

TRILOBITES FROM THE ORDOVICIAN
AUCHENSOU AND STINCHAR LIMESTONES
OF THE GIRVAN DISTRICT, STRATHCLYDE

by R. P. TRIPP

ABSTRACT. Four new trilobite faunules from the Barr Group of the Girvan District are recorded; three new species are described—*Remopleurides ateuchetos*, *Raymondaspis brocklochensis*, and *Hemiarges inghami*. A new specific name, *Xylabion kirkdandiensis*, is proposed for a form from the Confinis Flags. The trilobite assemblages indicate inshore conditions of deposition; the Stinchar Limestone fauna at Minuntion Quarry is a good example of the shallow-water illaenid-cheirurid community. The close resemblance to certain lower Esbataottine Formation species indicates equivalence in age, probably upper Chazyan. The upper part of the Stinchar Limestone is Llandeilo in terms of the British succession; it is not certain whether the lower horizons are Llanvirn or not, but there is no sign of a break in the trilobite faunas of the Barr Group, apart from that attributable to transgression.

THE Auchensoul Limestone yields the earliest trilobite fauna in the Barr Group. The lower/middle Stinchar Limestone faunas bridge the gap between the Confinis Flags (Tripp 1962) and the platy upper Stinchar Limestone (Tripp 1967). Brockloch Quarry exposes the youngest Stinchar Limestone. The trilobites are mainly from the following localities.

Auchensoul Limestone, Auchensoul Bridge. Nat. Grid Ref. NX 261929 (Williams 1962, p. 11, p. 255 (al); Tripp 1962, p. 34). Hunterian Museum Collection.

Lower/middle Stinchar Limestone, Water of Gregg, near Barr. (a) East of Barr. Nat. Grid Ref. NX 282941 (Williams 1962, p. 255 (bl)). Hunterian Museum Collection. (b) East of Barr. Nat. Grid Ref. NX 279940. I.G.S. Edinburgh Collection.

Lower/middle Stinchar Limestone, Minuntion Quarry. Nat. Grid Ref. NX 220911; Text-fig. 1. Massive Limestone (Williams 1962, p. 259). Mrs. Robert Gray's and Mr. John Smith's collections. Decalcified Limestone, uppermost beds, discovered by Dr. J. K. Ingham in 1972. Hunterian Museum Collection.

Top Stinchar Limestone, Brockloch Quarry, 0.8 kilometre north of east of Brockloch Farmhouse. Nat. Grid Ref. NX 256951 (Williams 1962, p. 13, p. 255 (b3)). Hunterian Museum Collection.

The terminology is essentially that adopted in the Treatise on Invertebrate Paleontology, Part O. Most rare taxa are illustrated, but not described. Specimens collected by the author have been purchased by the Hunterian Museum, Glasgow University, with the assistance of a Treasury Grant-in-aid. Records of the numbers of trilobite parts summarized in the Table 1 have been deposited with the British Library, Boston Spa, Wetherby, Yorkshire, LS23 7BQ, U.K. as Supplementary Publication No. SUP 14015 (4 pages).

[Palaeontology, Vol. 22, Part 2, 1979, pp. 339-361, pls. 37-40.]

TABLE 1. List of species recorded, and of their relative frequency. vc indicates very common, over 100 specimens; c indicates common, 11-100 specimens; r indicates rare, 2-10 specimens; vt indicates very rare, 1 specimen

	Auchensoul Limestone		Stinchar Limestone			Page	Plate	Figure
	Auchensoul Bridge	Water of Gregg near Barr	Minution Quarry		Brockloch Quarry			
			Massive limestone	Decalcified limestone				
<i>Trinodus</i> sp.	vt	r				342	37	1-6, 8
<i>Remopleurides ateuchetos</i> sp. nov.	c	c						
" "		c		vc	vt (1)	343	37	11
" "			c					
" "	r			r			37	12
" "	vt						37	9, 13
" "	vt					343	37	7
<i>Robergia</i> spp.		vt					37	14
<i>Hypodicranotus</i> sp.		vt					37	10
<i>Isotelus stincharensis</i> (Begg)			vt					
" spp.	c	r			vt (4)	344	37	15
Unassigned asaphid parts			r					
<i>Reymondaspis brocklochensis</i> sp. nov.				r		346	37	16-23
" spp.		r		r				
<i>Eobronteus latus</i> Tripp				r				
<i>Bumastoides</i> spp.		?		r			37	24
<i>Iliaenus beggi</i> Tripp			vt				37	26-27
" spp.		r		r			37	25
<i>Stenopareia</i> spp.	r	r		r				
Unassigned ilaenid parts	r	r		r	vt (4)	346		
? <i>Decoproetus</i> spp.				vt				
<i>Dimeropyge</i> aff. <i>labrosa</i> Tripp				r		346	38	1
? <i>Paraharpes</i> sp.	?				vt (2)	347	38	2
? <i>Dionide</i> sp.				r			38	3
<i>Ampyx</i> spp.	r	r			vt (3)		38	4
<i>Lonchodomas</i> spp.	r	r						

<i>Ceraurinella</i> aff. <i>maenilobata</i> Tripp								350	38	5-11
<i>Acanthoparypha</i> or <i>Pandaspiniayga</i> sp.	vt	f		vc					38	20
<i>Sphaerexochus filius</i> Tripp		f		c					38	17-19
" spp.	vt		f			vt				
<i>Sphaerocoryphe saba</i> Tripp				f				350	38	15-16
" spp.						c			38	12-14
<i>Ptiomerella</i> spp.						vt (1)			38	21
<i>Encrinuroides stincharensis</i> (Reed)								351	39	1-17
<i>Quinquecosta</i> aff. <i>stincharensis</i> Tripp	f		c	c				352	38	22-23
<i>Thallicola barbarus</i> Tripp									39	23-24
<i>Calypitaliax georgei</i> Tripp									39	18-22
<i>Amphitichas</i> spp.	f		f	c				354	39	25
<i>Hemiarques inghami</i> sp. nov.				vc				354	40	1-17
<i>Ceratocephala relativata</i> Tripp				c				357	40	18-24
Unassigned metaprotaspis				vt				358	40	25

*Tramitchell Quarry (1), Aldons Quarry (2), Benan Burn (3), Bougang Quarry (4).

SYSTEMATIC PALAEONTOLOGY

Family REMOPLEURIDIDAE Hawle and Corda, 1847

Genus REMOPLEURIDES Portlock, 1843

Remopleurides ateuchetos sp. nov.

Plate 37, figs. 1-6, 8

Diagnosis. Anterior tongue more than 50% maximum width of glabella, projecting. Genal and dorsal spines absent. Glabella smooth.

Holotype. A.13990a, b (cranium). Plate 37, figs. 1-3. Auchensoul Limestone, Auchensoul Bridge.

Other material. 13 cranidia, 7 free cheeks, 1 thorax (lacking first segment) with pygidium attached, 8 incomplete thoraxes or single segments; Auchensoul Limestone, Auchensoul Bridge.

Material from other horizon. 14 cranidia, 4 free cheeks, 1 hypostome, 1 thorax (lacking first segment) with pygidium attached; Stinchar Limestone, Water of Gregg, east of Barr.

Dimensions of holotype.

Length of cranium (sag.)	8.1 mm
Width of cranium	10.0 mm
Width of glabella	9.3 mm
Width of anterior tongue	4.6 mm
Distance between posterior extremities of eyes	5.6 mm

Description. Length of cranium 80% width, moderately convex in both directions, greatest width opposite midlength. Lateral glabellar furrows absent. Anterior tongue short, 50% maximum width of glabella, convex transversely and projecting, curving downwards. Occipital ring long (sag.); occipital furrow shallow. Palpebral lobe narrow, not extending forwards beyond base of tongue. Palpebral furrow shallow. Eye of moderate size, almost vertical; furrow above socle shallower than furrow below. Outer area of cheek narrows rapidly forwards, narrowing out anteriorly, gently convex. Genal angle acute; genal spine absent. Posterior border furrow dies out half-way across cheek. Doublure of free cheek extends to eye, flattened posteriorly; vincular ledge curves forwards and outwards from midwidth.

Hypostome moderately convex transversely, much wider than long. Middle body elliptical, not bilobate; oval maculae faintly swollen. Median boss absent (on internal mould). Anterior margin weakly convex. Anterior border short (sag.), expanding abaxially. Anteriorly wing projects laterally. Lateral and posterior borders narrow, convex; posterolateral fork short, broad-based, tapering rapidly, directed straight backwards. Posterior margin transverse.

Thorax narrows steadily backwards. Rachial rings weakly convex longitudinally and transversely, no spine on eighth ring. Rachial furrow deep. Pleurae approximately 30% width of ring, directed outwards anteriorly, free points curve successively more strongly backwards. Seventh pleurae slightly enlarged, extending backwards as far as eighth; posterior four pleurae reduced. Eleventh pleurae do not stretch beyond pygidium. Articulating bosses and sockets small but tall. Articulating half ring short; articulating furrow deep. Doublure extends to rachial furrow.

Pygidium more than twice as wide as long. Rachis short. First ring represented by a pair of transversely elongated lobes. Second ring weakly developed. Pleurae fused, free points hardly developed. Pleural furrows absent. Median embayment broad. Doublure convex, extending to rachis.

Glabella smooth. Occipital and thoracic rings smooth or with transverse raised lines; a row of inconspicuous tubercles at posterior margin of ring. Free cheek smooth or with faint raised lines which die out posteriorly. Doublure with terrace lines well developed.

Remarks. This species differs from described species in the absence of a spine on the eighth thoracic ring. The free cheek resembles that of *R. vulgaris* Tripp (1967, p. 46, pl. 1, figs. 5-19) but the vincular ledge is more oblique. The cranium has a characteristic outline, and is usually smooth.

Remopleurides sp. (*vulgaris* species group)

Plate 37, fig. 11

1903 ?*Remopleurides girvanensis* Reed; Reed, p. 41.

Material. 3 cranidia, 40 incomplete thoraces (17 with pygidia attached); massive Stinchar Limestone, Minunton Quarry.

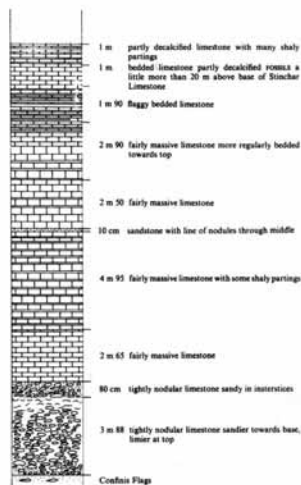
Remarks. Thoraces and pygidia correspond with *R. vulgaris* Tripp in gross morphology; the spine on the eighth ring, which extends backwards no further than half-way across the ninth ring in *R. vulgaris*, is even shorter in the above material, and pygidia are similar in outline. Cranidia differ in their stronger convexity and broader tongue, over 50% maximum width of glabella (compared with 40% in *R. vulgaris*). The occipital ring (and the margin of the glabella) are transversely striate, as is occasionally the case in *R. vulgaris* but not in *R. girvanensis*.

? *Remopleurides* sp.

Plate 37, fig. 7

Material. 1 incomplete thorax (see explanation of plate for registered numbers); Auchensoul Limestone, Auchensoul Bridge.

Remarks. One specimen consisting of four articulated thoracic segments, probably the seventh to the eleventh, has such long pleurae (exceeding the width of the rachis), that reference to the genus *Remopleurides*, despite the characteristic articulating system, must be treated as questionable.



TEXT-FIG. 1. Diagrammatic section in lower/middle Stinchar Limestone at Minunton Quarry, near Girvan. Prepared by Dr. J. K. Ingham.

Family ASAPHIDAE Burmeister, 1843
Genus ISOTELUS Dekay, 1824
Isotelus sp.

Plate 37, fig. 15

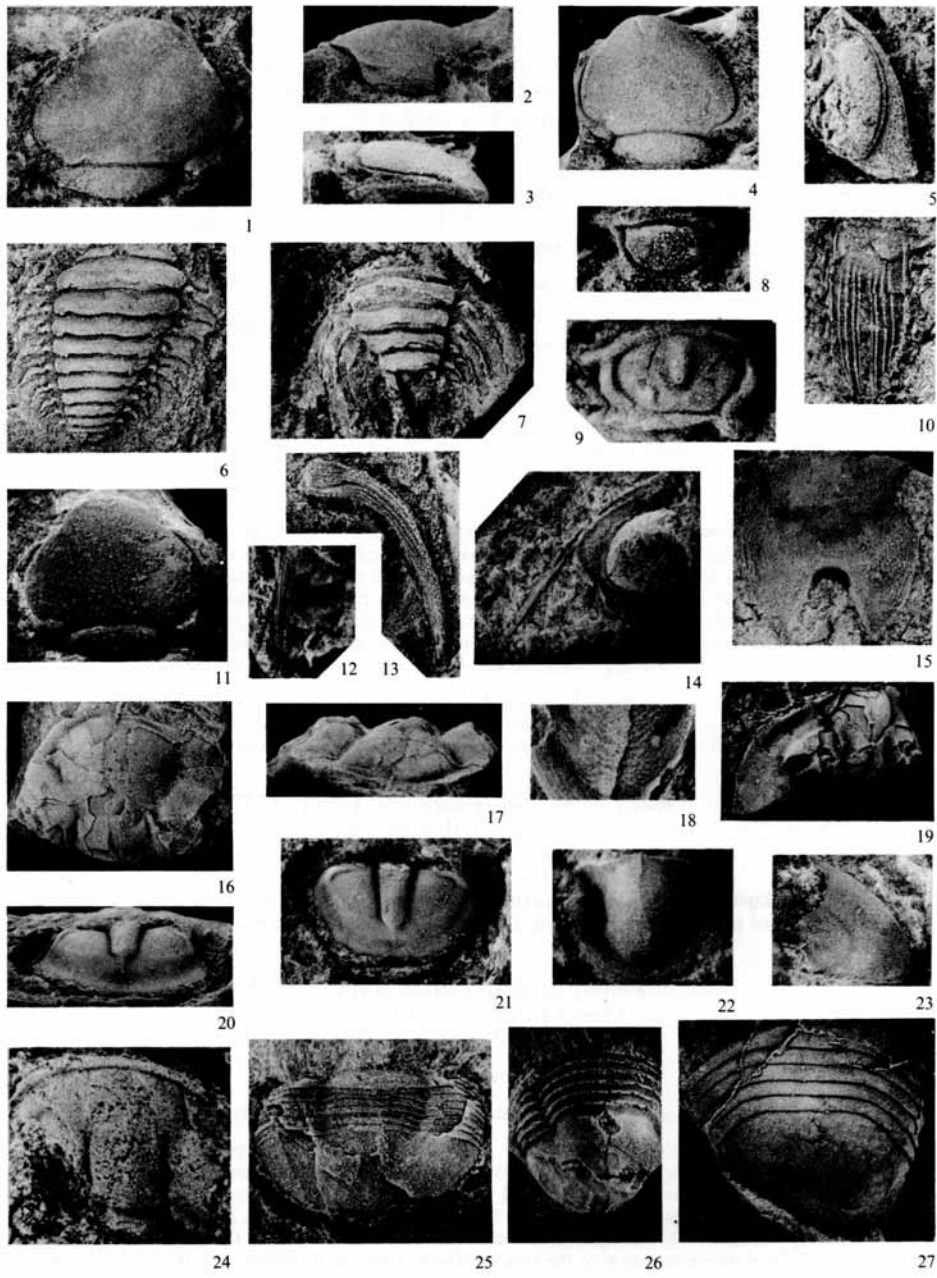
Material. 1 cranium, 2 free cheeks, 2 hypostomes, 6 thoracic segments, 1 pygidium; Auchensoul Limestone, Auchensoul Bridge.

Remarks. This form bears a general resemblance to *I. stincharensis* (Begg 1950, p. 288, pl. 14, figs. 4-5; Tripp 1962, p. 6, pl. 1, figs. 20-25) from the Confinis Flags. The following are the main points of difference. The branches of the facial suture are more divergent, the hypostome is narrower anteriorly, the rachis of the pygidium is considerably shorter.

EXPLANATION OF PLATE 37

The specimens are testiferous unless otherwise stated; all were lightly coated with ammonium chloride before being photographed.

- Figs. 1-6, 8. *Remopleurides ateuchetos* sp. nov. 1. Cranium (holotype, A.13990a). Dorsal view, $\times 3-4$. 2-3. The same, frontal and right lateral views, $\times 3$. Auchensoul Limestone, Auchensoul Bridge. 4. Cranium (A.13991), $\times 4$. Lower Stinchar Limestone, Water of Gregg, east of Barr. 5. Right free cheek (A.13992a), $\times 6$. Auchensoul Limestone, Auchensoul Bridge. 6. Ten thoracic segments and pygidium (A.13993a). Internal mould, $\times 4$. Auchensoul Limestone, Auchensoul Bridge. 8. Hypostome (A.13995), $\times 4-5$. Stinchar Limestone, Water of Gregg, east of Barr.
- Fig. 7. ? *Remopleurides* sp. Four thoracic segments (A.13994a), $\times 3-7$. Auchensoul Limestone, Auchensoul Bridge.
- Fig. 9. *Remopleurides* sp. Hypostome (A.13996a), $\times 4$. Top Stinchar Limestone, Brockloch Quarry.
- Fig. 10. *Hypodicranotus* sp. Hypostome (IGSE 13327), $\times 4-5$. Stinchar Limestone, Water of Gregg, east of Barr.
- Fig. 11. *Remopleurides* sp. (*vulgaris* species group). Cranium (BM. In.21136). Massive Stinchar Limestone, Minuntion Quarry, $\times 2$.
- Fig. 12. *Remopleurides* sp. Left free cheek (A.13997) with subgenal spine, $\times 6$. Top Stinchar Limestone, Brockloch Quarry.
- Fig. 13. *Remopleurides* sp. Doublure of left free cheek (A.13998), $\times 2-8$. Auchensoul Limestone, Auchensoul Bridge.
- Fig. 14. *Robergia* sp. Left free cheek (A.13999a), $\times 4$. Auchensoul Limestone, Auchensoul Bridge.
- Fig. 15. *Isotelus* sp. Hypostome (A.14000a), $\times 2-5$. Auchensoul Limestone, Auchensoul Bridge.
- Figs. 16-23. *Raymondaspis brocklochensis* sp. nov. Top Stinchar Limestone, Brockloch Quarry. 16-17. Cranium (holotype, A.14001), dorsal and frontal views, $\times 4$. 18. Hypostome (A.14002), showing small macula at end of lateral furrow, $\times 10$. 19. Cephalon (A.14003). Oblique left view, $\times 3-7$. 20-21. Pygidium (A.14004a). Posterior and dorsal views, $\times 3$. 22. Hypostome (A.14005), $\times 9$. 23. Right free cheek (A.14006), $\times 4$.
- Fig. 24. *Eobronteus latus* Tripp. Cranium (A.14064a). Internal mould, $\times 2$. Decalcified Stinchar Limestone, Minuntion Quarry.
- Fig. 25. Illaenid thorax and pygidium (A.14073a), $\times 3$. Auchensoul Limestone, Auchensoul Bridge.
- Figs. 26-27. *Bumastoides* sp. Five thoracic segments and pygidium (BM In.21786). 26. Internal mould, showing bicuspid anterior margin of doublure, $\times 2-5$. 27. Oblique posterior view of latex cast from external mould, $\times 3$. Massive Stinchar Limestone, Minuntion Quarry.



TRIPP, Ordovician trilobites

Family SCUTELLUIDAE Richter and Richter, 1955
 Genus *Raymondaspis* Přibyl, 1949
Raymondaspis brocklochensis sp. nov.

Plate 37, figs. 16-23

Diagnosis. Glabella gently swollen, basal width about 60% maximum width, 1S distinct. Anterior border clearly defined. Fine raised lines on glabella. Posterior margin of pygidium transverse; postrachial extension short. Pleural ribs absent.

Holotype. A.14001 (cranidium). Plate 37, figs. 16-17. Top Stinchar Limestone, Brockloch Quarry.

Other material. 6 cephalae, 8 cranidia, 23 free cheeks, 21 hypostomes, 1 incomplete thorax with pygidium attached, 25 pygidia; top Stinchar Limestone, Brockloch Quarry.

Dimensions of holotype.

Length of cranidium (est.)	6.7 mm
Width of cranidium	8.3 mm
Length of glabella (sag.)	5.2 mm
Width of glabella (max.)	5.1 mm
Basal width of glabella	2.9 mm

Description. Differs from *R. reedi* Tripp (1976, p. 382, pl. 3, figs. 19-28) from the basal Superstes Mudstones in the following features: glabella much wider posteriorly, about 60% anterior width (compared with 50%), convexity weaker. Glabella more strongly rounded in outline anteriorly. Preglabellar furrow deeper. Rachial furrow shallower. Anterior border longer (exs.). Eye smaller. Intramarginal furrow extends for full length of free cheek. Middle body of hypostome more convex. Pygidium concave abaxially, posterior margin transverse. Rachis with one ring well defined; postrachial ridge short. Faint terrace lines on pygidium, convex forwards on rachis, slanting backwards and inwards adaxially on pleural lobe.

Remarks. *R. brocklochensis* resembles *R. reedi* and *R. brumleyi* (Cooper 1953, p. 25, pl. 9, figs. 8-10) in the presence of 1S and absence of pygidial pleurae, but differs markedly in the greater posterior width of the glabella, and in other features mentioned above. *Raymondaspis* is the most abundant trilobite at Brockloch.

Family ILLAENIDAE Hawle and Corda, 1847
 Unassigned illaenid parts

Plate 37, fig. 25, text-fig. 2

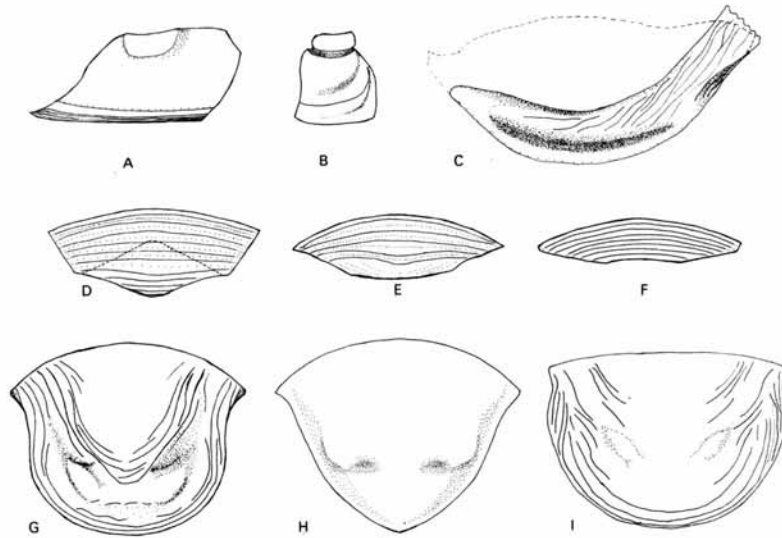
Remarks. A multiplicity of taxa is represented in the Auchensoul and Stinchar Limestones, but evidence for the association of parts is lacking. Text-fig. 2 illustrates the diversity of free cheeks, rostral plates, and hypostomes.

Family DIMEROPYGIDAE Hupé, 1953
 Genus DIMEROPYGE Öpik, 1937
Dimeropyge aff. *labrosa* Tripp, 1967

Plate 38, fig. 1

Material. 5 cranidia, 1 free cheek; decalcified Stinchar Limestone, Minunton Quarry.

Remarks. Differs from *D. labrosa* Tripp (1967, p. 54, pl. 2, figs. 21-32) from the platy upper Stinchar Limestone, in the following features: the three aciculate tubercles on the occipital ring are absent, the adaxial and abaxial tubercles on the posterior border of the cranidium are not so greatly enlarged, the field of the free cheek is broader and more tuberculate. *D. labrosa* was compared with *D. spinifera* Whittington and Evitt (1954, p. 42, pl. 22, 23; text-figs. 9-10) from the Lincolnshire Limestone. Chatterton and Ludvigsen (1976, p. 51) have drawn attention to the close similarity between *D. labrosa* and *D. clintonensis* Shaw



TEXT-FIG. 2. Illaenid free cheeks, rostral plates, and hypostomes. A. Left free cheek (A.14065a, b), $\times 3$. Auchensoul Limestone, Auchensoul Bridge. B. Left free cheek (A.14066a, b), $\times 3$. Decalcified Stinchar Limestone, Minunton Quarry. C. Left free cheek (A.14067). Ventral view showing vincular furrow and terrace lines, $\times 2$. Top Stinchar Limestone, Brockloch Quarry. D. Rostral plate (A.14068a, b). Dotted lines indicate shallow terrace lines between deeper ones; broken line indicates anterior margin of flange, $\times 3-5$. Stinchar Limestone, Water of Gregg, east of Barr. E. Rostral plate (A.14069a, b), $\times 3-5$. Decalcified Stinchar Limestone, Minunton Quarry. F. Rostral plate (A.14070), $\times 6$. Decalcified Stinchar Limestone, Minunton Quarry. G. Hypostome (BM In.152709), $\times 3$. Massive Stinchar Limestone, Minunton Quarry. H. Hypostome (A.14071), $\times 6$. Decalcified Stinchar Limestone, Minunton Quarry. I. Hypostome (A.14072a, b), $\times 12$. Decalcified Stinchar Limestone, Minunton Quarry.

(1968, p. 40, pl. 11, figs. 12-38) from the Chazy Group. The Minunton form of *D. labrosa* is closer both to *D. clintonensis* and to *D. spinifera* than is the type form, but both differ from the North American species in the circumflex outline of the anterior margin of the cranidium, and the straight genal spine.

Family DIONIDIDAE Gürich, 1907

Genus DIONIDE Barrande, 1847

? *Dionide* sp.

Plate 38, fig. 3

Material. 1 cranidium (internal and external moulds of upper lamella); top Stinchar Limestone, Brockloch Quarry.

Description. Cephalon semicircular in outline. Glabella longer than wide, moderately convex in both directions. Glabella widens abruptly to twice basal width at 25% length from back, narrowing steadily anteriorly. 1S short, running inwards and forwards at anterior extremity of neck. 2S short, transverse, placed near midlength of glabella, terminating in a large, shallow, rounded pit. Occipital ring conforms in width and convexity with neck of glabella. Occipital furrow shallow. Cheek gently convex adaxially, more

strongly convex abaxially. A shallow furrow commences opposite 1S, curving forwards and outwards, then backwards and outwards and becoming shallower: a faint, transverse furrow runs from the rachial furrow to the apex of this genal furrow, tangentially. Posterior border furrow possibly represented by a short (tr.) depression almost opposite occipital furrow: posterior border otherwise obsolete. Articulating ledge adaxially at back of cephalon. Lateral border weakly developed: genal angle not preserved. Glabella and occipital ring smooth, except for a low tubercle opposite 2S, with two smaller tubercles in line behind. Cheek anterior to genal furrow bears a network of low, anastomosing raised lines, with pits between; independent caecal ridge not developed. Inner limit of lower lamella probably indicated by change of convexity on right side. Cheek posterior to genal furrow pebbled and faintly pitted, without raised lines. Lateral border smooth.

Remarks. This cephalon combines characters of *Dionide turnbulli* Whittington (1952, p. 8, pl. 2, figs. 1-6, 10-11) and *Dionidella incisa* Prantl and Přibyl (1949, p. 6, pl. 1, fig. 1, text-fig. 4; Whittard 1958, p. 96, text-figs. 5a, b). Features of the former are the elongate, moderately convex glabella, with narrow neck, and narrow occipital ring; features of the latter are the presence of 2S terminating in a pit, and the uniform sculpture of the inner and outer parts of the cheek.

The course of the genal furrow recalls that of the posterior border furrow in a number of species, particularly that referred to *Dionide formosa* (Barrande) by Curtis (1961, p. 14, pl. 7, figs. 1-2, pl. 8, fig. 1) but in the Brockloch cephalon the furrow curves much more strongly forwards, and commences opposite 1S. A cephalon referred by Butts (1941, pl. 82, fig. 26) to *D. holdeni* Raymond, has a strong genal furrow

EXPLANATION OF PLATE 38

The specimens are internal moulds unless otherwise stated.

- Fig. 1. *Dimeropyge* aff. *labrosa* Tripp. Broad cranium (A.14007a), $\times 16$. Decalcified Stinchar Limestone, Minuntion Quarry.
- Fig. 2. ?*Paraharpes* sp. Testiferous brim of cephalon (A.14008), $\times 3$. Top Stinchar Limestone, Brockloch Quarry.
- Fig. 3. ?*Dionide* sp. Internal mould of upper lamella of cephalon (A.14009a), $\times 4$. Top Stinchar Limestone, Brockloch Quarry.
- Fig. 4. *Lonchodomas* sp. Testiferous cranium (A.14010), $\times 2.5$. Stinchar Limestone, Water of Gregg, east of Barr.
- Figs. 5-11. *Ceraurina* aff. *magnilobata* Tripp. Decalcified Stinchar Limestone, Minuntion Quarry. 5. Cranium (A.14011a), $\times 3$. 6. Small cranium (A.14012a), $\times 16$. 7. Hypostome (A.14063b). Latex cast from external mould, $\times 12$. 8. Left free cheek (A.14013a), $\times 6$. 9. Pygidium (A.14014). Oblique left posterolateral view, $\times 5$. 10. Doublure of pygidium (A.14015b). Latex cast from external mould, $\times 4.5$. 11. Pygidium (A.14016). Latex cast from external mould, illuminated to show downsloping anterior flange, $\times 4.5$.
- Figs. 12-14. *Sphaerocoryphe* sp. Top Stinchar Limestone, Brockloch Quarry. 12-13. Testiferous cephalon (A.14017). Dorsal and frontal views. Note absence of lateral spines, $\times 5$. 14. Testiferous hypostome (A.14018), $\times 6$.
- Figs. 15-16. *Sphaerocoryphe saba* Tripp. Decalcified Stinchar Limestone, Minuntion Quarry. 15. Cranium (A.14019), $\times 6$. Left free cheek (A.14020), $\times 15$.
- Figs. 17-19. *Sphaerexochus filius* Tripp. Stinchar Limestone, Minuntion Quarry. 17. Small holaspis with external mould of hypostome exposed (A.14021), $\times 8$. Decalcified Stinchar Limestone. 18. Cephalon (A.14022a). Right lateral view, $\times 3$. Decalcified Stinchar Limestone. 19. Testiferous cephalon (BM In.23522). Right lateral view, $\times 4$. Massive Stinchar Limestone.
- Fig. 20. *Acanthoparypha* or *Pandaspinyga* sp. Testiferous cranium (A.14023) closely associated with a left free cheek of *Quinquecosta* aff. *stincharensis*, $\times 2$. Auchensoul Limestone, Auchensoul Bridge.
- Fig. 21. *Pliomerella* sp. Testiferous left free cheek (A.14024), $\times 3.5$. Top Stinchar Limestone, Brockloch Quarry.
- Figs. 22-23. *Quinquecosta* aff. *stincharensis* Tripp. 22. Left free cheek (A.14025), $\times 4$. Stinchar Limestone, Water of Gregg, east of Barr. 23. Testiferous pygidium (A.14026), $\times 5$. Auchensoul Limestone, Auchensoul Bridge.



TRIPP, Ordovician trilobites

approximately in the position of the anterior branch of the specimen under description, but the sculpture anterior and posterior to the furrow is not modified. It seems likely that genal and posterior border furrows were homologous in function; the changes in morphology may prove to be of taxonomic significance, and for this reason the specimen is referred to *Dionide* with reserve.

Family CHEIRURIDAE Salter, 1864
Genus CERAURINELLA Cooper, 1953
Ceraurinella aff. *magnilobata* Tripp, 1967

Plate 38, figs. 5-11

Material. 2 cranidia from the massive Stinchar Limestone, Minuntion Quarry. 2 cephalae, 137 cranidia, 35 free cheeks, 49 hypostomes, 77 thoracic segments, 25 pygidia; decalcified Stinchar Limestone, Minuntion Quarry.

Remarks. Some specimens are indistinguishable from *C. magnilobata* Tripp (1967, p. 61, pl. 3, figs. 14-28) from the platy upper Stinchar Limestone, but most show the following differences: the convexity of the glabella is stronger, 1L is shorter compared with 2L and 3L, the eye is larger compared with the width of the cheek, the middle body of the hypostome is more convex, the great spine of the pygidium is set at a steeper angle to the slope of the rachis, and the spine curves upwards near the tip, the anterior flange of the pygidium slopes downwards.

New Specific Name. Lane (1971, p. 24) considered the holotype of *Bartoninus dispersus* Tripp (1962, p. 18, pl. 2, fig. 22a, b) from the Confinis Flags, to be attributable to *Ceraurinella*, and generically distinct from the remainder of the material referred to that species. I am in agreement with that conclusion and hereby propose the specific name *kirkdandiensis* for the other specimens referred to *B. dispersus*. I select as holotype the pygidium HM A.5312 from the Confinis Flags, Kirkdominae (Tripp 1962, pl. 2, fig. 31). The species is attributable to the genus *Xylabion* Lane (1971, p. 40). The weak definition of the anterior border of the cranidium, and the short, outwardly directed spine on the anterior flange of the pygidium distinguish *X. kirkdandiensis* from other species. *C. magnilobata* and *C. aff. magnilobata* differ from *C. dispersa* in their stronger glabellar furrows and larger eye.

In describing *C. kingstoni* Chatterton and Ludvigsen (1976, p. 52, pl. 8) compared their species most closely with *C. magnilobata*, and the resemblance to the affiliated form from Minuntion is even closer. The Scottish populations can be distinguished from the Canadian by the larger 1L of the cranidium and larger anterior flange of the pygidium.

The resemblance of *C. magnilobata* to *C. chondra* Whittington and Evitt, and to *A. typa* Whittington and Evitt has been discussed by Lane (1971, p. 19). Again, the Minuntion form stands closer to these two species than does the type material of *C. magnilobata*, particularly in the steeper slope of the great spine.

The degree of resemblance between the species discussed above is sufficiently great to indicate close relationship and therefore equivalence to the lower Esbataottine in age (see p. 359).

Genus SPHAEROCORYPHE Angelin, 1854
Sphaerocoryphe sp.

Plate 38, figs. 12-14

Material. 1 cephalon, 44 cranidia (mainly swollen anterior glabellar lobes), 7 hypostomes, 2 pygidia; top Stinchar Limestone, Brockloch Quarry.

Description. Neck of glabella short. 1L large. Lateral spines absent. Fixigenal spine stout, short, directed strongly outwards. Hypostome with elongate middle body lacking posterior lobe and middle furrow; borders narrow. Pygidial spines not greatly divergent. Anterior lobe of glabella and middle body of hypostome granulate.

Remarks. The above material resembles *S. pemphis* Lane (1971, p. 62, pl. 14, figs. 1-18) from the Balclatchie Group, in its short neck, but differs in its larger 1L, absence of lateral cranial spines, and stouter genal spine.

Family ENCRINURIDAE Angelin, 1854
 Genus ENCRINUROIDES Reed, 1931
Encrinuroides stincharensis (Reed, 1928)

Plate 39, figs. 1-17

- 1906 *Encrinurus punctatus* (Brünnich), var. *arenaceus*, Salter; Reed, p. 120, pl. 16, fig. 8.
 1928 *Encrinus stincharensis* Reed, p. 64.
 1931 *Encrinurus stincharensis* Reed; Reed p. 19.

Holotype (by monotypy). BM In.23157 (testiferous pygidium, massive Stinchar Limestone, Minuntion Quarry). Reed 1906, pl. 16, fig. 8. This paper, Plate 39, figs. 16-17.

Other material. 3 pygidia from the massive Stinchar Limestone, Minuntion Quarry. 1 cephalon, 9 cranidia, 4 free cheeks, 1 hypostome, 7 thoracic segments, 21 pygidia; decalcified Stinchar Limestone, Minuntion Quarry.

Description. Holotype pygidium triangular in outline, strongly vaulted, approximately as wide as long; 21 rachial rings and 9 pleurae, ninth pair not reaching posterior margin. Rachis almost 30% maximum width of pygidium, narrowing slowly and steadily to an ill-defined apex at 20% length from back, strongly convex longitudinally and transversely. Ring furrows continuous, increasingly shallow mesially on successive rings. Rachial furrow deep and narrow anteriorly, becoming shallow posteriorly. Pleural lobe curves strongly downwards near midwidth. Pleural ribs prominent; first four ribs end in blunt free tips, posterior ribs merge with lateral border. Anterior pleurae gently convex forwards, posterior pleurae straight. First four rib furrows deep and narrow throughout, fifth furrow shallow abaxially, subsequent furrows die out near margin. Lateral border of moderate and uniform width, extending horizontally inwards anteriorly, sloping slightly upwards posteriorly; inner margin almost straight. Articulating half-ring and facet short (sag.); articulating furrow shallow. Surface granulate; pairs of irregularly spaced, small tubercles or large granules on rachis. Pygidia from the decalcified limestone are identical with specimens from the massive limestone, and associated parts are attributed to *E. stincharensis* accordingly.

Cephalon elliptical in outline, sagittal length slightly less than 50% width at base of genal spines, which are small. Glabella longer than wide, width across 1L about 70% width across frontal lobe, strongly convex longitudinally and transversely. Frontal lobe 45% length of glabella, broadly rounded in outline anteriorly. Longitudinal median furrow broad, extending backwards from preglabellar furrow for 20% length of glabella. Lateral lobes represented by gentle swellings on steep lateral slope of glabella, 2L slightly longer than 3L, 1L shortest (exsag.), ridge-like and connected to neck of glabella. 1S, 2S, and 3S short and broad, successively shallower. Occipital ring short, of uniform length, wider (tr.) than base of glabella. Occipital furrow well defined, transverse. Preglabellar furrow uniformly deep and broad, undercutting glabella. Rachial furrow deep and narrow, straight; deep fossula at anterior extremity; stout apodemes adaxially at junctions with 2S, 1S, and occipital furrow. Anterior border of cranidium short (sag.), lengthening slightly abaxially. Fixed cheek convex, sloping steeply towards sides. Palpebral lobe small, elevated, midlength opposite 2S, anterior extremities 175% anterior width of glabella apart. Eye ridge absent. Posterior border short, approximately equal in length (exs.) to occipital ring, not widening abaxially, curving forwards abaxially. Genal spine short and slender, directed outwards, and only slightly backwards, forwardly placed. Anterior branch of facial suture runs obliquely inwards and downwards to fossula, and then curves forwards and inwards, defining anterior border of cranidium. Posterior branch of facial suture curves outwards and backwards cutting border opposite 1S.

Eye lobe small, elevated, separated from cheek by deep, broad furrow. Lens surface convex, expanded, occupying more than 50% height of lobe. Cheek slopes steeply outwards. Field flattened, considerably wider than border. Precranial lobe short (exs.), indistinctly marked off from anterior border. Lateral border narrow, continuous with anterior border in outline and convexity, not markedly incurved posteriorly. Lateral border furrow deep and broad, U-shaped in cross section.

Hypostome subtriangular, anterior outline strongly rounded. Middle body oval, 75% length of hypostome, very strongly convex. Rhynchos projects anteriorly but not overhanging border, ill defined posteriorly. Anterior border strongly developed. Anterior wing large, placed anteriorly to mid-length of hypostome rounded wing process near extremity. Lateral border narrow, depressed. Posterior tongue moderately long, flattened, pointed. Doublure unknown.

Cephalon irregularly tuberculate, lateral lobes sparsely tuberculate; about 90 tubercles on glabella, tubercle size index (Temple and Tripp in press, i.e. width of largest glabella tubercles as % of width of frontal lobe) 7%. An irregular row of about eleven small tubercles on anterior border of cranidium. Cheeks tuberculate, field of cheeks closely pitted between tubercles. External surface of middle body of hypostome granulate.

Attribute coding (Temple and Tripp in press). Pygidium: 1-0; 2-21; 3-1; 4-0; 5-0; 6-9; 7-0; 8-0; 9-1. Cranidium: 10-1; 11-1; 12-15-1100; 16-1; 17-0; 18-0; 19-0; 20-0; 21-0; 22-0; 23-0; 24-0; 25-0; 26-0; 27-90; 28-11; 29-0; 30-2; 31-0; 32-2; 33-7; 34-0.

Development. A meraspis cranidium (A.14078) 1.2 mm in sagittal length has a narrow cranidium, 1S and 2S connected across the glabella, and a small torular tubercle (Evitt and Tripp 1977, p. 114) situated adaxially on the fixed cheek opposite 2S. A small free cheek 1.9 mm in lateral length has eye lobe larger compared with the adult. Small pygidia lack full number of segments ring, furrows are deeper, and first four pairs of pleurae end in out-turned free points.

Remarks. *E. stincharensis*, *E. autochthon* Tripp (1962, p. 22, pl. 3, figs. 18-25) from the Confinis Flags, and *E. polypleura* Tripp (1967, p. 70, pl. 5, figs. 1-8) from the platy upper Stinchar Limestone, constitute a species group unified by the following features: glabella widens steadily forwards, glabellar furrows short, genal spine short, anterior border of free cheek not set at an angle to lateral border, 9 pairs of pleurae in pygidium, posterior pleurae fused abaxially, large paired granules on rachis of pygidium.

Genus QUINQUECOSTA Tripp, 1965
Quinquecosta aff. *stincharensis* Tripp, 1967

Plate 38, figs. 22-23

Material. 4 free cheeks, 1 thoracic segment, 1 pygidium; Auchensoul Limestone, Auchensoul Bridge. 2 cranidia, 1 cranidium with 12 thoracic segments attached, 9 free cheeks, 2 hypostomes, 6 pygidia; Stinchar Limestone, Water of Gregg, east of Barr.

Remarks. The above material agrees closely with topotypes from Auchensoul Quarry (Tripp 1967, p. 74, pl. 5, figs. 21-30) except that the eye is smaller, the field of the free cheek is larger and bears a greater number of pits, and the pygidial pleurae are longer. The thorax provides the first evidence that there were at least twelve segments present in *Quinquecosta*, none of which are spined or macropleural. *Q. stincharensis* is the only species to range (under open nomenclature) from the Auchensoul Limestone to the basal Superstes

EXPLANATION OF PLATE 39

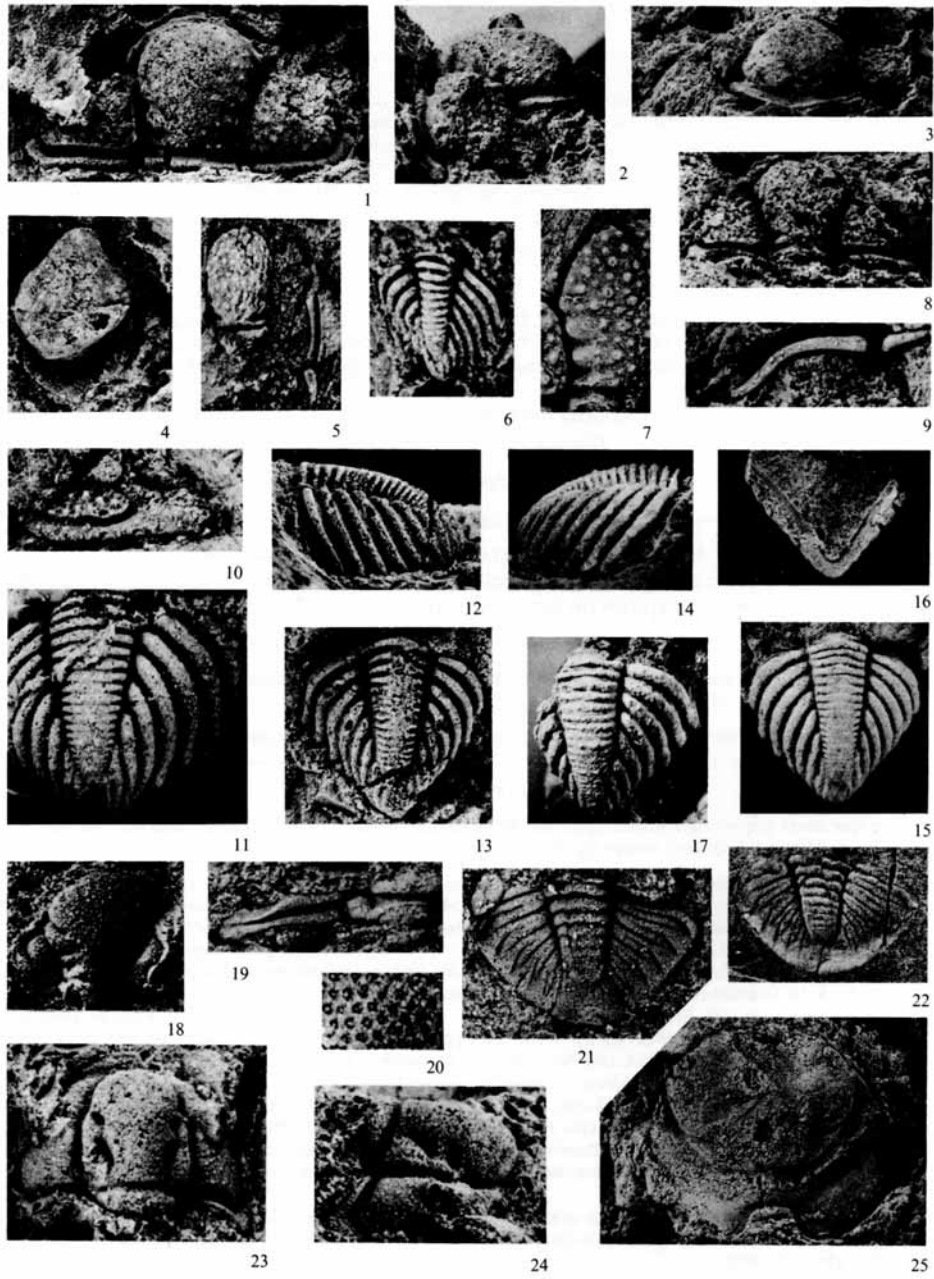
The specimens are internal moulds from the decalcified Stinchar Limestone, unless otherwise stated; all are from Minuntion Quarry.

Figs. 1-17. *Encrinuroides stincharensis* (Reed). 1-3. Cranidium (A.14027). Dorsal, oblique right lateral, and frontal views, $\times 3$. 4. Hypostome (A.14028), $\times 5$. 5. Two incomplete cranidia (A.14029a) showing left fixigenal spine, $\times 7$. 6. Small pygidium (A.14030a) showing free points on first four ribs, $\times 7.5$. 7. Cranidium (A.14031a) showing longitudinal anterior median furrow and coarse tuberculation. Oblique left lateral view, $\times 6$. 8. Cranidium (A.14032a) with glabella widening strongly forwards, $\times 5$. 9. Incomplete thoracic segment (A.14033a), $\times 8$. 10. Right free cheek (A.14034), $\times 8$. 11. Pygidium (A.14035). Latex cast from external mould, $\times 8$. 12-13. Pygidium (A.14036a). Left lateral and dorsal views, $\times 4.5$. 14-15. Testiferous pygidium (BM In.52699). Right lateral and dorsal views. Massive Stinchar Limestone, $\times 2$. 16-17. Pygidium (holotype, BM In.23157). Ventral view showing lateral border and dorsal view. Massive Stinchar Limestone, $\times 3$.

Figs. 18-22. *Calyptaulax georgei* Tripp. 18. Cranidium (A.14037a), $\times 6$. 19. Incomplete thoracic segment (A.14038a), $\times 9$. 20. Enlargement of lens surface of eye (A.14039b). External mould, $\times 12$. 21. Pygidium (A.14040b). Latex cast from external mould, $\times 8$. 22. Testiferous pygidium (BM In.23564). Massive Stinchar Limestone, $\times 4$.

Figs. 23-24. *Thulincola barbarus* Tripp. Cranidium (A.14041a). Right lateral and dorsal views, $\times 9$.

Fig. 25. *Amphilichas* sp. Hypostome (A.14042a), $\times 2.2$.



TRIPP, Ordovician trilobites

Mudstones; the genus is not known outside the Barr Group of the Girvan District. The closest relationship is with a new genus described in manuscript by DeMott (1963) from the Platteville (equivalent in age to upper Edinburg) Formation of Beloit, Wisconsin. The pygidium and free cheek closely resemble *Quinquecosta*, but the glabella, in which the basal lobe (1L) is obsolete, has a strong pliomeric appearance; the thorax, consisting of thirteen or more segments, is not unlike that recorded above from the Water of Gregg.

Family LICHIDAE Hawle and Corda, 1847

Genus AMPHILICHAS Raymond, 1905

Amphilichas spp.

Plate 39, fig. 25

Remarks. A pygidium from the Auchensoul Limestone (A.14079) closely resembles that figured from the Confinis Flags, Minuntion (Tripp 1962, p. 31, fig. 28) but the rachis is shorter. An exceptionally large hypostome from the decalcified Stinchar Limestone, Minuntion Quarry, is illustrated.

Genus HEMIARGES Gürich, 1901

Hemiarges inghami sp. nov.

Plate 40, figs. 1-17; text-fig. 3

1967 *Hemiarges* sp. Tripp, p. 81, pl. 6, fig. 26.

Diagnosis. Central lobe of glabella narrow. Bullar lobe confluent with basal lobe on external surface. Large paired tubercles consistently arranged on glabella and fixed cheek. A pair of short spines on occipital ring.

Holotype. A.14063a, b (cranidium). Plate 40, figs. 1-3. Decalcified Stinchar Limestone, Minuntion Quarry.

Other material. 105 cranidia, 4 free cheeks, 35 hypostomes, 1 thoracic segment, 23 pygidia. Decalcified Stinchar Limestone, Minuntion Quarry.

Material from other horizon. 1 cranidium from the platy upper Stinchar Limestone, Aldons Quarry.

EXPLANATION OF PLATE 40

The specimens are internal moulds from the decalcified Stinchar Limestone, unless otherwise stated; all are from Minuntion Quarry, except fig. 26.

Figs. 1-17. *Hemiarges inghami* sp. nov. 1-3. Cranidium (holotype, A.14043a). Dorsal, frontal, and oblique right lateral views, $\times 9$. 4. Cranidium (A.14044a). Oblique frontal view showing left palpebral lobe, $\times 12$. 5. Cranidium (A.14045a); tubercles at back of central lobe far apart, $\times 8$. 6. Left free cheek (A.14046). External mould, $\times 9$. 7. Left free cheek (A.14047a), doublure partly exposed, $\times 9$. 8. Cranidium (A.14048). External mould, showing tubercles with apical pillars, indicating setiferous pores, $\times 18$. 9-10. Cranidium (A.14049a). Oblique left lateral and oblique posterior views, $\times 8$. 11. Hypostome (A.14050a), $\times 9$. 12. Small cranidium (A.14051), $\times 16$. 13. Cranidium (A.14052). Frontal view of latex mould, showing occipital spines, $\times 10$. 14. Pygidium (A.14053b). Latex cast from external mould, $\times 12$. 15. Broad pygidium (A.14054a), $\times 8$. 16. Incomplete thoracic segment (A.14055a), doublure partly exposed, $\times 8$. 17. Cranidium (A.14049b). External mould, $\times 8$.

Figs. 18-24. *Ceratocephala relativa* Tripp. 18-19. Cranidium (A.14056a). Dorsal and frontal views, $\times 6$. 20. The same (A.14056b). Latex cast from external mould; note problematical alga top right, $\times 6$. 21. Small cranidium (A.14057a), showing glabella with narrow, convex central lobe, $\times 9$. 22. Dorsal shield (A.14058a), $\times 4-5$. 23. Left free cheek (A.14059b). External mould, $\times 9$. 24. Hypostome (A.14060). External mould, $\times 9$.

Fig. 25. Unassigned metaprotaspis (or degree zero meraspis) (A.14062), $\times 18$.

Fig. 26. Dasycladacean alga, *Vermiporella* sp. (BM V.59776). Thin section, $\times 30$. Top Stinchar Limestone, Brockloch Quarry.



TRIPP, Ordovician trilobites and alga

Dimensions of holotype.

Length of cranidium (sag.)	3.3 mm
Width of glabella (maximum)	2.4 mm
Width of central lobe (minimum)	0.8 mm
Length of bullar lobe (exs.)	1.5 mm

Description. Cranidium moderately convex longitudinally, weakly so transversely. Central lobe weakly expanded anteriorly, extending half-way across bullar lobe, narrowing slowly backwards, not marked off from posterior lobe. Bullar lobe equal to, or slightly wider than, central lobe opposite eye, with strong independent convexity. Basal lobe slightly depressed, indistinctly demarcated on all sides. Posterolateral swelling subelliptical, steeply inclined, confluent with basal lobe, strongly marked off from occipital ring. Occipital ring slopes forwards, tapering to a point abaxially, moderately arched transversely. Longitudinal furrow deep and narrow, curving outwards for a short distance posterior to bullar lobe before dying out on external surface. Occipital furrow broad and shallow mesially, deep and narrow behind posterolateral swelling. Preglabellar furrow deep and well defined, continuous with rachial furrow, which curves inwards towards back of bullar lobe and dies out on external surface.

Anterior border long (sag.), expanding abaxially. Palpebral lobe slopes steeply upwards (Plate 40, fig. 4); posterior extremity posterior to bullar lobe. Palpebral furrow distinct. Eye ridge low, running backwards and slightly outwards from anterolateral angle of glabella to palpebral lobe. Fixed cheek convex, sloping steeply outwards and backwards. Posterior border short, narrowing steadily abaxially, sloping forwards, set low compared with occipital ring and fixed cheek. Posterior border furrow deep, widening strongly abaxially. Anterior branch of facial suture runs forwards and cuts anterior border at a steep angle; posterior branch curves outwards and backwards, crossing posterior border abaxially to midwidth.

Eye lobe elevated, rounded, moderately large; lens surface occupies upper half of lobe. Free cheek falcate, gently sigmoidal in outline. Field subtriangular in shape, convex. Lateral and posterior borders moderately wide, weakly convex, merging to form backwardly curving librigenal spine, which narrows steadily. Border furrows broad and shallow, faintly continued as a single furrow on spine. Doublure wide, strongly convex abaxially, bearing faint terrace lines parallel to margin.

Cephalon tuberculate, with large paired tubercles consistently arranged. A pair of short spines at back of occipital ring, directed straight backwards. Five pairs of large tubercles: three pairs on central lobe alongside bullar lobe; one pair towards back of bullar lobe; one pair adaxially on fixed cheek, alongside basal lobe. Tubercles of intermediate size placed posteriorly on central lobe, anteriorly on bullar lobe, alongside palpebral lobe, and on field of free cheek. Positions of smaller tubercles is indicated on text-fig. 3. Well-preserved external moulds (Plate 40, fig. 8) show a pillar in the centre of the tubercle, possibly indicating presence of an open pore, presumably setiferous.

Hypostome 70% as long as wide. Central body broadly rounded in front, though narrower and more strongly rounded on some specimens than on others, 65% length of hypostome, weakly convex. Posterior lobe small. Lateral and posterior furrows deep and broad on internal surface, shallow on external. Lateral margin curves outwards and backwards at front, forming obtusely pointed posterior wing, converging posteriorly. Posterior border broad, slightly tumid mesially; posterior margin straight. Doublure of posterior margin extends as far as posterior furrow, convex except for an elliptical median boss which is separated by a narrow furrow from anterior margin of doublure. Surface smooth.

Thoracic segment with pleura curving strongly backwards. Pleural furrow sharp, mesial for most of its length, becoming shallow beyond midwidth. Doublure broad, with faint, closely spaced terrace lines. Surface coarsely granulate.

Pygidium much wider than long. Rachis 40% maximum width, strongly arched transversely, narrowing strongly at 65% pygidial length from front; postrachial ridge narrow, strongly developed, reaching to border. One ring well defined by a strong ring furrow; second ring marked off abaxially only. Rachial furrow deep and narrow. Pleural lobe weakly convex. First pleura short: posterior band swollen, extended into free point; pleural furrow dies out near margin. Second pleura larger than first, expanding abaxially. Anterior band moderately swollen, separated by border furrow from independently convex lateral border. Posterior band swollen, extended into long free point which reaches well beyond third pleura. Second pleural furrow dies out abruptly where it joins border furrow. Third pleura swollen, unfurrowed, circumscribed by second interpleural furrow and border furrow. Border well defined. Terminal free points tiny, placed close together behind postrachial ridge. A slightly larger free point at anterior extremity of third pleurae separated by

narrow, rounded notch from second free point. Doublure broad, convex; terrace lines faint. A tubercle on posterior bands of first and second pleurae, second adaxially placed; pairs of small tubercles on rachis and third pleurae (text-fig. 2).

Development. Smallest cranidia (Plate 40, fig. 12) 1.0 mm in sagittal length differ from full-grown specimens in that bullar lobe is shorter and does not extend so far forwards. Eye ridge more strongly developed, and separated by broad depressed area from anterior border. Longitudinal furrow extends beyond bullar lobe. Large paired tubercles arranged as in adult.

Remarks. The pair of occipital spines distinguishes *H. inghami* from all other species. The closest comparison is with *H. turneri* Chatterton and Ludvigsen (1976, p. 85, pl. 19, figs. 1-41) from the lower Esbataottine Formation. Both species have a lateral border to the free cheek bearing a few larger tubercles; the pygidia are remarkably similar except that in *H. inghami* the adaxial pair of free points on the third pleurae are smaller than the abaxial pair. The well-defined border distinguishes the pygidium from that of other Barr Group species—*H. insolitus* Tripp (1967, p. 80, pl. 6, figs. 20-25) from the platy upper Stinchar Limestone, and *H. sp.* (Tripp 1962, p. 32, pl. 4, figs. 29-32) from the Confinis Flags. The single cranidium from the upper Stinchar Limestone, Aldons, quoted in the synonymy possesses the diagnostic pair of occipital spines and large paired tubercles, but those on the central glabella lobe are less regularly arranged.

Family ODONTOPLEURIDAE Burmeister, 1843

Genus CERATOCEPHALA Warder, 1838

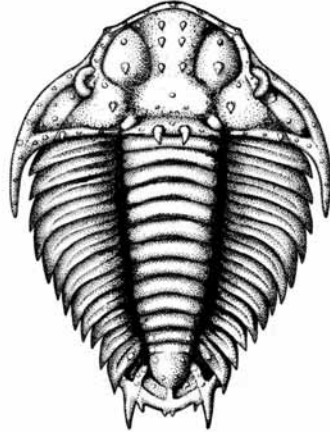
Ceratocephala relativa Tripp, 1967

Plate 40, figs. 18-24; text-fig. 4

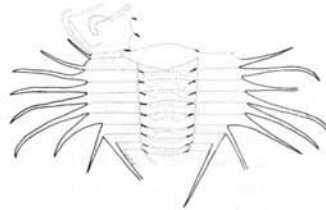
1967 *Ceratocephala relativa* Tripp, p. 81, pl. 6, figs. 27-34.

Material. 1 dorsal shield, 19 cranidia, 10 free cheeks, 1 hypostome, 1 thoracic segment, 2 pygidia; decalcified Stinchar Limestone, Minuntion Quarry.

Remarks. The articulated dorsal shield (Plate 40, fig. 22; text-fig. 3) resembles *C. laciniata* Whittington and



TEXT-FIG. 3. *Hemiarges inghami* sp. nov. Reconstruction of dorsal shield. Decalcified Stinchar Limestone, Minuntion Quarry.



TEXT-FIG. 4. *Ceratocephala relativa* Tripp. Outline drawing of incomplete articulated dorsal shield (Plate 40, fig. 22), $\times 10$. Decalcified Stinchar Limestone, Minuntion Quarry.

Evitt (1954, text-figs. 1, 13-14) from the Edinburg Limestone in general construction, but differs as follows: fourth to fifth pleural spines are the longest, whereas in *C. laciniata* the length increases on successive segments, in *C. relativa* spines curve slightly backwards near tips, in *C. relativa* spines of ninth segment are convergent, not divergent, and run parallel to first pygidial spines, surface is granulate and does not bear small spines as in *C. laciniata*.

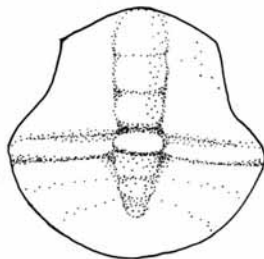
Unassigned metaprotaspis (or degree zero meraspis)

Plate 40, fig. 25; text-fig. 5

Material. 1 metaprotaspis (or degree zero meraspis) 0.7 mm in sagittal length; decalcified Stinchar Limestone, Minuntion Quarry.

Description. Dorsal shield as long as wide, gently convex; width of rachis 20% maximum width; cranium occupies 55% length. Glabella parallel sided; moderately arched transversely. Preglabellar and rachial furrows well defined, continuous. Faint transverse glabellar furrows at 30% and 60% length from occipital furrow. Occipital ring short, well defined. Occipital furrow deep. Fixed cheek large, gently convex, joining in a narrow band anterior to glabella without forming a distinct anterior border. Palpebral lobe and eye ridge not preserved. Facial suture apparently indents anterolateral margins, suggesting presence of a narrow free cheek. Posterior border of cranium short (exs.), widening slightly abaxially. Posterior border furrow firmly impressed, transverse, subcontinuous with occipital furrow. Anterior outline of pygidium subtransverse. Rachis of pygidium narrows backwards to a point 40% length of pygidium from posterior margin; two segments and a small, rounded terminal piece, which is strongly marked off. Rachial furrows almost straight, broad anteriorly, narrowing backwards. Pleural lobes gently convex; two very faint furrows are directed outwards and slightly backwards across lobe. Border absent.

Remarks. The closest comparison is with the asaphid degree zero meraspis figured by Hughes (in press, pl. 1, fig. 10) from the Lower Llandeilo. Our specimen is smaller, with pygidium less developed, but is possibly attributable to the family Asaphidae.



TEXT-FIG. 5. Unassigned metaprotaspis (or degree zero meraspis). Reconstruction (Plate 40, fig. 26), $\times 55$. Decalcified Stinchar Limestone, Minuntion Quarry.

REMARKS AND CONCLUSIONS

The Auchensoul and Stinchar Limestones are sparingly fossiliferous in the main, but yield mixed shelly faunas locally. Except for *Remopleurides*, nearly all the trilobites consist of isolated parts, frequently broken. Most of the specimens appear to have been transported a limited distance from the original habitat; the occasional occurrence of delicate articulated exoskeletons indicates temporarily quiet, undisturbed conditions.

The decalcified lower/middle Stinchar Limestone at Minuntion Quarry provides the shallowest-water fauna, the best example of the illaenid-cheirurid community (Fortey 1975, p. 340) in the Girvan District; *Ceraurinella* is the most common genus,

illaenids are represented by a diversity of forms although not numerically dominant, *Dimeropyge* is rare, and raphiophorids and other deeper-water elements are absent. Diversity is low. The frequency of a problematical spherical alga (Plate 40, fig. 20) and gastropods support the suggestion of shallow-water conditions. The trilobites are most closely related to those of the platy upper Stinchar Limestone, but that fauna includes deeper water genera and is more diverse; algae are absent, and gastropods rare, as the following comparison shows (specimens are lodged in the Hunterian Museum):

	DECALCIFIED STINCHAR LIMESTONE MINUNTION QUARRY	UPPER STINCHAR LIMESTONE AUCHENSOU L QUARRY
Algae?	very common	absent
Ostracodes	very common	very common
Bryozoa	very common	33
Gastropods	158	3
Trilobite cranidia	156	189
Brachiopods	95	184
Pelmatozoan cup plates	52	16
Bivalves	20	37
Conodonts	6	very common
Machaerids	9	33
Other	4	5

The remaining lower/middle Stinchar Limestone assemblages indicate slightly deeper conditions of deposition compared with the Minuntion, but shallower than the platy upper Stinchar Limestone. The top Stinchar Limestone of Brockloch Quarry is exceptional in the poverty of the trilobite fauna compared with the wealth of brachiopods. No species of trilobite present is certainly known to occur at any other locality. The occurrence of a dasycladacean alga (Plate 40, fig. 26) indicates warm, shallow conditions. The Stinchar Limestone is succeeded by the Superstes Mudstones, the basal part of which has yielded the offshore nileid community of Fortey.

A study of the conodonts led Bergström (1971, p. 114) to conclude that the boundary between the Llanvirn and the Llandeilo falls within the Stinchar Limestone. Williams *et al.* (1972, text-fig. 9) placed the base of the Barr Group within the Llandeilo Series. There is no indication of a break in the Stinchar Limestone trilobite faunas.

No trilobite species occurring in the Barr Group is known outside the Girvan District. The closest similarity is to certain species of upper Chazyan age from North America, in particular the lower Esbataottine Formation of the southern Mackenzie Mountains, Canada (see pp. 346, 350, 357).

Chatterton and Ludvigsen (1976) recognized four biofacies, dominated by different trilobite genera, in the lower Esbataottine. The Barr Group faunules do not compare closely with any of these, though the Minuntion illaenid-cheirurid community would fit best in the *Calyptaulax-Ceraurinella* biofacies. The platy upper Stinchar Limestone fauna might correspond to the deeper *Dimeropyge* biofacies (*Dimeropyge* is the most abundant trilobite at Auchensoul Quarry) though diversity is less than at some *Calyptaulax-Ceraurinella* localities. Chatterton and Ludvigsen (1976, p. 16)

table a list showing 74% of genera common to the lower Esbataottine Formation and to the Girvan District (possibly all Stinchar Limestone occurrences). The reciprocal figure, the proportion of genera common to the Stinchar Limestone and the lower Esbataottine Formation, is less than 40%, a reflection of the exclusive character of the Barr Group faunas.

Acknowledgements. I thank Dr. J. T. Temple and Dr. J. K. Ingham for suggestions regarding the manuscript, Dr. G. F. Elliott for advice regarding the algae, and M. L. Holloway for drawing Text-fig. 3. I also thank those responsible for the following collections for the loan of specimens: British Museum (Natural History) (BM); I.G.S., Edinburgh (IGSE); Royal Scottish Museum, Edinburgh (RSM); Sedgwick Museum, Cambridge.

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Typescript received 25 January 1978

Revised typescript received 28 July 1978