

A DIMORPHIC GONIATITE FROM THE NAMURIAN OF CHESHIRE

by N. H. TREWIN

ABSTRACT. *Eumorphoceras yatesae* sp. nov. is described from a high E2a Carboniferous horizon at Croker Hill, Cheshire. Dimorphs A and B are described under the same specific name since the initial stages of each are identical and they are both confined to the same horizon. Possible dimorphism in the goniatite genus *Eumorphoceras* is considered.

MANY authors have described dimorphism in ammonite genera, for example, Callomon (1963), Makowski (1962), and Palframan (1966, 1967). In general the dimorphs differ in size at maturity and the smaller form is usually taken as the male. The development of special modifications of aperture takes place at maturity—lappets, rostra, and apertral constrictions being frequently described. The general ornament of the shell is often different in the two dimorphs, usually after an initial period of development where the ornament of the two dimorphs is similar.

Dimorphism has been described in the Devonian goniatite genera *Manticoceras*, *Tornoceras*, and *Cheiloceras* (Makowski 1962) involving differences in size at maturity. Demanet (1943) described dimorphism in *Gastrioceras* species found in association where one form is characterized by a wide umbilicus and ventrally flattened whorl section and the other by a narrower umbilicus and higher whorl section. The form with the wide umbilicus is interpreted by him as the female, but he gives no indication of the relative sizes of the forms at maturity. Ramsbottom and Calver (1962) also consider it possible that dimorphism is shown by species of *Gastrioceras* from the *G. subcrenatum* and *G. listeri* horizons.

Absolute differences in size at maturity cannot be demonstrated for the dimorphs of *Eumorphoceras yatesae* as the specimens are always crushed. It can be demonstrated that in each of three marine bands two forms of *Eumorphoceras* are present with similar differences in ornamentation and that in the case of the *erinense-ferrimontanum* pair, and the *yatesae* A and B pair, the initial stages of development appear to be identical.

SYSTEMATIC DESCRIPTION

Order AMMONOIDEA Zittel 1825
Suborder GONIATITINA Hyatt 1884
Superfamily GONIATITACEA de Haan 1825
Family GONIATITIDAE de Haan 1825
Subfamily GIRTYOCERATINAE Wedekind 1918
Genus EUMORPHOCERAS Girty 1909

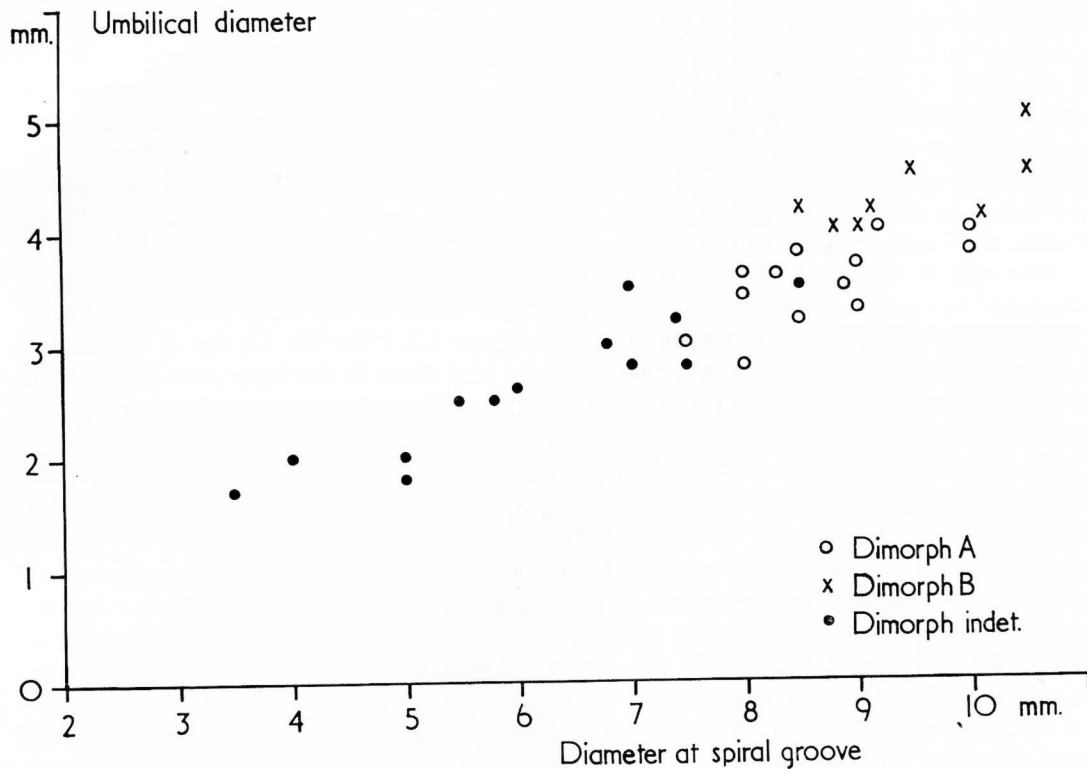
Eumorphoceras yatesae sp. nov.

Plate 12, figs. 1–5

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Material. All specimens are crushed in shale and preserved mainly as external moulds. Holotype: *E. yatesae* dimorph A. LZ 5779. Paratypes dimorph A: LZ 5782; LZ 5783. Paratypes dimorph B: *E. yatesae* dimorph B. LZ 5780; LZ 5784. Paratypes dimorph indeterminate *E. yatesae* LZ 5781; LZ 5785-90.

The specimen numbers quoted throughout the text refer to specimens deposited with the Institute of Geological Sciences, Leeds.



TEXT-FIG. 1. The relation between umbilical diameter and spiral groove diameter for *Eumorphoceras yatesae* sp. nov.

Description. The crushed nature of the material does not allow an accurate measurement of the over-all diameter to be made and so diameter measurements have been made at the spiral groove.

Up to 8 mm. spiral groove diameter, all specimens have similar features (LZ 5781; Pl. 12, fig. 4). Ribs are present on the second whorl where there are about 12 per half whorl. With increase in diameter ribs become more numerous until there are 17-20 per half whorl at 7-8 mm. spiral groove diameter. The ribs arise within the umbilicus and are radial or slightly forwardly directed for the first part of their course over the flanks. At a point about halfway from the umbilicus to the spiral groove the ribs bend evenly forward to meet the spiral groove.

At 8 mm. spiral groove diameter the umbilicus is 3 mm. wide and at 4 mm. diameter it measures 2 mm. The umbilical diameter is difficult to measure in this crushed material,

but text-fig. 1 illustrates the general relation between umbilical and spiral groove diameter for the species.

The spiral groove is present at 5 mm. diameter and persists to the largest diameters seen on all specimens. Constrictions are present on some specimens which appear as deep grooves between two sharp ribs, they are best seen at the umbilical margin or at the spiral groove. Constrictions are not invariably present and do not appear to be regularly spaced. On specimens larger than 8 mm. diameter dimorphs A and B can be distinguished.

Dimorph A. In this form the ribs begin to die out at 8 mm. diameter and are represented by umbilical nodes. These are clearly seen on the holotype LZ 5779 (Pl. 12, fig. 1) and paratype LZ 5783 (Pl. 12, fig. 2), where nodes are well developed and only growth-lines are present on the flanks. The spiral groove is still strong and has a subsidiary groove ventral to it. In the last part of the shell there are 13–14 nodes per half whorl before the flanks become smooth at about 11 mm. diameter.

Dimorph B. Dimorph B is characterized by ribs which persist to at least 11 mm. diameter but which are weak in comparison with those on the early part of the shell. The ribs are strongest near the umbilicus (Paratype LZ 5784; Pl. 12, fig. 5) but nodes are not developed. The ribs number about 17 per half whorl in the latter part of the shell. The spiral groove is still strong at 11 mm. diameter. These features are all seen on paratype LZ 5780 (Pl. 12, fig. 3).

The measurements of umbilical diameter made on the specimens of Dimorphs A and B vary considerably and it appears that Dimorph A has the smaller umbilicus, but the data are insufficient for this to be proved with certainty.

Discussion. This species falls within the original range of *Eumorphoceras bisulcatum* Girty (1909), but the redescription of part of Girty's original *E. bisulcatum* material by Elias (1956) as *Eumorphoceras girtyi* restricts the definition of *E. bisulcatum* to a *Eumorphoceras* with strong ribs present at 11 mm. diameter (9 mm. spiral groove diameter). The ribs in Girty's material are clearly sickle-shaped. According to McCaleb *et al.* (1964) the ribs on *E. bisulcatum* die out at an early intermediate stage of 25–30 mm. diameter. Thus *E. yatesae* is considered distinct from *E. bisulcatum* in its rib shape and in the diameter at which the ribs begin to die out. *E. yatesae* can be clearly distinguished from the described 'subspecies', 'mutation', and 'varieties' of *E. bisulcatum*.

EXPLANATION OF PLATE 12

- Fig. 1. *Eumorphoceras yatesae* sp. nov. Dimorph A. Holotype LZ 5779, $\times 5$: ribs reduce to nodes on umbilical margin at 8 mm. spiral groove diameter. Locality 354, Croker Hill, Cheshire.
- Fig. 2. *Eumorphoceras yatesae* sp. nov. Dimorph A. Paratype LZ 5783, $\times 5$: ribs reduce to nodes on umbilical margin at 8 mm. spiral groove diameter. Locality 354, Croker Hill, Cheshire.
- Fig. 3. *Eumorphoceras yatesae* sp. nov. Dimorph B. Paratype LZ 5780, $\times 5$: ribs persist weakly beyond 8 mm. spiral groove diameter. Locality 354, Croker Hill, Cheshire.
- Fig. 4. *Eumorphoceras yatesae* sp. nov. Dimorph indeterminate. Paratype LZ 5781, $\times 5$: small specimen showing numerous ribs. Locality 354, Croker Hill, Cheshire.
- Fig. 5. *Eumorphoceras yatesae* sp. nov. Dimorph B. Paratype LZ 5784, $\times 5$: ribs persist to about 11 mm. spiral groove diameter. Locality 354, Croker Hill, Cheshire.
- Fig. 6. *Eumorphoceras* sp. LZ 5778, $\times 5$: small undescribed form from *E. bisulcatum grassingtonense* horizon at Croker Hill, Cheshire. (Grid Ref. 93336675, north-west side of gully 630 yd. W. 7° S. from Dawsons.) This is possibly the 'A' dimorph of *E. bisulcatum grassingtonense*: note reduction of ribs to nodes on the umbilical margin at an early stage.

Yates (1962) subspecies *E. bisulcatum erinense* and *E. bisulcatum ferrimontanum* differ from *E. yatesae* in having ribs that persist to larger diameters, and which are nearer to the sickle-shaped ribs of *E. bisulcatum* Girty.

E. bisulcatum grassingtonense Dunham and Stubblefield (1944) differs in having markedly fewer ribs, a tendency for rib bifurcation and for thickening of ribs in the mid-flank region.

E. bisulcatum leitrinense Yates (1962) is similar in being of small size, having ribs that die out early, and possessing constrictions. However it appears from Yates's figures to have only 12–13 ribs per half whorl.

The forms described by Schmidt (1934) as *E. bisulcatum* var. *varicata* and *E. bisulcatum mut.* β differ markedly from *E. yatesae* in having fewer ribs. Moreover *varicata* is described as having short ribs which do not reach the spiral groove and *mut.* β is characterized by pairing of the ribs.

E. stubblefieldi Moore (1946) has ribbing that dies at 8 mm. diameter, and also constrictions, but the spiral groove does not appear until 8 mm. diameter and the ribs are not so numerous or as strong as in *E. yatesae*.

The combination of small size, up to 20 strong ribs per half whorl at 7–8 mm. diameter and the presence of constrictions immediately distinguishes both these dimorphs from any described *Eumorphoceras*. It is considered best to regard these specimens as being dimorphs of the same species as they are both found in the same horizon, appear to be confined to that horizon, and have identical initial stages.

Fauna associated with E. yatesae. The only other goniatite specimens present with *E. yatesae* include rare fragments of an unidentifiable *Cravenoceras* and specimens of *Anthracoeras* or *Dimorphoceras* which cannot be distinguished without sutural evidence. *P. corrugata* (Etheridge jun.) is abundant and *Posidoniella variabilis* Hind appears in the north Staffordshire basin succession for the first time at this level.

Stratigraphic position of the E. yatesae band. The horizon containing *E. yatesae* occurs between the main E2a marine band which contains *E. bisulcatum ferrimontanum* Yates and *E. bisulcatum erinense* Yates and E2b1 marine band with *Cravenoceratoides edalensis* (Bisat) and *Cravenoceratoides bisati* Hudson. The *E. yatesae* band is separated from the main E2a band by a unit of protoquartzitic sandstones and shale-mudstones which is about 40 m. thick and from the E2b1 band by shales and shale-mudstones 7 m. thick. The marker horizon with *Leiopteria longirostris* Hind lies about 0.5 m. below *E. yatesae* and K-bentonite B4 (Trewin 1968, fig. 2) lies 3.5 m. above *E. yatesae* in the Pyeclough section (Loc. 101). At Loc. 355 *E. yatesae* occurs from 1–1.5 m. above *L. longirostris*. The *E. yatesi* horizon is of limited stratigraphic value as it appears to be discontinuous within the north Staffordshire basin area.

Zonal position of E. yatesae. The horizon with *E. yatesae* is considered to be highest E2a faunal band present in the north Staffordshire basin area since its goniatite fauna is dominated by *Eumorphoceras*, and *Cravenoceratoides* is absent. Thus there are three *Eumorphoceras*-bearing horizons in the E2a succession of the north Staffordshire basin area. The lowest contains *E. bisulcatum grassingtonense* Dunham and Stubblefield, the middle band contains *E. bisulcatum ferrimontanum* Yates and *E. bisulcatum erinense* Yates, and the highest band *E. yatesae* sp. nov.

CORRELATION WITH OTHER AREAS

No other described faunas can be correlated with certainty with the *E. yatesae* band, but several records of '*E. bisulcatum*' close below *Ct. edalensis* may represent this horizon. The *Eumorphoceras* specimen (Zh 1023) from 368 to 369 ft. in the Alport Derbyshire borehole (Hudson and Cotton 1943) is too poorly preserved to permit useful comparison with *E. yatesae*, but the occurrence of a *Cravenoceratoides* fragment (Zh 1022) only a foot above may indicate that this horizon is slightly younger than the *E. yatesae* band.

The author has examined the exposures in Edale, Derbyshire, but has not found any *Eumorphoceras* at this level although a faunal band with *Anthracoceras* sp. or *Dimorphoceras* sp., *Posidoniella variabilis*, and *Posidonia corrugata* is present which probably correlates with this horizon. The fauna is found in a bank of a small tributary stream about 12 yards from the junction with the main stream near Loc 112 of Hudson and Cotton (1945).

Hudson (1944) records *E. bisulcatum*, *Posidonia* and *Anthracoceras* 25 ft. below a band with *Ct. edalensis* and *C. subplicatum* in Coppice Beck, Harrogate, Yorkshire. A *Eumorphoceras* fragment (RM 412) from this locality shows only the spiral groove and comparison with *E. yatesae* is not possible, but this fauna must lie very close to the position of the *E. yatesae* band.

A *Eumorphoceras* specimen (RS 1543) described by Evans *et al.* (1968, p. 80) from the stream section in which the *E. yatesae* specimens described here were found appears to have been obtained from higher in the succession, above the *Ct. edalensis* band. The specimen is small and has 30–40 ribs per whorl, and the ribs die out at 7–8 mm. spiral groove diameter. (The figure of 30 ribs per whorl mentioned on p. 80 of Evans *et al.* (1968) is a misprint (W. H. C. Ramsbottom pers. comm.).)

Yates (1962) does not record a *Eumorphoceras*-bearing band equivalent to this band, thus it is probably absent on Slieve Anierin, Eire.

Localities. Specimens have been obtained from the following localities, all the type material is from Loc. 354.

Locality no.	Notes
101 Pyecloough Brook	250 yd. south of Bradshaw, Staffordshire. (Grid. Ref. 04656488) Stream bank exposure upstream of bridge.
201 Blake Brook	450 yd. north of Upper-Hay Corner, Staffordshire. (Grid. Ref. 05726088) Near base of section exposed at upstream end.
354 Croker Hill	450 yd. north of Dawsons, Cheshire. (Grid. Ref. 92806723) Shale scar under tree upstream of tributary ditch.

NOTE ON APPARENT DIMORPHISM IN ARNSBERGIAN GONIATITES

The described differences between the dimorphs A and B of *E. yatesae* are of exactly the same type as the differences between the subspecies *E. bisulcatum erinense* Yates and *E. bisulcatum ferrimontanum* Yates. Both *erinense* and *ferrimontanum* appear to have identical initial stages of development, but in *ferrimontanum* the ribs die out at c. 10 mm. spiral groove diameter to leave umbilical nodes, and in *erinense* the ribs persist to 15 mm. spiral groove diameter. These features are seen on Yates's (1962) illustrations of these subspecies. Comparing with *E. yatesae*, *ferrimontanum* is the 'A' dimorph and *erinense*

the 'B' dimorph. Both *erinense* and *ferrimontanum* occur in the same marine band and are confined to the base of the band in north Staffordshire. Yates (1962) states that *erinense* occurs slightly above *ferrimontanum* on Slieve Anierin within the same marine band, but this is not the case in north Staffordshire.

The lowest Arnsbergian marine band in the north Staffordshire basin area is the *Eumorphoceras bisulcatum grassingtonense* band. Well-preserved *Eumorphoceras* specimens are scarce in this band, but apart from individuals which are identical with the specimen figured by Yates (1962, pl. 52, fig. 3) in which the ribs die out at about 12 mm. spiral groove diameter, there are also some small undescribed forms in which the ribs reduce to small plications on the umbilical margin at 6 mm. spiral groove diameter, and by 9 mm. spiral groove diameter only small nodes are present on the umbilical margin (see Pl. 12, fig. 6). Of these two forms *grassingtonense* is the 'B' dimorph and the small undescribed form is the 'A' dimorph.

Thus in each of the three *Eumorphoceras*-bearing horizons of E2a in the north Staffordshire basin area there exists two forms of *Eumorphoceras*, and in all three horizons the differences between the two forms are of a very similar kind. While the present evidence is somewhat inconclusive there appear to be increasing grounds for believing that in the Carboniferous goniatite genera *Eumorphoceras* and *Gastrioceras* dimorphic species existed.

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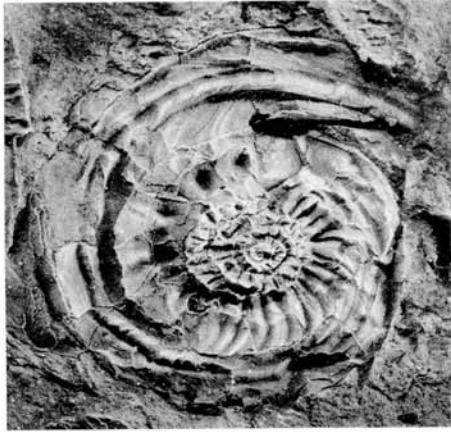
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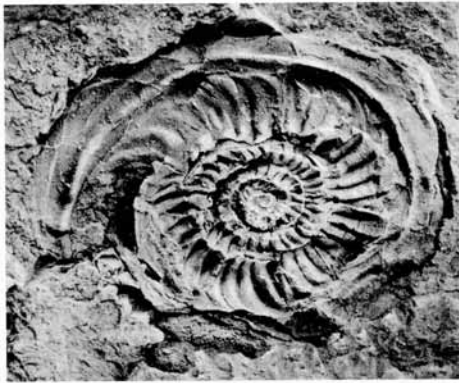
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TREWIN, *Eumorphoceras yatesae*