SPECIES OF *TRETAISPIS* (TRILOBITA) FROM THE ASHGILL SERIES IN WALES

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**Abstract.** Nine species of *Tretaspis* are recognized from various horizons of the Ashgill Series in Wales. *T. moeldomensis* Ingham is regarded as a sub-species of *T. moeldomensis* Cave. Four populations of *Tretaspis* are placed in *T. moeldomensis* (l.t.) and considered to occupy intermediate positions within the peakus connecting *T. moeldomensis* and *T. m. moeldomensis*; for the latter, large type samples also give increased knowledge of the fringe characters. *T. cf. radiatus* Lamont occurs throughout the bulk of the Sholeshooke Limestone Formation (south-west Dyfed) but is replaced in the topmost part by *T. aff. radiatus*. The pygidium of an indeterminate species from the Brynollt Limestone at Llanddula resembles that of *T. m. moeldomensis*. *T. haedlandicum brachystomus* Ingham is described from the highest Sholeshooke Limestone and succeeding Slade and Redhill Mudstone Formation, *T. cf. lusitanae disticha* Ingham from the high Ashgill of the south-west Berwyns and *T. cf. norseii* (Reed) from the topmost Ashgill of the Moelfo area. An indeterminate form from the Slade and Redhill Mudstones and *T. cf. caudata* Dean from the Rhwys Limestone are not yet placed within either of Ingham's two main species groups.

As with other trineurid trilobites at lower levels in the Ordovician, species of the genus *Tretaspis* are of stratigraphical importance within the Ashgill Series in that, apart from their abundance and wide geographical distribution, some forms appear to exhibit progressive evolutionary changes. Good examples of this are seen in some of the species described by Ingham (1970, pp. 45–57) from the north of England. Although the phylogeny of *Tretaspis* is far from completely understood, some evolutionary relationships are known, and these can be used for correlation in different Successions.

**Terminology.** The terminology and notation used in describing fringe characteristics largely follow those of Ingham (1970, pp. 40–41). Ingham has pointed out that in many species of *Tretaspis* new internal (I) arcs of pits are apparently inserted in evolution on the external side of the innermost arc already present. In many specimens this is strongly suggested by the disposition and small size of pits developed in this position (e.g. in the specimen illustrated here as PL 101, fig. 2). Accordingly the innermost pit-arc is regarded as complete and is unnumbered and referred to as the I₁ arc. Hughes et al. (1975, p. 6) have found the concept of the I₁ arc of wide application within family Trinucleidae and reveal that current work on silicified young stages of marroolithines shows I₁ to be the first arc to develop on the immature fringe. Ingham (1970) is also followed in using an AR notation to refer respectively to the radii containing the I₁, I₂, E₁, and E₂ pits which in members of his *T. seicornis* species group (see below) are out of line, and in his use of the terms ‘general roll’ and ‘brim’ solely for describing fringe shape. In addition, the term ‘list’ (Storner 1930) is used for the concentric ridges sometimes developed between the inner pit-arcs on the upper lamella. The cephalic orientation adopted for descriptive purposes is that suggested by Hughes et al. (1975, pp. 546–547, fig. 7) with the anterior and posterior fossula in the horizontal plane.

**Repositories.** The material upon which this paper is based is housed in the following museums, the prefixes for whose specimen numbers are indicated in brackets: British Museum (Natural History) (BM), Geology Museum, University of Birmingham (BU), Hunterian Museum, Glasgow (HM), Institute of Geological Sciences (GSM), National Museum of Wales (NMW), and the Sedgwick Museum, Cambridge (SM).

Family Trinucleidae Hawle and Corda, 1847
Subfamily Trinucleinae Hawle and Corda, 1847
Genus Tretaspis M'Coy, 1849

Type species. Subsequently designated by Basaler 1915, p. 1285; Asaphus seticornis Hisinger, 1840, p. 3, pl. 37, fig. 2; Fjæck Formation, Dalarna, Sweden.

Remarks. Ingham (1970, pp. 41-44) attempted a division of known species of Tretaspis into three species-groups typified respectively by T. moeldenensis Cave, 1960, T. seticornis (Hisinger), and T. granulata (Wahlenberg, 1818). T. granulata and allied forms such as T. portraitensis Lamont, 1941, have subsequently been removed from Tretaspis and placed in genus Nankinolithus Lu (Hughes et al. 1975). The genus Tretaspis is thus divided by the latter authors into two major groups of species.

As Ingham noted (1970, p. 41), the extent to which these groups form natural associations is not yet clear and there are difficulties in fitting a few forms (including two dealt with in this paper) into them. Accordingly the T. moeldenensis group and the T. seticornis group are adopted herein tentatively and with the reservation that the two forms referred to above (T. sp. indet. B and T. cf. calcaria Dean) are not placed in either group but are regarded as being, as yet, of uncertain affinity (see also p. 787 below).

THE TRETASPIS MOELDENENSIS GROUP

For the characteristics of the group see Ingham 1970, p. 43.

Tretaspis moeldenensis Cave, 1960 (sensu lato)

Plates 98 and 99; Plate 100, fig. 1; text-fig. 1

1909 Trinucleus seticornis, var. bucklandi, Barr.; Elles, faunal list, p. 182.
1909 Trinucleus fontebrius Mach.; Strahan et al., p. 56.
1921 Trinucleus cf. nicholsoni Reed; Wills and Smith, table, p. 187.
1921 Trinucleus seticornis Hisinger; Wills and Smith (pars) table, p. 187.
1921 Trinucleus sp., Wills and Smith (pars), table, p. 187.
1927 Trinucleus cf. nicholsoni Reed; Wedd et al., (pars), list, p. 40.
1927 Trinucleus seticornis (His.); Wedd et al. (pars), list, p. 40.
1927 Trinucleus sp., Wedd et al. (pars), list, p. 40.
1928 Trinucleus seticornis group, King, lists, p. 698.

EXPLANATION OF PLATE 98

Figs. 1-5. Tretaspis moeldenensis Cave (s.l.), Population A, Bodeidda Mudstone Formation, Bodeidda, near Conway, × 6. 1-3, GSM RV 9144a, internal mould of cephalon, dorsal, anterior, and left-lateral views. 4, GSM RV 9141, partial internal mould of cephalon, anterior view. 5, GSM RV 9142, internal mould of cephalon, anterior view.

Figs. 6-9. Tretaspis moeldenensis Cave (s.l.), Population B, basal Tre-wylan Beds, Glan-yrafon Farm, north of Llanmaffraid-y-Mechain, × 6. 6, Bu. 209, internal mould of cephalon, antero-dorsal view, × 4; original of Whitington 1938, pl. 38, fig. 2. 7, SM A94573a, internal mould of cephalon, dorsal view, × 5. 8, Bu. 208, internal mould of cephalon, oblique view, × 4; original of Whitington 1938, pl. 38, fig. 1. 9, SM A94592, internal mould of pygidium, dorsal view, × 5.
PRICE, *Tetraspis* from Wales
1929 *Trinucleus* sp.; Wedd et al. (*pars*), list, p. 61.
1938 *Treatispis* cf. *kiaeri* Størmer; Whittington (*pars*), p. 443, pl. 38, figs. 1-3; *non* list, p. 452.
1961 *Treatispis kiaeri* Størmer radialis Lamont; Dean (*pars*), pp. 122-125.
1962 *Treatispis kiaeri* Størmer radialis Lamont; Dean, p. 86, pl. 9, figs. 2-4.
1970 *Treatispis colliquia* Ingham, pp. 53-54, pl. 8, figs. 8-20; text-fig. 14b.
1970 *Treatispis cf. moedlenensis* Cave; Ingham, pp. 54-55, pl. 8, figs. 21-26; pl. 9, figs. 1-7; text-figs. 14c, 19.
1973a *Treatispis moedlenensis* Cave; Price, tables 3 and 4.
1973b *Treatispis moedlenensis* Cave; Price, p. 540.
1974 *Treatispis moedlenensis* Cave; Price, pp. 844-847, pl. 112, figs. 10-12; pl. 113, figs. 1-4; text-fig. 1.

**Holotype**. Figured by Cave 1960, pl. 10, figs. 1 and 3, SM A50668, from the basal Sholesbrook Limestone Formation of Moldia (= “Moedden”), near Llandowm, Dyfed, South Wales.

**Remarks**. Ingham (1970, p. 55) has referred to an evolving *T. colliquia*—*T. moedlenensis* plexus. In Wales there appear to be at least three or four populations which fall within this plexus and whose members in general show characters intermediate between those of *T. colliquia* and *T. moedlenensis*. In terms of fringe-characters, particularly the development of the l4 pit-arc, each of these populations shows much variation. This variation can be such (in Population B of text-fig. 1 for instance) that the fringe-characters of some members of a single population fall within the range of *T. colliquia*, the fringe-characters of other members within the range of *T. moedlenensis*, and those of yet other members fall between, outside the known range of either form. For this reason, *T. colliquia* and *T. moedlenensis* are no longer regarded as specifically distinct and *T. colliquia* is treated here as a sub-species of *T. moedlenensis* (s.l.). The name *T. m. colliquia* is considered applicable to populations with a similar range of fringe variation to that of the sample described by Ingham (1970, see synonymy) while the name *T. m. moedlenensis* is similarly applied to populations falling within the range of fringe variation of toptype material of that form (here described). Populations where the variation ranges outside that of either of these end-members might be compared with one or other of them by the use of such designations as ‘*cf.*’ and ‘*aff.*’. The large range of variation already referred to within some of these populations, however, renders such terms difficult of application. Partly for this reason and partly because of the small sample sizes and consequent limited knowledge of the range of variation of some of the populations involved (and of the described material of *T. m. colliquia*), such a course is not adopted and the populations described here are referred to as populations of *T. moedlenensis* (s.l.). This solution is also felt to be more appropriate in reflecting the probable existence of a continuum between *T. m. colliquia* and *T. m. moedlenensis*.

**Population A**
Plate 98, figs. 1-5; text-fig. 1

**Material, horizon, and locality**. Twenty specimens, in the collection of the Geological Survey, from the Bodedda Mudstone Formation; quarry 14 km west of Bodedda, about 2.5 km south-west of Conway, Gwynedd, North Wales.

**Description**. Cephalon approximately semicircular in dorsal view; exact proportions masked by distortion. Pseudofrontal glabella lobe occupying almost two-thirds of total glabellar length (sag.), sub-circular in
TEXT-FIG. 1. Histograms of selected fringe characters in species of Trexapis of the *T. moeldenensis* group. *n* is the sample number for each character shown. All histograms show half-fringe data. *T. moeldenensis* (s.l.): Population A from Bodeidda Mudstone Formation, Bodeidda, near Conwy, Population B from basal Tre-wylan Beds, near Llanwnnafaid-y-m-Mechain, Powys. *T. moeldenensis moeldenensis* topotype from basal Sholeshok Limestone Formation, Mudlin, near Llandowror, Dyfed. *T. cf. radialis* from Sholeshok Limestone Formation of Haverfordwest and Llandowror, Dyfed. *T. aff. radialis* from topmost Sholeshok Limestone and Slade and Redhill Mudstone Formation of Haverfordwest area.
dorsal view, strongly domed, particularly transversely, but never sub-spherical so that the outline in anterior view remains parabolic (Pl. 98, figs. 2, 4-5); bearing small, apically situated median tubercle; barely overhanging the fringe anteriorly. Occipital ring narrow and strongly convex (sag. and exsag.), orientated posterior-dorsally; curving forwards abaxially. Occipital furrow broad and shallow medially, abaxially containing deep ovoid apodermal pits. 1p lateral glabellar lobes short (tr.), gently convex, abaxially rounded. 1p lateral furrows in form of strongly oblique shallow slots, diverging posteriorly and almost reaching the occipital apodemes. 2p lobes only gently convex (exsag.), set transversely, narrowly adaxially, broadening outwards and coalescing anteriorly, around the 2p furrows, with the pseudo-frontal lobe. 2p furrows in form of large, shallow ovoid depressions of rather indistinct outline. 3p furrows present as faint but definite depressions on sides of pseudofrontal lobe. Axial furrows broad (tr.), particularly posteriorly; anteriorly containing small, deep fossulae. Genal lobes sub-quadrant shaped, moderately convex, and dropping steeply antero-laterally but not overhanging fringe; bearing lateral tubercles, rather larger than the median tubercles, on about the level of the anterior edges of the 2p lateral furrows; dropping steeply to broad (exsag.) posterior border furrows which abaxially contain large posterior fossulae. External moulds show surface of glabella and genal lobes to be smooth. Fringe moderately broad, comprising steeply inclined, convex genal roll and well-developed, gently concave brim; internal moulds show a deep, rather narrow girdle. Outer 3 pit-areas, E₁₁, I₁, arranged antero-frontally and antero-laterally in deep radial suture which persist on one specimen to about R₁₉, on another to R₂₃. The number of pits in E₁ ranges from 24 to 28 (half-fringe, see text-fig. 11); pits of E₁ are usually absent from the posterior row and sometimes from the posterior-most 2 rows. The number of pit-areas developed internally to the 3 outer areas and their degree of completeness is very variable. In addition to I₁, all specimens have a complete I₁ arc. Nine specimens show a complete I₁ arc but on 5 others I₁ arcs are absent from the posterior row (e.g. Pl. 98, figs. 4, 5). These 3 specimens do not show an I₁² pit-arc but on the 9 where I₁ is complete, a short I₁ arc, normally with between 1 and 5 pits, is developed in front of the axial furrows. One specimen, however (GSM RV9133), shows at least 10 I₁ pits. In no specimen is the I₁ arc complete frontally, pits generally being developed from R₃ or R₄ onwards. Pits of the I₁ arc are frequently large. All pits are arranged in strict radial alignment until the genal prolongations are reached, where the alignment breaks down due to the intercalation of extra pits between the I₁ and E₁ arcs; the fringe, thus expanded, may have from 11 to 14 pits in the posterior row. No lists have been observed on the fringe upper lamella. On the lower lamella, pits of the internal arcs are arranged, except on the genal prolongations, in strong radial suture (Pl. 98, fig. 3).

Thorax and pygidium unknown.

Population B
Plate 98, figs. 6-9; text-fig. 1

Material, horizon, and locality. Useful material comprises about twenty-eight specimens from the basal Tre-wynian Beds exposed around a small waterfall in the dingle 170 m north-west of Glan-yr-afon Farm, about 4 km north of Llanarford-yrn-Mechan, Powys, Mid-Wales. This is Locality 42 of Whittington 1938 and Locality 3 of Wedd et al. 1929 (list, p. 62).

Description. The general form and proportions of the cephalon are very similar to those described for specimens in Population A; however, no specimen so far seen definitely shows the presence of 3p lateral glabellar furrows. Again, the genal lobes, though dropping steeply antero-laterally, do not generally overhang the fringe. Both these and the pseudofrontal lobe are smooth. The fringe itself has a well-developed brim, particularly laterally and antero-laterally. Pit-areas E₂, E₃, and I₁ are contained in deep radial suture which persist laterally to R₂₃ or R₂₄. E₁ contains from 26 to 29 pits; E₁₁ are absent from the posterior row or posterior 2 rows. All specimens have a complete I₁ arc. Of 9 specimens which show clearly the distribution of pits anteriorly, 7 have the I₁ arc complete, the others have respectively 1 and 3 pits of I₁₁ missing. I₁ is very variably developed. Apart from the definite numbers shown in the histogram (text-fig. 1), this arc in other specimens contains respectively 1 or 2, at least 3, at least 4, at least 11, and at least 13 pits. Only in one specimen is the I₁ arc complete frontally, pits of I₁ usually being developed from R₃, R₄, R₅, or R₆ onwards. One specimen, however, appears to show a single pit of I₁ at about R₁₀. Pits of I₁ are frequently rather larger than those of the other arcs. The posterior row contains between 9 and 13 pits. Lists do not appear to be developed. The girdle is broad and deep with weak, closely spaced terrace lines. Pygidium (Pl. 98, fig. 9) sub-triangular in outline, broad (tr.), the sagittal length only about one-third
of the maximum width; posterior-lateral margins moderately convex; bluntly rounded posteriorly. Maximum pygidial width about four and a half times anterior width of axis. Latter tapers posteriorly at about 25° and is gently convex (fr.). Ring furrows shallow, gently arched forward, each containing a pair of deep apodemal pits a short distance from the axial furrows; axis bears eight such pairs of pits in all, the posteriormost pair usually only weakly developed. Pleural lobes flat, with up to four faintly defined pleural ribs. There is no submarginal rim.

Population C
Plate 99, figs. 1 - 5

Material, horizon, and locality. Twenty-four specimens in the collection of the Geological Survey, from the basal Ty'n-y-twmpli Beds of the Northern Berwyns; Locality 47 of Wedd et al., 1927 (p. 41), in the headwaters of the Nant-y-Lladrin, about 5 km south-south-east of Corwen. Most of this material is distorted and/or fragmentary and the comments below are effectively based on less than half of it.

Description. Cephalon similar in overall morphology to that described for specimens of Population A, with the surfaces of the pseudofrontal and genital lobes smooth and with the latter, although steep anterolaterally (Pl. 99, fig. 1), not overhanging the fringe. No 3p lateral glabellar furrows have been seen in the present material. Fringe with well-developed brim. E1, E2, and I1 pits arranged in deep radial sulci except on posterior parts of prolongations. I1 and I2 arcs complete frontally on all available material. The I1 arc is variably developed. On 2 specimens (Pl. 99, figs. 1, 3) it is definitely not developed and on a third it appears to be absent also. On 3 other specimens I1 is developed though the number of pits is difficult to estimate. On the original of Plate 99, fig. 3 at least 3 and possibly 5 pits are present, on the original of Plate 99, fig. 4, 2 pits are clearly present opposite the axial furrow and up to 7 further pits may be present sharing sulci with pits of I1; a third specimen shows at least 2 and possibly 3 or 4 I1 pits. The pits of the I1 arc tend to be large (Pl. 99, figs. 1, 3, 4). The number of pits in the E1 arc is difficult to count accurately due to fringe distortion but estimates on 4 specimens are as follows: 27 or 28, about 29, 28 or 29, about 28. There are 11 pits in the posterior row (3 specimens). Two pygidia are far too distorted for their proportions to be of any use. One of them (GSM LW836) shows at least 7 pairs of apodemes.

Discussion. The material of *T. m. colligata* described by Ingham (1970, pp. 53-54, pl. 8, figs. 8-23; text-fig. 14b) from the lower part of the Pugwilian Stage of the Cautley Mudstones shows less variation in fringe characters than the forms described here. Even so, the variation does encompass a frontally incomplete I1 pit-arc and up to two or three pits in the I1 arc. Population A is thus relatively close to *T. m. colligata* while Population B of the Welsh material differs more markedly in the relatively more frequently and more extensively developed I1 arc. In this respect it is nearer to *T. m. moeddenensis* in which, however, the I1 arc is invariably complete and in which no specimen has yet been seen with less than ten pits in the I1 arc (text-fig. 1). All the Welsh material differs from *T. m. colligata* in apparently lacking the faint pseudofrontal lobe reticulation seen in the latter and in that the genae do not definitely overhang the fringe. Pygidia, though relatively poorly known, differ too in that none shows definitely more than eight pairs of apodemal pits on the axis.

Another small sample of a form belonging within *T. moeddenensis* (s.l.) comes from the basal Ashgill Mudstones of the stream section south of the old quarry at Pen-y-garneedd, about 20 km north-west of Welshpool, Powys (Locality 1 of Wedd et al., 1929, list, p. 61). Of 8 specimens known, only 3 are complete enough and well-enough preserved to yield useful data. SM A42998 has 29 or 30 pits in the E1 arc, 6 pit-arcs (E1, I1, I2, I3) anteriorly from R1 to R4 and has the I1 arc developed from R5 to at least R13 (i.e. at least 9 pits are present): a specimen on the same block (SM A94999) shows at least 8 I1 pits. The third specimen, however, GSM WK 389, shows no sign
of the I₃ are even in the axial furrow region, although I₁ is complete. Again the variation is considerable though still well within the range seen, for instance, in Population B described above. Clearly a larger sample is needed before the relationships of this form can be properly assessed.

_Tretaspis moeldenensis moeldenensis_ Cave, 1960

Plate 99, figs. 6-9, 710; Plate 100, fig. 1; text-fig. 1

1909 _Trinemus funerarius_ Murch.; Strahan et al., p. 56.
1921 _Trinemus sp._ Wills and Smith (pars), plate, p. 187.
1927 _Trinemus sp._ Wedd et al. (pars), list, p. 40.
1928 _Trinemus seticornis_ group; King, lists, p. 698.
1973a _Tretaspis moeldenensis_ Cave; Price, tables 3 and 4.
1974 _Tretaspis moeldenensis_ Cave, Price, pp. 844-847, pl. 112, figs. 10-12; pl. 113, figs. 1-4; text-fig. 1.

_Holotype._ As under _T. moeldenensis_ (s.l.) above.

_Horizons and localities._ Apart from its presence in a thin basal horizon of the Sholesbrook Limestone Formation of South Wales (Localities 17, 24a, and 25 of Price 1973e), the subspecies is here tentatively recognized from (locally) basal or near-basal Ashgill strata at two localities in the Berwyn Hills.

_Discussion._ Topotype material of _T. m. moeldenensis_ has already been redescribed in detail (Price 1974, see synonymy), though fringe characters were dealt with at that time on the basis of rather small samples (Price 1974, text-fig. 1). However, to allow clear distinctions to be made between _T. m. moeldenensis_ and other closely related forms, it was considered desirable to work with much larger samples and extensive re-collecting of topotype material was undertaken. This has resulted in a much increased knowledge of fringe characters as shown by the histograms in text-fig. 1. (The I₇ arc, where seen frontally, is invariably complete.)

Larger samples of topotype pygidia show that larger and better preserved specimens occasionally bear nine pairs of apodemes on the axis, though the last pair is usually very faint (Pl. 99, fig. 9). Eight is the much more usual number (Pl. 99, fig. 6) and even then the posterior-most pair is often faint.

A small sample of _Tretaspis_ from a locality (Locality 36 of Wedd et al. 1927, p. 41)

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**Explanation of Plate 99**

Figs. 1-5. _Tretaspis moeldenensis_ Cave (s.l.), Population C, basal Ty'n-y-twmpath Beds, headwaters of Nant-y-Llardren, south of Corwen. 1. GSM 3908, cast from partial external mould of cephalon, anterior view, ×6. 2. GSM JM 3905, incomplete internal mould of cephalon, dorsal view, ×4. 3. GSM LW 832, partial internal mould of cephalon, anterior view, ×6. 4. GSM LW 844, cast from partial external mould of cephalon, left-lateral view, ×5. 5. GSM LW 835, partial internal mould of cephalon, anterior-dorsal view, ×6.

Figs. 6-9. _Tretaspis moeldenensis moeldenensis_ Cave, basal Sholesbrook Limestone Formation, Moldin, near Llandowr, 6, SM A77741, internal mould of pygidium, dorsal view, ×5. 7, 8, SM A99051a, internal mould of cephalon, anterior and left-lateral views, ×5. 9, SM A77734, incomplete internal mould of pygidium, dorsal view, ×6.

Fig. 10. _Tretaspis moeldenensis moeldenensis_ Cave, GSM LW 1289, internal mould of cephalon, low Ty'n-y-twmpath Beds, headwaters of Nant-y-Llardren, south of Corwen, anterior view, ×6.
PRICE, *Tetraspis* from Wales
in the Ty'n-y-twmpath Beds of the Northern Berwys, close to and stratigraphically perhaps 40 m above that from which Population C of _T. moedensensis_ (s.l.) was collected, appears to belong with _T. m. moedensensis_. External moulds show the cephalon to be non-reticulate. Three specimens show, in addition to a complete _I_ pitted-arc, at least 14 (Pl. 99, fig. 10), at least 10 (Pl. 100, fig. 1) and 9 or 10 (GSM LW 1297) pits in _I_. In the original of Plate 99, fig. 10, _I_ pits are absent for 1½ rows ventrally; the position in the original of Plate 100, fig. 1 is not clear. In the 3 specimens referred to, the _I_ pitted-arc, apart from being more extensively developed than in specimens of the slightly older Population C of _T. moedensensis_ (s.l.), are larger and more clearly separated from the _I_ pitted-arc, not closely associated with them as they are when developed in specimens of the latter form and the _I_ pitted-arc themselves are not noticeably large. A fourth specimen (GSM LW 1310) is a distorted pygidium which appears to show at least 8 pairs of apodemal pits.

A form first recorded by King (1928, p. 681) from the basal Ashgill Mudstones near Glyn Cottage at the head of Cwm Nant-y-michiaid, 3 km north-west of Melinog, may also belong here. Material collected by the author (SM A94800–A94811, A94826–A94830, and 94832) is of a non-reticulate form with 26 or 27 pits in _E_ (one specimen in each case). Seven specimens showing the appropriate regions of the fringe have a complete _I_ pitted-arc and an extensive _I_ pitted-arc developed. On one specimen _I_ is incomplete ventrally for 2 radii and on 4 others for an indeterminate but small number. In the first specimen _I_ extends from R3 to R14 (i.e. 11 pits), in 2 others to around R16. Two further specimens show respectively 11 and at least 10 pits in _I_ and a fringe fragment shows part only of an _I_ pitted-arc with 7 pits. The posterior row shows 10, 11, 12 (1 specimen each), or (in 3 specimens) 13 pits. An incomplete pygidium shows 7 or 8 pairs of apodemes on the axis.

For other material not described here but regarded as belonging within _T. moedensensis_ (s.l.)(see synonymy of that form), there is insufficient fringe data, particularly in relation to the extent of the _I_ pitted-arc, to establish its relationship with _T. m. moedensensis_.

_Tretaspis cf. radialis_ Lamont, 1941

Plate 100, fgs. 2–10; text-fig. 1

1909 _Trinucleus sp._; Strahan et al., table, p. 58.

1912 _Trinucleus retusorius_ (Hisinger); Reed, p. 391, pl. 19, fig. 5, 5a.

**EXPLANATION OF PLATE 100**

Fig. 1. _Tretaspis moedensensis moedensensis_ Cave, GSM LW 1311, internal mould of cephalon, low Ty'n-y-twmpath Beds, headwaters of Nant-y-LLadron, south of Corwen, antero-lateral view, ×6.

Figs. 2–10. _Tretaspis cf. radialis_ Lamont, Sholeshock Limestone Formation of Sholeshock and Prendergast, Haverfordwest, ×3. 2–4, BM It. 9200, internal mould of cephalon partially retaining exoskeleton, topmost Locality 8d, anterior, left-lateral, and dorsal views. 5, BM It. 9259, incomplete internal mould of cephalon, topmost Locality 8d, right-lateral view, ×5. 6, BM It. 9252, cast from incomplete external mould of cephalon, topmost Locality 8d, oblique view. 7, SM A85138, incomplete internal mould of pygidium, Locality 9h, dorsal view. 8, 9, SM A77523a, b, internal mould and cast from external mould of cephalon, Locality 9e, right-lateral and left antero-lateral views. 10, SM A31520, internal mould of pygidium and posterior part of thorax of enrolled specimen, Sholeshock, dorsal view of pygidium. Locality numbers are those of Price 1978a.
PRICE, *Tetraspis* from Wales
**Trinitreulus seticornis, Hisinger; Rodd, pl. 28, fig. 5, 5a.**

1914 *Trinitreulus seticornis* (Hs.); Strahan et al. *(prot)*, table, p. 64.

1914 *Trinitreulus seticornis* (Hs.); Strahan et al., *prot*, table, p. 64.

1938 *Trinitreulus cf. kilmeri Storrier*; Whittington, list, p. 452.

1945 *Trinitreulus ceniodes var. sortitus*; Lamont, p. 123.


1968 *Trinitreulus kilmeri Storrier*; Whittington *(prot)*, p. 91.


1973a *Trinitreulus aff. radialis Lamont*; Price *(prot)*, pp. 229, 234, 236, 238-239, 242; tables 1-5.


1974 *Trinitreulus radialis*; Price *(prot)*, p. 847.

**Lecture.** Subsequently selected by Dean 1961, p. 124, SM A16202, original of Lamont 1893, text-fig. 5, p. 407; from the Portrane Limestone, Portrane, Co. Dublin.

**Material, horizons, and localities.** This description is based on some forty-five specimens from the Sholesbrook Limestone Formation of South Wales. In the type development at Sholesbrook and Prondergast (Haverfordwest, Dyfed) the species is common throughout all but the topmost four metres of the formation, the highest occurrence being in the topmost locality 86 of Price 1973a. Around Llandow, however, it appears to range through most of the formation but is absent from the basal Moldin horizon (Localities 17, 26a, 23) and is not known with certainty above Locality 18a. One other occurrence, in mid-Wales, is noted in the discussion.

**Description.** Cephalon sub-quadricircular in dorsal view. Pseudofrontal lobe of glabella occupying two-thirds of sagittal length; sub-spherical in form, standing high above level of genal lobes and overhanging fringe in lateral view (Pl. 100, fig. 3); strongly reticulated and apically bearing a small median tubercle. Occipital ring narrow and strongly convex (sag. and exsag.) and shallow mesially, abaxially convex downwards. Occipital furrow broad (sag. and exsag.) and shallow mesially, abaxially convex downwards. Ovoid apodemal pits. 1p lateral glabellar lobes short (tr.), convex, abaxially rounded. 1p lateral furrows in form of deep, strongly oblique apodemal slots, converging anteriorly at 120-130°. 2p lateral lobes only gently convex (exsag.), set transversely, narrowest (exsag.) adaxially, broadening outwards and merging anteriorly with the pseudofrontal lobe around the 2p lateral furrows (Pl. 100, figs. 4-6). Latter in form of large, deep, ovoid pits, diverging anteriorly at about 140°. On well-preserved specimens the 3p lateral furrows are clearly visible as shallow, elongate-ovoid pits on the sides of the pseudofrontal lobe, slightly behind its mid-length (Pl. 100, fig. 6). Axial furrows broad (tr.) posteriorly, narrowing forwards and constricted slightly on about one-third of lateral furrows at the adaxial ends of faintly developed eye-ridges; at anterior ends containing deep, round anterior fossulae of about the same size as the pits of the 1*, arc of the fringe.

Genal lobes sub-quadricircular shaped; convex (tr. and exsag.), bearing prominent lateral tubercles at the level of the anterior margins of the 2p lateral furrows; variably reticulated, sometimes strongly, sometimes not at all. Where reticulation is absent, the faint eye-ridge referred to above may be seen on the external surface running obliquely forwards from the lateral tubercles to the level of the 3p furrows (Pl. 100, fig. 6). Genal lobes drop steeply to broad (exsag.), adaxially shallow posterior border furrows. Posterior borders narrow (exsag.) and gently convex (exsag.) adaxially, broadening outwards. Fringe with steeply inclined, convex genal roll; brain narrow anteriorly but broadening laterally. Internal moulds show a broad, deep gutter with five, closely spaced terrace lines (Pl. 100, fig. 8). Arrangement of pits similar to that in *T. moeddenensis* (s.l.), the strict radial alignment only broken down on the genal prolongations. There are 6 completely developed pit-arrays, E1, E2, E3, E4, and a variably developed E5. In 8 out of 10 specimens showing the pit arrangement frontally, the E5 arc is complete in front of the glabella, while in both of those remaining E5, pits are absent from R1 (text-fig. 1). The number of pits in I1 ranges from 10 to 18 (half-fringe), the pits merging with those of the I2 are between R12 and R19. The E5 arc has from 24 to 28 pits in the half-fringe. Pits of E6 are absent from the posterior-most row and occasionally from the posterior-most 2 rows; the posterior row contains from 9 to 11 pits. As in *T. moeddenensis*, the sulci containing E6, E7, and I1 pits anteriorly and antero-laterally on the upper lamella tend to contain only the E6 and E7 pits on the genal prolongations (Pl. 100, fig. 9), where the sulci containing the I1, I2, E7, and E8 pits on the lower lamella also break down (Pl. 100, fig. 8).
Well-developed lists separate the pits of the 1 arcs anteriorly on the upper lamella (Pl. 100, figs. 6, 9; see also Whittington 1968, pl. 29, fig. 1) and may persist laterally to around R14 or R15.

Thorax poorly known but apparently similar to that described below for T. aff. radialis. Pygidium (Pl. 100, figs. 7, 10) similar in over-all form to those described for Population B of T. moeldensis (s.l.) though with axis relatively slightly broader (tr.), occupying about one-quarter of total width anteriorly, tapering posteriorly at about 25° and bearing, in well-preserved specimens, seven pairs of apodomal pits, though frequently only six are visible in poorer specimens. Pleural lobes on available material poorly preserved.

Discussion. This form is synonymous with T. cf. radialis described by Ingham (1970) from the Cautleyan and low Rawtheyan Stages of the Cautley Mudstone Formation. Ingham concluded (1970, pp. 56-57) that this form is more likely than T. m. moeldensis and related forms to be identical with T. radialis Lamont from the Portrane Limestone. Whether or not this is the case (and the issue is now further complicated by the presence of a third related species in the Welsh faunas—T. aff. radialis, see below), separation of the form from T. m. moeldensis is justified on the basis of several morphological differences. Apart from the pit-count differences in the fringe (text-fig. 1) which mainly relate to the number of pits in E, and in the posterior row, the distinction is based on the degree of inflation of the pseudofrontal glabellar lobe, the presence or absence of reticulation, the presence or absence of 3p lateral furrows and of well-developed lists, the degree to which the brim is developed anteriorly, and the number of pairs of apodomal pits on the pygidial axis.

T. cf. radialis has also been collected by the author (Price 1973b, p. 539) (specimens SM A94697, A94701, 94704, 94712, and 94718) from a quarry at Ty-isaf-mawr near Llansamffraid-y-Mechain in the Berwys, a locality which Whittington (1938, his Locality 53) included in the ‘Diacalymene marginata Zone’ of the Lower Tre-wylian Beds.

_Tretaspis aff. radialis_ Lamont, 1941

Plate 101, figs. 1-7; text-fig. 1

1914 _Trinucleus seticornis_ (Hix): Strahan _et al._ (pars), tables, pp. 64, 75.
1914 _Trinucleus seticornis_ (Hix), var. bucklandi (Barr.): Strahan _et al._, table, p. 75.
1914 _Trinucleus sp._; Strahan _et al._, table, p. 75.
1923 _Trinucleus sp._; King (pars), list, p. 495.
1970 _Tretaspis cf. radialis_ Lamont; Ingham (pars), pl. 9, figs. 17-19 only.
1973a _Tretaspis cf. radialis_ Lamont; Price (pars), pp. 229, 238-239, 242; tables 1, 2, 5.

Material, horizons, and localities. This form replaces T. cf. radialis in the topmost four metres of the Sholstock Limestone Formation of Prendergast Place (Localities 8c, 8b of Price 1973b) and continues into the overlying Slade and Redhill Mudstone Formation (Locality 8a). It is the only species of _Tretaspis_ known from the exposures in the latter formation at Redhill Quarry (Locality 7 of Price 1973a). Material from these sources totals thirty-nine specimens (of which twenty-four are from the topmost Sholstock Limestone). A further occurrence at Aber-marchnant in the south-west Berwyns is noted in the discussion.

Description. In over-all cephalic morphology this form does not differ appreciably from T. cf. radialis, except in the extent of surface reticulation. On the pseudofrontal glabellar lobe, reticulation is subdued and appears to be confined to the post-apical region (just visible, for instance, on Pl. 101, fig. 7); the genal lobes on all known specimens are smooth. The main difference between the two forms is in the development of the 1, pit-arc of the fringe. Of 18 specimens of _T. aff. radialis_ showing the frontal area of the fringe, one-third had no 1 pits at all and the remaining 12 had short 1 arcs of between 1 and 4 pits (text-fig. 1).
When present, this short $l_1$ arc is developed between R2 and R6 with at least 1 and possibly as many as 5 pits absent frontally (half-fringe). There may also be a tendency for the $l_3$ arc in T. aff. radialis to contain slightly fewer pits than that in T. cf. radialis (text-fig. 1). Otherwise the arrangement of pits is similar in both forms, with the $l_1$ arc invariably complete.

Thorax (Pl. 101, fig. 3), known from single, poorly preserved specimen, of six segments. Axis occupies about one-third of total width (tr.) anteriorly, gradually tapering posteriorly, only gently convex (tr.). Axial rings separated by broad (sag. and exsag.) articulating furrows containing deep, oval apodemal pits a short distance from the axial furrows. Axial furrows rather shallow. Pleurae broad (exsag.) flat, apparently horizontal for most of length (tr.). Pygidium similar in over-all form to those described previously with axis occupying slightly over one-quarter of total width (tr.) anteriorly, tapering back at 25-30° and bearing six or seven pairs of apodemal pits. Pleural lobes on available material again poorly preserved.

Discussion. T. aff. radialis is readily distinguished from both T. cf. radialis and $T. m. moeldenensis$ by virtue of its very short or absent $l_1$ pit-arc. In this respect, however, the fringe is very similar to that of $T. m. colliquia$. This last form does show some fringe differences such as the anteriorly well-developed brim, the occasionally incomplete $l_1$ arc, and the large $l_1$ pits. There are differences, too, in the degree of inflation of the pseudofrontal glabellar lobe, the degree to which the genal lobes overhang the fringe and in pygidal characters, particularly the relatively broader and more rapidly tapering pygidal axis of T. aff. radialis with its fewer pairs of apodemal pits. So far as the Welsh populations of $T. m. moeldenensis$ (s.l.) described herein are concerned, these show much greater variation in the development of the $l_1$ arc in addition to most of the differences listed above.

Lamont (1941, p. 456) originally described $T. kieneri radialis$ on the basis of two fragments from the Portranke Limestone of Co. Dublin, Eire. Of these, the lectotype, SM A16202, has at least twelve pits clearly visible in the $l_1$ arc and the remaining syntype, SM A16203, appears to have had an extensive $l_1$ arc as well. The form described above is not, therefore, thought likely to prove identical with $T. radialis$. Nevertheless, redescription of the latter form from topotype material and clarification of the status of related forms is clearly urgent.

A further sample of 12 specimens of T. aff. radialis comes from the (locally) basal Ashgill strata of Aber-marchniant in the south-west Berwyns (locality a1 of King,

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**EXPLANATION OF PLATE 101**

Figs. 1-7. *Tretaspis aff. radialis* Lamont, 1, SM A94505, cast from partial external mould of cephalon, basal Ashgill Mudstones, Aber-marchniant, south-west Berwyns, oblique view, × 5. 2. BM It. 9203, partial internal mould of cephalon, basal Shale and Redhill Mudstones of Prendergrass Place, Haverfordwest, oblique view, × 5. 3. SM A77860a, internal mould of articulated exoskeleton, basal Shale and Redhill Mudstones of Prendergrass Place, dorsal view, × 4. 4. SM A31597, internal mould of pygidium, high Sholesbrook Limestone of Prendergrass Place, dorsal view, × 6. 5. SM A50643, partial internal mould of cephalon, topmost Sholesbrook Limestone of Prendergrass Place, oblique view, × 5. 6. SM A94507a, partial internal mould of cephalon, horizon, and locality as for fig. 1, oblique view, × 6. 7. SM A94998, cast from partial external mould of cephalon, horizon and locality as for fig. 5, anterior view, × 5. Fig. 8. *Tretaspis sp. indet*. A, BM It. 8913, cast from external mould of pygidium, Birdhill Limestone, Birdhill Farm, near Llandello, dorsal view, × 6.

Figs. 9, 10. *Tretaspis hudeandiaca* Stormer, *brachystichus* Ingham, 9, BM It. 9275, incomplete internal mould of cephalon. Sholesbrook Limestone horizon at Reepston Water (Locality 10a of Price 1973a), dorsal view, × 6. 10. SM A77794, incomplete internal mould of cephalon, horizon and locality as for fig. 9, antero-lateral view, × 6.
1923). One specimen has 23 pits in E₄. The number of pits in the posterior row is 11 in 2 specimens and 12 in a third though the original of Plate 101, fig. 1 shows only 6! The number of pits in I₄ varies from 0 (1 specimen) through 1 and 2 (1 specimen in each case, in the latter the original of Pl. 101, fig. 1) to 4 or 5 (original of Pl. 101, fig. 6). Two external moulds show subdued reticulation on the posterior part of the pseudofrontal glabellar lobe. In all other general features the material resembles _T. cf. radialis_. What makes its identity with _T. aff. radialis_ of further interest is its occurrence at Aber-marchant together with _T. hadelandica_ Stormer _brachystichus_ Ingham and _Kloucekia robertsi_ (Reed), a situation exactly paralleled with _T. aff. radialis_ in the high Shoneshok Limestone (see Price 1973a, p. 229 and table 2).

Ingham (1970, pl. 9, figs. 17–19) has figured, among forms which he refers to _T. cf. radialis_, a specimen from Zone 5 of the Rawtheyan Stage in the Westerdale Inlier which appears to have only four pits in the I₄ arc and which on the cast from the external mould does not appear to be obviously reticulated. It is conceivable that this and other forms referred to _T. cf. radialis_ in the topmost part of its range might belong with the forms described here as _T. aff. radialis_. Ingham (1970, p. 56) notes an association with _T. hadelandica brachystichus_ and it is from Zone 5 also that _Kloucekia cf. robertsi_ is recorded (Ingham 1966, table 2).

_Tretaspis_ sp. indet. A

Plate 101, fig. 8

1973a _Tretaspis_ of _T. moeldenum_ group; Price, list, p. 244.

_Material, horizon, and locality._ Eight specimens from the Birdhill Limestone of the old quarry 180 m north-west of Birdhill Farm, 2.5 km west-north-west of Llandilo, Dyfed. These specimens (BM H. 8946–8948, 8950–8954) comprise 4 fragments of fringe and 2 internal moulds and 2 external moulds of pygidia.

_Description._ The fringe fragments show that the pits are arranged in strict radial alignment and with the following arcs developed in all: E₂, L₂, I₃, I₄. One fragment appears to show 1 or 2 pits of an I₄ arc. On the upper lamella the E₂, E₃, and I₄ pits are contained in radial sulci and all the internal arcs are arranged in such sulci on the lower lamella. The E₄ pit is absent from the posterior row.

_Pygidium_ (Pl. 101, fig. 8) sub-triangular in outline, broad (tr.), maximum width three times sagittal length. Postero-lateral margins convex, posterior bluntly rounded; these margins strongly bevelled from a distinct sub-marginal rim. Axis narrow, occupying about one-fifth of maximum width (tr.) anteriorly and tapering back at about 25°; moderately convex (tr.). Ring furrows shallow mesially, gently arched forward, each containing a pair of prominent apodemal slots abaxially. Eight such pairs of slots are visible, the posteriormost markedly fainter than the rest. Axial furrows shallow. Pleural lobes nearly flat, horizontal, crossed by four distinct, broad pleural ribs and a faint fifth; ribs separated by shallow pleural furrows and each with faint interpleural furrows.

_Discussion._ The sparsity and fragmentary nature of the available material precludes detailed comparison with other forms. A close similarity may be noted, however, between the pygidia described above and topotype pygidia of _T. m. moeldenum_ (Pl. 99, figs. 6, 9).
PRICE: TRETASPI From the Ashgil of Wales

THE TRINUCLEUS SETICORNIS GROUP

For the characteristics of the group see Ingham 1970, p. 41.

Tretaspis hadelandica Sturmer, 1945, brachystichus Ingham, 1970
Plate 101, figs. 9, 10; Plate 102, figs. 1-5; text-fig. 2

1885 Trinucleus seticornis, Hist.; Marr & Roberts (pars), p. 480 (centre).
1914 Trinucleus seticornis (Hist.); Strahan et al. (pars), tables, pp. 64, 75.
1914 Trinucleus seticornis (Hist.), var. backlundii (Barr.), Strahan et al. (pars), tables, pp. 64, 75.
1914 Trinucleus seticornis (Hist.), var.; Strahan et al., table, p. 75.
1923 Trinucleus sp.; King (pars), list, p. 495.
1938 Tretaspis ceroides (Angelini); Whittington, list, p. 452.
1938 Tretaspis sp.; Whittington (pars), list, p. 452 (bottom).
1965 Tretaspis seticornis sundevallii Sturmer; Cave, p. 296.
1970 Tretaspis hadelandica Sturmer brachystichus Ingham, pp. 46-49, pl. 6, figs. 13-19; pl. 7, figs. 1-7; text-figs. 14, 16.
1975 Tretaspis cf. hadelandica Sturmer brachystichus Ingham; Cocks and Price, pp. 705-706, pl. 81, figs. 8, 9.

Holotype of subspecies: Figured Ingham 1970, pl. 6, fig. 15, HUD 410, an enrolled specimen from the Rawtheyan Stage, Zone 5, of the Cauley Mudstone Formation.

Material, horizons, and localities. The following description is based on samples totalling thirty-five specimens from the high Sholeshock Limestone and basal Slade and Redhill Mudstone Formations of the areas around Haverfordwest, Robeston, and Llandowr, Dyfed (Localities 8a, 8b, 9d, 10a, 15, and 22 of Price 1973) and a further sample of fourteen specimens from the high Slade and Redhill Mudstone Formation of Haverfordwest (Locality 1 of Cocks and Price 1975). When histograms of fringe data are plotted separately for these two sets of specimens there are no appreciable differences. They are therefore treated together in the histograms on text-fig. 2 and in the description. Occurrences in the Ashgill Series of the Breyburn Hills and of the Llwyd Peninsula are noted in the discussion.

Description. Cephalon approximately semicircular in dorsal view. Pseudofrontal lobe of glabella sub-spherical in form, standing high above level of genal lobes, occupying almost two-thirds of total glabellar length (sag.), and spicily bearing a small median tubercle. Occipital ring narrow and strongly convex (sag. and exsag.), strongly arched (tr.), and orientated postero-dorsally. Occipital furrow broad (sag. and exsag.) and shallow mesially, abaxially containing deep, ovoid apodomal pits. 1p lateral glabellar lobes short (tr.), convex, abaxially rounded. 1p lateral furrows deep, slot-like, converging anteriorly at 140-150°.

2p lobes gently convex (exsag.), set transversely, narrowest (exsag.) abaxially, broadening outwards. 2p lateral furrows in form of large, ovoid pits, diverging anteriorly at 150-160°. Well-preserved ex external moulds show the presence of a faintly developed pair of depressions on the sides of the pseudofrontal lobe representing the 3p lateral furrows. Axial furrows broad (tr.) posteriorly, less so anteriorly where they contain deep anterior fossae of about the same size as the pits of the 1p arc of the fringe. Genal lobes sub-quadrant shaped, steeply declined antero-laterally, not overhanging fringe; bearing prominent lateral tubercles on the level of the anterior margins of the 2p lateral furrows. In all external moulds so far examined, the surface of the glabella has been coarsely reticulated. In all but two of these external moulds the entire surface of the genal lobes has also been coarsely reticulated (Pl. 102, fig. 4; Cockes and Price 1975, pl. 81, fig. 9). Specimens GSM Fg. 216 and Pg. 226, however, both from the high Sholeshock Limestone of Pendergrass Place, Haverfordwest (Locality 8b, Price 1973) and similar in all other respects, including glabellar reticulation, show completely smooth genal lobe surfaces. The genal lobes drop steeply to broad, deep posterior border furrows which contain large posterior fossulae abaxially. Posterior borders narrow (exsag.) abaxially, broadening outwards. Fringe with anteriorly steep, gently convex genal roll; a gently curled rim is developed laterally. Genal prolongations rather short (Pl. 101, fig. 10), produced into stout
genal spines which project beyond the posterior margin of the pygidium (Pl. 102, fig. 2). Genal spines with narrow dorsal groove and a strong ventral ridge which is continuous with the prominent girder; the latter carries a few faint, widely spaced terrace lines. The half-fringe contains from 18 to 23 pits in the E₁ arc (text-fig. 2). Anteriorly these pits are contained in sulci with pits of the I₁ arc but beyond about R7 the 2 arcs become separate (Pl. 101, fig. 10). The E₂ arc is only developed postero-laterally where from 8 to 14 pits share sulci on the upper lamella with pits of the E₁ arc. E₃ pits are absent from the posterior row which contains from 7 to 10 pits, most usually 7 or 8. Pits in the arcs I₁ to J₁ are developed in separate 8R radii which are out of line with the 8R radii containing the E₁, I₁, and J₁ pits (Pl. 101, fig. 10; Pl. 102, figs. 4, 5). In front of the axial furrows pits of arcs I₁, I₂, and I₃ are developed but the I₃ arc merges with the I₁ arc both laterally and in front of the glabella. The number of pits in this short I₁ arc is usually between 5 and 6 in the available material though one specimen (GSM Pp. 226) shows only a single pit, from 1 to 3 pits (half-ings) are absent in front of the glabella. Lists may be developed on the upper lamella of the fringe separating the I₁ and I₂ arcs up to about aR₆ and the I₁/I₂ and I₃/I₄ arcs over the region in which I₃ is developed. On the lower lamella pits of the I₃-I₄ arc lie deep radial sulci forward of the genal prolongations. One of the fringes examined shows a slight irregularity antero-laterally where, in aR₁₀, a single pit of the I₃ arc is absent and appears to have merged with the rather large I₄ pit in the same radius (Pl. 101, fig. 10).

Thorax, known only from single internal mould (Pl. 102, fig. 2), of six segments. Axis occupies about one-third of total width (tr.) anteriorly. Axial rings moderately convex (tr.), slightly arched forward mesially, separated by brod d sag, and exag.) articulating furrows which contain deep, ovoid apodermal pits a short distance from the axial furrows. The elongated median tubercle near the anterior margin referred to by Ingham (1970, p. 48) and the associated row of small, sub-circular projections are not seen in this specimen. Axial furrows shallow. Pleurite directed transversely, straight, and horizontally for most
of length (tr.), deflected ventrally and slightly posteriorly at distal extremities. Broad (exsag.) pleural furrows are directed obliquely along each pleura.

Pyrigma sub-triangular in form, about three times as broad (tr.) as long (sag.). Postero-lateral margins moderately convex, strongly bevelled, and covered in fine, sub-parallel terrace lines (Pl. 102, fig. 3). A strong sub-marginal rim is developed. Axis rather over one-quarter the maximum pyrgial width anteriorly; crossed by six shallow, forwardly arched furrows, the posterior-most of which is extremely faint and each of which contains a pair of deep apodermal slots a short distance in from the axial furrows. Axial furrows shallow, converging posteriorly at about 35°. Pleural lobes horizontal; crossed by four pairs of divergent pleural furrows. Up to two pairs of very faint, narrow interpleural furrows are sometimes visible.

Discussion. The form described above is very similar in both overall morphology and fringe characters to that described by Ingham (1970, see synonymy) as T. hadelandica brachystichus subsp. nov. from the Rawtheyan and ?Cauleyan Stages of the Cautley Mudstone Formation and the two are regarded here as synonymous. The only major difference is in the degree of genal lobe reticulation which in mature individuals of the North of England populations affects only the posterior parts of the lobes. In view of the two Welsh specimens mentioned above with completely smooth genal lobes and in view of the great variability of reticulation in the other Welsh samples discussed below, it is thought that this difference may be of purely local (adaptive) significance.

Twelve specimens from the Crugan Mudstones of the Lleyn Peninsula (BM It, 9350–9353, 9355–9358, 9360–9362, and 9419) from an exposure at Berllan Cottage, 1.8 km north of Llanbedrog, also belong with this form (see Pl. 102, fig. 3) as do small samples from the following horizons and localities within the Ashgill Series of the southern Berwyn Hills: Locality 54 of Whittington 1938, an exposure by the side of a truck 450 m north of the crossroads at Cefn-y-bidwel, 1.5 km north-north-west of Llanyblodwel, Powys and within Whittington’s ‘Discalymene drummuckensis Zone’ of the Lower Tre-ylan Beds; Locality 61 of the same author which lies just below the basal Llandovery near Gelli Farm, 1.75 km south-east of Llansantffraid-y-mechain; and Locality 1 of King 1923, in (locally) basal Ashgill strata 140 m north-east of Aber-marchant Farm, 2 km east of Llanwddyn. The fringe characters of all these samples fall within the range given for the South Welsh forms. In spite of this, there is extreme variation in the degree of surface reticulation. External moulds from the Berllan Cottage material show no sign of either glabellar or genal lobe reticulation while reticulation on the specimens from Whittington’s Locality 54 is so coarse on both the glabella and genal lobes as to be clearly visible on the internal moulds.

Ingham (1970, p. 49) has distinguished T. hadelandica brachystichus from T. h. hadelandica, T. seticornis seticornis, and other related Scandinavian forms.

Tretaspis cf. latailimbus (Linnarsson, 1869) distichus Ingham, 1970

Plate 102, figs. 6–11; Plate 103, fig. 8; text-fig. 2

1923 Trinulesus cf. bucklandi Barrande; King, list, p. 497 (bottom).

1923 Trinulesus bucklandi Barrande; King, list, p. 498.

Holotype of subspecies. Figured Ingham 1970, pl. 7, fig. 15, HUD 4.25, partial cephalon from the Rawtheyan Stage, Zone 7 of the Cautley Mudstone Formation.

Material, horizon, and locality. The description below is based on sixteen specimens (NMW 74.6G.1–15, 72.18G.133) from Locality 48 of King 1923, fig. 3, in the higher part of his ‘Calymene quadrata Mudstones’
at Craig-Fower, 3 km south-east of Hirnant in the south-west Berwyns. A further single specimen (SM A39862) from King's Locality 86 near by may also belong here.

**Description.** Cephalon similar in over-all form and proportions to that of *T. h. brachystrichus*. Pseudofrontal lobe of glabella sub-spherical in form with depressions representing the 3p lateral furrows clearly developed along its sides about midway between the anterior margins of the 2p furrows and the anterior fossula. Neither the pseudofrontal glabella lobe nor the genal lobes overlap the fringe. Glabellar and genal surfaces strongly reticulated. The reticulation, clearly visible on internal moulds (Pl. 102, figs. 9, 11), is particularly coarse on the inner posterior parts of the genal lobes (Pl. 102, fig. 6); it is terminated posteriorly on the occiput at a transverse ridge joining the posterior parts of the 1p lateral lobes. Fringe anteriorly steep and only gently convex; the narrow, slightly curled brim is developed only laterally (Pl. 102, fig. 8). Pit-areas E₁, E₂, and L₁ are developed both frontally and laterally with either 17 or 18 pits in E₁. Though pits of arcs I₁ and I₂ appear to merge laterally on 1 or 2 specimens at around aR₁ (Pl. 102, fig. 7), they remain separate on others. On the upper lamella E₂ and I₁ pits share sulci frontally up to about aR₆ but form discrete arcs laterally. I₁ pits are only developed laterally from bR₁₀ or 11 where on the upper lamella they share sulci with the E₂ pits. Usually E₂ pits are absent from the posterior row so that between 6 and 8 pits are present in the half-fringe. On 2 specimens, however, E₂ pits are absent from the posterior-most 3 rows; these 2 specimens are responsible for the 2 lowest counts on the histogram in text-fig. 2. A short I₆ arc is developed in front of the axial furrow. The number of pits can only be counted in 1 specimen where 4 are present from aR₅ to aR₈ (Pl. 102, fig. 8). This same specimen has lists developed separating each of the internal pit-areas. The number of pits in the posterior row is 7, 8, or 9 (1 specimen in each case).

Thorax incompletely known. Axis moderately convex (tr.), occupying about one-third thoracic width anteriorly. Axial rings with broad (sag. and exsag.) ring furrows which contain deep, ovoid apodemal pits abaxially—at a distance of about their own length (tr.) inside the axial fringe. Pleuræ flat and horizontal for most of length (tr.), deflected ventrally and slightly posteriorly near distal tips. Pleuræ furrows commencing at inner anterior corners and running obliquely outwards and posteriorly, broadening rapidly and separating narrow (exsag.) transverse anterior bands from adaxially broad (exsag.) triangular posterior bands which narrow towards the fulcrum and have a prominent, slightly raised, oblique anterior margin.

**Pygidium** sub-triangular in form, about three times as wide (tr.) as long (sag.). Axis occupies about one-third of total width anteriorly and tapers back at 30–35°; on available material bears six apodemes. Axial furrows broad (tr.) and shallow. Pleural lobes not well-preserved; bearing perhaps four pleural ribs. There is a well-developed marginal rim.

**Discussion.** Although detailed comparison is hindered by the rather small amount of material, giving very low sample numbers on the histograms in text-fig. 2, the form described above does seem close to *T. latillimitus distichus* as described by Ingham (1970, p. 50, pl. 7, figs. 8–16; text-figs. 14g, 16e) from the Rawtheyan Stage, Zone 7 of the Caulton Mudstones. The stratigraphically older form *T. convergens Dean*.

**Explanation of Plate 102**

Figs. 1–5. *Tretaspis hadlandica* Stormer, *brachystrichus* Ingham. 1, BM It. 9272, incomplete internal mould of cephalon, Sholesbrook Limestone horizon at Robinson's Washen (Locality 10a of Price 1973), dorsal view, ×6. 2, SM A77802a, internal mould of articulated exoskeleton, horizon and locality as for fig. 1, dorsal view, ×4. 3, SM A77811b, cast from external mould of pygidium, horizon and locality as for fig. 1, dorsal view, ×4. 4, SM A77581b, cast from external mould of cephalon, horizon and locality as for fig. 1, anterior view, ×6. 5, BM It. 9352, cast from partial external mould of cephalon, Cugan Mudstone Formation, Berllan Cottage, north of Llanbedrog, anterior view, ×6.

Figs. 6–11. *Tretaspis cf*. *latillimitus* (Linnarsson) *distichus* Ingham, *Cañimene quadrata* Mudstones', Locality 38 of King 1923, south-west Berwyns, 6–9, NMW. 74.6G.13, a, cast from external mould of cephalon in dorsal, left-lateral, and anterior views and internal mould in dorsal view, ×5. 10, NMW. 74.6G.13, internal mould of cephalon, anterior view, ×5. 11, NMW. 72.18G.133, partial internal mould of cephalon, dorso-lateral view, ×4.
PRICE, *Tetraspis* from Wales
(1961, p. 127, pl. 9, figs. 1-6; see also Ingham 1970, pp. 45-46, pl. 6, figs. 1-12; text-figs. 14e, 15) is similar in many respects to the Welsh material but differs in having a greater number of pits in E1, in having E2 and I1 more extensively sulcate frontally and in its characteristic swollen genital lobes. Another specimen which may belong here comes from King’s Locality 86 (1923, fig. 4) about 1 km south-west of Craig Fair and from stratigraphically slightly higher than the other material. This specimen (P1. 103, fig. 8) is similar in most features but differs in showing 12 pits in the E2 arc and 7 pairs of apodemal pits on the pygidial axis. There are 10 pits in the posterior row. It may be noted that the number of apodemal pits on the pygidial axis in this specimen exceeds the maximum of 6 stated by Ingham (1970, p. 41) to be characteristic for the *T. seticornis* group.

*Tretaspis cf. sortita* (Reed, 1935)

Plate 103, figs. 1-7; text-fig. 2

1928 *Tetraspora seticornis* Hisinger; *King (pars)*, list, p. 690 (top).

1928 *Tetraspora kaeros*; *Whittington*, p. 92, list, p. 123, pl. 29, figs. 3, 5.

Type material. A lectotype was yet to be selected from the syntypes figured by Reed (1935, pl. 1, figs. 4-10) from the Starfish Bed of the Upper Drummuck Group, Girvan, Scotland.

Material, horizon, and locality. Fifteen specimens from the highest Ashgill Mudstones of Craig Wen Quarry, 120 m west of Craig-Wen-Fach Farm, 7 km south-west of Meifod (Locality 59 of King 1928). The specimens are all from phosphatic nodules and so retain the original connective and many have the exoskeleton preserved.

Description. Cephalon sub-rectangular in dorsal outline. Pseudofrontal lobe occupying three-fifths of glabellar length (saq.); sub-circular in dorsal view, strongly convex (tr. and saq.) but not overhanging fringe anteriorly; apically bearing small median tubercle. Occipital ring convex (tr.), oriented slightly dorsally and strongly posteriorly so that the mesial section is broad (saq. and exsaq.) in dorsal view, rather flat and not sharply separated from the occipital furrow, the posterior margin convex. Occipital furrow broad and shallow, transverse, abaxially containing deep, ovoid apodemal slots. 1p lateral glabellar lobes short (tr.), convex, strongly rounded abaxially. 1p and 2p lateral furrows deep and prominent, the former slot-like, diverging posteriorly at about 95°, the latter large, ovoid pits diverging anteriorly at 110-120°. Between them the 2p lateral lobes broaden (exsaq.) abaxially. There may be very faint traces of the 3p lateral furrows on some specimens but they are never clearly developed. Glabellas separated from genital lobes by broad (tr.) axial furrows which in dorsal view are slightly divergent anteriorly and abaxially convex. Anterior fossule small, rather far back from *I1*, arc of fringe. Genital lobes sub-triangularly shaped, convex (tr. and exsaq.) but not overhanging fringe; bearing prominent lateral tubercles on the level of the anterior margins of the 2p lateral furrows; dropping steeply posteriorly to broad (exsaq.), transverse posterior border furrows which abaxially contain large posterior fossules. Posterior borders narrow (exsaq.) over transverse adaxial section, broadening rapidly towards the posterior fossule where they are deflected posteriorly. External moulds and specimens retaining the exoskeleton show the pseudofrontal lobe of the glabella to be finely reticulated in a manner very similar to that seen in a specimen of *T. l. latilimbatus* figured by Ingham (1970, text-fig. 18). This reticulation is terminated posteriorly in a narrow (saq. and exsaq.), anteriorly convex ridge joining the posterior margins of the 1p lateral glabellar furrows. The genital lobes are smooth. The posterior margins of the posterior borders bear fine, sub-parallel terrace lines. Fringe anteriorly comprises steep, gently convex genital roll; the narrow (tr.), very slightly curled basin is developed only laterally. Anteriorly 6 pit-arcs are present in the fringe: E1, I1a, and I’. The pits of E2 and I1, which are out of line with the I1-I1, I2, in 1 or 2 specimens share short radial sulci but in most remain clearly separate (P1. 103, figs. 1, 6).

Available material shows 18 or 19 pits in E2. E1 is only developed laterally from between br7 and br10 outwards and is absent from the posterior row so that between 9 and 12 pits are present. Arcs E1, I1a, and I1 are complete. Arc I1 merges with I1, laterally between aR11 and aR14. In all but 1 of 7 specimens
showing the appropriate region of the fringe, a short arc is developed of between 1 and 4 pits, extending between aR3 and aR6 and absent frontally for between 2.5 and 4.5 radii. There are between 8 and 11 pits in the posterior row. On the upper lamella of the fringe lists may be developed between the internal piri-
nares and, laterally, between I1 and E1. Internal moulds show that on the lower lamella the I3-I4 pits are
associated in radial sulci, which, as in other forms, break down on the genal prolongations. Girder broad,
depth anteriorly but shallow laterally, ornamented with moderately strong, widely spaced sub-parallel
terrace lines.

Thorax of six segments. Axis occupying slightly less than one-third total width (tr.) anteriorly; only
moderately convex (tr.). Axial rings strongly convex (sag. and exsag.) mesially, becoming flatter and broadening
(exsag.) outwards to form sub-quadilateral axial lobes; separated by broad (sag. and exsag.) ring
furrows from lower, less strongly convex half-rings. Axial furrows shallow. Pleural rings straight and flat for
almost three-quarters of length (tr.) then deflected ventrally and strongly posteriorly with strongly truncat-
ronded antero-lateral corners. Pleural furrows commencing at inner anterior corners where they are
narrow and broadening rapidly as they run outwards and back separating narrow anterior pleural buds
from broader posterior bands. Anterior margins of latter raised and forming prominent oblique ridges.

Pygidium slightly less than three times as wide (tr.) as long (sag.), with convex posterio-lateral margins and
strongly bevelled from a narrow sub-marginal rim. Axis occupying rather over one-quarter of total width
(tr.) anteriorly, tapering back at about 35° and bearing six pairs of slot-like apodelic pits within the mesially
shallow ring-furrows. Pleural lobes almost flat and horizontal, crossed on available material by at least two
poorly defined ribs. Bevelled margin ornamented with fine, closely spaced, sub-parallel terrace lines.

Discussion. In terms of fringe characters the form described above relates to *T. sortita*
(Reed) as briefly characterized by Ingham (1970, p. 50, pl. 8, fig. 1). The specimen
illustrated by Ingham has four pits in I3 and as far as can be judged the numbers of
pits in other arcs are similar to those for the Welsh material. Dr. Ingham too
comments (pers. comm.) that the fringe characters of the Welsh specimens appear to fall
within the range of variation of *T. sortita* from the Upper Drummuck Group and that
there is a close similarity in general morphology. More detailed comparison is pre-
cluded until *T. sortita* itself is redescribed.

Ingham has also noted (1970, p. 43) the occurrence of a form apparently similar to
*T. sortita* in the Ddolhhir Beds of the Cynwyd area of the Northern Berwyns in Wales.
A specimen figured by Whittington (1968, pl. 29, figs. 3, 5) as *T. kiaeri*? has 19 pits
in E1, a laterally incomplete I3 arc, 2 or 3 pits in I4, 13 pits in E2, and 9 in the posterior
row. Five other specimens from the same general area (BM I 1308) are poorly
preserved but give the following pit-counts: 18, 19½ (1 specimen in each case), or
20 (2 specimens) pigs in E1, 7, 12, or 14 pigs in E2 (1 specimen in each case) and, in
1 specimen, 4 or 5 pigs in I4. As will be seen from the specimen figured by Whittington,
the over-all morphology is very similar to that of the Meifod specimens described
here. Close comparison, however, must await better-preserved material. The Cynwyd
area specimens in the BM collections are poorly localized (see Whittington 1968,
p. 123) and their position within the Ddolhhir Beds uncertain.

*Tretaspis of Uncertain Affinity*

Tretaspis sp. indet. B

Plate 103, fig. 14

1909 *Teinucleus secundus* (His.); Strahan et al., faunal list, p. 59.

*Material, horizon, and locality.* GSM Pr. 161, 162, counterpart moulds of almost complete articulated
eoskeleton; Pr. 150, poorly preserved internal mould of incomplete exoskeleton, both from a low horizon
in the Slade and Redhill Mudstone Formation at Lower Cresswell Farm, about 3.75 km south-east of Llandowr, Dyfed. Three other specimens from the same locality, a poor pygidium (Pl. 170) and two fringe fragments (Pl. 163, 165), probably also belong with this species.

Description. Cephalon approximately semicircular in outline with a sub-spherical pseudofrontal glabellar lobe and strongly convex (tr. and exsag.) glabellar lobes, subquadrangular and not overhanging the fringe. Both glabella and genal lobes are coarsely reticulated and this reticulation is strong enough to be discernible, faintly, even on internal moulds. The available fringes are incomplete and poorly preserved so that the over-all pit distribution is not clear. The half-fringe has about twenty-one pits in the E1 arc. An E2 arc is developed and the pits in this are clearly separate from the E1 pits except in the anterior-most radius (R1) where they become conjunct. Pits of the I1 arc are radially in line with the two E1 pits and these three pits are contained together in radial sulci on the upper lamella. On the lower lamella the pits of the remaining internal arcs are associated in radial sulci and these are seen to be out of line with the radii containing the E2, E3, and I1 pits. The number of internal arcs in addition to the I1 arc is uncertain but in front of the axial furrows there appear to be at least two more (I2, I3, ?). There are at least seven pits in the posterior row. The girder is broad and deep frontally, shallower laterally. The genal prolongations are relatively short and there are long, slender genal spines with dorsal grooves.

Thorax of six segments. Axis broad (tr.), gently convex, with broad (sag. and exsag.) mesially shallow articulate furrows containing deep, vovoid apodermal slots abaxially. Pleurae broad (exsag.), horizontal for most of length, deflected ventrally and slightly posterior at distal extremities.

Pygidium about two and a half times as broad (tr.) as long (sag.), with strongly rounded postero-lateral margins. Axis occupies about one-quarter of total width (tr.) anteriorly and tapers back at about 25°. Mesially shallow ring furrows contain deep apodermal slots near the abaxial ends; six such pairs of slots are clearly visible and a seventh may be faintly developed. Axial furrows shallow, Pleurae flat, crossed by four oblique, abaxially broadening, faintly defined ribs. A sub-marginal rim is developed and the posterior margin is strongly bevelled.

Discussion. Whilst the out-of-line arrangement of the E1, I1, and the I1–I3 pits in a R and bR radii in this species is characteristic of the T. seticornis species group of Ingham (1970, p. 41), the significance of the virtually complete E2 arc is uncertain. Species within the T. seticornis group are characterized by an E2 arc which is only developed laterally while the known species in which the E2 arc is continuous frontally have been placed (with the exception of T. persuleatus Reed, 1935) in the T. melildienensis group (Hughes et al. 1975, pp. 563–564). The typical form of the E2 arc in the species described here can only be ascertained when more material is available. While such information as this and the number and degree of completeness of the inner I arcs is lacking, comparisons are difficult.

Dr. Ingham (pers. comm.) has, however, drawn attention to the similarity of the form described here to a form, as yet unnamed, from the Lower Drummuck group of the Girvan area. This latter species, which appears to be a precursor of T. persuleatus Reed, is characterized by an E2 pit-arc which is incomplete frontally and also lacks the external pseudogirder which is developed in T. persuleatus itself (Hughes, et al. 1975, p. 564).

_Tretaspis_ cf. _calcaria_ Dean, 1971

Plate 163, figs. 9–13

1966 _Tretaspis kitaeri_ Stormer; Whittington (pars), pl. 28, figs. 1, 6-14; non pl. 29.

_Holotype._ Figured by Dean 1971, pl. 4, fig. 1, BM L. 8135, a cephalon from the Chair of Kildare Limestone of Eastern Ireland.

_Remarks._ Neither _T. kitaeri_ nor the allied _T. calcaria_ fit readily into one or other of
Ingham's two species groups. Whilst the fringe is made up of aR and bR radii out of line, the E₁ pit-arc is continuous frontally and, moreover, the arrangement of pits is very similar to that seen in such forms as *T. moeldendensis* and *T. cf. radialis* belonging to the *T. moeldendensis* species group. It is possible to emphasize these similarities and to consider, as Dean has done (1971, p. 16), that the affinities of *T. klaerti* and *T. calcarea* are with these members of the *T. moeldendensis* group and that the significance of the out-of-line arrangement of pits in aR and bR radii is not, in this case, very great. On the other hand, the development of the E₂ arc in members of the *T. seticornis* group is very variable. It is tempting, to the present author at least, to consider the form described above as *Tretaspis* sp. indet. B as a member of the *T. seticornis* group in which *E₂* has become almost complete frontally. It is then possible to regard *T. klaerti* and allied forms more reasonably as members of the *T. seticornis* group in which *E₂* is frontally complete.

*Material, horizon, and localities.* Available material total some twenty-nine specimens in various collections (BM, BU, NMW, and SM). Most of these are distorted and/or fragmentary and sample numbers for pit-counts are extremely small. The material is from various localities in the Rhwlas Limestone (Rawtheyan) of the Bala area, North Wales.

*Description.* Whittington's recent treatment (1966, see synonymy) of this form renders extensive illustration unnecessary.

Pseudofrontal lobe of glabella strongly inflated, sub-parabolic in anterior view, standing high above level of genae; in lateral view dropping very steeply anteriorly. Neither pseudofrontal lobe nor genal lobes overhang fringe. Surface of both genal lobes and glabella as far back as 1p latera lobes finely reticulated (Pl. 103, fig. 12). Genal roll steep and gently convex anteriorly, brim rather narrow (sag. and essag.), only becoming well-developed laterally. In front of the axial furrows the 8 pit-axes E₂₁-₁, ₁₁₂-₁, and ₁₁₁ are developed. ₁₁₁ is absent for ½ (1 specimen), 2 (2 specimens), or 3 radii (1 specimen) frontally but is developed from aR2 to approximately aR16 (estimate on 1 specimen). In all specimens examined the ₁₁₂ and ₁₁₁ pits do not share radial sulci but are clearly separate over the region in which the former arc is developed (Pl. 103, figs. 9, 11). Axes ₁₁₁-₁₁₁ and ₁₁₁ are complete laterally. On the upper lamella pits of the E₁₁₂ and ₁₁₁ axes are contained in bR radii which are out of line with the ₁₁₁-₁₁₁ pits in the aR radii. ₁₁₁ is contained in radial sulci with E₁ and E₁₁ to around bR15 or 16 outwards from which the sulci contain the E pits only except in the posterior row where there is a single E₁ pit. This posterior row contains 11 (1 specimen) or 12 pits (3 specimens). The number of pits in E₁ varies from 12 to 28 or 29 (1 specimen in each case). On available internal moulds the girdle is ornamented with only very weakly developed sub-parallel terrae-lines.

Pygidium sub-triangular, with postero-lateral margins strongly convex; rather over two and a half times as wide (tr.) as long (sag.). Axis occupies rather over one-quarter of total width (tr.) anteriorly, is moderately convex (tr.), and tapers back at about 30° bearing seven pairs of apodemal pits. Pleurae crossed by at least three faint ribs. There is a low sub-marginal rim.

*Discussion.* Though the fragmentary and distorted nature of much of the Rhwlas material renders comparison difficult, there appears to be close similarity in many features to the specimens of *T. calcarea* described by Dean (1971, pp. 12–16, pl. 4, figs. 1–8, 10, 11; pl. 5, fig. 6) from the Chair of Kildare Limestone. One difference is that in the Rhwlas specimens ₁₁₁ is developed as a clearly separate arc whereas in the Chair of Kildare specimens ₁₁₁ and ₁₁₁ pits are closely associated in short sulci. ₁₁₁ may be slightly more extensive laterally in the Welsh material. Otherwise differences in pit distribution between the two forms are slight, the Irish material possibly having a slightly higher peripheral pit-count. Irish material also appears to lack the well-developed lists seen in the Welsh specimens.
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_Tetraptus moeldenensis_ Cave (s.l.). Bodiedda Mudstone Formation; quarry 14 m west of Bodeddida, 2½ km south-west of Conway, Gwynedd (Population A). Basal Tre-wylan Beds exposed around waterfall in single 370 m north-west of Glan-yr-afon Farm, 4 km north of Llanastfrad-y-m-Mechain, Powys (= Locality 42 of Whittington, 1938 = Locality 3 of Wedd et al. 1929, list, p. 62) (Population B). Basal Ty’n-y-twmpath Beds in headwaters of Nant-y-Lladron, 5 km south-south-east of Corwen, Clwyd (= Locality 47 of Wedd et al. 1927, p. 41) (Population C). Basal Ashgill Mudstones in stream section south of quarry at Pen-y-garnedd, 20 km north-west of Welshpool, Powys (= Locality 1 of Wedd et al. 1929, p. 61).

_Tetraptus moeldenensis moeldenensis_ Cave. Thin, basal horizon of Sholesbrook Limestone Formation around Llandowror, 3 km south-west of St. Clears, Dyfed (Localities 17, 24a, and 25 of Price 1973a, last = type locality).

_Tetraptus moeldenensis moeldenensis._ About 40 m above base of Ty’n-y-twmpath Beds in headwaters of Nant-y-Lladron, 5 km south-east of Corwen, Clwyd (= Locality 36 of Wedd et al. 1927, p. 41). Basal Ashgill Mudstones, stream section in Cwm Nant-y-melchias at Glynn Cottage, 3½ km north-west of Meifod, Powys (= Locality 29 of King, 1928).

_Tetraptus cf. radialis_ Lamont—Ranges throughout all but topmost 4 m of Sholesbrook Limestone Formation of Sholesbrook and Prendergast, Haverfordwest, Dyfed, while around Llandowwor it is absent from the base of the formation (Localities 17, 24a, 25) and not known with certainty above Locality 18a of Price, 1973a, Lower Tre-wylan Beds; quarry at Ty-naf-mawr, 1-75 km north-east of Llanastfrad-y-m-Mechain, Powys (= Locality 53 of Whittington, 1938).

_Tetraptus aff. radialis_ Lamont. Topmost 4 m of Sholesbrook Limestone Formation and overlying Slade and Redhill Mudstone Formation at Prendergast Place, Haverfordwest, Dyfed (Localities 8c-8u of Price 1973) and latter formation at Redhill Quarry, 2-5 km north-west of Haverfordwest (Locality 7). Basal Ashgill

EXPLANATION OF PLATE 103

Figs. 1-7. _Tetraptus cf. urtica_ (Reed), topmost Ashgill of Craigwen Quarry, south-west of Meifod. 1-3, SM A14390, internal mould of undistorted cephalon, anterior, left-lateral, and dorsal views, ×6. 4, SM A14389, internal mould of articulated exoskeleton, dorsal view, ×4. 5, SM A14390a, pygidium and posterior part of thorax, part of enrolled specimen retaining exoskeleton, pygidium in dorsal view, ×5. 6, SM A14390a, internal mould of cephalon, antero-lateral view, ×5. 7, SM A14392, internal mould of right genal area of fringe, dorso-lateral view, ×5.

Fig. 8. _Tetraptus cf. batilimbus_ (Linnarson) _atraeus_ Ingham, SM A9889a, internal mould of articulated exoskeleton. Locality 86 of King 1923, head of first tributary on south side of Marchant Valley, southwest Berwyns, dorsal view, ×4.

Figs. 9-13. _Tetraptus cf. calcarea_ Dean, Rhwyl Limestone, Bala area. 9, SM A41329, partial internal mould of cephalon, anterior view, ×5. 10, NNM 27.110.G541, cephalon partially retaining exoskeleton, anterior view, ×4. 11, NNM 26.316.G9, partial internal mould of cephalon, antero-lateral view, ×6. 12, SM A41330, partial cephalon partly retaining articulated exoskeleton, dorsal view, ×5. 13, SM A85521, internal mould of pygidium, dorsal view, ×5.

Fig. 14. _Tetraptus sp. inad. B_, GSM P.162, articulated specimen partly retaining exoskeleton, Slade and Redhill Mudstone Formation, Lower Cresswell Farm, south-east of Llandowwor, dorsal view, ×4.
PRICE, Tetraspis from Wales
Mudstones, stream section east-north-east of Aber-marchant Farm, 2 km east of south end of Lake Vyrnwy, Powys (Locality 48 of King 1923).

*Tretaspis* sp. indet. A Birdhill Limestone; old quarry 180 m north-west of Birdhill Farm, 2-5 km north-west of Llandeilo, Dyfed.

*Tretaspis hudsoniana* Stormer, *brachyscyphus* Ingam. Highest Sholeshock Limestone Formation and base of succeeding Slade and Redhill Mudstone Formation at Sholeshock and Prendergast, Haverfordwest, and around Llandowror (Localities 8a, 8b, 9d, 15, and 22 of Price 1973a); Sholeshock Limestone horizon at Roebestan Wathen (Locality 14a); high Slade and Redhill Mudstones on west bank of Western Cleddau, Haverfordwest (Locality 1 of Cocks and Price 1975). Crucian Mudstone Formation; exposure at Berllan Cottage, 1 km north of Llanellygro, Llyn Peninsula. Lower Tre-wyran Beds; exposure by track 450 m north of crossoads at Cefn-y-blosowell, 1.5 km north-north-west of Llandowror, Powys (= Locality 54 of Whittington 1938). Upper Tre-wyran Beds; exposure 45 m north-north-west of Gelli Farm, 1.75 km south-east of Llanantfanfraid-y-m-Mechain, Powys (= Locality 61 of Whittington 1938). Basal Ashgill Mudstones, stream section east-north-east of Aber-marchant Farm, 2 km east of south end of Lake Vyrnwy, Powys (Locality 48 of King 1923).

*Tretaspis* cf. *latilimbus* (Linnaeus) *distichus* Ingam. Higher part of *Calymene quadrata* Mudstones on Craig-Fawr, 3 km south-east of Hirnant, Powys (= Locality 48 of King 1923, fig. 3).

*Tretaspis* cf. *latilimbus* (Linnaeus) *distichus* Ingam. *Trinucleus bucklandi* Mudstone* of King 1923, exposed near head of first tributary on south side of Marchant valley, 2-6 km south-south-east of Hirnant, Powys (= Locality 48 of King 1923, fig. 4).

*Tretaspis* cf. *sorita* (Reed). From phosphatic nodules in mudstones immediately beneath the Craig-wen Sandstone in Craig-wen Quarry, 120 m west of Craig-wen Fach Farm, 7 km south-west of Mefford, Powys (= Locality 59 of King 1928).

*Tretaspis* cf. *sorita* (Reed). Dolbhar Beds of area around Cymwydd, 3-5 km south-west of Corwen, Clwyd (exact horizons and localities uncertain).

*Tretaspis* sp. indet. B. Low horizon in Slade and Redhill Mudstone Formation; exposure at Lower Cresswell Farm, about 3-75 km south-east of Llandowror, Dyfed.

*Tretaspis* cf. *calcaria* Dean. Rhislas Limestone Member of Moelwyd Mudstone Formation; various localities around Bala, Gwynedd (for details see Whittington 1966, p. 90).

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