata in north Staffordshire have not been confirmed and again refer the Weaver Beds to the Upper Caninia (C_2) Zone (*ibid*, p. 168, table 1).

Conodont evidence suggests that the Brownend Quarry beds lie within the *Mestognathus beckmanni - Polygnathus bischoffi* Assemblage Zone of Rhodes, Austin and Druce (1969). The occurrence of *Scaliognathus anchoralis - Hindeodella segaformis* conodont assemblages lower in the succession in Brownend Quarry permits an approximate correlation of these rocks with the Tournaisian Tn3c - Viséan Vla Zones of the Belgian Lower Carboniferous succession (Conil, Pirlet and Lys, 1967, pp. 26-32; Morris, *in press*).

Materials and some general remarks

Spicules were isolated from residues left after treatment of limestone samples with a 15% formic acid solution. The specimens are silicified and generally well preserved. The registration numbers used below are those of the Department of Geology, Chelsea College of Science and Technology, where the figured specimens have been deposited.

Holothurian spicules are very viable in form, their overall morphological description being based on resemblances to everyday objects. Thus we find the use of such descriptive terms as hooks, anchors, wheels and plates. It is usual among modern holothurians for an association of several different types of spicules to occur in a particular species. In other species however, there may be only one type of spicule developed or none at all. Thus, when fossil spicules are considered, obvious difficulties arise during taxonomic treatment. For instance, where an assemblage of fossil spicules is studied, it must be evident that there will be uncertainty as to the number of species involved. Statistical studies may throw some light on this problem as, for example, in the work of Hampton (1960) on spicules from the Oxford Clay of Dorset. It is customary at present to designate individual spicules by generic and specific names, despite the fact that two or more spicule types may have occurred in the living holothurian. Although a purely artificial classification has been erected, it may be justified on the grounds that many discrete units belonging to certain natural assemblages of fossil parts may be of great stratigraphical value.

Numerical estimates by Hampton (1958b) suggest that well over 20,000,000 spicules may occur in a single individual of the modern species *Holothuria impatiens* (Forskal). One might suspect, therefore, that the rarity of spicules in the Brownend Quarry beds implies the presence of a very small number of individuals.

The only undoubted spicular elements recognised from Brownend Quarry are anchors (Text-fig. 1, b and c). There is little evidence of the development of anchor plates, such as those of *Leptosynapta inhaerens* (O.F. Muller), figured by Frizzell and Exline (1966, fig. 521). However, small perforate plates, also considered to be holothurian structures (Text-fig. 1d), have been collected from other limestone bands in the quarry.

EXPLANATION OF TEXT-FIGURE 1

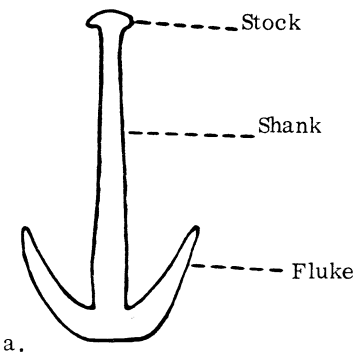
a. A generalised diagram of an anchor-shaped spicule and the morphological terms applied to it.

b. *Hampsancora brownendensis* gen and sp. nov. Holotype : Kd.1.2. The arrangement of the spicules into a tetrad is evident.
x 40.

c. *Hampsancora brownendensis* gen. and sp. nov. Paratype : Kd.1.4. A single anchor.
x 40.

d. Probable holothuroid plate.
No. Kd. 1.5.
x 40.

b - d are drawn from photographs of the spicules.



a.

b.

c.

d.

Systematic Palaeontology

Class : Holothuroidea de Blainville, 1834

Sub-class : Apodacea Brandt, 1835

Genus : Hampsancora gen nov.

Derivation of name : The name is based on the anchor-like form of the sclerites and their occurrence in the Hamps Valley.

Diagnosis : Sclerites consisting of anchors with a very short shank and prominent, flattened flukes; stock large, rounded in cross-section, but having a bar-like form in plan view; sclerites combined in tetrads to form a wheel-like compound element.

Type-species : Hampsancora brownendensis sp. nov.

Hampsancora brownendensis sp. nov.

(Text-fig. 1, b and c)

Derivation of name : The trivial name is derived from Brownend Quarry, where the specimens were collected.

Holotype : Kd.1.2.

Paratype : Kd.1.4.

Diagnosis : As for the genus.

Description : Sclerites in the form of an anchor; shank very short, rounded in cross-section, sides concave, merging rapidly into stock and flukes. Flukes two in number, very prominent, flattened. Stock greatly expanded, rounded in cross-section, becoming fused with stocks of other anchors. Whole unit wheel-like with the flukes overlapping one another.

Remarks : Although there is a tendency for the anchors to be fused to form wheel-like compound units, one specimen collected shows evidence of the fusion of additional anchors. It is possible therefore, that the "wheels" were themselves fused into "columns".

The affinity of these sclerites is debatable, particularly as inadequate material is as yet available for ontogenetic studies. Anchor-type sclerites appear to be restricted to holothurians in which tube-feet are usually entirely lacking (Pawson 1966, p. U644). This would place the genus in the sub-class Apodacea. Of the two fossil families known to possess anchors, the Calcancoridae and the Calcancorellidae, and the extant family Synaptidae, none seems a suitable repository for the new genus because of the difference in the form of the sclerites, and differences in the nature of association (and therefore presumably of function) of the sclerites. Pawson (1966, p. U644). for instance, states that in both orders of the Apodacea (the Apodida and Molpadiida) the anchors project through the body wall, and that they doubtless serve as accessory locomotor organs. Hyman (1955, p. 135) suggests that the anchors are brought close to the surface by pressure against the anchor-plates and that they do not pierce the surface but provide small points which catch on objects, serving for attachment during crawling and thus replacing the tube-feet. This cannot be the case, however, in *Hampsancora brownendensis* because of the relationship of the spicules to one another.

Hyman (1955, p. 134) also suggests that the form of the spicules in a given holothurian may bear some, but not much, relation to its ordinal or familial level. Thus on the basis of present familial definitions it would appear that the new species described above should be placed in a new family. However, it is considered that the introduction of yet another familial taxon would have little value until a great deal more information on spicule assemblages is available.

Probable holothurian structures

Finely perforated plates of the type shown in Text-fig. 1d occur in several of the Brownend Quarry bands (but notably in bands 20, 86 and 90). They have not been collected from band 220 which yielded *Hampsancora brownendensis* gen. and sp. nov.

The plates are all incomplete and it is uncertain whether they possessed an entire margin or whether part of the margin was irregular. The plate perforations are of very variable diameter and are always non-denticulate. There is no evidence for the presence of either a socket, strap or spire.

In general form these plates have features which are characteristic of the holothuroid family Calclamnidae Frizzell and Exline and, although incomplete, the plates bear a general resemblance to those of *Eocaudina* Martin (see Frizzell and Exline 1966, p. U663). They are therefore tentatively attributed to the family Calclamnidae.

P.G. Morris, B.Sc., Ph.D.,
Department of Geology,
Chelsea College of Science and Technology,
Manresa Road,
London, S.W.3.

REFERENCES

CONIL, R., PIRLET, H. & LYS, M.
1967 Echelle Biostratigraphique du Dinantien de la Belgique. Service Geol. de Belge Prof. Paper 13 56pp.

CRONEIS, C. & J. McCORMACK
1932 Fossil Holothuroidea. Journ. Paleont., vol. 6, pp. 111-148 7 pls., 4 text-figs.

ETHERIDGE, J. jun. 1873. Appendix II "List of Fossils" pp. 55-105 in Explanation of Sheet 23. Lanarkshire : Central Districts. Mem. Geol. Survey Scotland.

- - 1881 On the presence of scattered Skeletal Remains of Holothuroidea in the Carboniferous Limestone Series of Scotland. Proc. Roy. Phys. Soc., Edin., vol. 6, pp. 183-198, 2 pls.

FRIZZELL, D.L. & H. EXLINE

1956. Monograph of Fossil Holothurian Sclerites. Missouri Univ. School Mines and Met. Bull. Tech. Ser. no. 89, 204 pp., 11 pls.

- - 1966. Holothuroidea - Fossil Record. in Moore, R.C. (Ed.) : Treatise on Invertebrate Paleontology. Part U, Echinodermata 3, vol.2, pp. U646-U672, figs. 519-534. Kansas (Geol. Soc. Amer. & Univ. Kansas Press).

HAMPTON, J.S. 1957. Some Holothurian Spicules from the Upper Bathonian of the Dorset Coast. Geol. Mag., vol. 94, pp.507-510, 12 text-figs.

- - 1958a. Subgenera of the holothurian genus Anchistrum. Micropaleontology, vol. 4, pp. 75-77, 8 text-figs.

- - 1958b. Chemical analysis of holothurian sclerites. Nature, vol. 181, pp. 1608-1609.

- - 1958c. *Frizzellus irregularis*, a new holothurian sclerite from the Upper Bathonian of the Dorset coast, England. Micropaleontology, vol. 4, pp. 309-316. 1 pl., 3 text-figs.

- - 1959. Statistical analysis of holothurian sclerites. Micropaleontology, vol. 5.pp. 335-349, 4 pls., 3 text-figs.

- - 1960. A statistical study of *Rhabdotites dorsetensis* Micropaleontology, vol. 6, pp. 307-314, 1 pl.

HODSON, F., B. HARRIS & L. LAWSON

1956. Holothurian spicules from the Oxford Clay of Redcliff, near Weymouth (Dorset). Geol. Mag., vol. 93, pp. 336-344, 25 text-figs.

HYMAN, L.H. 1955. The Invertebrates : Echinodermata. 763 pp., 280 text-figs. McGraw-Hill Book Co., Inc., (New York).

LUDFORD, A. 1951. The Stratigraphy of the Carboniferous Rocks of the Weaver Hills District, north Staffordshire. Qt. Jl. Geol. Soc. Lond., vol.106, pp. 211-230, 1 pl.

MORRIS, P.G. Carboniferous conodonts in the south-western Pennines. Geol. Mag., vol. 106 (in press).

PARKINSON, D. & A. LUDFORD.

1964. The Carboniferous Limestone of the Blore-with-Swinscoe District, north-east Staffordshire, with revisions to the stratisgraphy of neighbouring areas. Geol. J., vol. 4, pp. 167-176, 1 pl., 2 text-figs.

PAWSON, D.L. 1966. Phylogeny and Evolution of Holothuroids. in MOORE, R.C. (Ed.) : Treatise on Invertebrate Paleontology. Part U, Echinodermata 3. vol. 2, pp. U641-U646.

PEACH, B.N. 1900. Appendix Pt. 1. Palaeontological in GEIKIE, A. The Geology of Central and Western Fife and Kinross. Mem. Geol. Survey Scot., Sheet 40 and pts. of 32 and 48, pp. 211-251.

PRENTICE, J.E. 1951. The Carboniferous Limestone of the Manifold Valley Region, north Staffordshire. Qt. Jl. Geol. Soc. Lond., vol. 106, pp. 171-210, 1 pl., 11 text-figs.

RHODES, F.H.T., AUSTIN, R.L. & E.C. DRUCE 1969. British Avonian (Carboniferous) Conodont Faunas, and their value in local and intercontinental correlation. Bull. Brit. Mus. (Nat. Hist.) Supplement 5, 133 pp., 31 pls.

SCHLUMBERGER, C. 1888. Note sur les holothuridées du Calcaire grossier. Bull. Soc. Geol. France, ser. 3, vol. 16, pp. 437-441, 14 text-figs.

SMITH, J. 1901. Carboniferous Echinodermata of the Clyde Drainage Area in The Geology and Palaeontology of the Clyde Drainage Area. Handbook of the Natural History of Glasgow and the West of Scotland. Brit. Assoc., Glasgow, pp. 399-567 (reprinted by Geol. Soc., Glasg., 1904).

Manuscript received 27th April 1970.