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NOTES
ON PTERASPIDS FROM ARTOIS AND THE ARDENNE,

by Errol Ivor WHITE (Londres).

(With 3 Plates.)

1. — THE PTERASPIDS OF VIMY-FRESNOY (Fosse No. 1).

The specimens from the « schistes et grès bigarré de Vimy » described here have been mentioned in print a number of times, and have been referred to several different species. BARROIS, PRUVOST and DUBOIS (1) first recorded them as « *Pteraspis dewalquei* FRAIPONT », noting them as « une remarquable série de boucliers d'un *Pteraspis* de grande taille recueillie à Vimy par M. le directeur LAFONT », and with them they recorded *Pteraspis rostrata* AGASSIZ. It is noteworthy that these authors clearly distinguished *P. dewalquei* from « *P. dunensis* du Coblentzien », in contrast to M. LERICHE (2) who considered the two forms to be identical. LERICHE's opinion was quoted with approval by ASSELBERGHS (3) in support of his idea that *P. dunensis* and *P. rostrata* overlapped in range in the Upper Gedinnian; but he also quotes, in a footnote, M. PRUVOST's important contrary opinion that not only were *Pteraspis dunensis* and *P. dewalquei* distinct, but that the specimens from Vimy belonged to neither species. Subsequent investigations have fully borne out Professor PRUVOST's contentions and the specimens are described as belonging to a new species in this communication.

In later years M. LERICHE undertook the study of the Vimy specimens and decided that, in spite of the large size of most of them, all were referable to *P. rostrata* (4); and, indeed, they do resemble large specimens of that species in many ways (5).

(1) C. BARROIS, P. PRUVOST et G. DUBOIS, 1922, p. 170.

(2) M. LERICHE, 1912, proc. verb., p. 6.

(3) E. ASSELBERGHS, 1942, pp. B37-38.

(4) M. LERICHE, 1948, p. 195, footnote.

(5) E. I. WHITE, 1935, p. 448, text-figs. 9, 34, 89.

His proposed memoir on them was never written, but before he died he did prepare a few very brief notes on some of the specimens and a good series of photographs, which I have been able to study along with some of the original specimens (B, D, E, J, K listed below) through the kindness of the acting director, M. LELOUP, and of Dr. Edgar CASIER.

One small dorsal disk with dorsal spine (U; Pl. III, fig. 6) seems clearly referable to *Pteraspis (Belgicaspis) crouchi* LANKESTER (6). It was found at a depth of 385 metres, 17 metres below the other specimens, which, with one exception, belong to much bigger animals. Although all the large plates are broken and come from depths varying between 368 and 333 metres — a range of 35 metres — they seem to belong to a single undescribed species; and so far as I know *P. rostrata*, as recorded by BARROIS, PRUVOST and DUBOIS, was not present.

Since M. LERICHE's death in 1948 considerable progress has been made in our knowledge of the agnatha and of *Pteraspis* in particular. In 1956 (7) I drew attention to the importance of the pre-oral fields and figured among others that of *P. rostrata*, which is very clearly marked and covers most of the undersurface of the rostrum. On the contrary, in the specimens from Vimy that show the ventral side of the rostrum, there is no pre-oral field as such, for the fine ridges of the so-called ornament run directly across the undersurface of the rostrum (Pl. I, fig. 2; Pl. II, fig. 1). They do not therefore belong to *P. rostrata* or to the typical sub-genus (of which *P. rostrata* is the type species), but may be referred to the group called « *Pseudopteraspis* » by STENSIÖ » (8), but properly *Althaspis* of ZYCH (9).

I propose, therefore, to establish for these specimens a new species, *Pteraspis (Althaspis) vimiensis* sp. nov.

SYSTEMATIC DESCRIPTION.

Pteraspis (Althaspis) vimiensis, sp. nov.

The specimens are as follows :

- A, B. Incomplete dorsal shields, dorsal view, showing the rostrum, pineal plate, parts of the orbitals and the anterior part of the dorsal disk. In B (I. G. No. 19.136/1) all the surface of the armour is lost, and in A. it is preserved only on the rostrum.

(6) See M. LERICHE, 1906, p. 27, pl. II.

(7) E. I. WHITE, 1956, p. 8, fig. 2.

(8) E. A. STENSIÖ, 1958, p. 254, etc., figs. 136 A, 140 A, B, 144, 157.

(9) W. ZYCH, 1931, pp. 89, 91.

Pteraspis elongata Zych is the only properly established species (see F. BROTZEN, *Die silurischen und devonischen Fischvorkommen in Westpodolien. I. Palaeobiologica, Band V, p. 456, fig. 16*) among those referred to « *Pseudopteraspis* » by STENSIÖ (*elongata*, *zychi*, *kujdanowiensis*) or to *Althaspis* by ZYCH (*elongata*, *major* ZYCH non ALTH) and is hereby selected as the type-species of both. The type-species of *Podalaspis* ZYCH, in which *Althaspis* was originally included as a sub-genus, was clearly meant to be *P. rostrata* ZYCH, non *Pteraspis rostrata* (AGASSIZ), as being the only species of *Podalaspis* not placed in a sub-genus, and is hereby selected as such.

- C. A rostrum without the tip, but with pineal plate and part of the orbitals, in dorsal view.
- D. A small almost complete rostrum in ventral view (I. G. No. 19.136/5).
- E. A large rostrum in ventral view, to which part of the dorsal disk is attached. The hinder (pre-oral) margin is broken away (I. G. No. 19.136/4).
- F. Imperfect dorsal spine.
- G. Fragment of dorsal spine.
- H. Imperfect left branchial plate.
- I. Internal cast of ventral disk, broken in front.
- J. Somewhat larger ventral disk with small part of disk attached (I. G. No. 19.136/3).
- K. Ventral disk lacking hindmost quarter (I. G. No. 19.136/2).
- L. Anterior part of ventral disk.
- N.-P. Flank-scales.
- Q. Dorsal ridge scale.
- R. Flank-scale.
- S. Ventral ridge-scale.
- T. Dorsal ridge-scale.
- V. Small ventral disk, very imperfect, possibly young form.

The vertical distribution of the specimens is as follows :

333 metres	...	...	...	Q
341	»	...	...	C, D, G, I, K, N, O, P, ?S, V
343	»	...	...	H
354	»	...	...	E, R
355	»	...	...	B
368	»	...	...	A, J, L
unknown	...	...	...	F, T

The Rostrum (A, B, C, D) is rather long and triangular with a broadly rounded tip. A, the holotype (Pl. I, fig. 1), has a dorsal median length of 6.5 cm with a maximum breadth of 4.0 cm, while in B (Text-fig. 1) the measurements are 6.0 cm and 3.8 cm respectively. The proper uncrushed state is indicated by E, which shows much of the under-surface, and a thick fractured cross-section, 1 cm thick, 4.3 cm from

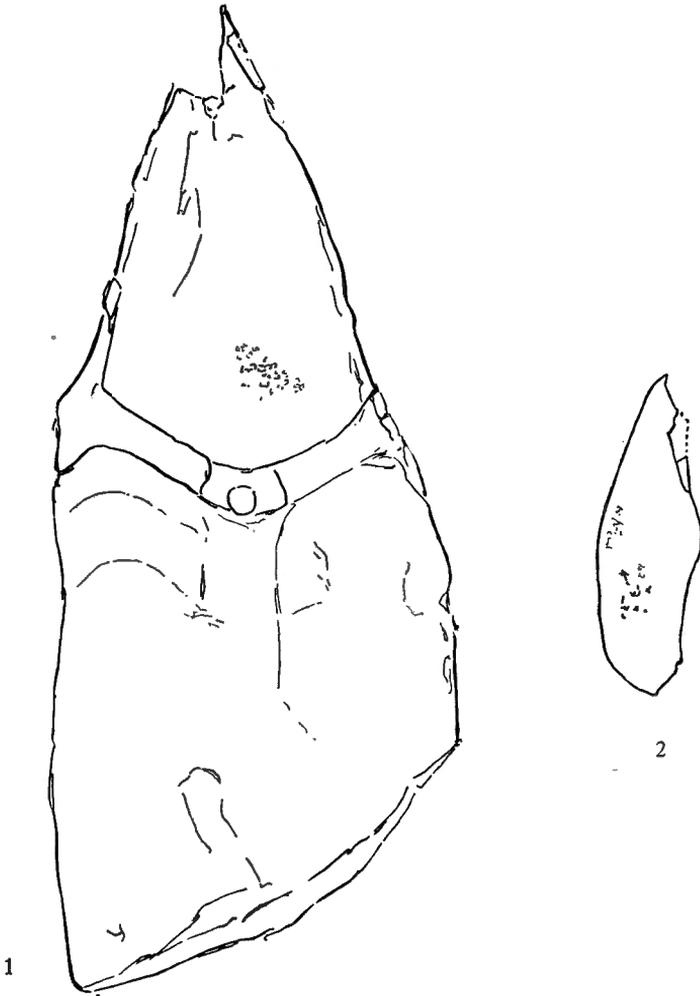


Fig. 1. — *Pteraspis (Althaspis) vimiensis*, sp. nov.
Imperfect dorsal shield (B) Vimy-Fresnoy, fosse no. 1. depth 355 metres
I. R. Sc. N. B., E. F. P 1444/IG. 19.136 ($\times 1$).

Fig. 2. — *Pteraspis (Althaspis) vimiensis*, sp. nov.
Natural cross-section of rostrum, ventral face to right (E), Vimy-Fresnoy, fosse No. 1, depth 354 metres. I. R. Sc. N. B., E. F. P 1439/IG. 19.136.4 ($\times 1\frac{1}{3}$).

the tip (Text-fig. 2). How much is missing it is difficult to say, but the upper side of the rostrum continues for another 4.2 cm without any indication of the orbitals or pineal plate that I can see. This rostrum was therefore at least 8.5 cm long. The section shows, of course, the honey-comb structure of the middle polygonal layer which fills the rostrum, and this extended backwards on the dorsal side for another 17 or 18 mm, where the basal layer commences. The maximum width (double the half-width preserved) near the broken hinder end is about 5.5 cm. The exposed undersurface of this is entirely covered with transverse ridges of the ornamentation. There is a marked broad median longitudinal ridge flanked by corresponding depressions with two smaller shallower grooves along the margin.

D is a much smaller specimen of a rostrum largely exposed from the ventral side (Pl. II, fig. 1). The underside is flattened, and the central ridge and corresponding grooves on either side completely suppressed, but the small marginal groove and those formed by the sensory canals are shown on its left side. The rounded tip is also curved downwards. The length of the undersurface is 3.1 cm from the tip to the slight median pre-oral projection. Whether this is the true pre-oral margin is not obvious, but it seems likely that it is, judging by its shape and the absence of the infilling of the polygonal middle layer in a nearby fracture, so that the specimen is juvenile and not fragmentary. A small part of the upper surface, fractured and broken short, is also exposed on the other side of the specimen, and here the infilling middle layer is thin and near its limit and the basal layer of the upper surface well-developed.

Pineal and orbital plates. — Specimens A, B (Pl. I, fig. 1; Text-fig. 1) and C show parts of these plates. The medial extensions of the orbitals are in full contact with the wide V-shaped pineal plate, completely cutting off the rostrum from the dorsal disk by a broad and usually even band. In « B » the pineal plate in impression was about 6 mm long and 11 mm broad.

Dorsal disk. — Only specimens A (Pl. I, fig. 1) and B (Text-fig. 1) show parts of the dorsal disk. The anterior emargination is very wide, occupying the whole of the front margin in B with a nearly straight edge on each side, but in A the edges especially on the left side, are more bowed. The growth-lines in this specimen also suggest that the curvature was more marked in the young animal.

Dorsal spine. — A very imperfect dorsal spine « F » includes part of the socket. It measures 3.8 cm long and was clearly considerably longer when complete. It was of the usual laterally compressed form, distally oval as a second fragment « G » shows.

Branchial plate. — The only example of this plate in the collection (H), from the left side, lacks the anterior end and has part of the surface broken away (Pl. II, fig. 2). As preserved it is just over 5 cm

in length, and judging by the marked appearance of the V-shaped growth-lines in front, little is missing in front.

The emargination for the branchial opening is long, while the plate in lateral view is still deep without indication of a sub-cornual posterior extension. The flattish upper and lower surfaces, of which the latter is much the broader, are clearly separated by a marked angle, especially sharp and keel-like behind (Pl. III, fig. 1).

Ventral disk. — There are four examples of this plate. I (Pl. I, fig. 4) and J are somewhat imperfect internal casts, the latter with a small fragment of plate preserved in front; K (Pl. II, fig. 3) is the anterior two-thirds of a rather flattened disk, and L comprises rather less than the anterior half.

They represent long and relatively narrow plates like those of *P. (Rhinopteraspis) dunensis*. J measures approximately 11.5 cm long, and may have been 1 cm or so longer as the posterior angle is broken away. Its left side (right of observer) seems reasonably undistorted and shows a moderately convex transverse profile in front but a markedly convex profile behind, where the two sides are, as usual in these long forms, pinched in to form a broad median ridge. The anterior margin is well rounded in K (Pl. II, fig. 3), and shows only a very short anterior flattening in L.

In I (Pl. I, fig. 4), a similar specimen to J but smaller, the posterior end is preserved. The two somewhat concave sides meet at approximately a right angle to form a blunt point.

Scales. — There are 7 scales in the collection (Pl. I, fig. 3; Pl. III, fig. 2-5), of which N, P, R are deep diamond-shaped flake-scales varying slightly in form, but all approximately symmetrical about the horizontal mid-line (10). Their exposed surfaces measure :

N, 6 mm broad \times 7 mm high.

P, 4.5 mm broad (+ 0.75 overlapped area) \times 6.5 mm high.

R, 4.5 mm broad \times 8 mm high.

O, from its asymmetry, belonged nearer the ventral or dorsal midline, probably the former. It measures approximately 6.0 mm broad and 4.5 mm high.

The other three scales are ridge-scales; Q and T are from the elongated dorsal series, T being over 20 mm long but about 4.0 mm broad in the photograph.

S, 10 mm long and 8 mm wide as preserved, almost certainly belongs to the pre-anal ventral series.

None of these scales shows features unusual in the group.

Sensory Canal System. — The sensory canal system is poorly preserved, especially on the dorsal shields, where most of the surface

has disappeared on the major specimens, but where indications are preserved they indicate no marked difference from the usual pteraspid pattern. The ventral disks, K and L show the usual pattern for elongated plates with the anterior median V-shaped canal extremely long, as are also the postero-median branches of the lateral canals.

Ornamentation. — The ornamentation of the plates consists of the usual ridges arranged in the usual way on the plates where they are preserved, that is in general running parallel with the periphery of the plate. They are, however, extremely fine, ranging in general between 8 to 10 per mm on the ventral disks and the underside of the rostra, except near the centre of the plates where they are coarser (down to $5\frac{1}{2}$ -6 per mm) or near the postero-lateral margins where they are finer (up to 12 per mm).

The scales show the same fine ridges, 8-10 per mm. On the flank-scales these are divided more or less evenly on the whole surface by grooves in the form of chevrons parallel with the anterior margin at intervals of $3\frac{1}{2}$ -4 per mm. The intervals are greater on the ridge-scales and tend to become longer towards the tip. In no specimens are there ridges at the anterior margins parallel with them.

This uniform division of the ridges of the flank-scales is a pattern seen also in *Pteraspis (Rhinopteraspis) dunensis* and *P. (Cymripteraspis) leachi*, only it is coarser in both those species.

	Ridges per mm	Intervals per mm
	—	—
<i>P. (Alt.) vimiensis</i> . . .	8-10	$3\frac{1}{2}$ -4
<i>P. (C.) leachi</i> . . .	7-9	$2\frac{1}{2}$ -3 (P. 18050, P. 29329)
<i>P. (Rh.) dunensis</i> . . .	$4-4\frac{1}{2}$	3 (P. 31630)

This type of scale-ornament is distinct from that of other well-known pteraspids, such as *Pteraspis (P.) rostrata*, *P. (Belgicaspis) crouchi* and *P. (Simopteraspis) leathensis* (11), for in those the chevron-grooves are fewer and the intervals between them increase to the rear, while along the anterior border there are a number of ridges parallel with the border (and with the chevron-grooves) and so at right angles to the other ridges.

Remarks. — This species is clearly distinguished from the three other species assigned to « *Pseudopteraspis* » by STENSIÖ (12); the rostrum is much stouter than in « *Ps.* » *elongata* ZYCH and presumably also than in « *Ps.* » *zychi* STENSIÖ, but longer than « *Ps.* » *kujdanowiensis* STENSIÖ, but these last two species are incompletely figured and not defined.

The most significant evidence as to the approximate age of the Belgian species is the occurrence of *P. (Belgicaspis) crouchi* 17 metres beneath

(11) E. I. WHITE, 1950, p. 82, text-figs. 10-14.

(12) E. A. STENSIÖ, 1958.

the lowest level of *P. (Alt.) vimiensis*. This, in conjunction with the apparent absence of either *P. (B.) crouchi* or *P. (P.) rostrata* in or above the strata containing *P. (Alt.) vimiensis* does suggest that the *vimiensis* layers are at least in the upper half of the upper Gedinnian, between the *rostrata* and *dewalquei* beds (13).

2. — PTERASPIDS FROM NEAR FRAIPONT.

Through the kindness of Professor G. UBAGHS of Liège I have been able to examine an interesting series of specimens from near Fraipont, about 5 km west of Pepinster. These specimens, although fragmentary, are specifically identifiable and accordingly well worthy of record.

The collection was originally sent to Paris for examination, but Professor Jean PIVETEAU, on hearing of my interest in them, generously sent them to me for study.

The locality is as follows : « Commune de Fraipont, à \pm 500 m au sud du château (de Haute Fraipont) sur la rive gauche du Ruisseau de Ribeaufossé. »

The collection consists of ten specimens (F 1-X), on which are to be found parts of 16 individual plates. All but four are fragments.

The most important specimen is the impression of the upper surface of a rostrum (F. IX). It is 7 cm long and tapers evenly with a rounded tip. The ornamentation consists of blunt backwardly directed chevrons throughout. In both shape and pattern or ornamentation it is typical *Pteraspis (Cymripteraspis) leachi* (14) with the individual ridges perhaps a little coarser than in the typical specimens from South Wales.

The dorsal disk is represented by a very large and nearly complete specimen, in counterpart (F. III, F. V) which measures a little short of 17 cm in length, from the pineal notch to the end of the socket of the dorsal spine. It has the fine ornamentation, 8 ridges per mm, and wide anterior emargination typical of *P. (C.) leachi*. It is about 4 cm longer than any of the British specimens.

Fragments of two dorsal disks, largely in impression (F. X), indicate specimens as large as the foregoing, with the same wide anterior emargination and fine ornament. Two other fragments are also of large plates. That on F. VII shows the anterior margin, with a very wide straight-sided indentation, about 8 cm across. The ornamentation is relatively coarse, about 5 ridges per mm. The fourth fragment (F. VIII) largely an

(13) E. I. WHITE, 1956, p. 5.

(14) *Pteraspis leachi* is here referred to a new sub-genus *Cymripteraspis* to distinguish it clearly from the group of which *P. (Rhinopteraspis) dunensis* is typical. In the latter the pre-oral field is a triangular plate with longitudinally disposed dentine ridges (L. B. TARLO, 1958, p. 8) which, since this is the first time it has been found, is clearly a separate element, like that of *P. (Belgicaspis) crouchi*, although different in form and ornamentation : in *P. leachi* the very small plate has concentric ridges and is completely fused to the rostrum (E. I. WHITE, 1956, p. 6, text-figs. 1, 3). There are other differences to be noted elsewhere.

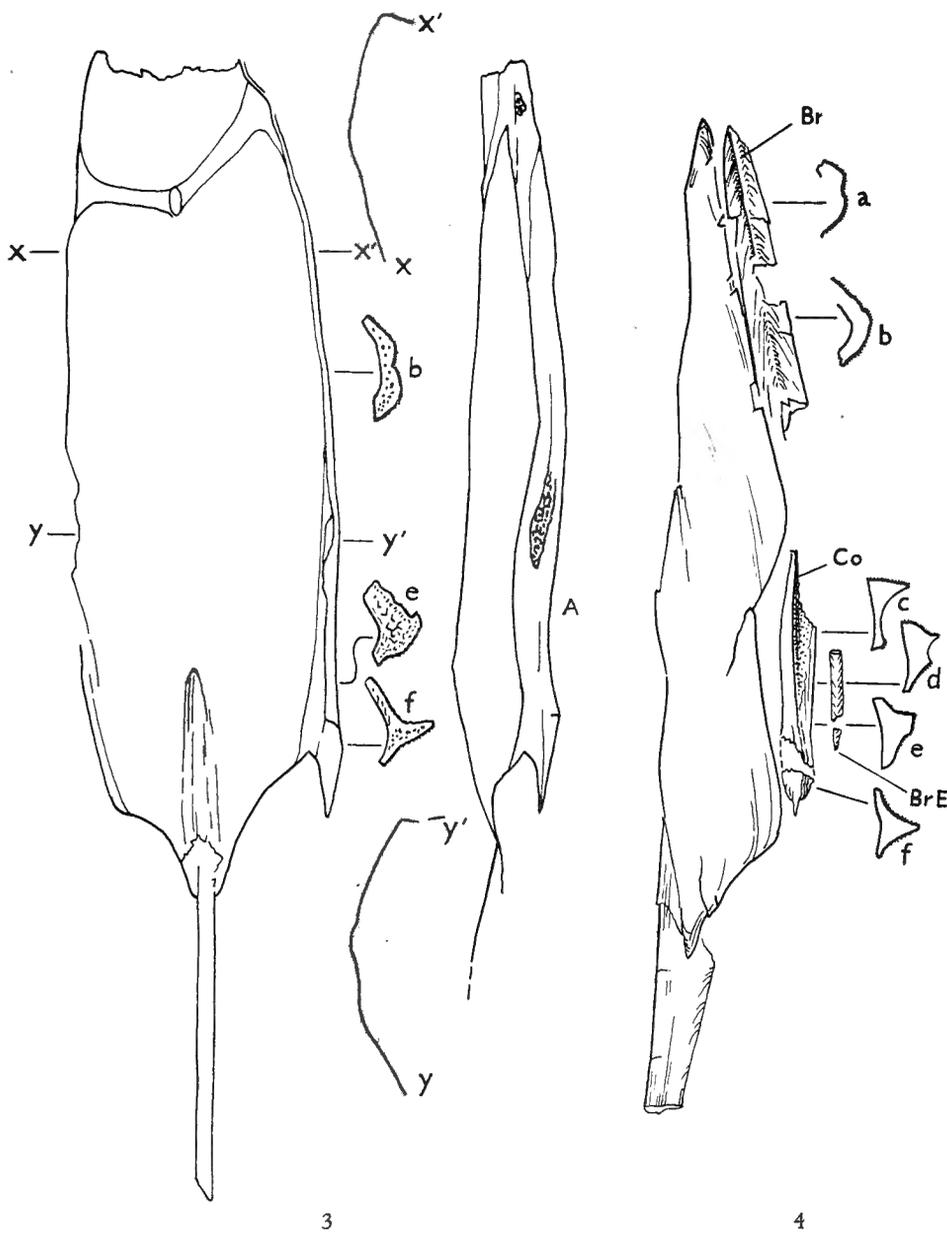


Fig. 3. — *Pteraspis dewalquei* FRAIPONT. The unique holotype, an internal cast with plates of the right side and the dorsal spine. Enlarged cross-sections (b, e, f) through the branchial and cornual plates. Cross-profiles of internal cast at x-x', y-y'. A, right side of internal cast. Schistes de St-Hubert, Carlsbourg, Lab. Pal. U. Liège ($\times \frac{2}{3}$).

Fig. 4. — *Pteraspis (Cymripteraspis) leachi* WHITE. Dorsal disk and spine from right side showing parts of the branchial plate (Br.) with its subcornual extension (Br. E.) and the cornual plate (Co.) with enlarged cross-sections a-f. Co-type, Swanlake Bay, S. Wales (Brit. Mus. P. 18044) ($\times \frac{5}{6}$).

internal cast, is even wider, measuring 9 cm across. Where the plate is preserved it shows 5-6 ridges per cm near the centre and 8-10 near the posterior edge of the lateral margin.

There is one almost complete branchial plate in the series and three fragments. The first (F. II) is nearly 9 cm long and resembles the branchial of *P. (C.) leachi* in general form and ornamentation, with the line of short vertical ridges between the two back-swept series running high under the lateral ridge, and not low down as in *P. (R.) dunensis* (cf. Text-fig. 4 and 6), and the anterior end of plate symmetrically pointed. The ornamentation, if a little coarser than in the typical *P. (C.) leachi*, is markedly less than in *P. (R.) dunensis*. The fragments (F. VII, F. IX) are not important.

All the Fraipont ventral disks are very imperfect. The two best (F. I, F. IV) are largely preserved as internal casts and represent plates of about 17 and 13 cm respectively in length. There are four other fragments (F. II, F. IV₂, F. VI(2), and F. X). Most show very coarse ridging in the central area, as coarse as 4 per mm, but reach twice that number marginally. The former number is within the range of *P. (R.) dunensis*, but hardly the latter. Unfortunately no specimens of this plate belonging to *P. (C.) leachi* are known from the type locality in Wales for comparison, but in a small example from Noncevaux the ridges are as few as 5 per cm. It is probable that the ornamentation is always relatively coarse in the central region of this plate in *P. (C.) leachi*, to which all this material may be assigned. Nevertheless, there is throughout this collection a tendency to a rather coarser ornamentation than is typical, and this combined with a generally larger size of individual plate suggests that we are dealing with a local form, or possibly with one differing somewhat in age from the original Welsh specimens. If the latter, then by analogy with the rather similar but unrelated *P. (R.) dunensis*, one might suppose that these specimens indicate a somewhat later age than the typical series, which are Lower Siegenien, but doubtfully so much later as previous writers have postulated. According to the map published by FOURMARIER, the beds are « Siegenien supérieur et emsien » (15) and according to ASSELBERGHS (16) they are « Siegenien supérieur », the nearest lower Siegenian outcrops being some distance to the East.

3. — PTERASPIS DEWALQUEI FRAIPONT.

In a previous note (17), I briefly described the features of the holotype of this species and figured a sketch of the cornual region, and I propose here to describe and figure it more fully.

(15) P. FOURMARIER, 1941, p. B 70.

(16) E. ASSELBERGHS, 1946, pls. IX, X.

(17) E. I. WHITE, 1956, pp. 3, 6, text-fig. 5.

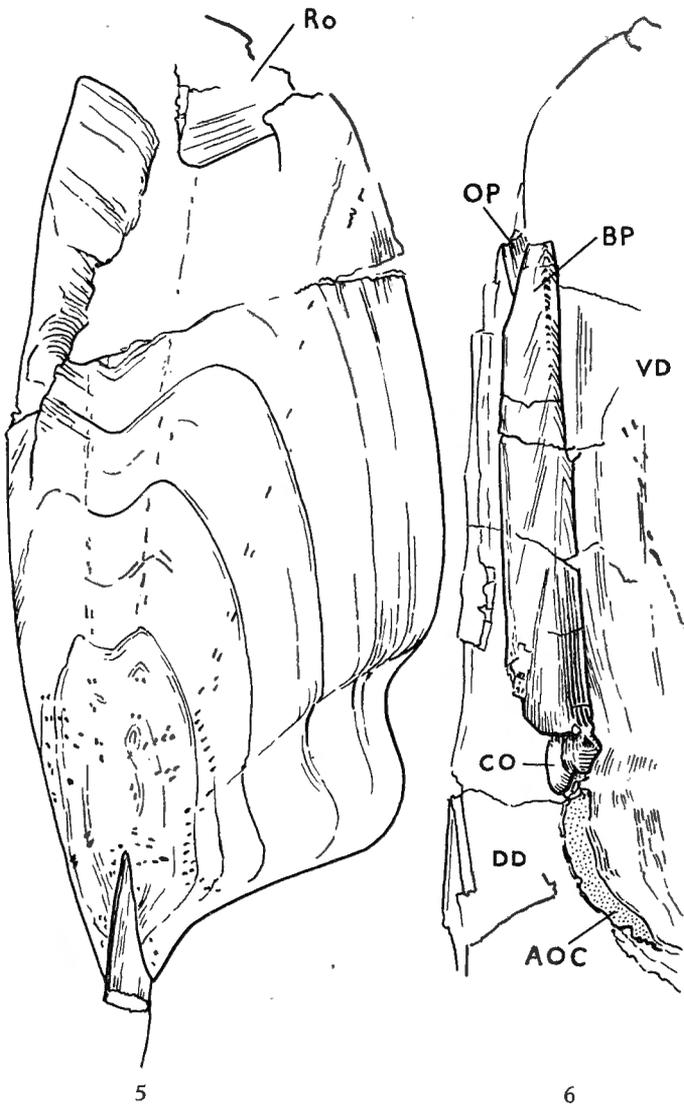


Fig. 5. — *Pteraspis (Rhinopteraspis) dunensis* (ROEMER). Imperfect dorsal disk. The left side is largely folded under. Ro. fragment of rostrum. Emsian : Schleiden, Eifel. (Brit. Mus. P. 31625) ($\times \frac{3}{4}$).

Fig. 6. — *Pteraspis (Rhinopteraspis) dunensis* (ROEMER). Part of specimen on same slab as fig. 5 shewing the branchial plate (B. P.) lying between remains of the dorsal disk (D. D.) and orbital plate (O. P.) and the ventral disk (V. D.). The missing cornual plate overlaps the branchial extension at C. O. and the central disk along A. O. C. Emsian : Schleiden, Eifel. (Brit. Mus. P. 31627) ($\times \frac{3}{4}$).

To recapitulate, the species was described by FRAIPONT (18) in 1908 from a single specimen from an unknown level in the « assise des grès et schistes verts de St-Hubert » (19), and since that time other specimens have been referred to the same form, but none in my opinion is conspecific.

It is, for the most part, in the form of an internal impression without the rostrum, and was referred to *P. dunensis* by LERICHE (20), on grounds that were then reasonable enough.

The specimen was well described and figured by both FRAIPONT and LERICHE in its original state, but in that condition the full breadth of the dorsal disk and none of the plates forming the side were known. Now, thanks to the courtesy of M^{me} CARPENTIER-LEJEUNE, I have developed it, particularly on the right side, and the complete shape, not only of the dorsal disk, but also of the orbital and branchial plates and, most important, the form of the cornual plate, is clear.

The fossil obviously has been diagonally distorted (Text-fig. 3), but the degree of distortion is not great and the proportions are virtually unaltered. The median length of the internal cast of the dorsal disk is 13.2 cm including the spinal socket, of which the internal impression is no less than 4.1 cm long. Practically the whole breadth of the dorsal disk was fully exposed in the first instance, although this was not clear from its original state. Measured over the curve and across the base of the rostrum and orbitals, and at points approximately 1.0, 4.5, 9.7 cm along the mid-line from the pineal plate (corresponding to FRAIPONT's original cross sections C-D, E-F, G-H, I-J) the breadth is 4.6, 5.8, 6.2, 5.0 cm respectively, so even when flattened the plate was remarkably narrow and even-sided, and since the hinder end is considerably more convex than the fore-part, the two sides appear naturally both straight and parallel.

The anterior margin is in the form of a wide, straight-sided V, as in *P. (C.) leachi*, with little or no indentation from the pineal plate. The posterior margins are only slightly concave, but the median projection is long and the socket deep, even for an internal impression. The impression of the base of the pineal opening is very large, but the lateral extent of the pineal plate is not to be made out, for it is continuous with the long medial processes of the orbitals. The orbitals are in themselves narrow, and this narrowness seems only in part to be due to distortion.

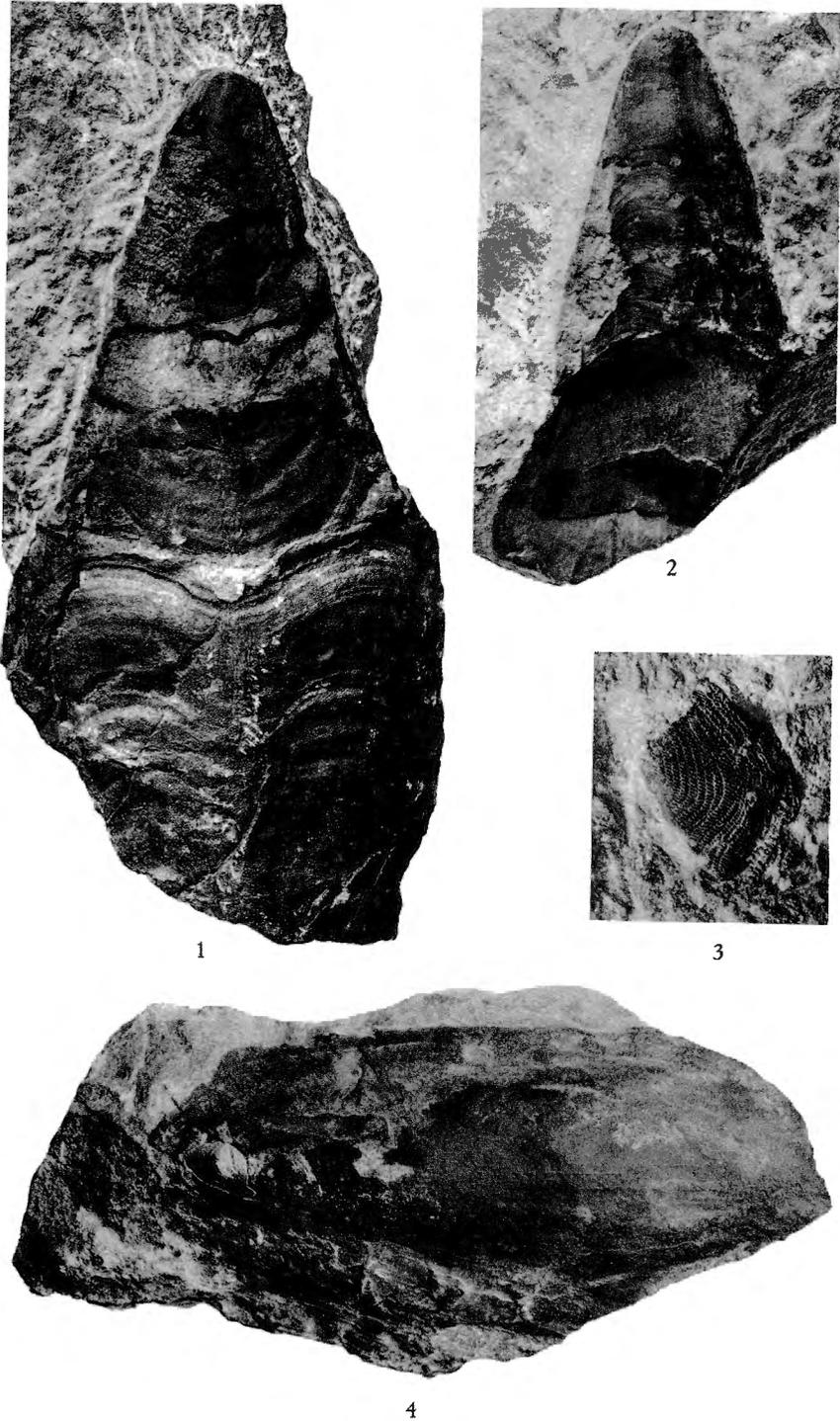
The base of the rostrum is broad, no less than 3.7 cm between the points of the orbitals. There is no certain indication as to its total length, although it seems likely to have been to some extent elongated.

The most interesting and diagnostic features preserved are shown by the branchial and cornual plates, which are preserved completely on the right side. Owing to the complete silicification of the fossil and the

(18) C. DE FRAIPONT, 1908, p. M. 13.

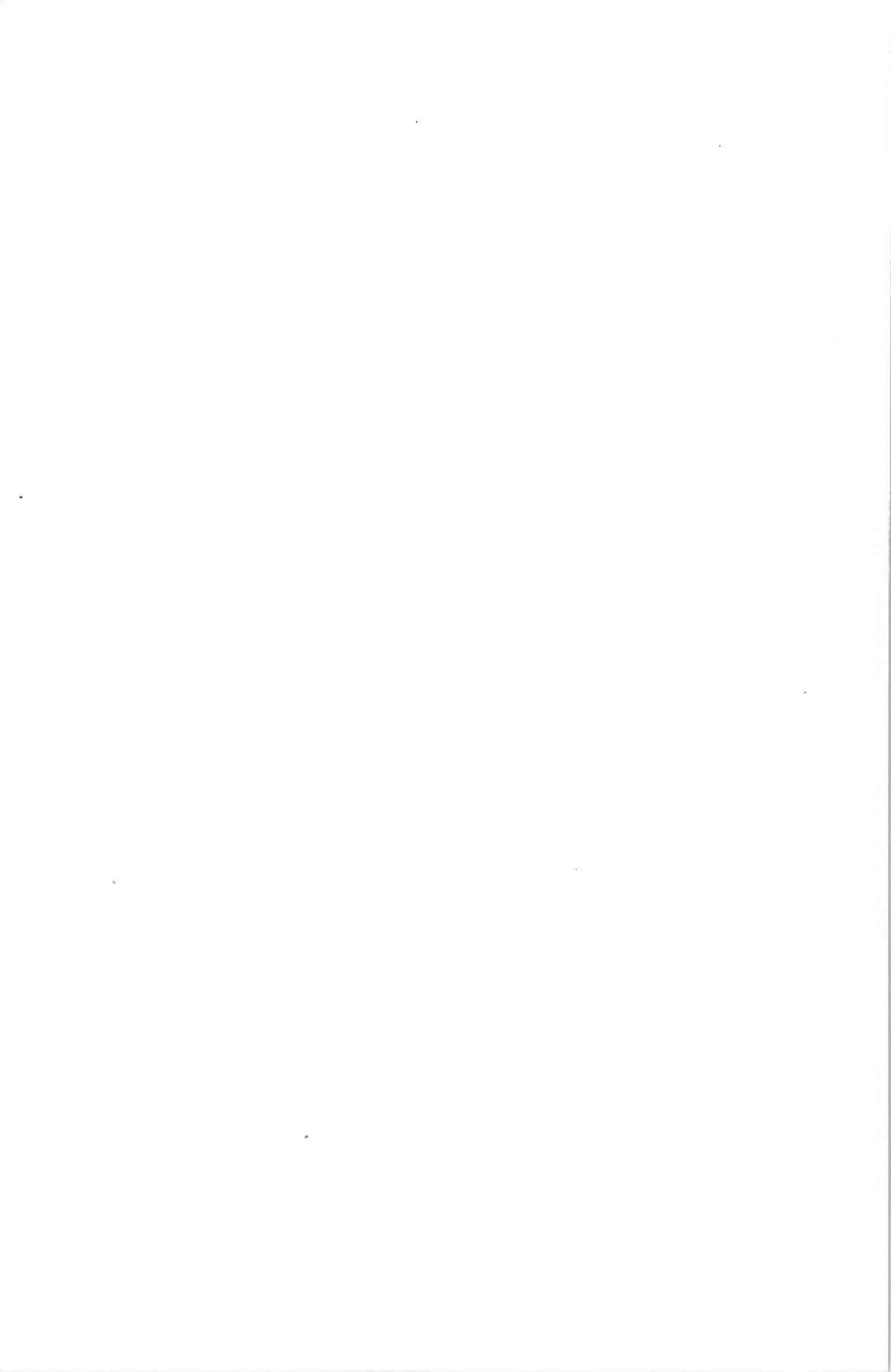
(19) E. ASSELBERGHS, 1942, p. B 36.

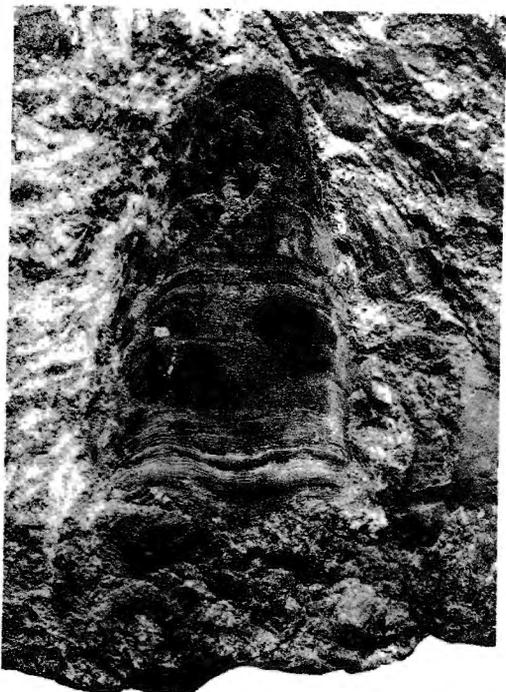
(20) M. LERICHE, 1912, p. 153, text-fig. 7.



Pteraspis (Althaspis) vimiensis sp. nov.

E. I. WHITE. — Pteraspids from Artois and the Ardenne.





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2



3

Pteraspis (Althaspis) vimiensis sp. nov.

E. I. WHITE. — Pteraspids from Artois and the Ardenne.

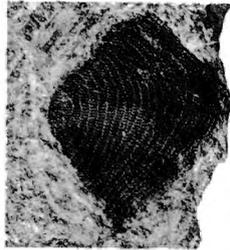




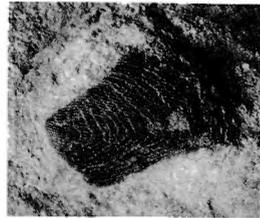
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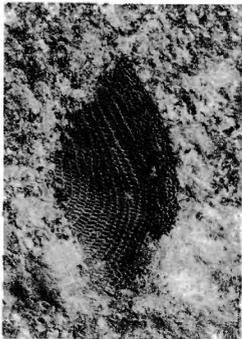
6. — *Pteraspis (Belgicaspis) crouchi*
LANKASTER.



3



4



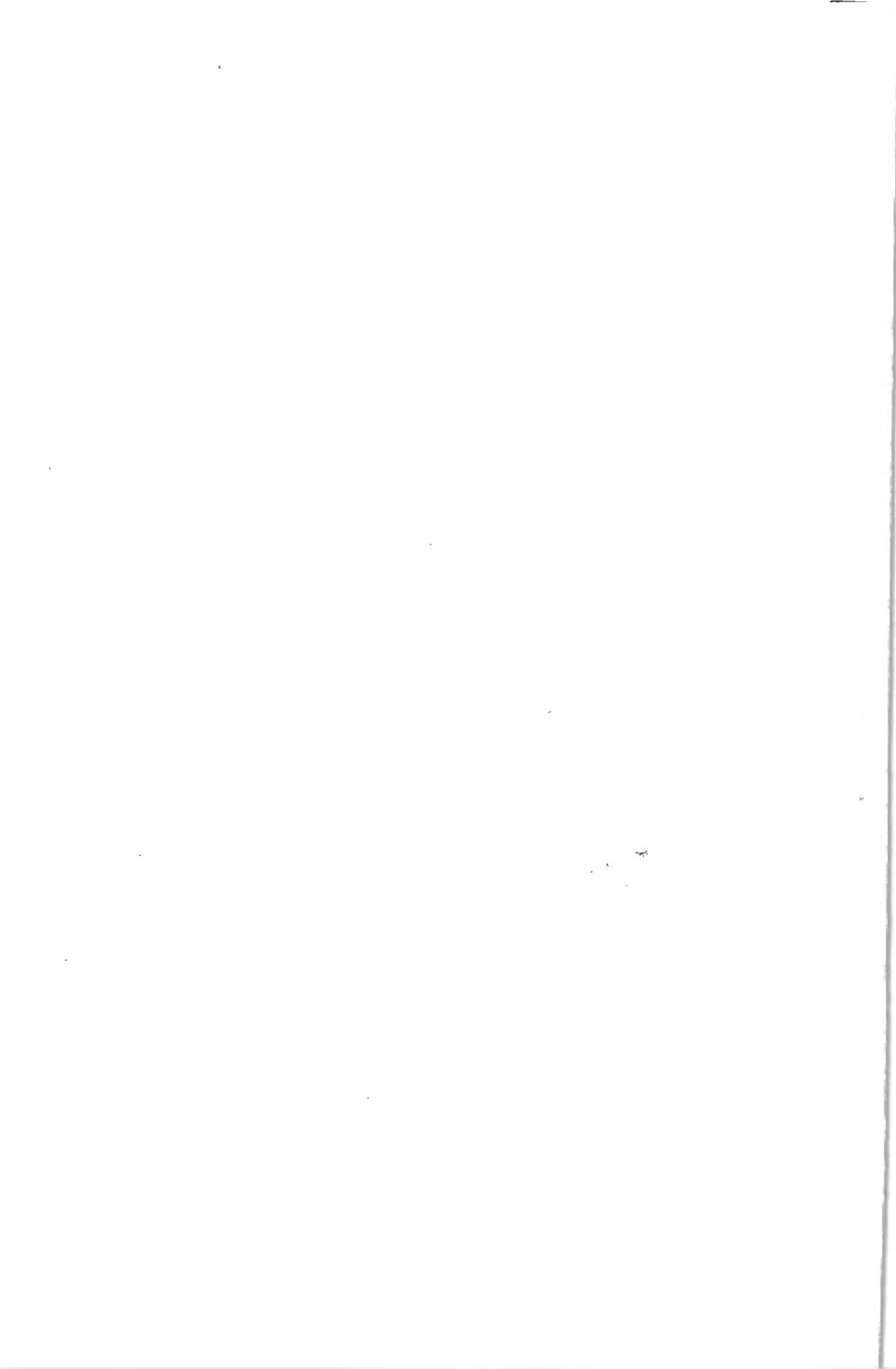
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5

1-5. — *Pteraspis (Althaspis) vimiensis* sp. nov.

E. I. WHITE. — Pteraspids from Artois and the Ardenne.



intractibility of the matrix, it has been impossible to disengage the outer surface of these plates and of the orbital from the matrix so that their form is shown for the most part only by their inner surfaces and by transverse sections. Also it has not been possible to mark the exact junction between the branchial and cornual plates, which in this specimen seem completely fused together, at least by the basal layer. However, the infilling of the passage to the branchial opening shews approximately where the cornual plate started, but of course not where the lower lamina of the branchial ended.

As preserved, the branchial and cornual plates are nowhere more than 1 cm deep, and their combined total length is approximately 14 cm, of which the first 2 cm are as usual bevelled above for the orbital, and the last 1 cm or so forms the cornual spine. A cross-section at 4.5 cm from the start of the branchial (b) shews this plate to have been moderately thick, up to 2.5 mm, and markedly convex on the outside with a clear median furrow. At about 6.5 cm the inner branchial opening starts and at this point the upper arm of the cornual plate begins. At 11 cm (e) the section shews only one plate, the cornual, with a very characteristic form shewing a strong longitudinal ridge separating a concave upper surface from a rather larger and more markedly convex under surface. The maximum thickness of the plate, i.e. at the edge, is 4 mm, mostly formed by the middle cancellar layer. The cornual plate ends after a further 1.5 cm, but the longitudinal ridge, which has become much thinner and shelf-like (f), continues directly backwards as a triangular spine more than 1 cm long.

Both branchial and cornual plates of *P. dewalquei* are markedly different from those of *P. (C.) leachi* (text-fig. 4). In the latter species the body of the branchial is relatively longer (and the cornual correspondingly shorter) and apparently tapers less under the orbital, while the longitudinal external groove is not only fainter (a) but soon disappears altogether (b), leaving the posterior half wholly convex. The cornual plate of *P. leachi* is less massive than that of *P. dewalquei*, being more triangular in cross-section, with a well marked groove all along below the longitudinal ridge (e, f). The ridge itself is less prominent and ends in no more than a curved hook instead of a substantial spine. It cannot be doubted that the cornual plate in *P. dewalquei* was very different from that in *P. (R.) dunensis*, in which it has not yet been described (21), for the backward position of the branchial notch in the dorsal disk (Text-fig. 5, 6) makes it certain that this plate was at least as small as, if not smaller, than in the Podolian *P. (A.) elongata* (22), wherein it is reduced substantially beyond the stage even of *P. (C.) leachi*. The branchial plate of *P. (R.) dunensis* is very different from that in the other species (23), for the sub-cornual process, instead of being a long

(21) W. GROSS, 1933, p. 48. K. FAHLBUSCH, 1957, p. 39.

(22) F. BROTZEN, 1936, p. 13, text-fig. 2.

(23) K. FAHLBUSCH, 1957, p. 36, fig. 5.

narrow strip, is a short boss with a strong concentric ornament and a deep area of overlap for the missing cornual plate above (Text-fig. 6, C. O.). This area of overlap is extended somewhat posteriorly on the ventral disk.

Finally the ridges of the ornamentation in *P. dewalquei*, well seen in cross-sections of the cornual and branchial plates, are much finer than one would expect in the lateral armour of *P. (R.) dunensis*, and even finer than I have seen on corresponding plates of *P. (C.) leachi* — 80 per cm on the lower face of the branchials and 160 per cm on the upper concave surface of the cornual in *P. dewalquei*, as against 70 and 40 respectively in *P. (C.) leachi*.

P. dewalquei, then, is distinct from *P. (R.) dunensis* and *P. (C.) leachi*, but as the pre-oral area of the underside of the rostrum is unknown, the sub-genus to which it belongs cannot be determined. Moreover, as it is represented by a single specimen from an uncertain horizon and unassociated with any other species, it is for the moment useless for purposes of correlation.

In conclusion, I wish to express my sincere thanks to Dr. E. LELOUP, late acting Director of the Institut royal des Sciences naturelles de Belgique, for allowing me to have on loan the interesting specimens from Vimy, a privilege generously continued by the present Director, Monsieur A. CAPART; to Madame CARPENTIER-LEJEUNE, conservateur du Laboratoire de Paléontologie Animale, Liège, for the loan of the specimen of *Pteraspis dewalquei*; to Professor G. UBAGHS, of the University of Liège, for the loan of the specimens from FRAIPONT, and for his cordial cooperation on all occasions; and finally to Dr Edgar CASIER of the Institut royal des Sciences naturelles de Belgique, for his unfailing kindness and help.

SUMMARY.

The pteraspids from the « schistes et grès bigarré » of Vimy-Fresnoy (fosse No. 1), previously identified as *Pteraspis dewalquei* or *P. rostrata*, are described as a new species, *P. (Althaspis) vimiensis*, sp. nov., and the beds referred to the upper half of the Upper Gedinnian.

Pteraspids from near Fraipont are identified as forms of *P. leachi*, and this species is placed in a new sub-genus, *Cymripteraspis* sub-gen. nov.; and *P. dewalquei* is redescribed and proved to be a distinct species.

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EXPLANATION OF PLATES.

PLATE I.

Pteraspis (Althaspis) vimiensis, sp. nov.

Schistes et Grès de Vimy, Fonçage de Vimy-Fresnoy; puits n° 1.

- Fig. 1. — Anterior half of dorsal shield (A), in dorsal view, mostly in form of internal cast. The holotype (I. R. Sc. N. B., Ht. P 1438/I.G. n° 19.136/5). Depth 368 metres ($\times 1$).
- Fig. 2. — Rostrum (E₁) shewing anterior half of lower surface and internal surface of posterior half (I. R. Sc. N. B., E. F. P 1439/I.G. n° 19.136/4). Depth 354 metres ($\times 1$).
- Fig. 3. — Flank-scale (P). Depth 341 metres ($\times 4$).
- Fig. 4. — Imperfect internal cast of ventral disk (I). Depth 341 metres ($\times 1$).

PLATE II.

Pteraspis (Althaspis) vimiensis, sp. nov.

Schistes et Grès de Vimy, Fonçage de Vimy-Fresnoy; puits n° 1.

- Fig. 1. — Lower surface of small rostrum (D) (I. R. Sc. N. B., E. F. P 1440/I.G. n° 19.136). Depth 341 metres ($\times 2$).
- Fig. 2. — Left branchial plate (H), in lateral view. Depth 343 metres ($\times 2$).
- Fig. 3. — Imperfect ventral disk lacking posterior end (K) (I. R. Sc. N. B., E. F. P 1442/I. G. n° 19.136). Depth 341 metres ($\times 1$).

PLATE III.

Pteraspis (Althaspis) vimiensis, sp. nov.

Schistes et Grès de Vimy, Fonçage de Vimy-Fresnoy; puits n° 1.

- Fig. 1. — Left branchial plate (H), in dorsal view. Depth 343 metres ($\times 2$).
- Fig. 2. — Flank-scale (R). Depth 354 metres ($\times 4$).
- Fig. 3. — Flank-scale (N). Depth 341 metres ($\times 4$).
- Fig. 4. — ? Ventral flank-scale (O). Depth 341 metres ($\times 4$).
- Fig. 5. — Dorsal ridge-scale (T). Depth unknown ($\times 2$).

Pteraspis (Belgicaspis) crouchi LANKASTER.

Schistes et Grès de Vimy, Fonçage de Vimy-Fresnoy; puits n° 1.

- Fig. 6. — Dorsal disk with base of spine (U). Depth 385 metres ($\times 1$).

ERRATUM.

Pl. III, fig. 6, 2^d line :

In the place of LANKASTER read LANKESTER.