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The trilobite *Actinopeltis (Valongia) wattisoni* CURTIS, 1961 from the Valongo Formation (Ordovician) of North Portugal

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Key-words: Trilobite; Ordovician; Portugal; *Actinopeltis (Valongia)*; Morphology; Classification; Assemblage.

Abstract: New material of *Actinopeltis (Valongia) wattisoni* CURTIS, 1961 from the *borni* Biozone of the Valongo Formation of North Portugal, provides additional morphological features not observed on the holotype. The subfamily rank of *Actinopeltis* is briefly discussed but remains unresolved. *Valongia* PŘIBYL & VANĚK, 1984 is relegated to subgeneric rank. The stratigraphic level of the species is established within the *Placoparia (Coplacoparia) borni* Biozone and the composition of the trilobite faunal assemblage is discussed in relation to contemporaneous Ibero-Armorican trilobite faunas.

Palavras-chave: Trilobite; Ordovícico; Portugal; *Actinopeltis (Valongia)*; Morfologia; Classificação; Agrupamento.

Resumo: Novo material de *Actinopeltis (Valongia) wattisoni* CURTIS, 1961, da Biozona *borni* da Formação de Valongo no Norte de Portugal, permite adicionar elementos morfológicos não observados no holótipo. A classificação da subfamília do *Actinopeltis* é brevemente discutida, mas mantém-se indefinida. *Valongia* PŘIBYL & VANĚK, 1984, é relegada para subgénero. O nivel estratigráfico da espécie é estabelecido dentro da Biozona de *Placoparia (Coplacoparia) borni* e a composição do agrupamento faunal das trilobites é discutida em relação às faunas das trilobites Ibero-Armoricanas contemporâneas.

INTRODUCTION

CURTIS (1961) described *Actinopeltis wattisoni* sp. nov. on the basis of a single, nearly complete, deformed specimen from the Valongo Formation (ROMANO & DIGGENS, 1973/74) of North Portugal, in which he noted the additional thoracic segment in *Actinopeltis wattisoni* compared to all the other species of the genus.

A new genus *Valongia* was erected by PŘIBYL & VANĚK (1984, p. 126), to accommodate the single species *Valongia wattisoni* (CURTIS, 1961), and the proposal of this new genus was provisionally accepted by ROMANO (1991, pp. 351-352).

DELGADO (1892, pp. 14, 29) listed *Cheirurus (Actinopeltis) octolobatus* M^{c}COY from the upper part (horizon C) of the Valongo slates; the species however was omitted from the faunal list in his «Système Silurique du Portugal» (DELGADO, 1908, p. 106) and indeed all cheirurinid material from the upper part of the Valongo Formation in the Delgado collection of the «Instituto Geológico e Mineiro» in Lisbon can be attributed to the genus *Eccoptochile* (*sensu* ROMANO, 1980).

We apply here the sample scheme adopted by TAUBER & REIS (1994, pp. 37, 40) and present data on the diversity and relative abundance of the trilobite assemblage at the level at which *Actinopeltis (Valongia) wattisoni* occurs.

New material of this species has recently been recovered which allows a more detailed morphological description together with firm evidence of the age and stratigraphic level of the species.

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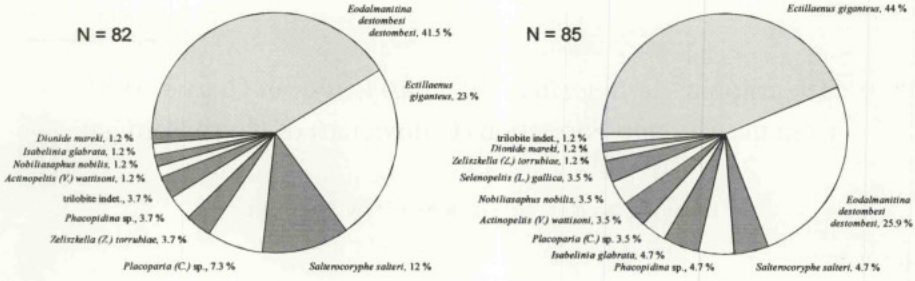

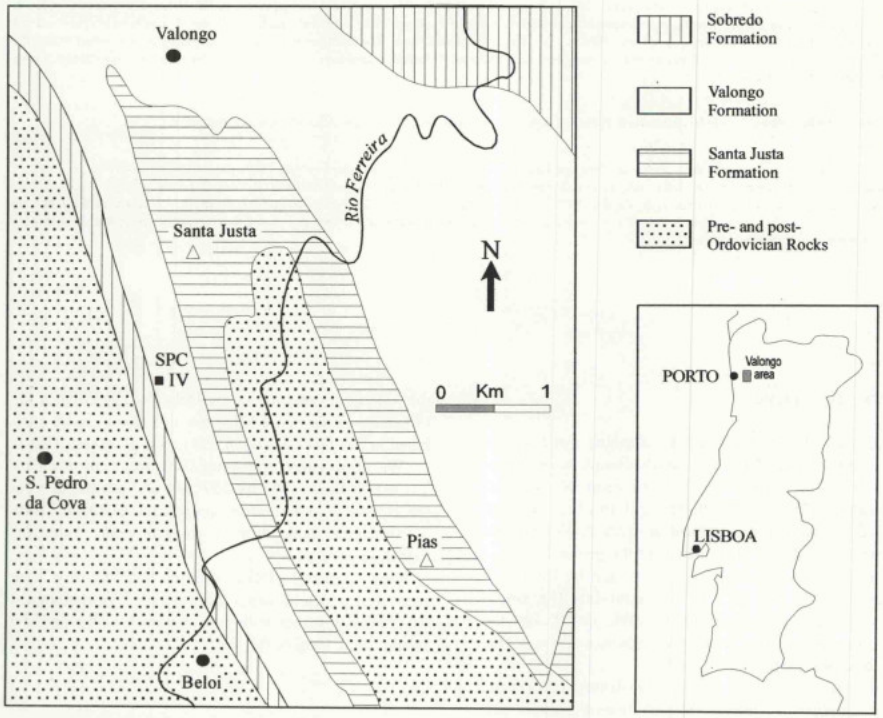

Fig. 1 – Simplified geological map of the Valongo area (after MEDEIROS *et al.*, 1980; Geological map of Portugal, sheet 9 - D).
a, b - Pie charts showing composition and relative abundance of trilobite faunas from sample SPC IV cq and sample SPC IV cr respectively. For explanation see text.

SYSTEMATICS

Family Cheiruridae HAWLE & CORDA, 1847

Subfamily uncertain

Remarks

The genus *Actinopeltis* HAWLE & CORDA, 1847 was questionably assigned to the subfamily Cheirurinae by LANE (1971, pp. 8-9) on the basis of the similarities in the construction of the thoracic pleurae; he noted however similarities with the Eccoptochilinae in both the cephalon and pygidium. PŘIBYL *et al.* (1985, p. 125) maintained the subfamily Cyrtometo-pinae, regarded as a junior synonym of the Cheirurinae by LANE (1971, p. 9), to which they assigned *Actinopeltis* and *Valongia* PŘIBYL & VANĚK (1984, p. 126). HAMMANN (1992, p. 100) maintained *Actinopeltis* within the Cheirurinae, but noted the resemblance in glabellar and thoracic construction with the Deiphoninae.

Actinopeltis (Valongia) wattisoni CURTIS, 1961 does show close affinities with the Eccoptochilinae (*sensu* LANE, 1971, p. 44 and HAMMANN, 1992, p. 103) in thoracic construction, while the younger subgenus *Actinopeltis (Actinopeltis)* is very similar to the Deiphoninae, suggesting a close affinity for the subfamilies Eccoptochilinae and Deiphoninae with the genus *Actinopeltis*. The inclusion of *Actinopeltis* within the Cheirurinae is therefore not followed here. The current knowledge of early Ordovician cheirurid phylogeny does however not allow a clear classification of *Actinopeltis* within the presently defined subfamilies.

Genus *Actinopeltis* HAWLE & CORDA, 1847

Type species. *Cheirurus globosus* BARRANDE, 1846 from the Zahorany and Bohdalec formations, Caradoc, Bohemia.

Diagnosis

The diagnosis given by PRANTL & PŘIBYL (1947, pp. 27-28) is retained with the exception of 'Thorax of 11 or 12 segments.'.

Subgenus *Valongia* (PŘIBYL & VANĚK, 1984)

Type species. *Actinopeltis wattisoni* CURTIS, 1961 from the upper part of the Valongo Formation, *Placoparia (Coplacoparia) borni* Biozone, Llandeilian/Dobrotivian (*sensu* FORTEY *et al.*, 1995/GUTIÉRREZ-MARCO *et al.*, 1995), near Covelo, North Portugal.

Diagnosis (emended from PŘIBYL & VANĚK, 1984)

Glabella overhanging anterior margin of cephalon by about two-sevenths of glabellar length (excluding occipital ring). Eye situated well forwards near glabella. Length of palpebral lobe about one-fourth of glabellar length (excluding occipital ring). Thorax with twelve segments, proximal part of pleurae parallel sided. Pygidium with large terminal piece which extends to posterior margin.

Ornament of large tubercles on glabella, transverse row of large nodes on occipital ring, posterior border of cephalon, posterior part of axial rings and pleurae of both thorax and pygidium.

Remarks

The present authors regard the presence of twelve thoracic segments to be only of subgeneric status, and that the general morphological characteristics of *Actinopeltis (Valongia) wattisoni* indicate inclusion within the genus *Actinopeltis*. Thus *Valongia* PŘIBYL & VANĚK, 1984 is here relegated to subgeneric rank.

Actinopeltis (Valongia) wattisoni CURTIS, 1961

(Pl. I, Figs 1-5; Pl. II, Figs 1-4)

v* 1961 *Actinopeltis wattisoni* sp. nov. - CURTIS, pp. 8-11; Pl. 3, Fig. 2; Pl. 4, Fig. 1.

1974 *Actinopeltis wattisoni* CURTIS - HAMMANN, p. 105.

1982 *Actinopeltis wattisoni* CURTIS - ROMANO, p. 96.

1984 *Valongia wattisoni* (CURTIS) - PŘIBYL & VANĚK, p. 126; Fig. 4.3.

1985 *Valongia wattisoni* (CURTIS) - PŘIBYL, VANĚK & PEK, p. 130; Pl. 2, Fig. 4.

1989 *Valongia wattisoni* (CURTIS) - RÀBANO, Figs 5, 6.

1991 *Valongia wattisoni* (CURTIS) - ROMANO, pp. 351-352.

1994 *Valongia wattisoni* (CURTIS) - TAUBER & REIS, Tbl. 2.

Material

Holotype: In 49184, internal and external moulds of nearly complete specimen. Upper part of Valongo Formation, near Covelo. J. T. Wattison collection, The Natural History Museum, London.

Hypotypes: Internal and external moulds of nearly complete specimen, SPC IV cq 95029; internal mould of incomplete cephalon-thorax, SPC IV cr 96071; internal and external moulds of pygidium SPC IV cr 01396.

Other material: Internal mould of cranidium, SPC IV cr 96074, and a small fragment of an internal mould of a cranidium from sample SPC IV cr (not collected).

Hypotypes and other material from the upper part of the Valongo Formation; Locality SPC IV, samples cq and cr, 40-41 and 41-42 metres below the top of the formation respectively, *borni* Biozone, 1125 m 189° SSW from the summit of Santa Justa.

Hypotypes deposited in the «Instituto Geológico e Mineiro» in Lisbon.

Diagnosis

As for subgenus.

Description

Cephalon convex, about twice as wide as long and less than two-sevenths of total length of carapace. Glabella strongly convex, about six-sevenths as wide as long (excluding occipital ring), oval in outline and expanding anteriorly, reaching maximum width at about level with anterior corner of lateral border furrow and overhanging anterior margin of cephalon by about two-sevenths of glabellar length. L1 lobe prominent with independent convexity, defined by well-developed S1 furrow which starts just under one-fourth of glabellar length, directed backwards and inwards, reaching to about half L1 length. Distance between S1 furrows just under four-sevenths of glabellar width at level of L1. S2 short, directed slightly forwards and starting just under half of glabellar length. Very short S3 starts just under five-sevenths of glabellar length, approximately level with antero-lateral margin of cephalon.

Occipital ring less elevated than glabella and just over one-fourth of width of cephalon, posterior margin arching forwards medially, anterior part medially sloping down to shallow and wide median part of occipital furrow which is curved forwards. Lateral part of occipital ring furrow deep and wide, delimiting slightly forwards orientated occipital ring lobe.

Fixed cheek with deep and wide posterior border furrow. Posterior border slightly convex (exsag.), outer half sloping downwards abaxially, point of bending slightly swollen. Genal spine rounded in cross-section and bluntly pointed, more than half as long as glabellar length (excluding occipital ring) and extending backwards and slightly outwards to about posterior end of second thoracic segment.

Free cheek small, sharply sloping down anteriorly, lateral border wide and strongly convex, lateral border furrow deep anteriorly, becoming shallow where it curves inwards to meet posterior border furrow near base of genal spine.

Eye on raised palpebral lobe which is postero-laterally orientated and forwardly inclined, palpebral furrow deep and situated approximately level with L2, relatively close to axial furrow anteriorly. Eye well below level of top of glabella. Length of palpebral lobe about one-fourth of glabellar length. Posterior section of facial suture directed outwards from posterior end of palpebral lobe, crossing lateral border furrow, then curving sharply backwards cutting lateral margin approximately level with middle of L1. Anterior section of facial suture runs forwards and inwards, passing under overhanging glabella.

Doublure ventrally convex and nearly as wide as lateral border.

Hypostome unknown.

Thorax with twelve segments, less than four-sevenths as long as total length of carapace, anteriorly as wide as cephalon, progressively tapering posteriorly. Axis convex, about one-fourth of thoracic width (tr.) and delimited by moderately deep axial furrows. Posterior margin of rings arching forwards medially, anterior part of rings medially sloping down, separated from raised articulated half rings by transverse furrows. Ring lobes slightly directed forwards; deep apodemal pits situated anterior to ring lobes.

Proximal part of pleurae parallel sided and with thin anterior and posterior auxiliary bands. Antero-lateral corner of pleurae slightly swollen, proximal part of pleurae separated from tapering spines by a swollen and raised fulcrum. Spines bluntly pointed and orientated downwards, posteriorly progressively orientated backwards. Doublure extending as far in as fulcrum.

Pygidium slightly more than one-seventh of total length of carapace and about three-sevenths as long as wide. Axis with four axial rings and a large terminal piece which extends to posterior margin (sag.), axis rapidly sloping downwards and tapering posteriorly, delimited by progressively weaker axial furrows. Anterior ring with articulated half ring, other rings fused medially.

Pleural region with four pairs of pleurae. Proximal part of pleurae with adaxially deep, pit-like interpleural furrows which rapidly shallow and widen abaxially, showing fused auxiliary bands. Proximal part of posterior pair of pleurae with posterior auxiliary band fused to terminal piece. Pleurae with spines which are bluntly pointed. Spines progressively decrease in length and directed more rearwards posteriorly, except for posterior pair which is considerably shorter.

Doublure at least as wide as spines of pleurae, crossing posterior one-third of terminal piece.

Ornament. Glabella with widely spaced large tubercles of irregular size. Posterior border with transverse row of large nodes. Fixed and free cheeks, except borders, with pits which are broadly arranged in semi-elliptical curves. Lateral border and genal spine with apparently randomly arranged large nodes.

Posterior parts of occipital ring and axial rings of both thorax and pygidium with a transverse row of large nodes, about ten on occipital ring and first thoracic ring, eight on last thoracic ring, six on first pygidial ring and two on last pygidial ring.

Posterior parts of pleurae of both thorax and pygidium with a transverse row of large nodes, more prominent on proximal part of thoracic segments which bear a maximum of four nodes. Anterior border of proximal part of thoracic segments with transversely orientated median sized nodes occasionally visible.

Proximal part of pleurae of thoracic segments and first two pygidial segments with a median transverse row of small pits only preserved on internal mould of holotype, preserved as a shallow furrow on external moulds.

A faint median 'furrow' is occasionally visible on spines of both thorax and pygidium on both internal and external moulds, which is here interpreted as being an internal structure.

External surface of entire carapace covered with fine granules.

Discussion

Three closely related species of *Actinopeltis (Actinopeltis)* are present in the upper Ordovician of Iberia; *A. (Actinopeltis) tejoensis* ROMANO, 1991 (Queixoperra Member of the Cabeço do Peão Formation, early Caradoc, central Portugal), *A. (Actinopeltis) spjeldnaesi* HAMMANN, 1972 ('Bancos Mixtos', ?middle Caradoc, central Spain) and *A. (Actinopeltis)* aff. *spjeldnaesi* HAMMANN, 1992 (Cystoid Limestone, Ashgill, NE Spain).

Although only in the Portuguese species is the number of thoracic segments known (11), all three species show consistent differences from *A. (Valongia) wattisoni*.

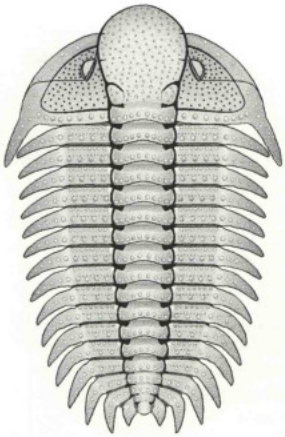

Fig. 2 – Tentative reconstruction of *Actinopeltis (Valongia) wattisoni* CURTIS, 1961, approximately x 1.5.

They possess a more strongly inflated and overhanging anterior part of glabella and less well developed L1, longer genal spines, an abaxial constriction on the proximal part of the thoracic pleurae, weaker interpleural furrows on the pygidium and a less developed and more enclosed terminal piece.

At least seven Bohemian species of *A. (Actinopeltis)* are known which range from Caradoc to Ashgill (see BARRANDE, 1846, 1852, 1872; KIELAN, 1959; PŘIBYL & VANĚK, 1969; ŠNAJDR, 1982). A maximum of eleven thoracic segments is present in these species and the cephala show substantial morphological variation (KIELAN, 1959, p. 51). However it is the thorax and pygidium which exhibit considerable differences to those present in *A. (Valongia) wattisoni*. The proximal part of the thoracic and pygidial pleurae of the Bohemian species show similar characteristics to those of the Iberian species of *A. (Actinopeltis)*, and the pygidial spines show more variation in shape but less range in length than either in the Iberian species of *A. (Actinopeltis)* or *A. (Valongia) wattisoni*.

PŘIBYL *et al.* (1985, p. 128) discussed the evolutionary lineage of *Valongia-Actinopeltis* and considered *Valongia* to be ancestral to *Actinopeltis*. We provisionally agree with these authors and consider that *A. (Valongia) wattisoni* is a likely ancestor of the *A. (Actinopeltis)* group but more material is required, such as ontogenetic stages and hypostomes, before details of the phylogenetic relationships may be resolved.

TABLE I

Reduced data of samples cq and cr from locality SPC IV, 40-41 and 41-42 metres below the top of the formation respectively. A = total trilobite remains. B = estimated exoskeletons. C = percentage of estimated exoskeletons

	Sample SPC IV cq			Sample SPC IV cr		
	A	B	C	A	B	C
Placoparia (C.) sp.	13	6	7.3	4	3	3.5
Actinopeltis (Valongia) wattisoni	1	1	1.2	4	3	3.5
Salterocoryphe salteri	14	10	12	6	4	4.7
Eodalmanitina destombesi destombesi	52	34	41.5	32	22	25.9
Zeliszkella (Z.) torrubiae	3	3	3.7	1	1	1.2
Phacopidina sp.	3	3	3.7	4	4	4.7
Nobiliasaphus nobilis	1	1	1.2	2	2	2.4
Isabelinia glabrata	2	1	1.2	5	4	4.7
Dionide mareki	1	1	1.2	1	1	1.2
Ectillaenus giganteus	32	19	23	48	37	44
Selenopeltis (L.) gallica	0	0	0	3	3	3.5
Trilobite indet.	31	3	3.7	40	1	1.2
Total	153	82	100.1	150	85	100

BIOSTRATIGRAPHY AND BIOGEOGRAPHY

Actinopeltis (Valongia) wattisoni is presently only known from between 40-42 m below the top of the Valongo Formation. The species appears to be rare and is represented by only six specimens (including holotype of unknown locality); it has not been recorded outside the Valongo area.

Actinopeltis (Valongia) wattisoni occurs in an assemblage dominated by trilobites, with rare (sample cq) to very common (sample cr) crinoids, common cephalopods, and very rare brachiopods. The trilobite faunal assemblage (see Table 1) indicates the *borni* Biozone (*sensu* HENRY & CLARKSON, 1975), particularly by the presence of *Eodalmanitina destombesi destombesi* and *Zeliszkella (Z.) torrubiae* (see TAUBER & REIS, 1994, Fig. 3). This is further supported by the occurrence of *Placoparia (Coplacoparia) borni* 25 m below sample SPC IV cr. Faunal assemblages with *Placoparia (C.) borni, Eodalmanitina destombesi destombesi* and *Zeliszkella (Z.) torrubiae* are present in contemporaneous Spanish and French sequences but *Actinopeltis (Valongia) wattisoni* has not been recorded from these areas. The reasons for this are not readily apparent but may be due to a combination of the rarity of the species, sample bias and/or restricted distribution of the species. The middle Ordovician sequences in North Portugal are representative of relatively deep water/offshore environments (BRENCHLEY *et al.*, 1986; RÀBANO, 1989) and may have favoured the life style of *A. (Valongia) wattisoni*; hence it is not surprising that the species has not been recorded from more proximal facies.

The reason for the apparent sudden appearance of the species is not obvious but may be associated with the concomitant increase in abundance of *Selenopeltis (L.) gallica*, the relative rareness of the genus *Placoparia* and the absence of *Neseuretus (N.) tristani.* These changes in the faunal composition may be related to a relative increase in sea level.

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PLATES

PLATE I

Actinopeltis (Valongia) wattisoni CURTIS, 1961.

1 – Internal mould of laterally compressed and partly flattened cephalon-thorax, hypotype SPC IV cr 96071 (x 4.3).

2, 4 – Internal mould (x 7) and latex cast of external mould (x 7.5) of laterally compressed pygidium, hypotype SPC IVcr 01396.

3, 5 – Latex cast of external mould (x 2.3) and lateral view of cephalon (x 4.3) of obliquely deformed nearly complete specimen with convexity partly preserved, hypotype SPC IV cq 95029.

For details of localities and horizon see text. All material whitened with ammonium chloride before photographing.

1

2

3

4

5

PLATE II

Actinopeltis (Valongia) wattisoni CURTIS, 1961.

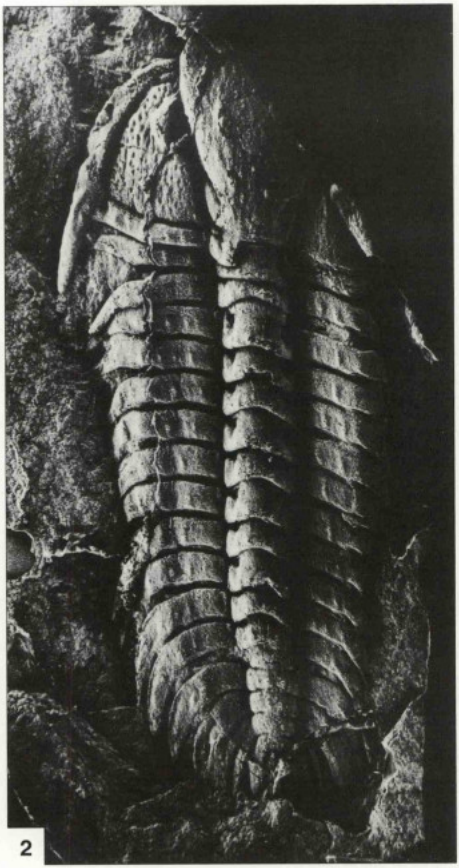
1, 2 – Internal mould (x 2.2) and latex cast of external mould (x 2.3) of laterally compressed and partly flattened nearly complete specimen, holotype In 49184 (figured: CURTIS, 1961; Pl. 3, Fig. 4; Pl. 4, Fig. 1).

3 – Detail of thoracic segments from internal mould of holotype showing transverse row of pits (x 5.1).

4 – Lateral view of cephalon from latex cast of external mould of holotype (x 3.1).

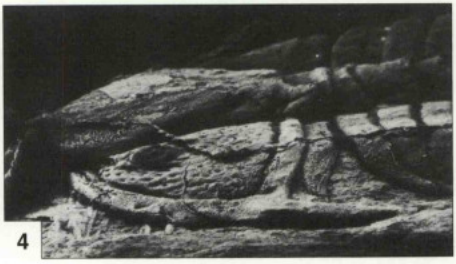
For details of localities and horizon see text. All material whitened with ammonium chloride before photographing.

1



2

3



4