LOWER TOURNAISIAN TRILOBITES IN THE CARBONIFEROUS LIMESTONE FACIES OF THE SOUTH-WEST PROVINCE OF GREAT BRITAIN AND OF BELGIUM

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ABSTRACT. Trilobites from the lowermost beds of the Carboniferous, from the south-west Province and from Belgium are described. The species are assigned to *Moschoglossis* gen. nov., *Cummingella?*, *Piltonia*, and *Brachymetopus*. The trilobite fauna is regarded as a limestone facies fauna of the *Gattendorfia* Stage.

INTRODUCTION AND STRATIGRAPHY

As a continuation to the author's (1955) description of the Upper Devonian and Lower Carboniferous trilobites of the Pilton Beds (sandstone-shale facies) in north Devon, south-west England, the trilobites of the lowest beds of the Carboniferous Limestone have been investigated. The present material has been assembled from museums in Great Britain, from the Musée royal d'Histoire naturelle in Brussels, and by collecting from the Lower Limestone Shale (Kellaway and Welch 1955, p. 8; K Zone of Vaughan 1905, p. 189) in the Avon Gorge, Bristol.

Trilobites are uncommon in the lowest Carboniferous Limestone but specimens of *Moschoglossis*, *Piltonia*, and *Brachymetopus* were found in the Lower Limestone Shale of the Avon Gorge. *Phillipsia truncatula* auct., which is not described in the present paper, occurs relatively more commonly than the above genera in the upper part of the Shale, towards the top of K_2, and in β. Collecting at Portishead, near Bristol, in the Mendips, and in Pembrokeshire yielded only *Phillipsia truncatula* auct., although specimens of *Moschoglossis* have been identified in museum collections from Portishead. The author has not collected in Belgium.

In the south-west Province of the Carboniferous Limestone in Great Britain the highest beds of the Upper Old Red Sandstone are conformably overlain by the Lower Limestone Shale. The Shale varies in thickness from over 500 feet in the Mendips to about 200 feet in the Avon Gorge, and from 300 to 600 feet in Pembrokeshire.

In Belgium (Delépine 1940) the marine Upper Devonian, Comblain-au-Pont Beds, equivalent to the Étroeungt Beds of north France, are succeeded by the Hastière Limestone (Tn1b). This is in turn followed by the Shales with *Spiriferellina peracuta* (Tn2a) and the Landelies Limestone (Tn2b); the highest horizon covered by the present study.

None of the species here described has been previously described from the cephalopod facies, in Germany or England, or from the Pilton Beds. The ranges of the species and genera in the relevant areas are as follows:

Moschoglossis. In Britain *M. decorata* is found at the base of K_2 and ranges at least into Z, Black Rock Limestone. In Belgium it is found in Tn1b, and ranges into Tn2b and possibly higher. No species of the genus has yet been recorded from the Pilton Beds of Devon. Nor can the genus be recognized in the large trilobite faunas described from

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the U.S.S.R. (Weber 1937), though Weber (1937, p. 145) mentions the presence of pygidia which may belong to the genus.

Cummingella is doubtfully present in the Lower Limestone Shale.

Cyrtosymbole. No species of *Cyrtosymbole* have been found in the lowest Tournaisian facies of Britain or Belgium in contrast to the prominence of species of *C.* (*Macrobole*) and *C.* (*Waribole*) in the cephalopod facies and in the Pilton Beds. *C.* (*Waribole*) *sargaensis* (Weber 1937, pl. 1, 2) from the Urals is close to *C.* (*Waribole*) *abruptirhachis* (R. and E. Richter 1919; 1951, pl. 1) from Germany.

Liobolina. This genus is only known from the cephalopod facies of Germany, where it is confined to the *Gattendorfia* Stage.

Piltonia. *Piltonia fryi* appears in the Avon Gorge, Bristol near the base of K_1 and ranges probably into β. In Belgium it is doubtfully present below the Hastière Limestone but definitely occurs in the Hastière Limestone, *peracuta*-Shales, and Landelies Limestone. *P. kassini* occurs in the Kassin Beds of the Kirghiz Steppe, and possibly in the southern Urals (Balaschova 1956), and *P. salteri* in Pilton Beds C. *Piltonia* may be regarded as a genus typical of the lowest Tournaisian.

Brachymetopus. Only a fragment of *Brachymetopus* is known from the Carboniferous Limestone of south-west England, and it is poorly represented in Germany. In contrast it is common in the Pilton Beds.

Phillipsia has not been recorded below the top of K_2 in Britain and below Tn2b in Belgium. The record of *P. gemmulifera* from Tn2a (Paul 1937*b*, p. 13) has not been substantiated. It is highly unlikely that this species is present at so low a horizon and the record may refer to *Piltonia fryi*.

The correlation of the Lower Limestone Shale with the Pilton Beds and with their equivalents on the continent of Europe is a difficult problem. Paul (1937*a*, p. 435) concluded, mainly on brachiopod evidence, that the upper part of the Shale (K_1 and K_2) is equivalent to the Hastière Limestone, and in a more comprehensive paper he (1937*b*, table 1) correlated the Hastière Limestone and *peracuta*-Shales with the Hangenberg Limestone of Germany (*Gattendorfia* Stage). The base of the Tournaisian is here taken as the base of the *Gattendorfia* Stage and not at the base of Tn1a, Comblain-au-Pont Beds, of Belgian nomenclature, or T_1 of Paul (1937*b*), although the Belgian coding is retained in describing the location of specimens.

As George has remarked (1952, p. 35) it is not possible to apply the ammonoid chronology to the lowest beds of the Carboniferous Limestone. The presence of *Gattendorfia*, associated with trilobites typical of the *Gattendorfia* Stage, in Pilton Beds B affords good correlation of this part of the Pilton Beds with the *Gattendorfia* Stage. R. and E. Richter (1951, p. 229) proposed three parachronological Stages (Stufen) for the Lower Carboniferous; the *Liobolina*, *Liobole*, and *Phillibole* Stages, equivalent respectively to the *Gattendorfia*, *Pericyclus*, and *Goniatites* Stages of the orthochronology. The genus *Moschoglossis* has morphological similarities with *Liobolina*, and its presence in the Lower Limestone Shale of the Bristol area and in the Lower Tournaisian of Belgium accompanied by *Piltonia* is therefore interesting for the stratigraphical correlation of the Lower Tournaisian with the cephalopod succession as developed in Germany and with the Pilton Beds of north Devon.

Whilst it is not proposed to enter into a critical correlation of the British and Belgian areas it would seem that there is no evidence that K_1 and K_2 are not lowermost Car-

boniferous, and it is suggested that the Hastière Limestone (Tn1b) and the *peracuta*-Shales (Tn2a) may together be equivalent to the Lower Limestone Shale (K_1 and K_2) rather than to β as suggested by Vaughan (1915). This is a slight emendation of the correlation proposed by Paul (1937*a*). The base of the Black Rock Limestone may be then nearly equivalent to the base of the Landelies Limestone (Tn2b). The Lower Limestone Shale (K_1 and K_2) may be correlated with at least part of the *Gattendorfia* Stage.

The trilobite fauna of the lowest Tournaisian in Belgium and south-west England is not typically Tournaisian or Dinantian. *Phillipsia* is for the most part absent and *Cummingella* questionably present. *Weberides* and *Griffithides* are both absent. Moreover, the fauna has no Famennian aspect as there is no sign of *Phacops*. It is, however, a distinct fauna, with elements which compare with the trilobite fauna of the *Gattendorfia* Stage in Germany and north Devon. It may therefore be regarded as a limestone facies trilobite fauna as opposed to that typical of the cephalopod facies of the *Gattendorfia* Stage.

Preservation of material. Whilst collecting in the Lower Limestone Shale of the Bristol area I noticed that trilobites were to be found in only one type of lithology. In other types they were extremely uncommon. The thin limestone bands in which they occur are rubbly-weathering and have a most conspicuous lack of preferred orientation of the contained fossils. The fossils are for the most part well separated from each other and well preserved, and show no signs of abrasion, though the pygidia and cranidia were always separate. Examination by microscope indicated many shells and limestone fragments. In the thin limestone bands small (5 mm.) Athyrids were very abundant; '*Avonia*' *bassa* and species of *Chonetes* and *Schellwienella* were quite common, but crinoid ossicles notably rare. In other limestones showing a bedded arrangement of the fossils, and in particular in '*Chonetes*-sands', the trilobites were very rare or absent. The shales were not exhaustively searched because of the poor preservation of fossils in them. Collecting elsewhere, in the Mendips and in Pembrokeshire, yielded no bands with randomly orientated shells and no trilobites were found.

The assembled material from British museums supports the conclusion that there is a greater abundance of trilobites in the one type of lithology. All the Portishead trilobites are in this type of limestone, though with these crinoid ossicles are common. Several other specimens are in a crinoid sand. The Belgian trilobites occur in more varied lithologies. Those from the Landelies Limestone (Tn2b) are mostly in 'petit-granit', but those from the Hastière Limestone (Tn1b) do lack a preferred orientation.

Bohlin (1949, p. 558) has described limestones with similar random orientation of the fossils from the Ordovician of Öland, Sweden and has discussed their origin. It is likely that this type of limestone occurs not uncommonly elsewhere.

Terminology. The terminology used in description is that of Goldring (1957). In description the side and front views essentially refer to the profiles seen in these aspects, whereas the plan is a description in general. In the side and front views of cranidia, the plane perpendicular to the median plane (sag.) of the glabella and occipital ring and touching them is placed horizontally. Although this seldom corresponds with the horizontal plane of the cephalon in life, the orientation allows for a more definite description, is more easily appreciated, and can be more accurately reproduced, in these particular species (cf. R. and E. Richter 1956, p. 367; orientation of cephalon in side view).

Material. Described and figured specimens are deposited in museums, abbreviated in description as follows: BC—Bristol City Museum, England. BM—British Museum (Natural History), London. BR—Musée royal d'Histoire naturelle, Brussels. BU—Bristol University (Department of Geology), England. GS—Geological Survey Museum, London. HM—Hunterian Museum, Glasgow, Scotland. O—University Museum, Oxford, England. SMF—Senckenberg Museum, Frankfurt am Main, Germany.

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DESCRIPTIONS

Genus MOSCHOGLOSSIS gen. nov.

Derivation of name. Greek—calf's tongue—from the shape of the glabella.
Type species. Moschoglossis decorata decorata subsp. nov.
Range. Lower Carboniferous, Tournaisian.
Distribution. England, Bristol area, Lower Limestone Shale; Belgium, Dinant synclinorium; France, Avesnelles; ?U.S.S.R., Urals.
Species assigned to the genus. The type species comprising *M. decorata decorata* and *M. decorata brevicauda* subsp. nov.

Diagnosis. Glabella cylindrical and moderately inflated. Occipital ring an even band, scarcely narrower at the axial furrows than medianly. No branch furrow. Large eyes and narrow palpebral lobes. High narrow anterior border. Anterior branch of facial suture rather strongly diverging and β strongly rounded. Anterior fixed cheek markedly triangular. γ opposite glabellar furrow 3p and close to axial furrow. ϵ slightly posterior to half length of glabellar lobe 1p. Posterior branch strongly diverging. Free cheeks with small genal spine. Pygidium with thirteen rings and nine ribs. Weak or absent border furrow. Ring and pleural furrows weak, and anterior and posterior portions of ribs equally developed. Ornament on glabella of fine transverse scale-like ridges with steep posterior edges: much finer on occipital ring and pygidium.

Material. Cranidia, free cheeks, pygidia, and hypostome.

Comparisons with other genera. 1. *Cummingella* Reed 1942. The type species of *Cummingella, C. jonesi* (Portlock 1843) (Opinion 352. Opinion and Declaration rendered I.C.Z.N. vol. **11,** pt. 2, pp. 25–46, 1 pl., 1955) is closely comparable with *M. decorata* only in some details. The glabella of the two species differs considerably, that of *C. jonesi* being anteriorly inflated so that the breadth anteriorly is as great as the breadth posteriorly. In other species assigned to *Cummingella* the anterior part is still more inflated and the breadth anteriorly is the greatest breadth. In *C. jonesi* the facial suture closely follows the axial furrows and the anterior part of the fixed cheek is extremely narrow, whereas in *M. decorata* β is sharper, γ–β diverges more strongly from the median line, and the anterior fixed cheek is comparatively large. The steep anterior border in *C.*

jonesi is close to that in *M. decorata* but in *C. jonesi* carries down posteriorly below the glabella, whereas in *M. decorata* the border continues the line of the glabella, though offset. The size of the large eyes is very similar, though the Russian variety *C.* '*derbyensis* var. *kargini*' (Weber 1933) has comparatively small eyes. The lateral terminations of the occipital ring in *C. jonesi* are similar to those in *M. decorata*, and the form of the posterior border of the fixed cheek is also similar in both. The glabellar furrows are more strongly incised in *jonesi*, where 1p reach to the occipital furrow. The free cheeks of the two species are very similar, and short genal spines are present in both.

The pygidia of *C. jonesi* and *M. decorata* differ in that *C. jonesi* has more prominent rings and ribs, and deeper ring and pleural furrows, though each has the same number. The posterior portions of the ribs in *C. jonesi* are comparatively narrower than in *M. decorata*. Both species have broad borders.

The main difference between *M. decorata* and *C. jonesi* is in the shape of the glabella. The anterior inflation of the glabella with geological time is a well-known trend in trilobites, and the several points of close similarity between *C. jonesi* and *M. decorata* suggests that *Moschoglossis* may be a forerunner of *Cummingella*.

2. *Liobolina* R. and E. Richter 1951. Type species *L. nebulosa* R. and E. Richter 1951. The outline of the glabella in *M. decorata* is similar to that in *Liobolina*. Apart from this the cephalon of *M. decorata* differs in detail from the cephalon of the two species included in *Liobolina*, *nebulosa* R. and E. Richter 1951, and *submonstrans* R. and E. Richter 1951. The anterior border of the cranidium in *M. decorata* is much steeper than in either *L. nebulosa* or *L. submonstrans*. The occipital ring also differs in that laterally it only slightly shortens and is almost as long at the axial furrows as it is centrally (sag.). Of the two species the free cheek is only known in *L. nebulosa* and the genal angle is strongly rounded. The course of the facial suture and the size of the eyes are very different in *M. decorata* from those in *L. nebulosa* and *L. submonstrans*. In *L. nebulosa* the palpebral lobe is practically absent and the posterior branch of the facial suture diverges from the axial furrow. In *L. submonstrans* the palpebral lobe is small, more or less centrally placed to the glabella (glabellar furrow 1p slightly anterior to ϵ), and the posterior branch of the facial suture is rather long and for nearly half its course parallels the axial furrow. In *M. decorata decorata* the palpebral lobe is large and extends almost to the occipital furrow. ϵ is situated far posterior and a part of the posterior branch of the suture which parallels the axial furrow is virtually absent. ϵ and, especially, γ are also rather closer to the axial furrow than in *L. submonstrans*. In *L. nebulosa* they are well away from the axial furrow. The glabellar furrows are weak in all three species, but the slight anterior fork in furrow 1p in *M. decorata* is not discernible in either *L. nebulosa* or *L. submonstrans*.

The pygidium of *M. decorata* is similar to the pygidium of *L. nebulosa* and *L. submonstrans* in that the segmentation is weak, though it is less so in *M. decorata*. The position of the rib furrow is similar in all species. *M. decorata* has a greater number of axial rings, thirteen as against nine plus two more indistinct rings in *L. submonstrans* and *L. nebulosa*, and probably also a greater number of ribs, nine as against six plus considerable room for more in *L. submonstrans* and *L. nebulosa*.

The size of the eyes may well be due to an environmental factor; the large eyes associated with the species from the Carboniferous Limestone facies and the small or absent eyes from the cephalopod facies. Blindness in trilobites from the Upper Devonian and

Lower Carboniferous has been discussed by R. and E. Richter (1951, p. 226). It is particularly prominent amongst Upper Devonian and Lower Carboniferous species from the cephalopod facies.

Although *M. decorata* has some resemblances to *L. nebulosa* and *L. submonstrans*, the similarity is not sufficiently close for it to be considered a species of *Liobolina* in the Carboniferous Limestone facies. The several points besides the facial suture on which it differs from *L. nebulosa* and *L. submonstrans* are considered to be sufficiently distinct for it to be assigned to a new genus.

Moschoglossis decorata decorata subsp. nov.

Plate 43, figs. 1–7

Derivation of name. Manuscript name given by F. R. C. Reed to pygidium (HM A 495) which, characteristic of the species, has scale-like ornamentation.
Holotype. Cranidium (GS 86982), Pl. 43, fig. 1.
Type locality. Bristol, Avon Gorge, right bank, from scree at end of wall, by bed marked '*Chonetes* cf. *buchiana*' on pl. 2 of Vaughan 1906.
Horizon. Carboniferous Limestone, Lower Limestone Shale, K_2 Subzone (Vaughan 1905).
Material. A few cranidia, together with free cheeks and pygidia probably belonging to the species.

Diagnosis. Cranidium and free cheek: as for genus. Pygidium with length rather greater than breadth of axis plus 1 pleural lobe. No border furrow.

Description. Cranidium, side view. Glabella anteriorly moderately curved. Posterior $\frac{1}{3}$ and occipital ring almost flat, the occipital ring continuing the line of the glabella. Occipital furrow sharp. Very short (sag.) but high anterior border, which almost parallels the offset line of the glabella.

Front view. Glabella a triplet of three very low arches, which together form a low curve. The outer two are narrower than the central one and steepen towards the axial furrow, which is rounded. Palpebral lobes narrow and weakly arched.

Plan. Anterior margin only moderately curved. Border very narrow and with eight to ten parallel lines. Glabella almost rectangular, with a slight nick scarcely constricting the glabella between glabellar furrows 2p and 3p at about half length of glabella, anterior to which it is almost parallel-sided with a broad, rounded termination. Posteriorly it broadens slightly and is broadest at glabellar furrows 1p but there only slightly broader than the anterior part of the glabella. Posterior to furrows 1p it narrows very

EXPLANATION OF PLATE 43

Figs. 1–7. *Moschoglossis decorata decorata* subsp. nov. 1–3, plan, front view, and side view of holotype cranidium, ×3, (GS 86982); 4, free cheek, ×3 (GS 95324); 5–7, plan, side view, and posterior view of pygidium, ×2·5 (BM I 13569).
Figs. 8–11. *Moschoglossis decorata brevicauda* subsp. nov. 8, 9, plan and side view of holotype pygidium, ×5 (BR IG 13829/1);10, 11, plan and side view of hypostome, ×5 (BR IG 13828).
Fig. 12. *Moschoglossis sp.* A, cranidium, ×4 (GS 33713).
Fig. 13. *Cummingella? sp.*, cranidium, ×3 (GS 95325).
Figs. 14–16. *Cummingella? costabisulca* sp. nov., plan, side view, and posterior view of holotype pygidium, ×4 (GS 33712).
Figs. 17–20. *Piltonia fryi* sp. nov. 17–19, plan, side view, and posterior view of holotype pygidium, ×3 (GS 86984); and 20, pygidium, ×5 (BR IG 9136).

slightly to the occipital furrow. Four pairs of glabellar furrows which are not impressed; they are scarcely discernible, and almost only so because they lack ornamentation. 1p strongly rounded, clear at the axial furrows, and forking with very short anterior branch furrow. Posterior branch not quite reaching to the occipital furrow; the distance between the posterior terminations of the furrows rather less than half the maximum breadth of the glabella. 2p almost straight. 3p and 4p parallel to 2p; 4p only a slight mark. Occipital furrow arches slightly anteriorly, medianly, and towards the axial furrows. The occipital ring is scarcely narrower at the axial furrows than medianly and bears a small occipital node.

Facial suture. Anterior branch moderately diverging from the glabella. β strongly rounded and rather angular; anterior fixed cheeks triangular. γ close to the axial furrow and opposite glabellar furrows 3p. ϵ slightly posterior to half length of glabellar lobe 1p. Palpebral lobe long and narrow, widest about opposite to glabellar furrows 1p. β only just farther from the median line than δ. Posterior branch almost immediately running outwards, terminating at a distance from the axial furrow about equal to one-third breadth (tr.) of occipital ring, though in the cranidium (GS 63063) the right termination is at a distance equal to half the length of the occipital ring. Posterior border furrow scarcely discernible and posterior border very narrow, only one-third length of occipital ring. Posterior fixed cheek very narrow.

Ornamentation. Glabella and occipital ring with fine transverse scale-like ridges with steep posterior edges. The ridges are much finer on the occipital ring. Towards the anterior margin and on the anterior fixed cheek the ridges become weaker and are accompanied by a fine punctation. The palpebral lobes are finely punctate.

Free cheek. Rather longer than broad. Cheek area evenly but not strongly arched, and with slight levelling around the eye. Eye large and regularly curved. Lateral border furrow indistinct and lateral border, like anterior border of cranidium, strongly rounded and with eight to ten parallel lines. Posterior border furrow rather sharp and V-shaped; the posterior border weakly arched but moderately wide. A short blunt genal spine.

Pygidium. Side view. Axis rather less high than pleural lobe, curving gently and evenly and terminating a little sharper at the border. Only a slight re-entrant angle between the axis and the border, which has the same convexity as the axis. The rings are scarcely arched but all are distinct and scale-like with sharp posterior edges.

Rear view. Axis rather strongly curved. Pleural lobes flat near the axial furrows, then arching strongly and falling steeply to the margin.

Plan. Length rather greater than breadth of axis plus one pleural lobe. The axis tapers gently with almost straight sides to a broad rounded termination which is not succeeded by any post-axial ridge. The border is wide and is not separated from the ribs by any furrow.

Thirteen rings, all distinct. Ring furrows sharp, abruptly constricting to only a fine line between trace of longitudinal grooves and axial furrows. Longitudinal grooves generally not discernible and otherwise extremely weak (GS 63062). Ring 1 slightly shorter than 2. 1–4 slightly arched anteriorly.

Ribs 1–4 distinct, 5–7 less distinct, and 8 and 9 indistinct. The ribs are moderately curved but scarcely arched, and the pleural furrows narrow and sharp. Rib furrows, which divide the ribs into equal parts, only a trace but distinct on ribs 1–5, and on rib 1 pass on to the border. The ribs do not continue on to the border.

Ornamentation. At ×20 punctate, and with fine short scale-like ridges, much weaker than on the glabella but similar to those on the occipital ring. Near to the margin laterally are numerous fine lines which approach the margin posteriorly and meet it at an acute angle.

Measurements (in mm.)

	GS 86982 Pl. 43, fig. 1	GS 63063
Length of cranidium	9·1	8·5
Length of glabella	7·1	6·7
Breadth of glabella	5·1	4·8

	BM I 13569 Pl. 43, fig. 5	GS 63062	BU 1146/2	BU 1147/1
Length of pygidium	9·6	10·4	8·0	4·8
Breadth of pygidium	11·0	13·8	. .	6·0
Length of axis	8·1	9·0	6·7	4·1
Breadth of axis	4·5	5·1	4·0	2·5

Comparisons. For comparisons with *Cummingella jonesi* Portlock 1843, *Liobolina nebulosa* R. and E. Richter 1951, and *L. submonstrans* R. and E. Richter 1951 see pp. 234–6. Weber (1937, p. 145) stated that in the Lower Tournaisian of the Urals pygidia similar to *Cummingella* '*derbyensis* var. *kiritchenkoi*' (Weber 1937) are present, but he did not say how the variety differed and gave no figures.

Occurrence. England, Lower Limestone Shale. Holotype (above) and pygidia (GS 86983); Bristol, Avon Gorge, indefinite locality but accompanied by '*Avonia*' *bassa* (Vaughan), with lithology resembling that of holotype, cranidium, free cheek, pygidium (GS 63062–4); Avon Gorge, indefinite locality but probably Lower Limestone Shale, with *Camarotoechia mitcheldeanensis* Vaughan and *Chonetes* cf. *hardrensis* (Phillips), cranidium, pygidium, and free cheeks (GS 95324, ? 95326, 95327); Bristol, Westbury-on-Trym, St. Monica's Home (Reynolds and Smith 1925, p. 469), free cheek and pygidia (BU 1146/1–3, 1147/1–2), Coombe Farm, Cherry Orchard (562.777), pygidium (O E1365); a single pygidium from the Avon Gorge (BU 1149) is labelled Z Zone (the presence of the species in Z has not been confirmed by present collecting); Portishead, near Bristol, indefinite locality but almost certainly Nightingale Valley Quarry (450.752), pygidia (BM I13569, HM A495, O E1352–3).

Moschoglossis decorata brevicauda subsp. nov.

Plate 43, figs. 8–11

Derivation of name. From the comparatively short pygidium.
Holotype. Pygidium (BR IG 13829/1), Pl. 43, fig. 8.
Type locality. Feluy 41, Feluy, abandoned quarry east of Feluy 31.
Horizon. Carboniferous Limestone, Tournaisian, Landelies Limestone (Tn2b).
Material. Pygidia, together with cranidium, hypostome, and free cheeks probably belonging to the species.

Diagnosis. A subspecies of *M. decorata* with the following differences from *decorata decorata*: pygidium comparatively shorter and length only very slightly greater than the breadth of axis plus one pleural lobe. Slight border furrow.

Description. Cranidium. The only incomplete cranidium (BR IG 13829/2), showing part of the glabella and anterior border, does not differ in form or ornamentation from *M. decorata decorata.*

Hypostome (BR IG 13828—posterior border broken). Anterior margin weakly curving posteriorly to the anterior wings. Anterior wings moderately projecting with almost straight outer margins, strongly curving inwards and upwards to lateral margins. Lateral margins subparallel, diverging slightly to weak shoulders and then converging more sharply to the broken, but apparently rather narrow, rounded termination. Middle body strongly convex transversely, not separated or defined anteriorly from wings, but laterally outlined by sharp furrow and posteriorly by sharp change of slope. Longitudinally it is moderately and evenly convex to four-fifths length. Posterior fifth separated by gradual concave slope, then dropping with subgeniculate bend to border. Two small lateral prominences (maculae) just posterior to change in slope. Posterior border flat, becoming convex towards wings. Strong lines present on all surfaces except on crest of middle body, between middle body and wings, and on border posterior to shoulders.

Free cheek. The several free cheeks show no differences in form or ornamentation from *L. decorata decorata.*

Pygidium. Side view. In comparison with *M. decorata decorata* the axis in side view falls more steeply posteriorly and there is a distinct and sharp drop at the termination.

The posterior view does not differ in any respect.

In plan the proportions differ from those of *M. decorata decorata.* The pygidium is comparatively shorter and the length is only very slightly greater than the breadth of the axis plus one pleural lobe. The number and prominence of the rings and ribs is the same and the incision of the ring, rib, and pleural furrows agrees in all respects. A slight but distinct border furrow is present at the termination of the rib and pleural furrows, and very weak longitudinal grooves may be present. The ornament agrees with that of the previous species.

Measurements (in mm.)

	BR IG 13828	BR IG 13829/1 Pl. 43, fig. 8
Length of pygidium . . .	6·3	7·5
Breadth of pygidium . . .	7·8	9·0
Length of axis	5·4	6·2
Breadth of axis	3·3	3·6

Remarks. The subspecies is incompletely known, morphologically and stratigraphically. Although the main known differences with the nominate-subspecies are of shape and not ornamentation, it would seem preferable to use ternary nomenclature rather than to erect a new species.

Occurrence. Belgium (all specimens in BR); Hastière Limestone (Tn1b), Methel 4, Ermeton s/Biert, railway cutting, pygidium (IG 13.777); *peracuta*-Shales (Tn2a) Landelies, quarry, pygidia (IG 10024, IG 10004); Landelies Limestone (Tn2b), Feluy, old quarry east of Feluy 31, holotype pygidium, free cheek (IG 13.829), Feluy, canal de Charleroi, lock 30, hypostome, pygidium (IG 13.828), Feluy, Rocque quarry, level 6, free cheek (IG 13827); Hastière, Meuse Valley between Km. 100.3 and 100.4, pygidium (IG 10234); France, Avesnelles Shales, Avesnelles, pygidia (SMF 3798).

Moschoglossis sp. A

Plate 43, fig. 12

A single cranidium (GS 33713) from the Avon Gorge, Bristol, but without precise locality, and without other stratigraphically indicative species on specimen, differs from *M. decorata* sp. nov. in the following points:

The anterior border is proportionally slightly longer (sag.) and the glabella broadens more sharply to the maximum breadth at glabellar furrows 1p.

The specimen differs sufficiently from the previous species to be considered as a separate species and the differences are not considered to be merely due to the immaturity of the specimen. Specimens of *Liobolina nebulosa* R. and E. Richter 1951 with similar variation in size have been examined and the smaller of these show no such differences from the larger and type specimen.

Measurements in mm.: length of cranidium 5·0, length of glabella 4·0, breadth of glabella 3·0.

Genus CUMMINGELLA Reed 1943

Cummingella? costabisulca sp. nov.

Plate 43, figs. 14–16

Derivation of name. From the cloven ribs.
Holotype. Pygidium (GS 33712), Pl. 43, fig. 14.
Type locality. Bristol, Avon Gorge, without precise locality.
Horizon. Carboniferous Limestone, possibly Lower Limestone Shale.
Material. Only pygidia known.

Diagnosis. A species possibly of *Cummingella* with the following characteristics: pygidium strongly rounded with length about equal to breadth of axis plus one pleural lobe. Broad smooth border. Twelve rings and eight (+one) ribs. Sharp rib furrows, more prominent at border furrow, dividing ribs into equal portions.

Description. Pygidium. Side view. Axis somewhat less high than pleural lobes, sloping with only slight curvature to ring 7, then more steeply to last ring. Axis terminates steeply and rather sharply to border, which is broad but only weakly arched. Rings all clearly outlined, the first moderately arched, the remainder weakly arched but with sharp posterior edges.

Posterior view. Axis strongly arched. Inner parts of pleural lobes almost flat, curving over strongly to flat outer parts of lobes.

Plan. Length of pygidium approximately equal to breadth of axis plus one pleural lobe. Axis only slightly narrower than a pleural lobe, tapering rather strongly with almost uncurved sides and ending in a broad blunt termination. No postaxial ridge but termination of axis not clearly bounded. Border broad (rather more so posteriorly than in fig. 14) and weakly convex, separated from the ribs by a broad border furrow which makes a distinct re-entrant between the ribs and border.

Twelve distinct rings. Ring furrows rather sharp and narrow, constricting sharply before axial furrows but continuing to them. Anterior edge of ring 1 arches forwards medianly; remainder even bands.

Eight (+one) ribs. Ribs 1–5 gently curved; the remainder almost straight. Pleural furrows sharp and incised. Rib furrows, which divide ribs into almost equal parts, weak

but distinct on ribs 1–6, becoming more prominent towards the border furrow, where they are like a deep elongated pit cleaving the ribs. Both portions of ribs weakly arched, the anterior portions rather greater. The anterior portions narrow slightly laterally and especially near the border furrow, where the anterior portions of the ribs are rather higher than the posterior portions. The posterior portions widen slightly laterally. Both portions of ribs continue shortly on to the border; the anterior portions slightly farther. Outer two-thirds of border non-undulating.

Ornament. At ×20 both ribs and rings with fine granulations. The border antero-laterally bears numerous fine lines approaching the margin posteriorly.

Measurements (in mm.)

	GS 33712 Pl. 43, fig. 14	BC Cb 3756
Length of pygidium	4·3	4·5
Breadth of pygidium	5·5	(5·5)
Length of axis	3·5	(3·5)
Breadth of axis	2·0	(2·0)

Comparisons. The species differs from '*Griffithides?*' *carringtonensis* Woodward (1884, p. 41, pl. 9 figs. 6*a–b*; refigured in Weber, 1937, pl. 11, fig. 17) in having a narrower axis and more strongly curved ribs. It differs from *Phillipsia laticaudata* var. *kuzneciana* Weber (1937, pp. 6, 127, pl. 5, figs. 21–23) from U. Tournaisian and L. Visean in having the rib furrow more centrally placed.

Remarks. The species is assigned tentatively to *Cummingella* because of the broad border, well-defined border furrow, and prominence of the rib furrows about where they meet the border furrow.

Occurrence. Carboniferous Limestone, probably Lower Limestone Shale, Bristol, England. Holotype, above; (BC Cb 3756) as for holotype—this specimen has the label 'Bristol, Cook's Folly, Sneyd Park'. Cook's Folly occupies ground stratigraphically lower than the Bryozoa Bed (Km.) which outcrops along the south boundary of the property. The specimen therefore did not come *in situ* from this locality. Cook's Folly is a locality which was commonly given at the beginning of the century to specimens collected from the right bank of the Avon in K_1, K_2, β, and the lower part of Z.

Cummingella? sp.

Plate 43, fig. 13

A single cranidium (GS 95325) from the Avon Gorge, Bristol, but without precise locality, and without other stratigraphically indicative species on specimen, differs from *M. decorata* sp. nov. in the following points:

Although the cranidium is broken longitudinally by a calcite vein, the glabella is comparatively shorter. The anterior branch of the facial suture only weakly diverges from the glabella and the anterior part of the fixed cheek is narrow. δ is farther from the median line than β. The ornamentation is of granules which have steep posterior edges rather than ridges.

Measurements in mm.: length of cranidium 8·2, length of glabella 6·5, breadth of glabella (5·0).

Genus PILTONIA Goldring 1955

Piltonia fryi sp. nov.

Plate 43, figs. 17–20

Derivation of name. After Mr. T. R. Fry of Bristol.
Holotype. Pygidium (GS 86984), Pl. 43, fig. 17.
Type locality. Bristol, Avon Gorge, right bank, from weathered rock at end of wall, by bed marked '*Chonetes* cf. *buchiana*' at end of wall in pl. 2 of Vaughan 1906.
Horizon. Carboniferous Limestone, Lower Limestone Shale.
Material. Pygidium and incompletely known cranidium and thorax.

Diagnosis. A species of *Piltonia* with the following characteristics: Longitudinally elliptical. Breadth of axis slightly greater than breadth of a pleural lobe. Twelve tubercular rings. Ten tubercular ribs; two posterior to axis. Anterior portions of ribs more strongly developed than posterior portions.

Description. Cranidium and thorax. (*a*) A compressed, partially preserved specimen (BR IG 10865) has a cylindrical glabella with only slight constriction at about one-half length. It bears coarse tubercles. Glabellar lobes 1p prominently demarcated by strong furrows which join the occipital furrow at two-sevenths breadth of glabella. Glabellar furrows 2p and 3p sharp. Anterior fixed cheek with tubercles. Only anterior part of facial suture discernible and moderately diverging. Anterior border not clear but distance from anterior end of glabella to margin very short. Thorax with tubercular segments.

(*b*) Two fragmentary cranidia (BU 1144, 1148) may belong to the species. No pygidia have been found with them at the locality, which is at a higher horizon than that at which any other pygidia have been found. Both cranidia show a coarsely tubercular glabella and one shows a distinct subcranial furrow. This distinguishes them from species of *Phillipsia*, which occur commonly at the locality, and is the sole criterion for assigning them to the species.

Pygidium. Side view. Axis less high than pleural lobes, curving gently to last ring, and then falling steeply to long, and only slightly convex, postaxial portion. Rings prominent, strongly arched, and with steep posterior slopes. They bear tubercles and the furrows are deep and rounded. Ring 1, postannulus, is much higher than ring 2.

Posterior view. Outline of ring 1, postannulus, almost trapezoidal with nearly flat sides and weakly convex roof. The outline of ring 2 is more uniformly arched with weak longitudinal grooves. Pleural lobes very strongly convex, terminating vertically.

Plan. Outline longitudinally elliptical. Breadth of axis rather greater than breadth of a pleural lobe. Axial furrows only slightly curved and with rounded but narrow termination.

Twelve rings. The articulating half-ring is narrow and strongly arched, and the articulating furrow deep and narrow. In ring 1 the preannulus is a weak arch less than half length (sag.) of postannulus and without tubercles. The postannulus bears tubercles and is shorter (sag.) than ring 2. The interannular furrow is very weak and only distinct on the crest of the ring. The succeeding rings are even bands which arch forward slightly. The ring furrows are only slightly less deep from the axial furrows to the longitudinal grooves. The latter are weak and situated between the outer pair of tubercles.

Tubercles strong with height at least equal to diameter: rings 1–2 with nine, the median smaller than the others, rings 7–10 with six.

Ten ribs posterior to which are two more, represented by two parallel rows of three to four tubercles posterior to the axis. Rib 1 moderately curved; the remainder only weakly so. Ribs strongly arched with deep pleural furrows; 1–5/6 clearly divided by a prominent rib furrow which terminates well before margin. Anterior portions twice as wide as posterior portions and tubercular 1 with 7, 8 with 4. Posterior portions with small close-set tubercles; 1 with 8/9. Border poorly demarcated and indistinct border furrow. Anterior portions continue prominently to margin but except on ribs 1–2 posterior portions terminate at border furrow.

Development and variation. The smallest pygidium (GS 86986) has ten rings and ribs. It is comparatively broader, has less prominent posterior portions to the ribs, and the preannulus is not developed. A somewhat larger pygidium (GS 86988) has twelve rings and eleven ribs plus one more, shared, at the termination to the axis. The proportions of this specimen are almost the same as those of the holotype. In the Belgian specimen (BR IG 9136) the axis tapers less strongly, the border furrow is more prominent, and the posterior portions of the ribs also are more prominent.

Measurements (in mm.)

	GS 86984 Pl. 43, fig. 17	BR IG 9136 Pl. 43, fig. 20	GS 86988	GS 86986
Length of pygidium	7·8	(8·0)	5·0	2·9
Length of axis	6·7	(7·0)	. .	. .
Breadth of pygidium	(9·0)	9·2	5·6	4·2
Breadth of axis	2·5	3·5	. .	. .

Comparisons. The species differs from *P. salteri* Goldring (1955, p. 42, pl. 2, figs. 8–13) and *P. kassini* (Weber 1937, pp. 48, 128, pl. 9, figs. 42–47) especially in being comparatively longer. It is nearer to the unnamed variety of *P. salteri* (Goldring 1955, p. 43, BU 7987–8) in having anterior portions of the ribs stronger than the posterior portions, and although longitudinal grooves are weakly present there is only one tubercle between the grooves and axial furrows instead of the introduction of a double row. *Metaphillipsia seminifera* (Phillips 1836) has very weak posterior portions to the ribs. The species may be immediately distinguished from species of *Brachymetopus* by the absence of prominent medial tubercles on the axis. In *Phillipsia* Portlock 1843 the posterior portions of the ribs are weakly developed and do not carry tubercles; there is a definite smooth border and no preannulus on ring 1. No preannulus is present in the type species, *P. salteri*, but it would seem that the preannulus is only of specific significance (R. and E. Richter 1956, p. 348).

Occurrence. England, Lower Limestone Shale, Bristol, Avon Gorge: (1) right bank, holotype (above) and pygidia (GS 86985–8); (2) left bank, in 8 ft. shelly limestone occurring 9 ft. 6 in. above top of Bryozoa Bed, pygidium; Shepton Mallet, Windsor Hill Quarry horizon β, ?cranidia (BU 1144, 1148); Belgium (all specimens in BR), Hastière and Étroeungt Beds (Tn1a) Hastière 1, Insemont Road, partially preserved complete specimen (IG 10865) (it is not known how the stratigraphical horizon of this locality differs from the following); Hastière Limestone (Tn1b) Hastière 1, Insemont Road, pygidium (IG 9136); *peracuta*-Shales (Tn2a) Dinant 25, Gendron-Celles, Furfooz road,

pygidium (IG 14007), Méverquies, Duchâteau quarry, pygidium (IG 10024/a), Landelies, Limestone Quarry, pygidium (IG 9540a); Landelies Limestone (Tn2b) Feluy 41, abandoned quarry east of Feluy 31, ? pygidium (IG 13829).

Brachymetopus sp.

A single cephalon (GS 86989) was found *in situ* in the Lower Limestone Shale (top of K_1 Subzone), right bank, Avon Gorge, Bristol. Only the anterior border is fully preserved. The border is wide, very slightly convex, and ornamented with a single row of tubercles (4 to 5 per mm.). It is not distinguishable from *Brachymetopus woodwardi* Whidborne 1896 (Goldring 1955, p. 44). *B. maccoyi* (Portlock 1843) seems to have a proportionally wider border.

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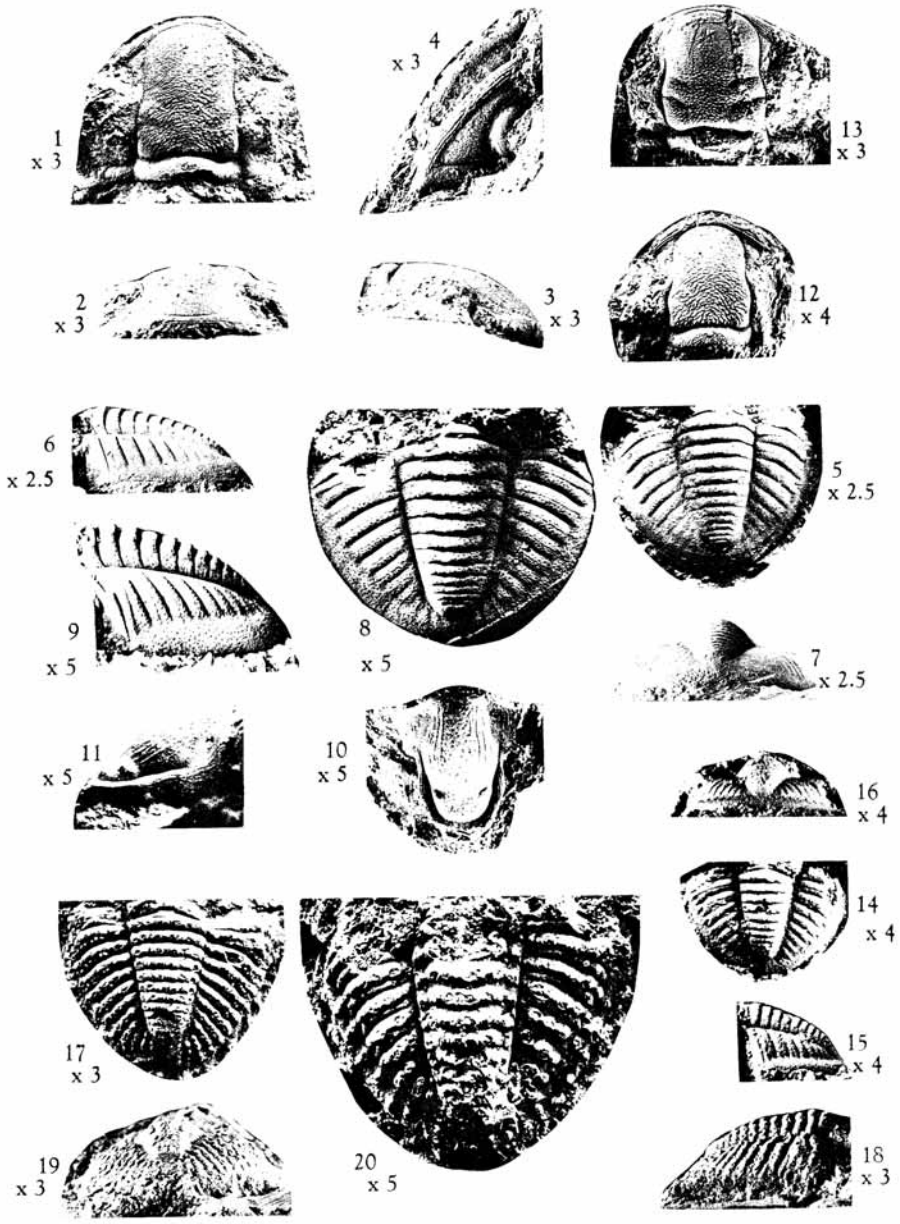

GOLDRING, Lower Tournaisian trilobites