TRILOBITES (PROETACEA) FROM VISÉAN REEF LIMESTONES AT TREAK CLIFF, CASTLETON, DERBYSHIRE

by

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Summary

A unique assemblage of trilobites of Upper B_2 age has been collected from a single exposure of reef limestone at Treak Cliff, Castleton, Derbyshire. The locality has yielded no less than 9 genera and 11 species belonging to the Brachymetopidae, Otarionidae and Proetidae. Descriptions of the trilobites are presented in this paper.

Introduction

Treak Cliff has long been famous for the abundant and rich variety of well preserved fossils found in the exposures of the Lower Carboniferous, apron-reef limestone complex. (Shirley and Horsfield 1940; Wolfenden 1958; Parkinson 1965, 1974; Stevenson *et al.* 1971; Broadhurst and Simpson 1969, 1973.)

The reef complex comprises algal, back- and fore-reef limestones the age of which on the goniatite evidence is Viséan, Upper Beyrichoceras (B_2) sub-zone. Fossils commonly occur in lenses or pockets within the reef, and are sometimes restricted to a particular fossil group; brachiopods, goniatites (Ford 1965) or bivalves (Shaw 1970), but more often comprise a variety of invertebrate groups.

The trilobites discussed in this paper were found by R. C. Elliott and the author during 1975-76 in weathered rubbly limestone within the fore-reef at a locality at the north-west end of Treak Cliff. A more precise indication of the locality is not given here in the interests of geological conservation, although details will be supplied on application to the author.

As with many groups of Lower Carboniferous fossils, trilobites have received scant attention in Britain this century; the most recent comprehensive monograph having been written by Woodward in 1883-84. Other references include Reed (1899, 1942-43) on *Bollandia*, *Cyrtoproetus* and *Namuropyge*; Weber (1937) - *Brachymetopus*; Osmólska (1967, 1968, 1970) featuring all the species and Hahn (1964) on *Brachymetopus*.

Trilobite morphology

The accompanying illustrations, text-figs. 1-3 show the parts of the trilobite exoskeleton referred to in the text. The morphology is based on Harrington *et al.* (1959).

The occurrence and preservation of the trilobites

The fossils were found in a restricted deposit, confined by soil cover. The fauna, in addition to the trilobites, contained brachiopods, bryozoa, gastropods, crinoid ossicles and rarer ostracodes, blastoids, crinoid calices, algae and goniatites. A faunal list (excluding the trilobites) is given in appendix 1 (p.169) and the relationship of the locality to other fossiliferous limestones is shown in text-fig. 4.

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pp. 155-170, text-figs 1-5, Pl. 10-13.
App. 1.

Fig. 1 *Brachymetopus ouralicus* (Verneuil, 1845)

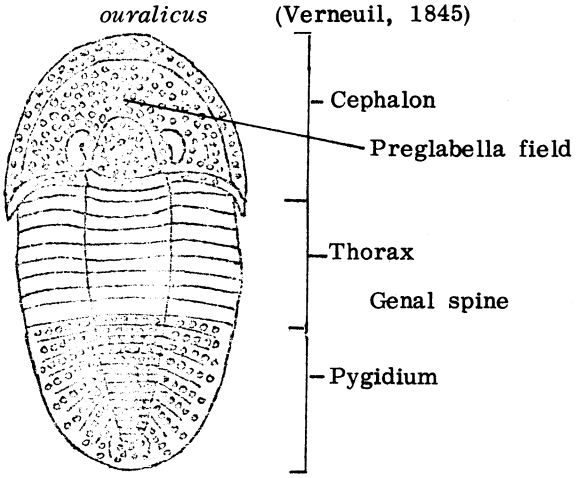


Fig. 2 *Cummingella jonesi.* (Portlock, 1843)

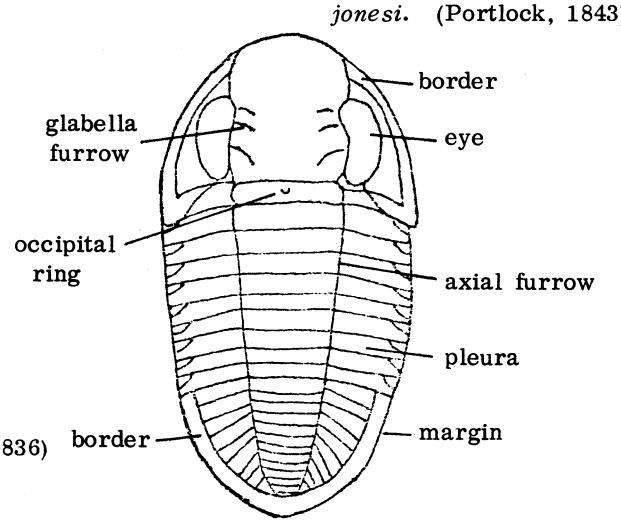
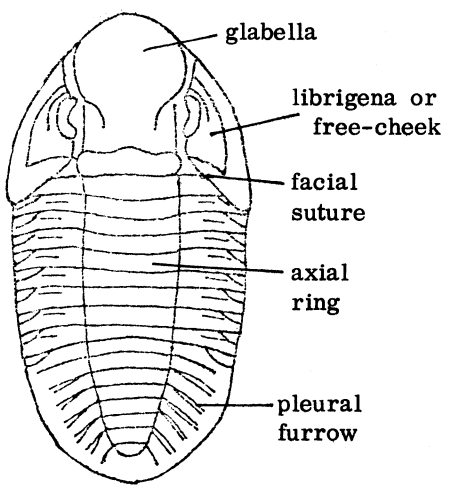
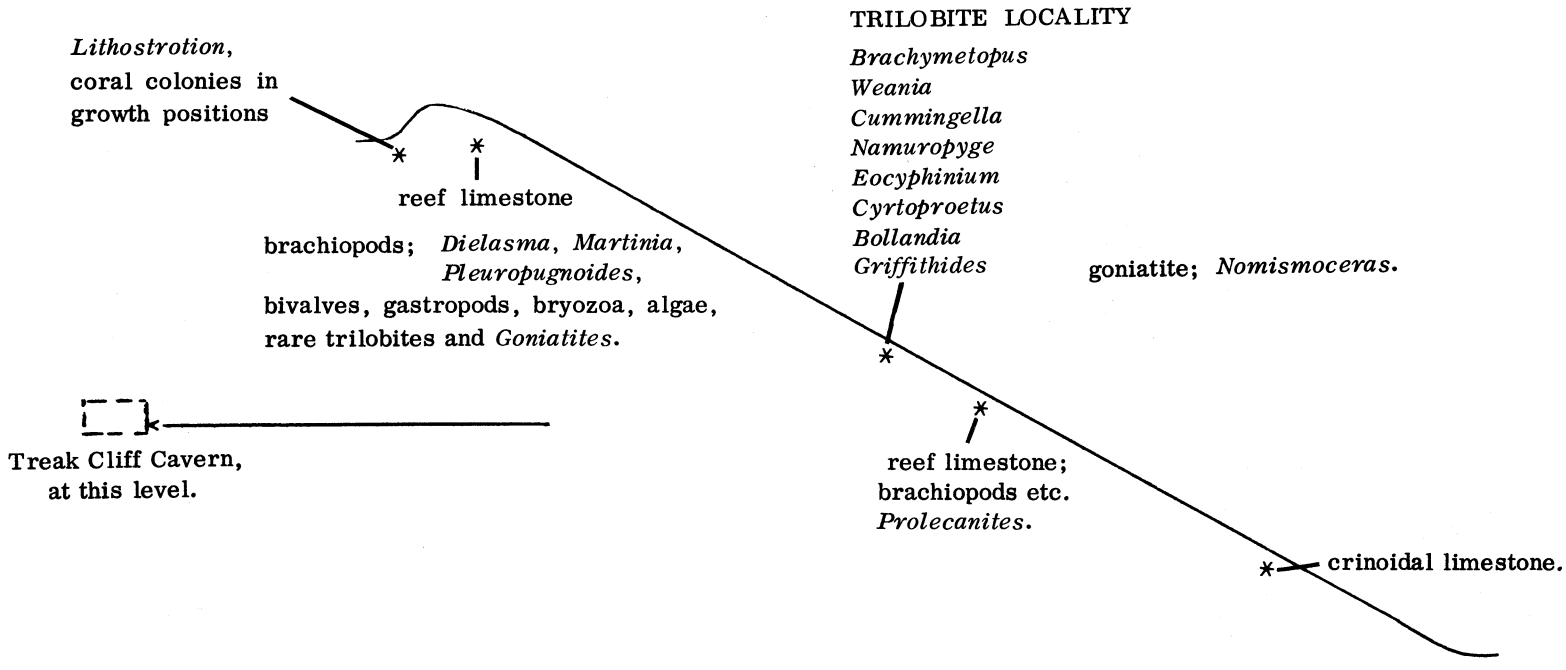


Fig. 3 *Bollandia globiceps.* (Phillips, 1836)



outline after H. Woodward (1883-84)
terminology after Harrington (1959).

Text-figs. 1 - 3 Morphology of Carboniferous trilobites.



Text-fig. 4. Faunal variations on the reef slope.

(For comparison see Broadhurst & Simpson 1973.

Bathymetry on a carboniferous reef.)

The trilobites are preserved in original relief with exoskeleton adhering, or as internal and external moulds, nearly all as isolated cephala, cranidia, librigenae (free cheeks), pygidia and rare hypostoma (Plate 12, figs. 10,11); only a few specimens were found with articulating thoracic segments attached to the pygidium. Thus it seems as if nearly all are moults; the preservation of delicate spines on *Namuropyge* specimens suggests that the assemblage cannot have been transported far and was presumably moved by gentle currents into a hollow or fissure within the reef and buried fairly rapidly by carbonate sediment.

Recognition of the species

On initial acquaintance, most Carboniferous trilobites exhibit a good deal of similarity, compared with, say, an association of specimens of Ordovician or Silurian age. Part of the reason for this is that in earlier periods, many more families, genera and species of great diversity were in existence, whilst in the Carboniferous, only three families remain, all belonging to one superfamily, the Proetacea. It was formerly customary to place nearly all Carboniferous trilobites in the genera *Phillipsia*, *Griffithides* or *Brachymetopus*, but studies over the last 50 years or so have revealed that many of these placings were artificial and based on superficial resemblance only. It is now realised that there was a good deal of parallel evolution within the Proetacea, and that the end members of many lineages took on a similar appearance because they were adapted to similar environmental niches. Consequently a number of additional genera and subgenera have been defined to accommodate these species. Because many of them superficially resemble one another, discrimination between them is difficult and requires a careful and critical examination. Thus the notes below are intended to assist with the determination of the Treak Cliff species. Longer formal descriptions of them are available in the monographs and papers mentioned above.

Description of trilobites

List of species

Superfamily: Proetacea Salter, 1864.

Family: Brachymetopidae Prantl and Pribyl, 1950.

Brachymetopus ouralicus (de Verneuil, 1845)

Brachymetopus moelleri Weber, 1937

Family: Otarionidae Richter and Richter, 1926

Namuropyge acanthina (Coignou, 1890)

Namuropyge kingii Richer and Richter, 1939

Family: Proetidae Salter, 1864

Subfamily: Cyrtosymbolinae Hupe, 1953

Cyrtoproetus cracoensis Osmolska, 1970

Carbonocoryphe (*Winterbergia*) Hahn and Brauckmann, 1975, sp. nov?

Weania anglica Osmolska, 1970

Subfamily: Proetinae Salter, 1864

Bollandia aff. *claviceps* (Burmeister, 1846)

Subfamily: Phillipsinae Oehlert, 1886

Eocyphinium cf. *castletonensis* Osmolska, 1970

Subfamily: Cummingellinae Hahn, G. and R., 1967

Cummingella carringtonensis (Woodward, 1884)

Subfamily: Griffithidinae Hupe, 1953

Griffithides longiceps Portlock, 1843

Table 1 - Total number of trilobite specimens obtained from the locality

	Cephala	Cranidia	Librigenae	Pygidia
Bollandia	1	4	1	5
Eocyphinium	2	1	0	3
Cyrtoproetus	4	18	3	15
Weania	8	20	5	30
Cummingella	25	4	0	24
Carbonocoryphe	0	2	0	8
Brachymetopus ouralicus	50+	0	0	100+
B. moelleri	12	0	0	2
Namuropyge acanthina	10	0	0	6
N. kingi	0	0	0	1
Griffithides	0	1	0	0

In addition: 6 hypostoma and thoracic segments

Superfamily	PROETACEA	Salter, 1864
Family	Brachymetopidae	Prantl & Přibyl, 1950
Genus	*Brachymetopus*	McCoy, 1847.

Brachymetopus ouralicus (de Verneuil, 1845)

(Plate 10, figs.1-5; Plate 13, figs. 3-6.)

Treak Cliff specimens. The description below is made up from over 150 specimens of which 50 are cephala and the rest pygidia. No complete individuals and no thoracic segments were recovered.

Description. The cephalon has a tuberculate exoskeleton. The glabella is triangular shaped and small, extending only one-third of the distance to the anterior margin. The eyes are smooth without discernable lens detail, crescentic and extend from close to the posterior margin to over half the glabella length (Plate 10, fig. 3). The preglabellar field is greatly expanded, the genal angle is extended into a spine, directed parallel with the axis of the trilobite. There is no facial suture. The pygidium has paired pleural ribs, each with a row of tubercles, over 16 axial rings and 7 distinct ribs. The pygidial widths on 45 random selected specimens is given below:

Max. width, mm	5	6	7	8	9	10	11	12	13
No. of specimens	3	7	7	6	13	5	1	1	2

Remarks The specimens described above may be confused with those here allocated to the genus *Eocyphinium*. However, specimens of this genus possess a facial suture and a large glabella overhanging the anterior border. The pygidia are more difficult to separate but those of *Eocyphinium* have single bands of tubercles separated by a smooth zone. Thoracic segments were not found; this seems typical of the species, for at other localities, only cephala and pygidia are preserved. This suggests that thoracic pleurae were delicate and readily fragmented.

Brachymetopus moelleri Weber, 1937

(Plate 10, figs. 6-9)

Treak Cliff specimens 12 cephala and 2 pygidia have been collected.

Description The cephala are all of a small size, maximum width, 6 mm. The genal angles are rounded, a flat border with a row of tubercles is separated from the rest of the cephalon by a smooth band. The preglabellar field is steeply sloping, almost vertical. The pygidium has over 13 rings and 7 pleurae with tuberculate ornament.

Remarks This species, described here, from Britain, for the first time, is closely related to *B. moelleri parvus* Osmolska, 1970, from Poland and *B. moelleri thuringensis* Hahn, 1964, from Germany.

Cephalic comparison:

B. ouralicus	*B. moelleri*
1. Triangular glabella	parallel sided glabella
2. horizontal expanded preglabellar field	narrow, vertical preglabellar field
3. no border.	anterior border present
4. genal spines present	rounded genal angles

Family	Otarionidae	Richter & Richter 1926
Genus	Namuropyge	Richter & Richter 1939

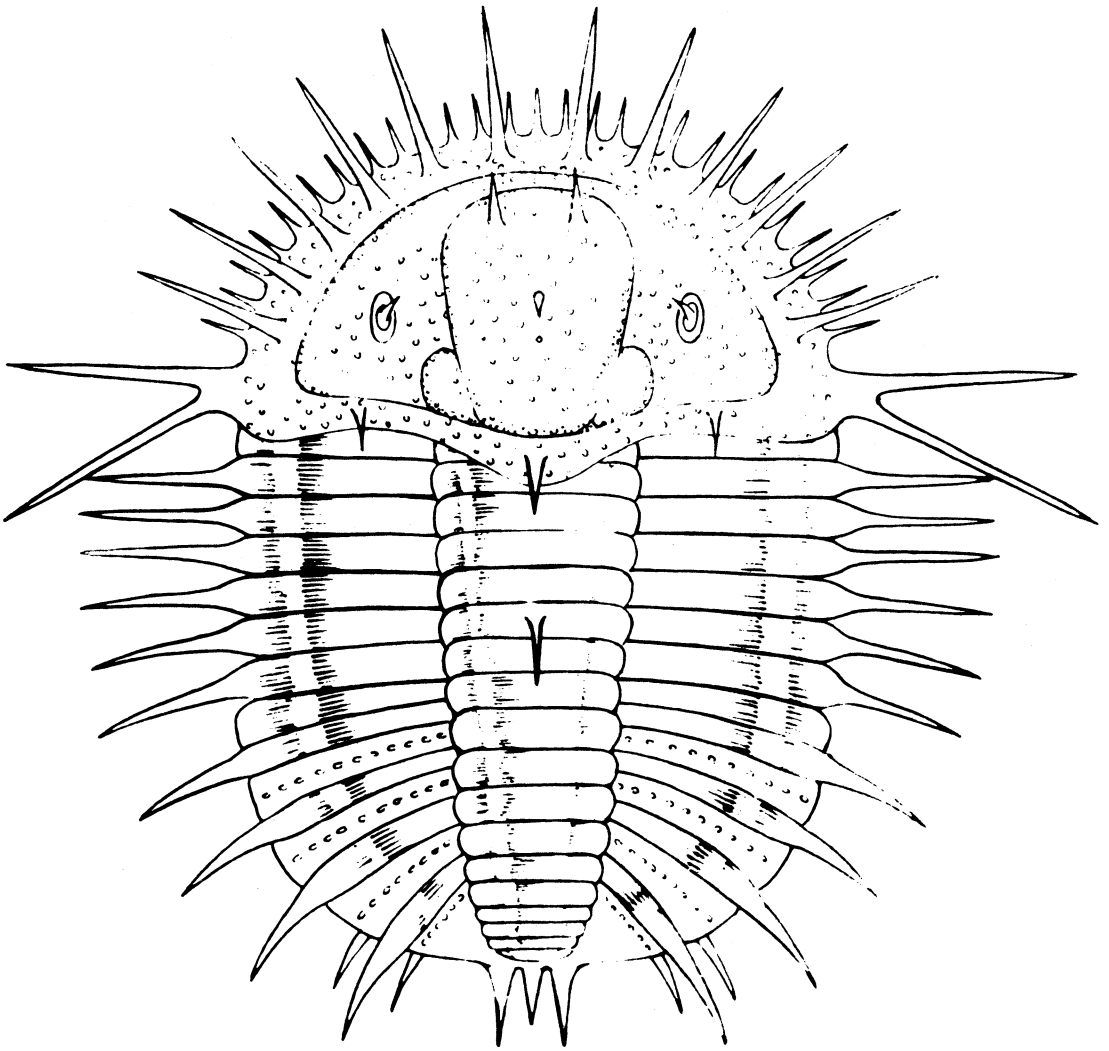
Namuropyge acanthina (Coignou 1890)

(Text-fig. 5, Plate 11, figs. 13-15; Plate 12, figs. 1-2; Plate 13, figs. 1-2)

Treak Cliff specimens This species is represented by 10 cephala, most of which are incomplete, the largest being 7 mm; and by six pygidia. The pygidia are new finds and are described for the first time.

Description The cephalon has ankylosed facial sutures and the surface is tuberculate and spinose. The glabella is inflated with prominent basal lobes and the cephalic margin has two rows of spines. The pygidia have four pleurae and about nine rings; also marginal and postaxial spines and an interpleural row of ornament.

Remarks The discovery by the author in 1975 of a complete specimen of *N. acanthina* at a nearby exposure on Treak Cliff has confirmed the long suspected association of the cephala described as *Coignovina* and the pygidia described as *Namuropyge* which occur together at several localities in Visean reef limestones; the latter name has historic precedence over the former. Although *N. acanthina* 'eyes' have no obvious visual surfaces, it is thought (Miller, 1973, that the tubercles may have borne tactile satae. Further, one specimen (TC85, Plate 11, fig. 13) clearly indicates a most unusual adaptation for the 'eye-mould' is protruded into a curved spine. The rostral plate and suture are visible on specimen TC 82 (Plate 11, fig. 15), the rostral plate is nearly vertical to this.



Text-fig. 5. *Namuropyge acanthina* (Coignou, 1890) Reconstruction of the complete trilobite. (Specially drawn by Roy Turlington, Sheffield Polytechnic.)

Namuropyge kingi Richter & Richter 1939

(Plate 12, fig. 3)

Treak Cliff has so far yielded only one pygidium, TC 88.

Description An almost semicircular pygidium with 4 ribs and at least 10 axial rings. Marginal pleurae and postaxial spines are present. The width is 5 mm.

Remarks The holotype is the only other specimen previously described. *N. kingi* differs from *N. acanthina* in overall shape, the lack of interpleural ornament and the extra spines on the pleurae. *N. kingi* is similar to *N. discors discors* but the type specimen of that species has been lost.

Family Proetidae Salter, 1864

Subfamily Cyrtosymbolinae Hupé, 1953

Genus *Cyrtoproetus* Reed, 1943

Cyrtoproetus cracoensis Osmolska, 1970

(Plate 11, figs. 7, 8, 9)

Treak Cliff material The collection comprises 4 cephala, 18 crandidia and 15 pygidia.

Description The exoskeleton is smooth. Eyes are large about half the length of the glabella which is almost parallel sided but tapering gently forwards. Its anterior part does not overhang the border which is distinctly striated. The free-cheeks are without a genal spine. There are three pairs of indistinct glabellar furrows whilst a fourth is represented only by a faint dot. The pygidium is without a border. The pleural and axial areas have poorly defined ribs, in some specimens appearing to be smooth.

Remarks This species somewhat resembles *Cummingella carringtonensis* but specimens of this latter species have a 'waisted' glabella, large eyes, genal spines and the glabella overhangs the anterior border. The pygidia have well defined ribs and a distinct border.

Genus *Carbonocoryphe* Richter & Richter, 1950

Subgenus *Carbonocoryphe* (*Winterbergia*) Hahn & Brauckmann, 1975.

Sp. nov. ? (Plate 11, figs. 4, 5, 6)

Treak Cliff material consists of 8 pygidia and 2 cranidia, questionably referred to this subgenus

Description The pygidia have 10 axial rings and 8 ribs. The pleurae are distinct and continue to the border which is slightly raised. The anterior parts of the ribs form or a characteristic ridge. The doublure is broad and is clearly discernable through the exoskeleton.

Two unusual cranidia, TC95 and TC96 were collected. They are distinct from all the other genera and may be related to the above pygidia. They have the following features; a conical glabella with four distinct glabella furrows, an occipital ring with lobes, a restricted preglabella field which is broad (transversely) and a mesial tubercle. The exoskeleton appears to be smooth but is very finely granulated. The specimens may represent a new species.

Remarks This genus is not well documented, some of the twelve species so far described are known only from the pygidia. These superficially resemble *Weania* but differ in the number of rings and the well defined pleural ribs. The cranidia exhibit similarities towards *C. hahnorum* Miller 1973. For further discussion on this point see Brauckmann 1973 and Hahn & Brauckmann 1975.

Genus *Weania* Campbell, 1963

Weania anglica Osmolska, 1970

Plate 12, figs. 4-8)

The Treak Cliff material consists of 8 cephala, 20 cranidia, 5 free-cheeks and 30 pygidia.

Description Cephalon is almost semicircular, mostly smooth and with large eyes. Width of the cephela is variable: 5.5 mm, 8.5 mm and 13.5 mm from three individuals. The anterior border furrow is deep with the border upturned in front of the glabella. The glabella has a granular ornament and is bluntly rounded towards the anterior. Free-cheeks have a characteristic 'ridge' below the eye and another joining this from the genal angle; the palpebral lobe is broad. The pygidia have 12 rings and 8-9 ribs, the pleurae becoming indistinct towards the posterior.

Remarks The ridges on the free-cheek and the waisted glabella distinguish the species from *Cyrtoproetus cracoensis*. A comparison is made below (p.164) with *Cummingella carringtoensis*. The species has been recorded from only one other locality at Narrowdale, Staffordshire.

Subfamily Proetinae Salter 1864

Genus *Bollandia* Reed, 1943

Bollandia aff. *claviceps* (Burmeister 1846)

(Plate 10, figs. 10, 11, 12)

Treak Cliff material The collection consists of 1 cephalon, 4 cranidia, 1 free-cheek and 5 pygidia. A rostral plate of *Bollandia* sp. is illustrated on Plate 12, fig.12.

Description The exoskeleton exhibits fine striae on the glabella but these are not visible on internal moulds. The one cephalon is over 22 mm in width. The eyes are small, about one-quarter the length of the glabella. The glabella is more or less parallel sided with a strongly inflated frontal lobe which overhangs the anterior border; preoccipital lobes are prominent. A ridge on the free-cheek runs towards the rounded genal angle. The free-cheeks are broad and steeply inclined. The doublure with terrace lines is clearly seen on the cephalon and pygidium, whilst the rostral plate and suture are present on specimen TC 125, (Plate 12, fig.12). The exoskeleton may be up to 0.5 mm thick. The pygidium is without border with moderately defined pleural ribs which are not present on the internal moulds.

Remarks The type of ornament upon the cephalon of this species suggests a close relationship with *Brachymetopus claviceps* (Burmeister, 1846) and distinguishes it from *B. globiceps* (Phillips, 1836). Dr. R.M. Owens suggests (personal communication 1976) that the Treak Cliff specimens probably represent a new species. The inflated glabella, distinct preoccipital lobes and the small eyes make the cephalon distinctive. The pygidium differs from *Cyrtoproetus carringtoensis* in lacking a border, and from *C. cracoensis* in having defined pleural ribs.

Subfamily Phillipsinae Oehlert 1886

Genus *Eocyphinium* Reed, 1942

Eocyphinium cf. *castletonensis* Osmolska, 1970

(Plate 11, figs. 10, 11, 12)

The Treak Cliff material comprises 2 cephala, 1 glabella and 3 pygidia.

Description The exoskeleton is tuberculate. The eyes are small being about one quarter the length of the glabella. The latter is slightly 'waisted' (constricted) at mid-length but continues anteriorly to overhang the anterior border, which is deep and upturned. Free-cheeks have a genal spine; ornamentation is spinose but the anterior and posterior borders are smooth. One cephalon, RE 90 (Plate 11, fig. 10) has a width of 17.5 mm and the genal spine is preserved for 1.5 mm. The pygidium has a single row of tubercles on each ring and rib.

Remarks This is a rare species at Treak Cliff. *Brachymetopus ouralicus* has a tuberculate exoskeleton but the cephala are easily distinguished as *Eocyphinium* has a facial suture, a large glabella and a restricted preglabella field.

Subfamily Cummingellinae Hahn, G. &R., 1967.

Genus *Cummingella* Reed, 1942.

Cummingella carringtonensis (Woodward 1884)

(Plate 10, figs. 13, 14; Plate 11, figs. 1, 2, 3)

Treak Cliff material The description is based on 25 cephala, 4 cranidia and 24 pygidia, two of which contained some thoracic segments. The doublure of a specimen (*Cummingella* sp.) is illustrated on Plate 12, fig. 9).

Description The exoskeleton is smooth, apart from granulated free-cheeks. The eyes are very large. The glabella is constricted slightly at mid-length and glabella furrows are faintly marked; the anterior part of the glabella overhangs the border. Free-cheeks are steeply inclined, granulose and with thin, short genal spines. The pygidium has a distinct border and there are 12 axial rings and 9-10 ribs.

Remarks A comparison has been made above (p.162) with *Cyrtoproetus cracoensis*. A comparison can also be made with *Weania anglica*, but in this species the glabella tapers forewords, the eyes are more convex with broad palpebral lobes and there is a distinct ridge on the free-cheek.

Subfamily Griffithidinae Hupé, 1953

Genus *Griffithides* Portlock 1843

Griffithides longiceps Portlock 1843

Treak Cliff collection contains only one specimen, a cranidium, TC 50.

Description A most obvious inverted pear-shaped glabella with a pair of small detatched basal lobes. Glabellar furrows are absent. The glabella is expanded frontally and is distinctly convex in longitudinal view; there is no preglabellar field or anterior border. Unfortunately the specimen is weathered and most of the exoskeleton is missing but the ornamentation present suggests a smooth surface, although there are a few small tubercles upon the posterior edge of the occipital ring.

Remarks The specimen is distinct from all the other genera at this locality.

Conclusions

The specimens of well preserved trilobite exuviae occur at all angles within the rock matrix. Ornament and fine skeletal detail are still present and the fossil population probably represents a drifted assemblage. Other reef fossils are present and include numerous single lamellibranch and brachiopod valves. Trilobites are generally uncommon fossils in the Carboniferous Limestone, so that the number and variety of species at this locality make it a unique deposit. The fossils occur in soft weathered limestone and this may have formed in a hollow or fissure within the reef. Ford (1965) concluded that the Cow Low Nick goniatite pocket deposit accumulated in, "a hollow such as an inactive surge channel or submarine cave". Miller (1972, 1973) described two new trilobite species suggesting that they may have been specially adapted for life in a fissure habitat.

Most of our knowledge of British Carboniferous trilobites is from specimens in old collections, and in many cases the range and distribution of individual species are known only in the broadest terms. This situation will only be rectified when much more detailed collecting and study has been carried out. These notes demonstrate that in the reef facies of Derbyshire a large number of specimens and species may be obtained. This has also proved to be true in areas outside Derbyshire where reef limestones are exposed, for example in the Craven district of North Yorkshire. Trilobites are rare in the massive well-bedded limestones, but

are commoner in the Yoredale Shales and in the "Culm" of south-west England.

On the European continent, trilobites in the culm facies have been used for zonation, complimentary to the goniatite scheme (Hahn, 1974) and this combined approach has been applied successfully to south-west England. Further knowledge of trilobite distribution in the Carboniferous Limestone Group is required before it will be possible to test the usefulness of trilobites as zonal fossils in that facies.

Acknowledgements

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References

BRAUCHMANN, C. 1973. *Kulm trilobiten von Aprath.* Freien University Berlin.

BROADHURST, F.M. and SIMPSON, I.M. 1973. Bathymetry on a Carboniferous reef. *Lethaia.* Vol.6, pp. 367-381.

FORD, T.D. 1965. The palaeoecology of the goniatite bed at Cow Low Nick, Castleton, Derbyshire. Vol.8, pp.186-191.

HAHN, G. 1964. Revision von *Brachymetopus maccoyi* (Portlock, 1843). *Senckenberg. Leth.* Bd.45, pp.151-165. 1964. Die Gattung *Brachymetopus* McCoy (Trilobita) im Etroeungt und Unter-Karbon Deutschlands. *Senckenberg. Leth.* Bd.45, pp.167-199.

HAHN, G., and BRAUCHMANN, C. 1975. Zur Evolution von *Carbonocoryphe* (Trilobita, Unter-Karbon). *Senckenberg. Leth.* Bd.56.

HARRINGTON, H.J. *et al.* 1959. *Treatise on Invertebrate Palaeontology*, Part O, Arthropoda 1. Geological Soc.America, University of Kansas Press.

MILLER, J. and GRAYSON, R.F. 1972. Origin and structure of the Lower Visean 'Reef' Limestone, near Clitheroe, Lancashire. *Proc. Yorks Geol. Soc.* Vol.38, part 4, no.26.

MILLER, J. 1973. *Coignouina decora* sp.nov., and *Carbonocoryphe hahnorum* sp. nov. (Trilobita) from a Viséan fissure deposit near Clitheroe, Lancashire. *Geol. Mag.* Vol.110, pp.113-124.

OSMÓLSKA, H. 1967. Some Otarionida (Trilobita) from the Lower Carboniferous of Europe. *Acta palaeont. pol.* Vol. XII, No.1, pp.119-150.

OSMÓLSKA, H. 1968. Contribution to the Lower Carboniferous Cyrtosymbolinae (Trilobita). *Acta palaeont. pol.* Vol.XII, No.2. pp.161-173.

OSMÓLSKA, H. 1968. *Brachymetopus* McCoy. (Trilobita) in the Carboniferous of Poland and the U.S.S.R. *Acta palaeont. pol.* Vol.XIII No.3, pp.359-374.

OSMÓLSKA, H. 1970. On some rare genera of the Carboniferous Cyrtosymbolinae Hupé 1953 (Trilobita). *Acta palaeont. pol.* Vol.XV, No.1, pp.116-131.

OSMÓLSKA, H. 1970. Revision of non-cyrtosymbolinid trilobites from the Tournaisian-Namurian of Eurasia. *Palaeont. pol.* No.23.

PARKINSON, D. 1965. Aspects of the Carboniferous stratigraphy of the Castleton-Treak area of North Derbyshire. *Mercian Geol.* Vol.1, No.2, pp.161-180.

PARKINSON, D. 1974. The Beach Beds of Castleton, Derbyshire and their relationship with the apron-reef limestones. *Mercian Geol.* Vol.5, No.2. pp.105-113.

REED, F.R.C. 1899. A new Carboniferous trilobite. *Geol. Mag.* Vol.11, pp.241-245.

REED, F.R.C. 1942. Some new Carboniferous trilobites. *Ann. Mag. Nat. Hist.* Vol.9, pp.649-672.

REED, F.R.C. 1943. The genera of British Carboniferous trilobites. *Ann.Mag. Nat. Hist.* Vol.10, pp. 54-65.

SHAW, K.R. 1970. *Pseudomusium ellipticum* limestone, a new lithostratigraphical unit in the Lower Carboniferous at Castleton, Derbyshire. *Mercian Geol.* Vol.3. No.3. pp.223-232.

SHIRLEY, J. and HORSFIELD, E.L. 1940. The Carboniferous Limestone of the Castleton-Bradwell Area, north Derbyshire. *Q.Jl. geol. Soc. Lond.* Vol.96, pp.271-279.

SIMPSON, I.M. and BROADHURST, F.M. 1969. A boulder bed at Treak Cliff, north Derbyshire. *Proc., Yorks. Geol. Soc.*, Vol.37, part 2, pp.141-152.

STEVENSON, I.P. *et al.* 1971. The geology of the country around Chapel-en-le-Frith. *Mem. Geol. Surv. Eng. Wales* London.

WEBER, V. 1937. Trilobites of the Carboniferous and Permian Systems of the U.S.S.R. *Palaeont. U.S.S.R.* Monograph 71. pp. 114-159.

WOLFENDEN, E.B. 1958. Palaeoecology of the Carboniferous reef complex and shelf limestones in north-west Derbyshire, England. *Bull. Geol. Soc. America.* Vol.69, pp. 871-898.

WOODWARD, H. 1883-1884. A monograph of the British Carboniferous trilobites. *Palaeont. Soc. Monogr.* 86.pp.

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APPENDIX I

List of fossils, excluding trilobites found at the Treak Cliff locality

Brachiopoda		
	'Camarotoechia' trilatera	(de Koninck)
	Dielasma hastatum	(J. de. C Sowerby)
	Leptagonia sp.	
	'Martinia' glabra	(J Sowerby)
	Phricodothyris lineata	(J. Sowerby)
	Pleuropugnoides pleurodon	(Phillips)
	Productus sp.	
	Pugnax pugnus	(Martin)
	Retzia radialis	(Phillips)
	Rhipidomella michelini	(Leveille)
	Spirifer sp.	
Arthropoda		
	Richteria	(Jones)
Echinodermata		
	orbitremites derbienses	(J. Sowerby)
Cephalopoda	crinoid ossicles, two calyces.	
	Nomismoceras cf vittigerum	(Phillips)
Bivalvia		
	Conocardium aleforme	(J. de. C. Sowerby)
	Parallelodon bistriatus	(Portlock)
	Parallelodon verneuilianus	(de Koninck)
Gastropoda		
	Euconospira conica	(Phillips)
	Natiscopsis sp.	
	Platyceras vetrustum	(J. de C. Sowerby)
	Straparollus sp.	
Bryozoa		
Algae		

Explanation for Plates 10, 11, 12 and 13

Specimen nos. preceded by the letters 'RE' were kindly loaned by Richard Elliott; others are from the authors collection. A representative selection of the figured specimens will be deposited in the National Museum of Wales, Cardiff.

Explanation for Plate 10

Fig. 1.	*Brachymetopus ouralicus*	×5	(Spm. no. RE 45)
Fig. 2.	*B. ouralicus* (genal spine detail)	×4	(Spm. no. 40)
Fig. 3.	*B. ouralicus*	×4	(Spm. no. 40)
Fig. 4.	*B. ouralicus*	×5	(Spm. no. 47)
Fig. 5.	*B. ouralicus*	×4	(Spm. no. 49)
Fig. 6.	*Brachymetopus moelleri*	×5	(Spm. no. 73)
Fig. 7.	*B. moelleri*	×5	(Spm. no. 71)
Fig. 8.	*B. moelleri* (pygidium)	×3	(Spm. no. 74)
Fig. 9.	*B. moelleri* (genal angle detail)	×5	(Spm. no. 72)
Fig. 10.	*Bollandia* aff. *claviceps* (cephalon with cuticle preserved)	×2	(Spm. no. 125)
Fig. 11.	*B.* aff. *claviceps* (glabella)	×2	(Spm. no. RE 50)
Fig. 12.	*B.* aff. *claviceps* (free-cheek)	×5	(Spm. no. 126)
Fig. 13.	*Cummingella carringtonensis*	×6	(Spm. no. 30)
Fig. 14.	*C. carringtonensis*	×4	(Spm. no. RE 21)
Fig. 15.	*Cummingella sp.* (pygidium)	×5	(Spm. no. 34)

Explanation for Plate 11

Fig. 1.	*Cummingella carringtonensis* (tubercles on the free cheek)	×4	(Spm. no. RE 20)
Fig. 2.	*C. carringtonensis* (thorax and pygidium)	×6	(Spm. no. 100)
Fig. 3.	*C. carringtonensis* (pygidium)	×5	(Spm. no. 91)
Fig. 4.	*Carbonocoryphe* sp. nov. (cranidium)	×5	(Spm. no. 96)
Fig. 5.	*Carbonocoryphe* sp. nov. (pygidium)	×5	(Spm. no. 97)
Fig. 6.	*Carbonocoryphe* sp. nov. (cranidium)	×5	(Spm. no. 95)
Fig. 7.	*Cyrtoproetus cracoensis* (cranidium)	×5	(Spm. no. 151)
Fig. 8.	*C. cracoensis*	×4	(Spm. no. 155)
Fig. 9.	*C. cracoensis*	×6	(Spm. no. 150)
Fig. 10.	*Eocyphium castletonensis*	×4	(Spm. no. RE 90)
Fig. 11.	*E. castletonensis*	×3	(Spm. no. 110)
Fig. 12.	*E. castletonensis*	×4	(Spm. no. RE 91)
Fig. 13.	*Namuropyge acanthina* (ventral view with 'eye' spine)	×4	(Spm. no. 85)
Fig. 14.	*N. acanthina*	×6	(Spm. no. 83)
Fig. 15.	*N. acanthina* (cephalon & rostral plate)	×4	(Spm. no. 82)

Explanation for Plate 12

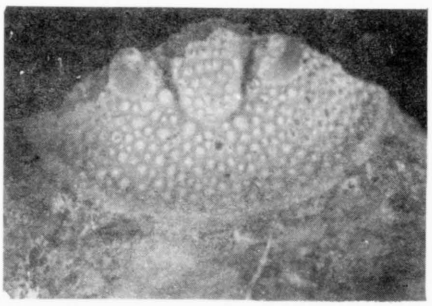
Fig. 1	*Namuropyge acanthina*	×5	(Spm. no. 84)
Fig. 2	*N. acanthina*	×5	(Spm. no. 81)
Fig. 3	*Namuropyge kingi*	×6	(Spm. no. 88)
Fig. 4	*Weania anglica*	×5	(Spm. no. 38)
Fig. 5	*W. anglica*	×4	(Spm. no. 35)
Fig. 6	*W. anglica*	×5	(Spm. no. 36)
Fig. 7	*W. anglica*	×4	(Spm. no. 37)
Fig. 8	*W. anglica*	×4	(Spm. no. RE 60)
Fig. 9	*Cummingella* sp. Doublure (ventral side)	×4	(Spm. no. 23)
Fig. 10	Hypostome (species unknown)	×5	(Spm. no. 201)
Fig. 11	Hypostome (species unknown)	×4	(Spm. no. 202)
Fig. 12	*Bollandia* sp. (Rostral plate (ventral side)	×6	(Spm. no. 125)

Explanation for Plate 13

All the figs. are scanning electron micrographs.

The specimens were coated with gold palladium.

Fig. 1.	*Namuropyge acanthina* Cephalon (side-view)	×25	(Spm. no. 55)
Fig. 2.	*N. acanthina* Pygidium with pleural spine.	×10	(Spm. no. 56)
Fig. 3.	*Brachymetopus ouralicus* Cephalon.	×10	(Spm. no. 53)
Fig. 4.	*B. ouralicus* Genal spine detail.	×10	(Spm. no. 53)
Fig. 5.	*B. ouralicus*	×10	(Spm. no. 51)
Fig. 6.	*B. ouralicus* Eye detail.	×35	(Spm. no. 51)



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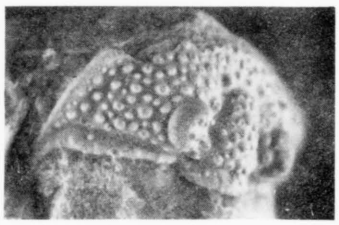

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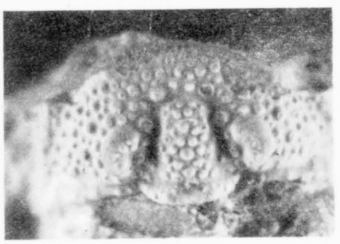

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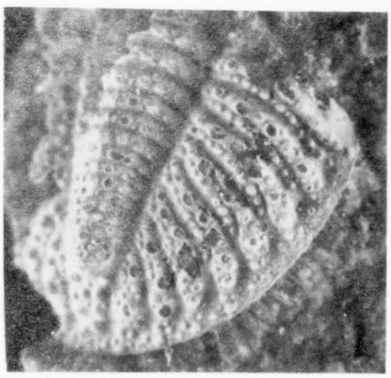

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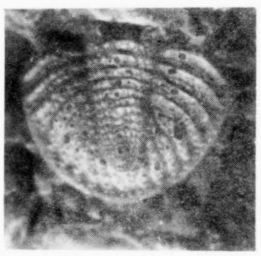

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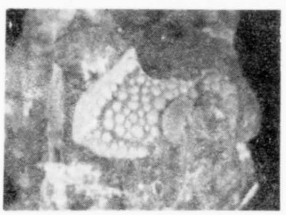

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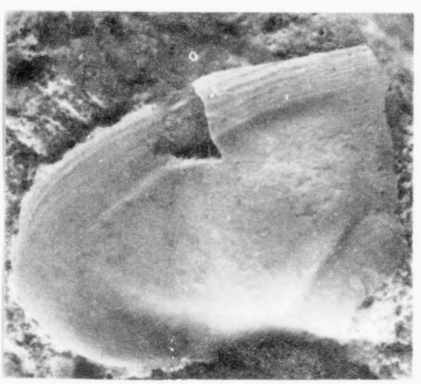

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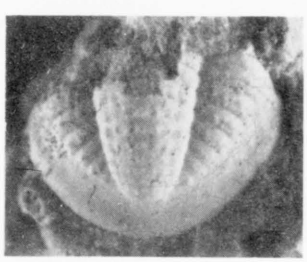

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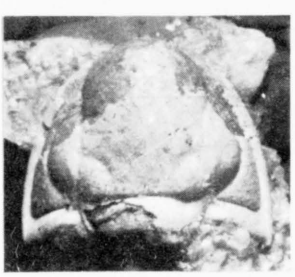

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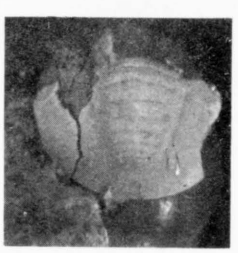

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Tilsley - Derbyshire trilobites

(Explanation on p.168)

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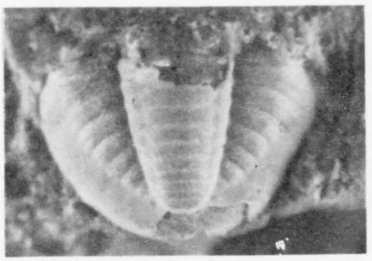

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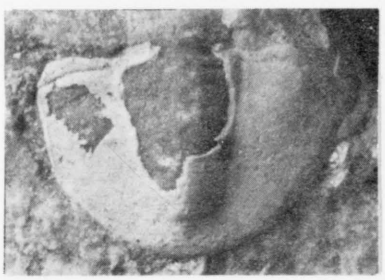

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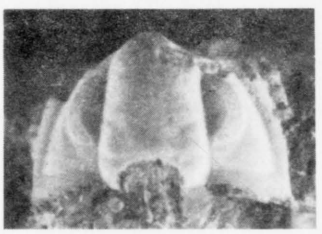

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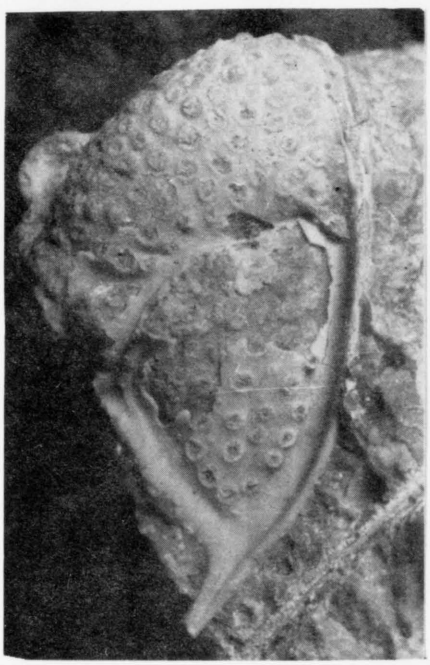

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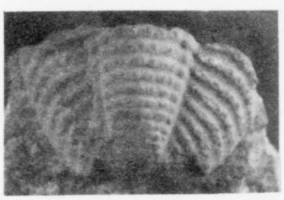

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Tilsley - Derbyshire trilobites

(Explanation on p. 169)

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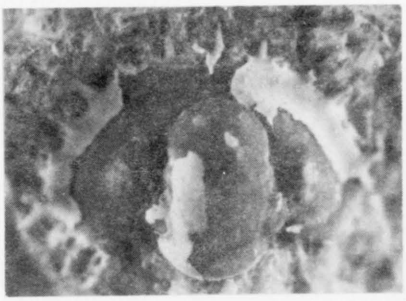

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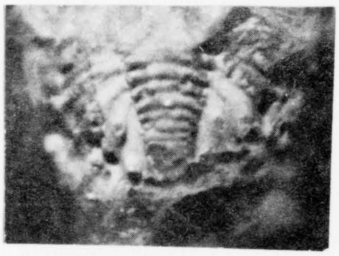

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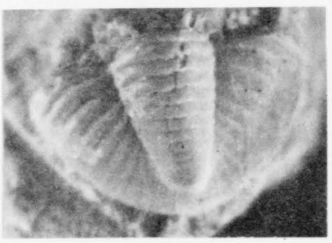

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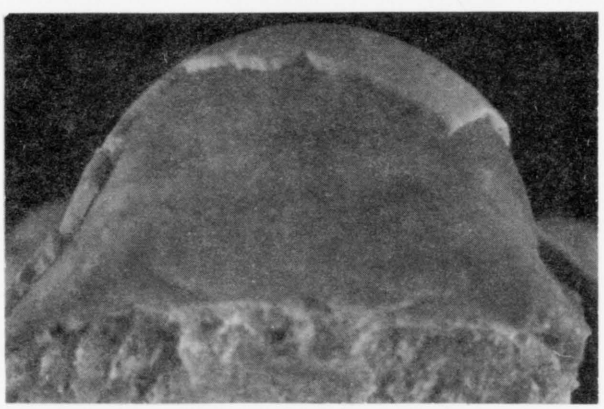

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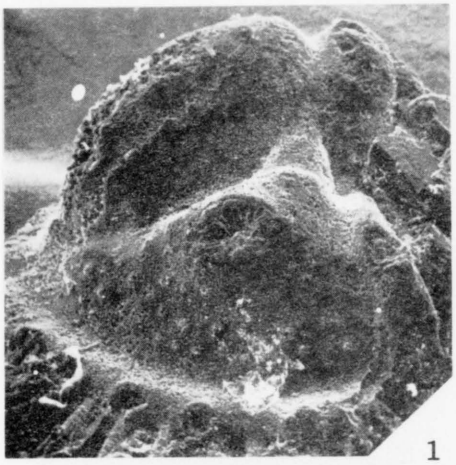
Tilsley - Derbyshire trilobites

(Explanation on p.170)



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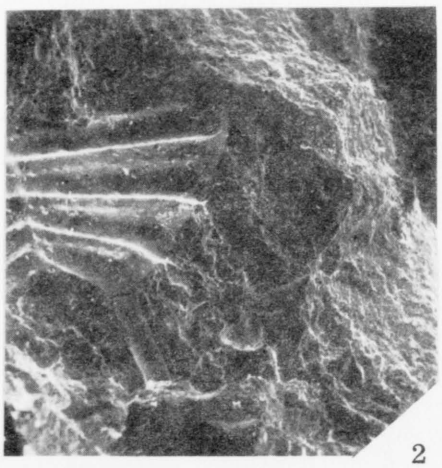

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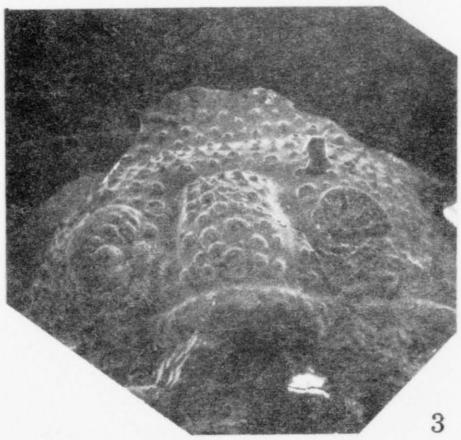

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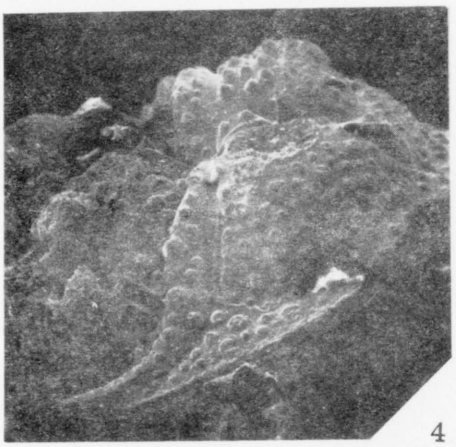

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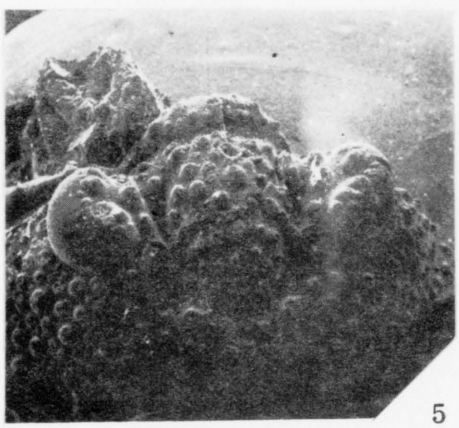

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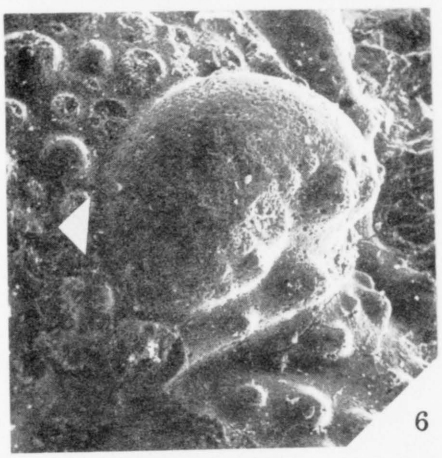

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Tilsley - Derbyshire trilobites

(Explanation on p. 170)