

THE NAMURIAN GONIAITITE *NUCULOCERAS* *STELLARUM* (BISAT)

by B. K. HOLDSWORTH

ABSTRACT. The goniatite previously known as '*Cravenoceratoides stellarum*' is spirally ornamented and usually possesses a small umbilicus. The early Homoceratina are best classified at generic level in terms of ornament and *stellarum* should be included in the genus *Nuculoceras*. English material is described and comparison made with foreign descriptions of the species. A revision of zonal classification in the Arnsbergian Stage (E2) of the Namurian is proposed.

Nuculoceras stellarum, originally described by Bisat (1932) from Gill Beck, Cowling, Yorks, occurs at a single horizon in the English shale-sandstone development of the Namurian Series. The band containing the goniatite is thus a valuable marker horizon in stratigraphical studies. Unfortunately the original description of *N. stellarum* is somewhat inadequate and during recent work it has become apparent that neither Bisat's description nor the amplified description given by Hudson (1946) brings out the most important diagnostic features of the species or allows a clear distinction to be made between *N. stellarum* and the rather closely allied species *Cravenoceratoides nititoides* (Bisat) and *N. nuculum* Bisat. As the horizon of *Ct. nititoides* is immediately below *N. stellarum* and three horizons with *N. nuculum* (Ramsbottom *et al.* 1962, p. 130) immediately succeed the *N. stellarum* band there is some difficulty at present in distinguishing between three important levels in the Namurian succession. *Ct. nititoides* has been redescribed and figured (Yates 1962, p. 391, pl. 57, figs. 4, 5) and it is desirable that *N. stellarum* should also be redescribed.

The present description is based upon three collections:

Collection 1. Small suite of specimens completely crushed in hard limestone, Upper Dove Valley, south-west Derbyshire, Grid Ref. SK 08666631 (Locality 326—Holdsworth 1963).

Collection 2. Suite of specimens crushed and partially crushed in decalcified silty limestone lying 13 feet above the horizon of *Eumorphoceras rostratum* Yates and 25 feet above *Cravenoceras holmesi* Bisat, Oakenclough Brook, north-east Staffordshire, Grid. Ref. SK 05046368 (Locality 206c—Holdsworth 1963).

Collection 3. Topotypes of *N. stellarum*, Geological Survey of Great Britain collection, Leeds Office, Nos. Da 1626-60.

SYSTEMATIC DESCRIPTION

Order AMMONOIDEA Zittel 1884
Suborder GONIAITITINA Hyatt 1884
Superfamily GONIAITITACEA de Haan 1825
Family GONIAITITIDEA de Haan
Subfamily HOMOCERATINA Spath
Genus NUCULOCERAS Bisat 1924

Type species. Nuculoceras nuculum Bisat 1924.

Diagnosis. Early Homoceratina with ventral lobe of suture narrower than in *Homoceras*. Conch involute, subglobose with small or very small umbilicus. Shell surface bears bifurcating transverse ribs and subsidiary spiral ornament.

Nuculoceras stellarum (Bisat)

Plate 25, figs. 1-6

- 1927 *Homoceras cf. nitidum* (Phillips), Bray, p. 55.
 1932 *Cravenoceras stellarum* Bisat, pp. 33-34, pl. 2, fig. 1.
 1934 *Cravenoceras stellarum* Bisat; Schmidt, p. 450, fig. 46.
 1934 ? *Cravenoceras nititoides* Bisat; Schmidt, p. 450, fig. 47.
 1941 *Cravenoceras stellarum* Bisat; Demanet, p. 144, pl. 6, figs. 9, 10.
 1941 *Cravenoceratooides stellarum* (Bisat); Hudson, p. 282, footnote.
 1946 *Cravenoceratooides stellarum* (Bisat); Hudson, p. 380, pl. 21, fig. 9.

The true original shape of the shell is impossible to determine in the available material, but is probably subglobose (Hudson 1946, p. 380). The ratio of umbilicus diameter to diameter of the crushed shell (u/d) is variable but, except in the very early growth stage, usually exceeds 4.0—i.e. the umbilicus is relatively small.

	Specimen	Shell diameter	Umbilicus diameter	u/d
Collection 1	326.2	> 11.0 mm.	1.5 mm.	> 7.33
	326.3	> 19.0	4.0	> 4.75
	326.1	> 25.0	5.0	> 5.00
Collection 2	206c.1	4.0	1.0	4.00
	206c.4	9.0	1.5	6.00
	206c.2	> 16.0	< 2.0	> 8.00
	206c.3	≥ 28.0	6.0	≥ 4.70
Collection 3	Da.1631	6.0	ca. 1.0	6.00
	Da.1639	10.0	2.0	5.00
	Da.1632	ca. 11.0	2.0	5.50
	Da.1628	> 16.0	2.5	> 6.40
	Da.1642	> 20.0	3.0	> 6.60
	Da.1637	> 25.0	6.5	> 3.84
	Da.1629	ca. 26.0	5.0	5.20

At 4.0 mm. diameter the shell is evolute. At 9.0 mm. the typical narrow umbilicus has been assumed. Ribs with spacing *c.* 4 per mm. at the venter have a very slight forward tendency at the umbilicus (Pl. 25, fig. 6). Neither umbilical rim nor spiral ornament appear to be developed, and at this growth stage there is a similarity with the adult *Ct. nititoides* (cf. Yates 1962, pl. 57, figs. 4, 5). At diameter slightly greater than 16.0 mm. the 'nititoides aspect' is lost. Rib direction now appears essentially truly radial with spacing *c.* 5 per 2 mm. at the venter. Ribs are symmetrical (tented) in elevation and the external mould clearly displays spiral corrugation of inter-rib areas. Though hardly ever detectable on shell surfaces, this spiral ornament can frequently be seen on good external moulds of the adult flank (Pl. 25, fig. 3) and venter (fig. 4). Almost invariably ribs appear non-crenulate on shell surfaces and crenulation is not detectable on external moulds. Only on a few shell sectors of Specimen 326.1 is a faint, rather broad crenulation of ribs

detectable. The umbilical margin in the adult is very frequently raised into a rounded rim across which the ribs pass without weakening. The feature is particularly clear on Specimens Da 1629 and Da 1637 (Pl. 25, fig. 2) and the rim imprint is commonly seen on external moulds (Pl. 25, fig. 5).

Discussion. The holotype of *N. stellarum* has u/d ratio 3.6 at diameter 18 mm. and in view of the measurements made on topotypes (Collection 3) appears to be untypical of the species at the Gill Beck locality. There is no reason to believe, therefore, that the 'similar form, but with a smaller umbilicus' recorded by Bisat (1932, p. 34) from Glutton Bridge, Derbyshire—possibly the locality of Collection 1—is 'a late form of the species'.

N. stellarum is distinguished from *Ct. nititoides* and all true *Cravenoceratoides* (see below) by its weak, rather coarse spiral ornament. In collections of moderate preservation, traces of this ornament and the presence of the raised umbilical rim are the most useful criteria for distinguishing *stellarum* from *nititoides*. In small specimens of *stellarum* neither feature seems to be developed and distinction between *stellarum* and *nititoides* cannot be made with certainty. *N. nuculum* is a smaller species than *stellarum*, 'the adult being apparently not more than 18 mm.' in diameter (Bisat 1924, p. 100). *Nuculum* lacks the raised umbilical rim of *stellarum* at the shell surface, though a rim is sometimes apparent on the solid internal cast. In shale, mudstone, and fissile limestone the spiral ornament of *nuculum*, in contrast to that of *stellarum*, is seldom detectable on either shell surfaces or external moulds. Conversely, the crenulation of transverse ribs—so very rarely visible on *stellarum*—can usually be detected on *nuculum* specimens in a similar state of preservation.

The generic assignment of stellarum

The genus *Nuculoceras* was founded by Bisat (1924, p. 100) with *nuculum* as type species and sole member. Spiral ornament and globose conch are the two features mentioned in the generic diagnosis. Bisat (1928, p. 132) erected the genus *Cravenoceras* to include 'early *Homoceras*-like forms' having a suture with ventral lobe narrower than in *Homoceras* proper, two of which forms—*malhamense* and *nitidum*—had earlier (Bisat 1924) been included in *Homoceras*. Hudson (1914, p. 282, footnote) restricted the name

EXPLANATION OF PLATE 25

- Fig. 1. *Nuculoceras stellarum* (Bisat), external mould of specimen crushed in hard limestone with some small areas of shell-surface, slightly displaced. Specimen shows small umbilicus, essentially truly radial ribs, weak imprint of umbilical rim and traces of spiral ornament. Upper Dove Valley, Derbyshire. 326.1, $\times 4.4$.
- Fig. 2. *Nuculoceras stellarum* (Bisat), shell-surface of topotype crushed in mudstone and showing raised umbilical rim; Gill Beck, Yorkshire. Da 1637, $\times 3.2$.
- Fig. 3. *Nuculoceras stellarum* (Bisat), detail of external mould showing spiral ornament. 326.1, $\times 6.0$.
- Fig. 4. *Nuculoceras stellarum* (Bisat), external mould of venter with shell patina, showing spiral ornament; Oakencloough Brook, Staffordshire. 206c.7, $\times 6.0$.
- Fig. 5. *Nuculoceras stellarum* (Bisat), external mould of umbilical fragment, showing imprint of umbilical rim; Oakencloough Brook, Staffordshire. 206c.8, $\times 5.0$.
- Fig. 6. *Nuculoceras stellarum* (Bisat), external mould of small adolescent showing 'nititoides-aspect'; Oakencloough Brook, Staffordshire. 206c.4, $\times 7.8$. (Owing to a common optical illusion the ribs appear, in the photograph, to be preserved in relief. In fact the specimen is a mould and the true appearance can be obtained by inverting the figure.)

Cravenoceras to early Homoceratina with non-bifurcating transverse ribs, proposing the new genus *Cravenoceratoides* to include forms such as *nitidum* in which the ribs bifurcate.

As regards width of ventral lobe there is no marked difference between *nuculum* (cf. McCaleb 1963, fig. 3a) and species included in *Cravenoceras*. Material of species assigned to *Cravenoceratoides* seldom displays sutures, but the ventral lobe and general form of suture in *nitidum* (cf. Bisat 1924, p. 107) and *Cravenoceratoides edalense* (Bisat) (cf. Schmidt 1934, fig. 30) are essentially similar to the basic *Cravenoceras* type. Thus the early Homoceratina, including *nuculum*, appear to constitute a rather closely related group, best classified at generic level in terms of ornament.

The distinction between *Nuculoceras* and *Cravenoceratoides* is largely blurred by the fact that Delépine (1941) defined *Nuculoceras* as a genus of globose forms with extremely reduced umbilici, making no reference to the important spiral ornament of the type species. He included in *Nuculoceras* his new species *djeradae*, lacking spiral ornament, and a second new species, *agaiae*, insecurely founded on a single specimen with no ornament preserved.

The original conch shape of both *stellarum* and *nititoides* is probably subglobose and similar to that of *nuculum*. The umbilicus, though variable in both *stellarum* and *nititoides*, may be very small. Thus, though the two forms are currently included in *Cravenoceratoides* they also fall within Delépine's definition of *Nuculoceras*. Classification might be rationalized by either (a) suppressing the name *Cravenoceratoides* and including all early Homoceratina with bifurcating ribs in the earlier genus *Nuculoceras* or (b) by returning to Bisat's original concept of *Nuculoceras* and including here only forms with both bifurcating ribs and spiral ornament. The latter alternative is the more satisfactory as it involves comparatively little revision of present nomenclature and also serves to separate stratigraphically earlier (*Cravenoceratoides*) and later (*Nuculoceras*) members of the pre-Homoceras group of goniatites seen in European successions.

Here, therefore, *stellarum*, together with *nuculum* and *tenuispirale* Demanet (1941), are assigned to *Nuculoceras* and *djeradae* to *Cravenoceratoides*. In the absence of preserved ornament the genus of *agaiae* is uncertain.

Zonal allocation of N. stellarum

Currently four zones are recognized as constituting the Arnsbergian Stage (E2) of the Namurian, *stellarum* being taken as index of the third zone, E2c, and *nuculum* as index of the fourth, E2d. With respect to faunal richness, E2c is hardly comparable with the other three zones. It contains only a single fauna—that of *stellarum*—developed in a single thin band. A tripartite zonal division of the Arnsbergian seems more justifiable, the *Nuculoceras*-containing strata being grouped together in the *Nuculoceras nuculum* Zone E2c, with *stellarum* as index of a lower subzone, E2c.1, and *nuculum* index of an upper subzone, E2c.2.

N. stellarum at other localities

Poor material from 294–5 feet in the Alport Boring (Geological Survey Collection Zh. 933–42), recorded by Hudson and Cotton (1943, p. 161) as *Ct. stellarum* and *Ct. cf. nititoides*, includes a few specimens showing the relatively small umbilicus with raised rim typical of *stellarum*. The remaining specimens are not identifiable with certainty, but there appears to be no form referable to *nititoides*. Material from the Crowburn Brook,

Edale (Geological Survey Collection RS. 2873–82) recorded as *stellarum* includes a single external mould showing spiral ornament.

Schmidt (1934, p. 450) identified as *stellarum* a spirally ornamented form with u/d ratio about 4.0 at 20.0 mm. diameter (fig. 46) and at the same horizon—'Schicht mit *Cravenoceras stellarum*'—found a spirally ornamented form with u/d ratio about 8.0 at comparable diameter (op. cit., *supra*, fig. 47) to be slightly more common. This latter form he attributed to *nititoides*, but in view of the re-examination of the features of *stellarum* it seems probable that both widely and narrowly umbilicate forms should be referred to this species. There is a suggestion of an umbilical rim in Schmidt's fig. 46.

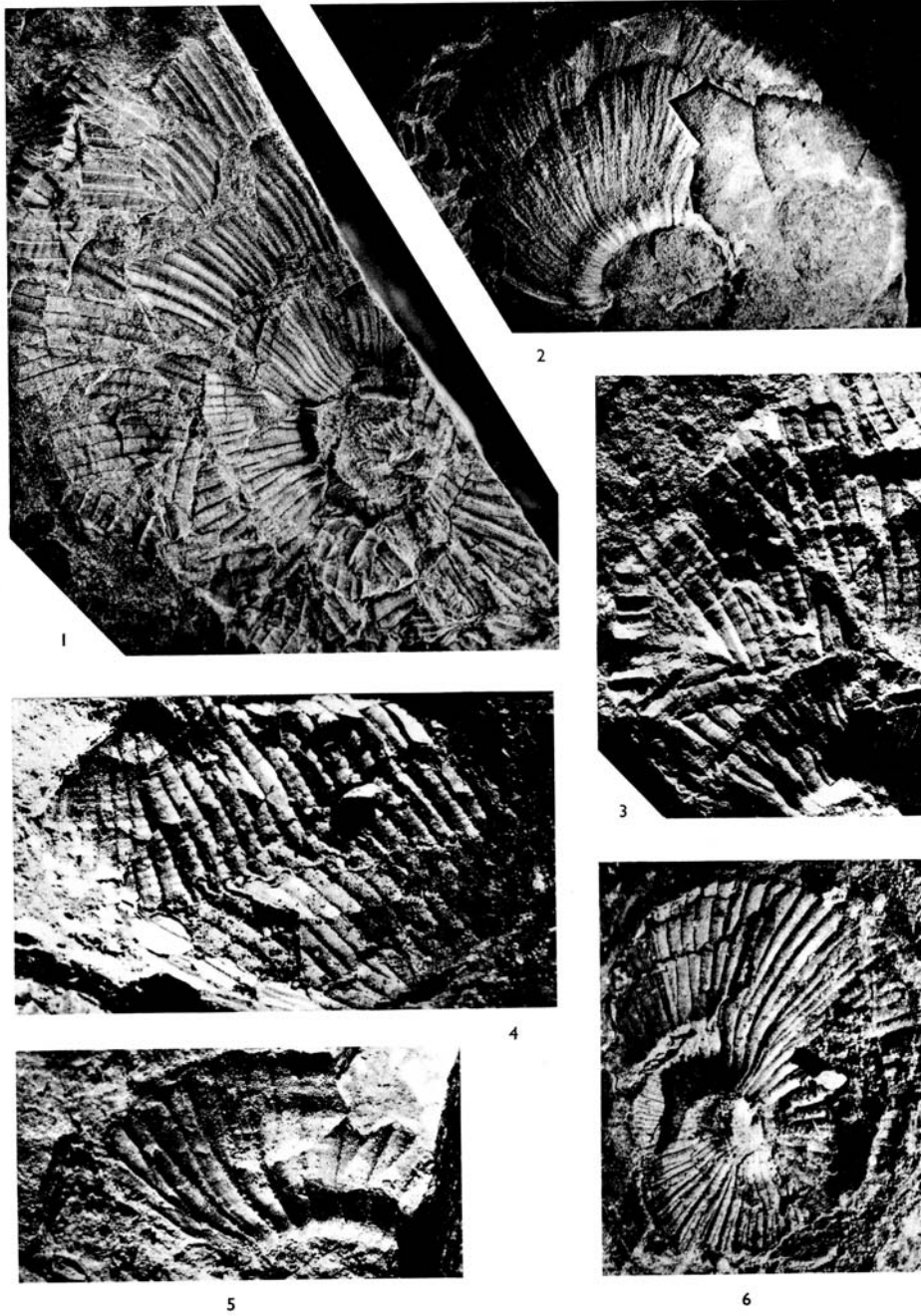
The form from the Asisse de Chokier identified by Demanet (1941, p. 144) as *stellarum* is similar to the English specimens in that spiral ornament is apparently visible only on external moulds. It is not clear whether Demanet's specimens possess an umbilical rim. The superposition of slightly displaced portions of crushed shell, giving a reticulate appearance, which Demanet described is seen in specimens of Collection 1 (cf. Pl. 25, fig. 1).

Acknowledgements. The writer is grateful to the Director of the Geological Survey of Great Britain for permission to examine Survey collections and borrow specimens and to Dr. W. H. C. Ramsbottom for valuable discussion concerning the contents of the paper and critical reading of the manuscript.

REFERENCES

- BISAT, W. S. 1924. The Carboniferous goniatites of the north of England and their zones. *Proc. Yorks. Geol. Soc.* **20**, 40–124, pl. 1–10.
- 1928. The Carboniferous goniatite zones of England and their continental equivalents. *Congr. Avanc. Ét. Stratigr. carbonif.* Heerlen, 1927, 117–33, pl. 6, 6a.
- 1932. On some Lower Sabdenian goniatites. *Trans. Leeds geol. Ass.* **5**, 27–37, pl. 1, 2.
- BRAY, A. 1927. The Carboniferous sequence between Lothersdale and Cowling (Colne). *J. Manchr. geol. Ass.* **1**, 44–57.
- DELÉPINE, G. 1941. Les Goniatites de Carbonifère du Maroc et des Confins Algero-Marocains du sud (Dinantien-Westphalien). *Notes Serv. Min. Maroc.* **56**, 1–108, pl. 1–8.
- DEMANET, F. 1941. Faune et stratigraphie de l'étage namurien de la Belgique. *Mem. Mus. Hist. nat. Belg.* **84**.
- HOLDSWORTH, B. K. 1963. Unpublished Ph.D. Thesis, University of Manchester.
- HUDSON, R. G. S. 1941. The Mirk Fell Beds (Namurian, E2) of Tan Hill, Yorkshire. *Proc. Yorks. geol. Soc.*, **24**, 259–89.
- 1946. The Namurian goniatites *Cravenoceratoides bisati* Hudson and *Cravenoceratoides livifer* n.sp. *Proc. Yorks. geol. Soc.* **25**, 375–86, pl. 21, 21a.
- and COTTON, G. 1943. The Namurian of Alport Dale, Derbyshire. *Ibid.* **25**, 142–73.
- MCCALEB, J. A. 1963. The goniatite fauna from the Pennsylvanian Winslow Formation of north-west Arkansas. *J. Paleont.* **37**, 867–88, pl. 111–15.
- RAMSBOTTOM, W. H. C., RHYS, G. H. and SMITH, E. G. 1962. Boreholes in the Carboniferous rocks of the Ashover district, Derbyshire. *Bull. Geol. Survey Gt. Br.* **19**, 75–168.
- YATES, P. J. 1962. The palaeontology of the Namurian rocks of Slieve Anierin, Co. Leitrim, Eire. *Palaeontology*, **5**, 355–443, pl. 51–62.

B. K. HOLDSWORTH
Department of Geology,
The University,
Keele,
Staffordshire



HOLDSWORTH, Namurian goniatite *Nuculoceras*