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A new species of *Embsaygnathus* (Conodonta) from the Arundian (Carboniferous) of Co. Dublin, Ireland.

GARETH Ll. JONES
Conodate International Ltd, 7A Olivemount Terrace, Windy Arbour, Dublin 14, Ireland

ABSTRACT — *Embsaygnathus crosbiei* sp. nov. Jones is recorded from Arundian limestones at Newcastle, Co. Dublin, Ireland. It is suggested that *E. crosbiei* and *Embsaygnathus asymmetricus* Metcalfe were derived from the *Geniculatus claviger* Roundy — *Geniculatus glottoides* Vosges lineage.

INTRODUCTION

Investigation for Chevron Mineral Corporation of Ireland, of the 130m deep borehole CN/NC-18 (Grid ref. N 998 286), at Newcastle, 17km east-south-east of Dublin, produced a conodont fauna at 4.0m depth, including *Embsaygnathus crosbiei* sp. nov. described here. Foraminifera from the same level confirmed the Arundian age. Processing of further intervals from the drill core failed to produce any more examples of this species, but a specimen of *Embsaygnathus asymmetricus* Metcalfe 1981 and several specimens of *Geniculatus claviger* Roundy 1926 *emended* Hass 1953 were recovered. It is considered that this new species may be an intermediate form on the evolutionary pathway from *Ge. claviger* to *E. asymmetricus* (see Fig. 1). Examples of recurved or geniculate platform conodonts are rare in the Dinantian. It is unusual to erect a new species on the strength of one specimen, but occurrences of the genus are rare and it is thought unlikely that further examples will be recovered for some time. Enquiries from other workers in this area and processing of available material have failed to produce any more examples. Since it is considered to be an important link in the evolutionary story of rare recurved and geniculate platform conodont elements, it was considered worthwhile publishing.

The rarity of this conodont animal also means that only the Pa-element is described here, the determination of the rest of the apparatus must wait until more evidence has been gathered.

The holotype and other figured specimens are presently stored in the micropalaeontology collection of Conodate International Ltd. They will eventually be reposited in the collection of the National Museum of Ireland numbers NMING: F20941-7.

MICROPALAEONTOLOGY

Metcalfe (1981) first described *E. asymmetricus* from the Craven lowlands of nothern England. He recovered three specimens from the G. homopunctatus Biozone (Chadian and Arundian) of the Embasy Limestone of Embasy Bank, Skipton, Yorkshire. Since then a few further individuals have been recorded, making a total of eight. Swift recovered a single specimen from the *commutata* Zone (Arundian -?lower) of the Isle of Man, Ronaldsway Member, Derbyhaven Formation (Varker & Sevastopulo 1985, Pl. 5.6, Figs 11 & 16), Reynolds found the species in the Visean Limestones of the Eshton and Rylston areas of the Craven Basin (*in* Metcalfe 1980).

Two specimens are reported here. One (Pl. 1, Figs 5, 6) from Dublin Basin Group Limestones in CN/NC-18, 26.2-31.2m (Arundian, Newcastle, Co. Dublin and a second (Pl. 1, Figs 3, 4) from Pettigoe Limestone, Pettigoe, Co. Donegal (Grid ref. H 108673), also Arundian. Since it is possible that the Embsay Limestone is restricted to the Arundian (N Riley *pers. comm.* 1987) it is likely that the range of *E. asymmetricus* is also restricted to the Arundian.

The other genus discussed here is *Geniculatus* Hass 1953. Examples of *Ge. Claviger* are not uncommon and range throughout the Dinantian, but the species *Ge. glottoides* Vosges 1959 is rare. Previously recorded specimens of *Ge. glottoides* include one from the *L. commutata* Zone (Arundian) at Reenydonagen, Co. Cork, (Varker and Sevastopulo 1985, Pl. 5.6, figs 5, 6) whilst Voges' (1959) twenty specimens were recorded from the junction of the "Liegende Alaunschiefer" — the predominantly Hydrite horizon (cuII/*anchoralis* Zone) of Bömighausen, W. Germany. Groessens found a single reworked specimen in V3bγ Chert Limestones in the Houthem borehole DB105 in Holland (*in* Bless *et al.* 1976), the only recorded specimen of this age, but probably derived from older rocks.

This paper reports two specimens from the Dublin Basin. The first (Pl. 1, Figs 7, 10) from the Arundian in Chevron borehole KN-1, 31.0-35.0m (Pl. 1, Figs 10, 11) at Kinnegad, Co. Meath, 50km west of Dublin (Grid ref. N 560428). Another (Pl. 1, Fig. 7) was recovered from the Chadian in Chevron borehole OT-9, 12.8-19.0m at Oldtown, Co. Dublin, 20km north of Dublin (Grid ref. O 119543).

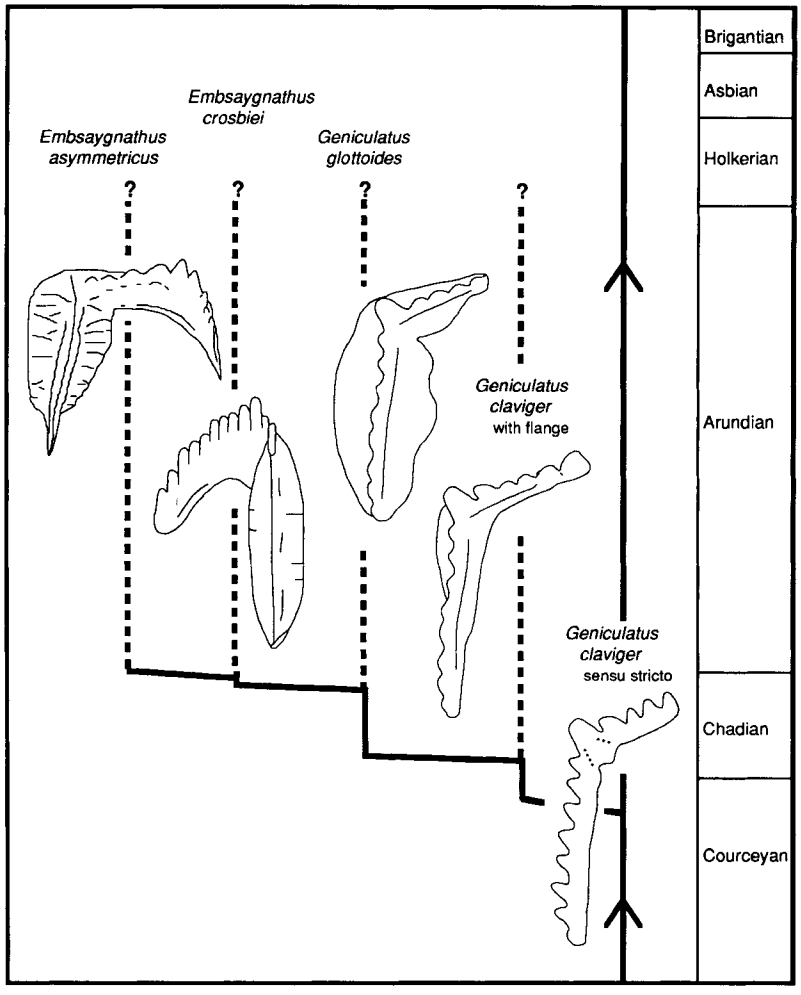

Fig. 1. Suggested phylogeny of *Geniculatus*—*Embsaygnathus* during the Chadian and Arundian Stages of the Dinantian Subsystem.

SYSTEMATICS

Order Conodontophorida Eichenberg 1930
Genus *Embsaygnathus* Metcalfe 1981
Type species *Embsaygnathus asymmetricus* Metcalfe 1981

The orientation of the element has been inverted from Metacalfe's description, so that anterior and posterior are reversed, *i.e.* It is the anterior bar that is strongly recurved, and the platform continues with a posterior bar.

Embsaygnathus crosbiei sp. nov.
(Pl. 1, figs 1; 2)

Derivation of name. This species is named in honour of the late Dr Crosbie Matthews of Bristol University, and in memory of his strong associations with Ireland.

Diagnosis. A species of *Embsaygnathus* having a straight platform with restricted ornament. The carina carries four fused blunt denticles.

Holotype. NMING: F20941; Pa element.

Type locality and horizon. Chevron borehole CN/NC-18: at a depth of 4.0m. Grid ref. N 998 286. Lucan Formation, calciturbidite, Arundian Stage, Dinantian Subsystem.

Range. Since only one specimen of *E. crosbiei* has so far been recorded, it is not possible to define a range. However its recovery

Explanation of Plate 1

Figs 1, 2	*Embsaygnathus crosbiei* Jones, Pa element, Holotype NMING:F20941; Chevron borehole CN/NC-18, 4.0m Newcastle, Co. Dublin, (Grid ref. N 998 286). Fig. 1, oral view; note scar where posterior process may have been broken off; Fig. 2 aboral view.
Figs 3-6	*Embsaygnathus asymmetricus* Metcalfe; Figs 3, 4, NMING:F20942, Pettigoe Limestone, Pettigoe, Co. Donegal, (Grid ref. H108673). Figs 5, 6, NMING:F20943 Chevron borehole CN/NC-18, 26.1-31.2m, Newcastle, Co. Dublin; Figs 3, 5, oral views; Figs 4, 6, aboral views.
Figs 7,10,11	*Geniculatus glottoides* Voges; Fig. 7, NMINGH:F20944, Chevron borehole OT-9, 12.8-19.0m, Oldtown, Co. Dublin, (Grid ref. O 119543). Figs 10, 11, NMING:F20945 Chevron Borehole KN-1, 31-35m, Kinnegad, Co. Meath (Grid ref. N560428); Figs 7, 10, oral views; Fig. 11, aboral view.
Figs 8. 9	*Geniculatus claviger* Hass, specimen with flanges.
Figs 12, 13	*Geniculatus claviger* Hass sensu stricto, NMING:F20947, Chevron borehole KN-1, 31-35m Kinnegad, Co. Meath. Fig. 12, oral view; Fig. 13, aboral view.


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from mid Arundian limestones is within the established range of *Embsaygnathus*, which runs from late Chadian to Arundian (Metcalfe 1981).

Description. *E. crosbiei* is strongly recurved and possesses a narrow platform with restricted ornament. The anterior bar extension curves outwards and then to the posterior through a total of 160°. The small basal cavity is subcircular and located at the junction of the platform and the anterior bar which are both keeled.

ASSOCIATED FAUNA

The sample at 4m from CN/NC18 yielded the Pa elements *E. crosbiei* sp. nov. (1) and *Mestognathus beckmanni* Bischoff 1957 (7). Also recovered were other elements, here given their separate element taxonomy; *Ozarkodina* sp. (3), *Neoprioniodus* sp. (3), *Hindeodella* (1), *Hibbardella* (*Hibbardella*) sp. (1), and *"Apatognathus"* sp. (1). Two fish teeth were also recovered.

The yield of eight Pa elements/kg is high for Dublin Basin calciturbidites, except when they possess coarse bases. The presence of *Mestognathus* indicates the shallow water origin of this reworked fauna and suggests that *E. crosbiei* may also have been a shallow water animal.

Remarks. *E. crosbiei* differs from *E. asymmetricus* in the following features. The platform is narrow and symmetrical but bears only two to four low nodes on the edges, whereas there are eight to ten transverse ridges on the wide platform of *E. asymmetricus*. In lateral view it is straight without the arch seen in *E. asymmetricus*. The sharp carina develops only four blunt fused nodes posteriorly instead of thirteen to fourteen. There is a shallow trough on each side of the carina. *E. asymmetricus* carries no main cusp which is a feature of *Geniculatus*, but *E. crosbiei* does bear a strong denticle at the start of the anterior blade. Metcalfe (1981) describes the recurved blade of *E. asymmetricus* as being a posterior bar, but it is considered here that it is the anterior bar which is recurved and compares with the geniculate anterior bar of *Geniculatus* (Fig. 1 and Table 1). In *E. asymmetricus* the anterior blade curving outwards and posteriorly through a total of 170°, carries ten denticles which slope towards the anterior. In *E. crosbiei* the carina continues towards the anterior into a strong blade, with ten sharp denticles, which curves to the posterior through 160° (Table 2).

In both species of *Embsaygnathus* the arboral surface is strongly keeled, as opposed to that of *Geniculatus* which is grooved (Table 2). In *E. asymmetricus* the anterior keel diverges from the cavity at 110° whilst in *E. crosbiei* it diverges at 100°. In *E. crosbiei* the basal cavity is also found at the anterior end at the junction of the platform and blade, it is small subcircular and flared, and slightly pointed to the posterior.

This new species clearly falls within *Embsaygnathus* although it does bear similarities to *Geniculatus* (Tables 1 and 2).

PHYLOGENY

Examination of a number of specimens of *Ge. claviger* revealed a variation in the width of the posterior bar. An example found at 20.7-25.4m from CN/NC-18 (Pl. 1 and Fig. 1) carries a flange which is broadest at the anterior and tapers posteriorly. Thornbury (1985) figured a specimen with a broad flange from the *D. latus* Subbiozone of the *S. anchoralis* Biozone (late Courceyan), at Ballygarvan, Co. Cork. This form appears to be a morphological intermediate between *Ge. claviger* sensu stricto and *Ge. glottoides*, and it is likely that it is from such a variant that *E. crosbiei* is derived (Fig. 1). It is envisaged that the broad flange enlarged into the somewhat plain platform of *E. crosbiei* which then went on to develop into the well ribbed platform of *E. asymmetricus*. Evidence for the transition of the anterior bar from the stubby geniculate form of *Geniculatus*, to the strongly recurved form of *Embsaygnathus* has not yet been seen. Morphological comparisons of these forms are seen in Tables 1 & 2. The combination of all the features described and illustrated in Table 2 excludes the possibility that *E. crosbiei* is an aberrant form of *E. asymmetricus*.

It is interesting to speculate from the form similarities, that the lineage may have had its origins in the Devonian from *Palmatolepis (Tripodellus) gracilis*, and may have given rise in the Silesian to *Neogondolella*.

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	Geniculatus Hass 1953	*Embsaygnathus* Metcalfe 1981
Type species	*Ge. claviger* Roundy 1926	*E. asymmetricus* Metcalfe 1981
Outline	geniculate	recurved.
Posterior	denticulate bar tapering from apex.	platform with posterior blade
Platform	Not in the type species, although some forms may develop flanges along the posterior bar. The species *Ge. gloddoides.* develops a smooth crenulate platform	present, cf *Polygnathus*
Anterior	denticulate bar tapering from apex angled inwards. *Ge. glottoides* develops a small platform along this bar.	bar extension curves outwards and then towards the posterior.
Main Cusp	situated at vertex.	absent, or a strong denticle at start of anterior blade.
Cavity	small, located at junction of anterior bar and platform, beneath main cusp.	small, located at junction of anterior blade and platform.
Aboral surface	grooved along midline.	keeled.

NB: In Metcalfe's original description, anterior and posterior were reversed, although he actually figures his specimens in the revised position presented here.

Table 1. Comparison of the morphological characters of *Geniculatus* and *Embsaygnathus*.

	E. asymmetricus Metcalfe 1981	*E. crosbiei* Jones 1991
Posterior blade	25% of platform, 4 denticles	May have been broken off
Platform	wide and symmetrical, 8-10 transverse ridges, carina with 13-14 fused blunt denticles, trough on each side of carina.	narrow and symmetrical, 2-4 nodes on edges, sharp carina develops 4 blunt fused nodes towards the posterior trough on each side of carina.
Main cusp	absent.	start of anterior blade bears a strong denticle.
Anterior blade	row of nodes or denticles at right angles to carina develop outwards into an anterior bar with 10 denticles sloping towards the anterior. It then curves towards the posterior through (a further 80o).	carina continues anteriorly into a strong blade with 10 sharp denticles which curves posteriorly through 160^{o}.
Aboral surface	strongly keeled the anterior keel diverges from the cavity at 110^{o}.	strongly keeled, the anterior keel diverges from the cavity at 100^{o}.
Cavity	at the anterior end at the junction of the platform and anterior bar. It is small, subcircular, strongly flared with extended lips. It is slightly pointed towards the posterior and extends along platform and anterior bar as grooves.	at the anterior end at the junction of the platform and blade. It is small, subcircular flared. It is slightly pointed towards the posterior.

Table 2. Morphological comparison of *Embsaygnathus asymmetricus* and *Embsaygnathus crosbiei*.