

COPROLITIC CONODONT ASSEMBLAGES FROM THE LOWER WESTPHALIAN OF NORTH STAFFORDSHIRE

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ABSTRACT. Coprolitic assemblages of conodonts belonging to *Idiognathoides* Harris and Hollingsworth have been found in a marine black shale of Lower Westphalian age, the *Gastrioceras listeri* marine band. The assemblages, although coprolitic, include most of the elements one would expect to find in an Upper Carboniferous assemblage which includes platform elements closely similar to *Idiognathodus* Gunnell. The P element corresponds to the form species element, *Idiognathoides sinuatus* Harris and Hollingsworth, the O₁ element to *Ozarkodina delicatula* (Stauffer and Plummer), the A_{1a} element to *Hindeodella ibergensis*, the A_{1c} element to *Hindeodella uncatata* (Hass) and the A₂ element to *Hindeodella simplex* Higgins and Bouckaert. The proportions of the elements in the assemblages do not correspond to the proportions of these elements in the fauna extracted after hypochlorite treatment of the same horizon because of the breakage of fragile components during the breakdown process.

THE Westphalian of Britain has a number of goniatite rich marine horizons, which include fissile black shales sometimes with conodonts preserved on the surfaces. A number of these horizons bear coprolitic and natural assemblages of conodonts (Rhodes and Austin 1979). Unfortunately, in the majority of the P element bearing assemblages the P element, which is the only element giving accurate identification, is preserved in a lateral position which precludes identification except in a general sense. The assemblages from north Staffordshire also have the P element preserved in a lateral position, but careful extraction and cleaning has allowed identification of it and provided some clues as to the nature of the *Idiognathoides* type of assemblage. Carboniferous assemblages are now known from the Upper Mississippian (Scott 1934, 1942) and from the Pennsylvanian (Dubois 1941, 1943, Rhodes 1952, Collinson, Avcin, Norby and Merrill 1972, Von Bitter 1972, 1976, Rhodes and Austin, 1979). The North American Pennsylvanian assemblages of this type are all from the Middle and Upper Pennsylvanian and are outside the range of *Idiognathoides* whereas the British faunas, of Westphalian age (Lower Pennsylvanian) are referred to the genus *Idiognathodus*. Rhodes (1952) described the idiognathodontan type of assemblage as consisting of a pair of idiognathodontans or streptognathodontans, a pair of ozarkodontans, a pair of synprioniodontans, and four pairs of hindeodellans, arranged linearly and bilaterally symmetrically. Collinson, Avcin, Norby and Merrill (1972) confirmed the general arrangement proposed by Rhodes but modified the arrangement of the hindeodellan and synprioniodontan elements. Baesemann (1973) using the Klapper and Philip (1971) model, divided the hindeodellan element into two (A_{1a} and A_{1b}), and added an angulodontan (A₂) element and a diplododellan (A₃) element to his idiognathodontan multielement species. Von Bitter (1972) recognized an O₂ element, an Ne element, an Hi element, and a Tr element which were basically the same as those of Baesemann but he did not split the A₁ (hindeodellan) element or recognize an angulodontan element.

LOCATION OF THE ASSEMBLAGES AND ASSOCIATED FAUNA

The specimens from North Staffordshire come from black shales collected from a tip 804 m north of the village of Froghall (0255 4812). These shales yield a rich fauna of goniatites which include *Gastrioceras listeri* a species characteristic of the widespread *G. listeri* marine band of early

Westphalian A age. This marine band always yields good conodont faunas both from the shales, in which the P elements are dominant and from the calcareous concretions (bullions), in which the non P elements are dominant, which are common at this horizon. The shales are normally well indurated and the faunas can only be extracted with difficulty by soaking the shale for several weeks in sodium hypochlorite thus softening the rock sufficiently to free the specimens which can then be washed in running water.

Specimens extracted from the *G. listeri* shales are referred to the following form species (number of specimens in brackets): *Hindeodella ibergensis* Bischoff (2); *Roundya subacoda* (Gunnell) (2); *Ligonodina typa* (Gunnell) (2); *Idiognathoides corrugatus* (Harris and Hollingsworth) (6); *Idiognathoides sinuatus* Harris and Hollingsworth (8); *Idiognathoides sulcatus sulcatus* Higgins and Bouckaert (2); *Idiognathoides macer* (Wirth) (4); *Idiognathoides attenuatus* (Harris and Hollingsworth) (1); *Idiognathodus delicatus* s.l. Gunnell (8); *Streptognathodus nodosus* Ellison and Graves (3); *Idiognathoides sulcatus parvus* Higgins and Bouckaert (3); *Idiognathodus* cf. *claviformis* Gunnell (1); *Neognathodus roundyi* (Gunnell) (1).

Over 80% of the fauna belongs to the P elements (idiognathodontan (55%) and idiognathodontan (26%)) which is typical for extracted faunas from shales of the Westphalian of north-west Europe, but probably not for North America, where the non P elements are usually much more abundant. Few faunas yield the 1:1:1:4 ratio of Rhodes for the *Scottognathus* (*Idiognathodus*) type of assemblage but the best of the bullion faunas show a much greater abundance of non P elements. One such fauna from the *G. listeri* band in Burnley, Lancashire, yields a 2:1:1:4 ratio for *Idiognathodus*/*Idiognathoides* type of assemblages. The hard bullion limestones, which yield solid goniatites, provide protection for the more delicate non P elements which suffer the cracking evident in specimens seen on shale surfaces. Other factors, such as post-mortem sorting, are not evident in the Carboniferous shales although it may well be important in limestone.

The Froghall assemblages occur in black shales, associated with *Caneyella* sp., preserved in brown, phosphatic material which is probably coprolitic in origin. Ten specimens of this type were recovered ranging from single specimens to the best-preserved example (fig. 1) which has seventeen specimens. The hindeodellan and angulodontan elements are commonly orientated parallel to each other even in assemblages where they are widely separated. In one assemblage the ozarkodontans are preserved as a pair and are parallel to each other and to the other non P elements. Few of the assemblages correspond to the orientation of *Scottognathus* as illustrated by Rhodes (1952) or to the several arrangements of Collinson, Avcin, Norby and Merrill (1972) and this observation, together with their preservation in a phosphate points to a coprolitic origin for the assemblages. One assemblage has six hindeodellan elements (A_{1a}) orientated parallel to each other, but is preserved in phosphatic groundmass.

DESCRIPTION OF THE ASSEMBLAGES

All specimens are in the micropalaeontological collection of Sheffield University, catalogue numbers CA1-10. The extracted specimens are catalogued under number F341.

Genus *IDIOGNATHOIDES* Harris and Hollingsworth

Type Species. Idiognathoides sinuatus Harris and Hollingsworth 1933.

- 1933 *Idiognathoides* Harris and Hollingsworth.
- 1933 *Polygnathodella* Harlton.
- 1941 *Cavusgnathus* (Harris and Hollingsworth), Ellison and Graves.

Remarks. No natural assemblages have been described which include the genus *Idiognathoides* but examination of the species list of faunas in which idiognathodontans are the dominant P element such as those from the Chokierian-Kinderscoutian Stages of the Namurian (Higgins 1975), implies that such assemblages are not very different from the idiognathodontan type. It approximates to a Type I apparatus of Klapper and Philip (1971) consisting of a P element (idiognathodontan), an O_1

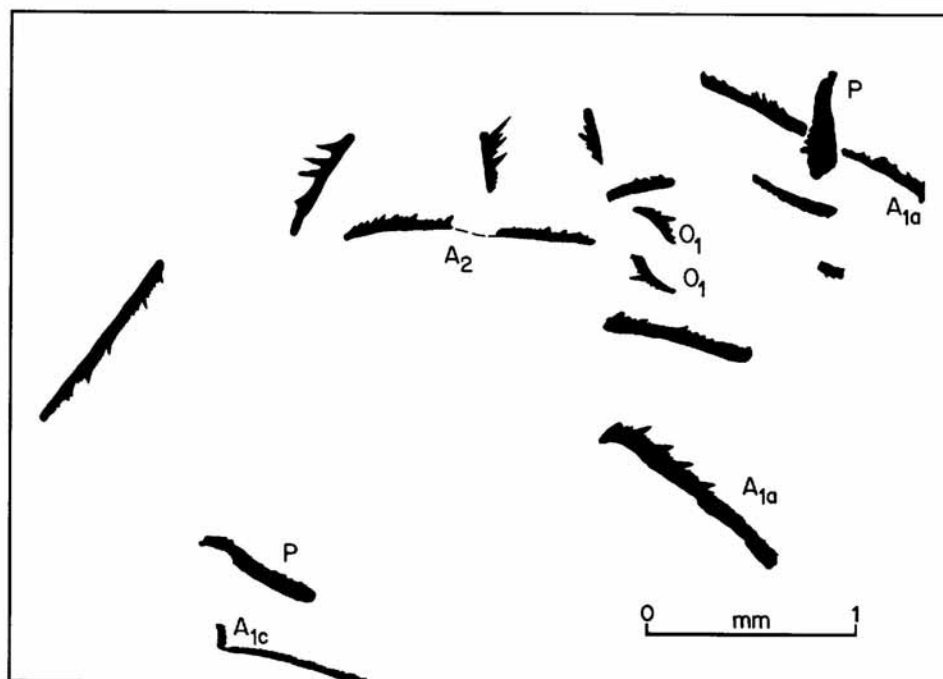


FIG. 1. Conodont assemblage from Froghall, Staffordshire.

element (ozarkodontan), three hindeodellan elements (A_{1a} , A_{1b} , A_{1c}), and an angulodontan (A_2) element. A neoprioniodontan element which is usually present in idiognathodontan assemblages has not been recorded but is commonly present as *Synprioniodina microdenta* Ellison in bullion faunas. Similarly there is no diplododellan element which Baesemann included in his multi-element reconstruction of *Idiognathodus* but this element has not been recorded from a natural assemblage. *Hibbardella acuta* Murray and Chronic which corresponds to Baesemann's diplododellan element (A_3) is present in bullion faunas from the *G. listeri* horizon.

Idiognathoides sinuatus Harris and Hollingsworth

P element

- 1933 *Idiognathoides sinuata* Harris and Hollingsworth p. 20, pl. 1, fig. 14.
 1941 *Cavusgnathus sinuata* (Harris and Hollingsworth), Ellison and Graves p. 5, pl. 2, figs. 1, 5, 7.
 1964 *Gnathodus opimus* Igo and Koike (partim), p. 189, pl. 28, fig. 18 (non figs. 15-17 = *Idiognathoides sulcatus*).

Remarks. This species has been extensively described by Higgins (1975, pp. 55, 56) and Lane and Straka (1974). This exclusively left-sided element has been identified in three assemblages, but in only one assemblage is a pair of P elements present and since one of these is preserved as an impression it is not possible to say if both elements are left sided. Lane and Straka suggested that the right-sided element of the apparatus would be *Idiognathoides corrugatus* (Harris and Hollingsworth) a form which has been identified in the coprolitic masses but not in association with other elements.

O₁ element

1932 *Bryantodus delicatulus* Stauffer and Plummer, p. 29, pl. 2, fig. 27.

1941 *Ozarkodina delicatula* (Stauffer and Plummer), Ellison, p. 120, pl. 20, figs. 40-42, 47.

Remarks. This element is preserved as a pair which are close together and parallel but pointing in opposite directions. Their close proximity may be due to the factors suggested by Collinson, Avcin, Norby and Merrill (1972) which suggested that the ozarkodontan unit appears to have been a separate unit individually bound by connective tissue.

A_{1a} Element

1957 *Hindeodella ibergensis* Bischoff p. 28, pl. 8, figs. 33, 37, 39.

Remarks. Baesemann (1973) recognized two forms which can be referred to *Hindeodella ibergensis* which he referred to as the A_{1a} and A_{1b} elements. Both elements are present in bullion faunas from the *G. listeri* band but only the A_{1a} element has been recognized in the assemblages probably because the anterior end of this element is commonly missing due to breakage. Two specimens of this element can be recognized with certainty in the assemblages (fig. 1) but other fragments may also belong to it. One assemblage has six specimens aligned parallel to each other.

A_{1c} Element

1957 *Hindeodella brevis* Branson and Mehl, Bischoff p. 26, pl. 6, fig. 24.

1959 *Hindeodina uncata* Hass, p. 383, pl. 47, fig. 6.

1968 *Hindeodella uncata* (Hass), Higgins and Bouckaert, pp. 37, 38, pl. 1, fig. 5.

Remarks. This element is a common constituent of all Namurian and Westphalian faunas but has not been recorded from either the Pennsylvanian assemblages of Rhodes (1952) and Collinson, Avcin, Norby and Merrill (1972) or included in the multi-element groupings of Baesemann (1973) and von Bitter (1972). It is very similar to the unassigned element *Hindeodella parva* Ellison and is also similar to a hindeodellan element recorded by Schmidt and Müller (1964) from early Namurian assemblages of *Gnathodus bilineatus* (Roundy). It is present as a single specimen in the assemblage figured as fig. 1.

A₂ element

1957 *Angulodus walrathi* (Hibbard) Bischoff, p. 17, pl. 5, figs. 44, 45.

1968 *Angulodus simplex* Higgins and Bouckaert, pp. 28, 29, pl. 1, fig. 7.

1975 *Hindeodella simplex* (Higgins and Bouckaert), Higgins, pp. 42, 43 pl. 5, figs. 10, 12, 13.

Remarks. This element was included in the multi-element grouping *Idiognathodus* by Baesemann (1973) but has not been recorded from any Pennsylvanian natural assemblages. It is represented by one specimen in the figured assemblage.

REFERENCES

- BAESEMANN, J. F. 1973. Missourian (Upper Pennsylvanian) conodonts of north eastern Kansas. *J. Paleont.* **47** (4), 689-710, pls. 1-3.
- COLLINSON, C., AVCIN, M. J., NORBY, R. D. and MERRILL, G. 1972. Pennsylvanian conodont assemblages from La Salle County, Northern Illinois. *Guidebk Ser. Ill. St. geol. Surv.* **10**, 1-37.
- DUBOIS, E. P. 1941. Additional evidence on the origin of conodonts. *Trans. Ill. St. Acad. Sci.* **34**, p. 168.
- 1943. Evidence on the nature of conodonts. *J. Paleont.* **17**, 155-159, pl. 25.
- HIGGINS, A. C. 1975. Conodont zonation of the late Viséan-early Westphalian strata of the south and central Pennines of northern England. *Bull. geol. Surv. Gt. Br.* **53**, 1-90, pls. 1-18.
- and BOUCKAERT, J. 1968. Conodont stratigraphy and palaeontology of the Namurian of Belgium. *Mém. Servir Explíc. Cartes géol. min. Belg.* **10**, 1-64, pls. 1-6.
- KLAPPER, G. and PHILIP, G. M. 1971. Devonian conodont apparatuses and their vicarious skeletal elements. *Lethaia*, **4**, 429-452.

- LANE, H. R. and STRAKA, J. L. 1974. Late Mississippian and early Pennsylvanian conodonts, Arkansas and Oklahoma. *Spec. Pap. geol. Soc. Am.* **152**, 1-144, pls. 32-44.
- RHODES, F. H. T. 1952. A classification of Pennsylvanian conodont assemblages. *J. Paleont.* **26**, 886-901, pls. 126-129.
- and AUSTIN, R. L. 1979. Conodont assemblages from the Carboniferous of Britain, Abs. *In*, Abstract of papers presented at the *Ninth Int. Cong. Carb. Strat. and Geology*, 180.
- SCHMIDT, H. and MÜLLER, K. J. 1964. Weitere Funde von Conodonten-Gruppen aus dem oberen Karbon des Sauerlandes. *Paläont. Z.* **38**, 105-135.
- SCOTT, H. W. 1934. The zoological relationship of conodonts. *J. Paleont.* **8**, 448-455.
- 1942. Conodont assemblages from the Heath Formation, Montana. *Ibid.* **16**, 293-300, pls. 37-40.
- VON BITTER, P. H. 1972. Environmental control of conodont distribution in the Shawnee Group (Upper Pennsylvanian) of eastern Kansas. *Paleont. Contr. Univ. Kans.* **59**, 1-105, pls 1-16.
- 1976. The Apparatus of *Gondolella sublanceolata* Gunnell (Conodontophorida, Upper Pennsylvanian) and its relationship to *Illinella typica* Rhodes. *Contr. Life Sci. Div. R. Ont. Mus.* **109**, 1-44, 15 figs.

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