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LOWER ORDOVICIAN TRILOBITES FROM THE VICINITY OF SOUTH CATCHER POND, NORTHEASTERN NEWFOUNDLAND

(Report, 1 figure, 2 plates)

W. T. Dean

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Abstract

Trilobites from limestone within volcanic rocks at localities near South Catcher Pond, southwest of Notre Dame Bay, are shown to be of Lower Ordovician, probably Arenig, age, and exhibit affinities with faunas in western Newfoundland, Quebec, and Sweden. At least four genera are present: *Geragnostus*, *Selenoharpes*?, *Leiostegium* and *Ischyrophyma*, the last-named represented by *I. marmorea* sp. nov. The unnamed formation containing the fossils, previously considered to be of Silurian age, is provisionally reassigned to the Lush's Bight Group, for which a Lower Ordovician age had been established, though on the basis of meagre faunal evidence.

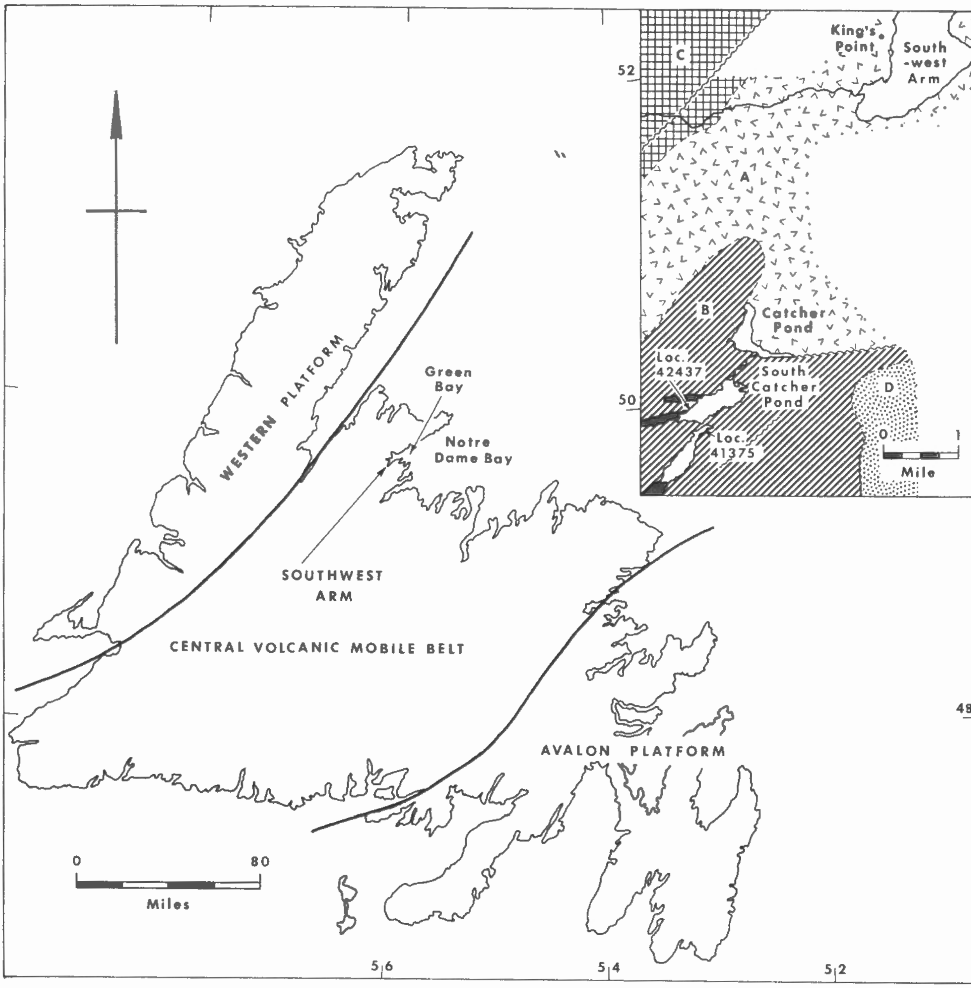

Figure 1. Outline map of Newfoundland showing the location of Southwest Arm and the area under consideration. The boundaries of the tectonic subdivisions of Newfoundland are taken from Williams (1967, p. 98). Inset sketch-map shows the position of fossil localities near South Catcher Pond. Geology from Neale *et al.*, 1960. Wavy lines indicate faults. Key to shading as follows: A. Lush's Bight Group (Lower Ordovician), basic metavolcanic rocks; B. Unnamed group of basic to silicic volcanic rocks with rare limestone beds (Lower Ordovician), now provisionally assigned to Lush's Bight Group; C. Springdale Group (Silurian), lower part, quartz-feldspar porphyry and silicic volcanic rocks; D. Springdale Group (Silurian), upper part, including conglomerates and volcanic rocks. The black areas represent intrusive porphyry, probably of Devonian age.

LOWER ORDOVICIAN TRILOBITES FROM THE VICINITY OF SOUTH CATCHER POND, NORTHEASTERN NEWFOUNDLAND

INTRODUCTION

The area from which the material described in this account was obtained lies near the Southwest Arm of Green Bay, at the western end of Notre Dame Bay, on the north coast of Newfoundland (Fig. 1). About four miles south-southwest of the settlement of King's Point is a group of three "ponds", arranged in a line running north-northeast. The northernmost of these is named Catcher Pond, the middle one is South Catcher (sometimes Upper Catcher or Silver) Pond, whilst the southernmost is apparently unnamed. The first detailed geological account of the area was given by MacLean (1947) who established the following succession, in ascending order, for the stratified rocks: Lush's Bight Group, Roberts Arm Volcanics, Springdale Group and Middle Arm Ridge Group. These comprised volcanic rocks for the most part, with subsidiary sediments. Fossils were unknown except for one specimen of an inarticulate brachiopod, *Discotreta*, found in a shale bed within the Lush's Bight Group and claimed to indicate a Lower Ordovician, probably late Canadian, age. On his accompanying map MacLean (1947, Pl. I) showed rocks of the Lush's Bight Group forming an outcrop which was about three miles wide in the vicinity of Catcher Pond and extended eastwards where it widened still farther.

Subsequently Neale, Nash and Innes (1960) published a one inch to one mile geological map of the King's Point area, and on it most of the rocks at and just south of King's Point were regarded as Lush's Bight Group. However, those around Catcher Pond were separated as an additional unnamed unit of Silurian age. This distinction was made on the basis of fossils discovered earlier by geologists of British Newfoundland Exploration Ltd. and held to indicate a Silurian age as they included, *inter al.*, the trilobite species *Prionopeltis archiaci* (Barrande), stated to be characteristic of a horizon at the top of the Kopanina Formation, Ludlow Series, in central Bohemia (Svoboda *et al.*, 1966, pp. 305-306). This interpretation was reiterated by Neale and Nash (1963, p. 19), though they conceded that there was "some slight structural evidence" for the Ordovician age of certain lavas to the southwest, as had been suggested earlier by Kalliokoski (1953).

Collections of fossils from localities GSC 41375 and 42437, in the vicinity of South Catcher Pond (*see* Fig. 1), were made by E.R.W. Neale in 1959 and subsequently by L.M. Cumming in 1960. Additional material was obtained by W.S. McKerrow at the instigation of A. Boucot in 1967, in the belief that the rocks were of Silurian age, and it was at this juncture that G. Klapper, after examination of the contained conodonts, suggested that the age was, in reality, Lower Ordovician, a conclusion confirmed by W. Sweet and S. Bergström (A.J. Boucot, personal communication). The present paper is based primarily on the original collections in the Geological Survey of Canada, but I have also been able to examine McKerrow's collection thanks to the kindness of

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Prof. A.R. Palmer. There can be no doubt that the trilobites, though poorly preserved, are of Lower Ordovician age, and their correlation and affinities are discussed below. The rocks in which they occur form part of the so-called Central Volcanic (or Paleozoic) Mobile Belt, one of three Paleozoic tectonic units into which Newfoundland has been divided (Williams, 1967, p. 98). According to Williams the Ordovician rocks of the Catcher Pond area, part of his "Sprindale Belt" (*loc. cit.*, p. 115), are of deep water marine eugeosynclinal facies; and are distinct from the "shallow water marine shelf facies" of the Avalon Platform to the east (see text, Fig. 1), and the "shallow water marine carbonate-quartzite platform facies" of the Western Platform. The fossils near Catcher Pond are of particular interest in that they lie within rocks of supposed deep water facies and yet exhibit affinities with faunas of shallow water carbonate facies in Sweden and in Quebec east of Logan's Line where the stratigraphy is comparable with that of the Western Platform of Newfoundland, although structurally west of Logan's Line.

Prof. H.B. Whittington and W.H. Poole have kindly read the manuscript. I am particularly indebted to Prof. Whittington for useful discussion of the trilobites and for suggestions regarding the generic position of *Ischyrophyma marmorea*.

SYSTEMATIC PALEONTOLOGY

The terminology employed herein is essentially that used in the Treatise on Invertebrate Paleontology (Harrington, Moore & Stubblefield *in* Moore, 1959, p. O 49) but includes certain terms regarded there as less important or obsolete. For the description of *Geragnostus*, I prefer to follow Whittington (1963, p. 28) in regarding the triangular lobes at the back of the cranidium as lateral occipital lobes rather than basal glabellar lobes. Terminology involving harpid trilobites is that of Whittington, 1950a.

Family AGNOSTIDAE McCoy, 1849

Genus *Geragnostus* Howell, 1935

Type species. *Agnostus sidenbladhi* Linnarsson, 1869.

Geragnostus sp.

Plate I, Figure 1

Figured Specimen. GSC 26245.

Locality and Horizon. GSC Loc. 42437, by west side of South Catcher Pond, near southwestern end. Lower Ordovician, probably Lush's Bight Group, but see later.

Description. Only a few fragments of agnostid trilobites have been found and the best-preserved is now illustrated. The cranidium is approximately as broad as long with a well-defined border that becomes narrower posterolaterally and is delimited by a broad border furrow. The glabella and occipital ring together occupy a little less than four-fifths of the median length of the cranidium. The glabella is divided into two unequal lobes, the anterior of which is the smaller, by a transverse furrow, and narrows forwards to the elliptical front of the anterior lobe. The transverse furrow appears superficially to be in the form of a broad chevron with apex directed forwards, but this is almost certainly the result of crushing and its original course was probably straighter. There is a suggestion of a median tubercle just behind the furrow. A pair of lateral occipital lobes are triangular in plan, their bases separated by a small median band behind the hindmost portion of the slightly swollen posterior lobe of the glabella. The maximum breadth of the glabella is two-thirds that of the occipital ring and two-fifths that of the cranidium.

Discussion. For convenience, the age and affinities of the whole fauna are discussed together at the end of this paper.

Family HARPIDAE Hawle & Corda, 1847

Genus *Selenoharpes* Whittington, 1950

Type species. *Harpes (Eoharpes) youngi* Reed, 1914.

Selenoharpes? sp.

Plate I, Figures 5, 6, 10

Figured Specimen. GSC 26248.

Locality and Horizon. GSC Loc. 42437, by South Catcher Pond. Lower Ordovician, probably Lush's Bight Group, but see later.

Description. A single incomplete cranidium, although poorly preserved, exhibits nevertheless certain features that suggest its inclusion in *Selenoharpes*. The transverse convexity of the cranidium and the proportions of the glabella and genae have been affected by lateral crushing but not to any great extent, and the original glabellar outline was probably relatively narrow, tapering gently forwards and with a pair of small basal glabellar lobes. Alae are barely discernible but the left one can be detected and is small, depressed below the adjacent surface of the gena. The glabella extends well forwards and the preglabellar field is narrow (*sag.*), equal to just over one-sixth of the length of the glabella. The left eye tubercle is better preserved than the right and sited well forwards, three-quarters of the distance from the occipital furrow to the front of the glabella, and close to the axial furrow, with traces of an eye ridge connecting the two. Little remains of the brim and genal roll but frontally they must have been broad (*sag.*), whilst the prolongations had a length at least equal to that of the glabella.

Family LEIOSTEGIIDAE Bradley, 1925

Genus *Leiostegium* Raymond, 1913

Type species. *Bathyurus quadratus* Billings, 1860.

Leiostegium sp.

Plate II, Figures 4, 6, 8, 11

Figured Specimens. GSC 26252 (Pl. II, Figs. 4, 6, 11), GSC 26255 (Pl. II, Fig. 8).

Locality and Horizon. GSC Loc. 42437, by South Catcher Pond. Lower Ordovician, probably Lush's Bight Group, but see later.

Description. Two fragmentary small cranidia exhibit features that enable them to be included in *Leiostegium* as generally interpreted (*see* Berg and Ross, 1959, p. 113; Lochman-Balk *in* Moore, 1959, p. O 313) but are insufficient for specific or subgeneric determination. One specimen (Pl. II, Fig. 8) is a little compressed dorsally whilst the other is slightly distorted, but both have the characteristically unfurrowed glabella, subrectangular in outline, of low convexity, and moderately arched-down frontally. The narrow *sag.* occipital furrow is transversely straight; the occipital ring is widest *sag.* medially and narrows near the axial furrows. The anterior border is gently arched forwards in plan, and uniformly narrow *sag.* around the front of the glabella; it continues in front of the fixigenae, with a momentary widening opposite the axial furrows. The fixigenae are incompletely preserved but the posterior portions are small and subtriangular in plan. As far as can be judged, the eyes are positioned opposite a point just behind centre of the glabella, but the palpebral lobes are not preserved.

Family DIMEROPYGIDAE Hupé, 1953

Genus *Ischyrophyma* Whittington, 1963

Type species. *Ischyrophyma tuberculata* Whittington, 1963.

Ischyrophyma marmorea sp. nov.

Plate I, Figures 2,3,7,9,11,13; Plate II, Figures 1-3,5,7,10,12,13

Diagnosis. Glabellar longer than wide, with almost straight sides converging forwards gently. Well-rounded frontal glabellar lobe strongly arched-down anteriorly to deep, narrow furrow separating it from low, upturned anterior border. Large, composite basal glabellar lobes made up of 1p glabellar lobes combined with 1p glabellar furrows, the whole being bounded adaxially by a pair of deep curved furrows, slightly divergent forwards, that do not reach axial or occipital furrows. 2p lobes approximately same size as 1p lobes. Glabellar outline narrows slightly in front of 2p lobes. Traces of very small 3p and 4p glabellar lobes. Facial suture opisthoparian; genal angles end in pair of short librigenal spines. Surface of test coarsely tuberculated.

Holotype. GSC 26246 (Pl. I, Figs. 2, 11, 13).

Paratypes. GSC 26247 (Pl. I, Figs. 3, 7, 9), GSC 26249 (Pl. II, Fig. 1), GSC 26250 (Pl. II, Fig. 2), GSC 26251 (Pl. II, Fig. 3), GSC 26253 (Pl. II, Fig. 5), GSC 26254 (Pl. II, Fig. 7), GSC 26256 (Pl. II, Fig. 9), GSC 26257 (Pl. II, Figs. 10, 13), GSC 26258 (Pl. II, Fig. 12).

Localities and Horizon. Of the material from the area of South Catcher Pond, GSC 26247 was collected at GSC Locality 41375 (see Fig. 1), whilst all the remaining specimens are from GSC Locality 42437. Lower Ordovician, probably Lush's Bight Group, but see later.

Description. The glabella has a basal breadth three-quarters of its median length and is broadly rounded posterolaterally, with almost straight sides converging gently forwards to an almost semicircular frontal glabellar lobe that occupies between one-quarter and one-third of the median glabellar length. The overall convexity is only moderate but becomes more marked anteriorly, where the frontal glabellar lobe projects forwards slightly to overhang the preglabellar furrow. There are four pairs of glabellar lobes. What appear superficially to be a pair of unusually large basal glabellar lobes are, in fact, composite structures, formed by fusion of the 1p glabellar lobes with the portion of the exoskeleton that would normally, as in *Ischyrophyma tuberculata* Whittington (1963, p. 48; Pl. 8, Figs. 1-10), occupy the floor of the 1p glabellar furrows. In *I. marmorea* this part of the exoskeleton is level with, and coalesces with the anterior parts of the true 1p glabellar lobes, but the boundary between the two structures is indicated clearly by the change in ornamentation. A somewhat similar, but less well developed, condition is found in *Ischyrophyma tumida* Whittington (1966, p. 339, Pl. 9, Figs. 6-12, 15), in which species, however, the floor of the abaxial portions of the 1p glabellar furrows, though bridging the gap between 1p and 2p glabellar lobes, is set slightly below the level of the 1p lobes. In *Ischyrophyma marmorea* the conjoined 1p glabellar lobes and 1p furrows are delimited to a large extent on their adaxial sides by a pair of long, deep furrows that are slightly divergent forwards, gently curved and abaxially convex in plan. The 1p glabellar lobes are equal to about one-third, or slightly less, of the median length of the glabella, and are roughly subtriangular in outline, linked to the median body of the glabella by narrow "necks" that are slightly depressed. The composite lobes are separated from the 2p lobes by a pair of faint, shallow grooves that represent the anterior margins of the 1p glabellar furrows (*see* especially Pl. I, Figs. 7, 13) and unite with the deep longitudinal furrows already noted. The 2p glabellar lobes occupy between one-quarter and one-fifth of the median length of the glabella and are bounded anteriorly by 2p glabellar furrows that are both short *tr.* and broad *exsag.* At this point there is a slight "step" in the glabellar outline, which becomes slightly narrower immediately in front of the 2p furrows. The presence of 3p and 4p glabellar lobes is indicated by small, shallow indentations of the glabellar margin, but these are not preserved in all the type material. The 3p lobes so formed are approximately one-quarter the length of the 2p lobes, and twice the length of the 4p lobes. The anterior border is low, uniformly thick and steeply upturned. It passes abaxially, without perceptible change, into a lateral border that is seen, from an example of the right librigena (Pl. II, Fig. 5), to be narrow, bounded by a broad, shallow lateral border furrow. The latter dies out towards the genal angle, which is produced to form a short librigenal spine. A true preglabellar field is not developed but the preglabellar furrow and anterior border furrow coalesce frontally so that the frontal glabellar lobe is separated from the anterior border by a single wide (*sag.*) furrow. The occipital ring is transversely parallel-sided in plan over its median half, but the abaxial quarters curve forwards slightly to form a pair of occipital lobes, immediately in front of which a pair of apodemes is sited in the otherwise shallow occipital furrow. Both occipital ring and occipital furrow are equally broad (*sag.*) at the sagittal line, where their combined breadth is about one-third that of the glabellar length. The posterior border is narrow (*exsag.*), bounded by a broad, shallow posterior border furrow, and runs only slightly backwards abaxially; its posterior margin is set well in front of that of the occipital ring (*see* Pl. I, Fig. 13). The palpebral lobes are positioned approximately opposite the 2p glabellar lobes, but are imperfectly known from cranidia, though the librigena shows each to be moderately convex in plan. The visual surface is unknown but the lower margin of the eye is bounded by a broad, smooth, ill-defined eye platform. The anterior branches of the facial suture are slightly convergent forwards, subparallel to the axial furrows and at a distance from each of the latter equal to about one-third of the breadth of the frontal glabellar lobe. They extend forwards almost to the anterior border furrow and then curve strongly inwards towards the sagittal line, running in front of and just below the top of the anterior border to meet in a smooth curve. Each posterior branch of the facial suture runs backwards abaxially from the eye in an even curve to cut the posterior margin at an acute angle and at a distance from the axial furrow equal to half the breadth of the glabella. Excluding the smooth furrows, the surface of most of the cephalon is ornamented with coarse, closely-grouped tubercles.

The hypostoma, excluding anterior wings, is longer than broad, with outline constricted medially. The anterior margin is slightly convex forwards and is produced laterally to form a pair of subtriangular anterior wings. The latter pass posteriorly into a narrow, raised lateral border, and at the same time the overall outline of the hypostoma becomes markedly narrower due to the presence of a pair of large lateral notches. Still farther back the outline expands again to form small posterior wings which appear from the damaged internal mould, to be separated by a median notch; however, the external mould shows the posterior margin to be entire, with a narrow (*sag.*) border. The median body is divided by a broad (*sag.*), shallow median furrow into two convex lobes, the anterior of which is twice as long as the posterior lobe.

The thorax is known only from occasional fragmentary segments (*see* Pl. II, Fig. 1). The axial ring is bounded by broad, straight, shallow axial furrows and is transversely straight and parallel-sided for the most part, with the ends curving forwards gently to form a pair of axial lobes. The articulating half-ring is large, separated from the axial ring by a deep, broad articulating furrow that curves forwards near the axial furrows. Each pleura is transversely straight and parallel-sided as far as the fulcrum and then tapers to a pointed tip directed abaxially backwards; it is traversed by a broad (*exsag.*) pleural furrow that begins at the anterior margin by the axial furrow and runs gently backwards and outwards as far as the fulcrum, where it dies out. The surface of the axial ring carries a few scattered tubercles.

The pygidial proportions in the material available have been slightly distorted and cannot be assessed accurately except to state that the breadth exceeds the median length. The outline is well rounded with the anterior margin slightly convex forwards. The axis stands slightly higher than the pleural regions and has straight, slightly-tapered sides that are slightly indented at the ends of three transversely-straight ring furrows. A fourth ring furrow is less well defined, and the axis ends with a small, rounded terminal piece that does not extend to the posterior margin, but is connected to it by a low post-axial ridge. The pleural regions are of low convexity, carry three poorly-defined pairs of pleural ribs, and are separated from the slightly higher, rounded border by a broad shallow furrow. The external surface, excluding furrows, is ornamented with tubercles similar to those of the cephalon and thorax.

<u>Discussion</u>. See later.

AGE AND AFFINITIES OF THE TRILOBITES

Tjernvik (1956, p. 188, Pl. 1, Figs. 5, 6) has redescribed and illustrated the type species of *Geragnostus*, *G. sidenbladhi* (Linnarsson) from the late Tremadoc Series of Sweden. The specimens from Newfoundland are congeneric but as far as can be judged differ in having a slightly broader glabella, the sides of which are more convergent forwards, and the median tubercle and transverse furrow is set a little farther back. They may perhaps, be better compared with *Geragnostus clusus* Whittington (1963, p. 28, Pl. 1, Figs. 1-17) from the late Arenig or early Llanvirn Series at Lower Head, western Newfoundland (*see* Whittington, 1963, p. 15 for discussion), but the material is inadequate for detailed assessment. However, *Geragnostus* is essentially a Lower Ordovician genus, known first from the Tremadoc Series and particularly abundant and widespread in rocks of Arenig age, but recorded as high as the Llandeilo Series in Bohemia and the Anglo-Welsh area (Whittard, 1955, p. 9; 1966, p. 265).

Of the harpid trilobite genera described in detail by Whittington (1950a *in* Moore, 1959, p. O 418), the genus most like the Newfoundland specimen is *Selenoharpes*. The type species, *S. youngi* (Reed), is from the Balclatchie Group, Caradoc Series in part, of the Girvan district, Scotland, but the genus has a long stratigraphical range, being known first from the Arenig Series of Sweden whilst Whittington (1963, p. 35) now regards *Aristoharpes*, the type and other species of which came from the Llandovery Series of the Anglo-Welsh area, as a subjective synonym. Among the distinguishing features of *Selenoharpes* originally listed by Whittington were: faint genal ridges; broad genal roll and brim; large, depressed alae. The last-named feature has to be modified slightly so as to accommodate *Aristoharpes*, which was stated to have small alae. Whittington (1950b, p. 303) redescribed *Selenoharpes excavatus* (Linnarsson), apparently the oldest-known species, from the *Megistaspis planilimbata* Zone of the Swedish Lower Arenig Series, and Tjernvik (1956, p. 268) recorded it from the succeeding *Megalaspides dalecarlicus* Zone. This species has the same type of glabella as the Newfoundland specimen, though it is probably relatively shorter, whilst the basal glabellar breadth is slightly greater, with larger basal lobes and alae. Although the state of the material from South Catcher Pond does not warrant detailed comparison, the shape and proportions of the glabella and the position of the eye tubercles bear a general resemblance to those of *Selenoharpes vitilis* Whittington and *S. fragilis* (Raymond), particularly the former; both these species are from boulders in the Cow Head Group of western Newfoundland (*see* Whittington, 1963, pp. 32, 35).

Ischyrophyma marmorea, easily the most common trilobite in the present sample, presents certain difficulties in its generic assignment, and differs in some respects from other members of the genus. The type species, *Ischyrophyma tuberculata* Whittington (1963, p. 48, Pl. 8, Figs. 1-10), from a boulder in the Lower Ordovician conglomerate at Lower Head, western Newfoundland, has well defined 1p glabellar lobes, the 2p glabellar furrows are only faint, 3p and 4p furrows are absent, and the glabella is of even breadth for the most part. On the other hand *Ischyrophyma tumida* Whittington (1966, p. 339, Pl. 19, Figs. 6-12, 15), from the Table Head Formation of western Newfoundland, has 2p and 3p glabellar furrows, and the 1p glabellar furrows are broad *exsag.*, becoming shallower near the axial furrows, so that a smooth, slightly swollen area links the 1p and 2p glabellar lobes (*see* especially Whittington, 1966, Pl. 19, Figs. 7, 9). The analogous structures in *I. marmorea* are more strongly developed and merge with the front of the 1p glabellar lobes to create the impression of unusually large basal glabellar lobes. In these respects *I. tumida* is perhaps closer to the new species than it is to the type species, but in both *I. tuberculata* and *I. tumida* the glabella is more strongly convex than in *I. marmorea*. As the last-named is represented by very much larger specimens, the significance of such a difference cannot be judged.

The trilobite described by Billings (1865a, p. 333, Fig. 321; 1865b, p. 333, Fig. 321) as *Harpides*? *desertus*, a determination repeated by Raymond (1937, p. 1081), is not a harpidid and may be synonymous with *Ischyrophyma marmorea*. Billings' species was founded on a single damaged cranidium, now refigured (Pl. I, Figs. 4, 8, 12). The glabellar outline, form of the 1p and 2p glabellar lobes and furrows, and the size of the anterior border are generally similar to those of *I. marmorea*, but the specimen is incomplete, abraded, and unsuitable for detailed comparison. Although Billings' original description of *Harpides*? *desertus* mentioned a median tubercle on the occipital ring, and this is shown on his drawing of the species, such a structure has not been found and the apparent excrescence on the holotype is due to a small fracture that affects also the adjacent part of the glabella. Billings' specific name was used later, as *Sphaerexochus desertus*, by Raymond (1925, pp. 151, 152) for certain cranidia from the Table Head Formation. Subsequently Whittington

(1966, p. 339) identified these specimens as *Ischyrophyma tumida* and noted that they differed from *Harpides? desertus*. The latter is now believed to be congeneric with *Ischyrophyma marmorea*, and may even be synonymous, but in view of the uncertainty noted above, it is proposed that the binomen *Ischyrophyma deserta* be restricted to the holotype, as it is unlikely that more material will become available. The holotype was stated to come from the "Quebec Group", on the "east side of the village of Bedford in the bed of Pike River" (Billings, 1865a, p. 334). However, as was demonstrated by Clark and McGerrigle (1927), Bedford stands on the outcrop of the Stanbridge Slates and Billings' specimen was probably in a loose rock fragment from either the Philipsburg Series (Lower Ordovician), which crops out a short distance south of Bedford, or the Mystic Conglomerate, which crops out to both south and northwest of the town.

The species most closely resembling *I. marmorea* was described originally as *Glaphurina? insolita* Tjernvik (1956, p. 265, Pl. 10, Figs. 20, 21) and came from the Arenig Series, *Megistaspis* (previously *Plesiomegalaspis*) *planilimbata* Zone, in south central Sweden. The difficulties of comparing *I. marmorea* in detail with the type species of *Ischyrophyma* apply also to the Swedish trilobite, but there can be little doubt that *G.? insolita* and the new species are congeneric. *Ischyrophyma insolita* differs from *I. marmorea* in the following respects: the glabella is slightly broader; the 1p glabellar lobes and the smooth, swollen areas representing the outer parts of the 2p glabellar furrow are better differentiated; the longitudinal furrows which delimit the adaxial sides of the 1p glabellar lobes and merge with the front of the 2p glabellar furrows are more divergent forwards; the surface of the cranidium is covered with coarser, more sparsely distributed tubercles. The anterior border of the Swedish species may be somewhat lower but comparison is difficult, as it is for the eyes, though the latter appear to be set a little farther forward. Only the cranidium of *Ischyrophyma insolita* is known, so it is not possible to compare the hypostoma attributed here to *I. marmorea*, though one may note its general resemblance to that of *Celmus granulatus* Angelin (*see* Jaanusson, 1956) from the Expansus Limestone, Arenig Series, of Sweden. Whittington (1963, p. 49) noted only small differences between *Celmus* and *Ischyrophyma*, but pointed out that the pygidium of *Celmus* is quite unlike that of *Ischyrotoma*. It is also unlike the pygidium attributed here to *Ischyrophyma marmorea*. Jaanusson (1956) discussed the affinities of *Celmus* with reference to the Glaphuridae and other trilobite families, and concluded that the differences were so marked as to justify the erection of a new family Celmidae. He pointed out that *Glaphurus* has a levisellid facial suture and bicomposite basal glabellar lobes, and considered that *Glaphurina* (Ulrich, 1930, p. 44; Shaw, 1968, p. 28), generally regarded as related, was only superficially similar. *Glaphurina*, in which genus Tjernvik questionably placed *I. insolita*, resembles *Ischyrophyma* in having a raised anterior border, and the 1p and 2p glabellar lobes are confluent. However, compared with *Ischyrophyma insolita* and *I. marmorea*, in *Glaphurina* the 2p glabellar lobes are much larger; the 2p glabellar furrows are represented only by a pair of pits that do not reach the axial furrows; the elongated furrows on the adaxial sides of the 1p and 2p glabellar lobes are shorter and concave abaxially instead of adaxially; the anterior border is smaller, narrower *sag.*, and closer to the glabella; the lateral border furrow is narrower and deeper; the ornamentation of fine granules and paired larger tubercles is quite distinct. In addition the anterior branches of the facial suture are possibly more divergent forwards, but they are difficult to compare in the distorted material from Newfoundland. According to Tjernvik (1956, p. 185) the *Megistaspis planilimbata* Zone, from which *I. insolita* derives, is the lowest zone but one of the Arenig Series in Sweden, separated from the Tremadoc Series by only the *Megistaspis armata* Zone. On the basis of the affinities of *I. marmorea* the material from the vicinity of Catcher Pond is likely, therefore, to be of Lower Arenig age, and this would not contradict the evidence of the other trilobites present.

Both *Geragnostus* and *Selenoharpes*? are somewhat inconclusive age indicators though they tend to suggest Lower Ordovician rather than later strata. Likewise *Leiostegium*, a Lower Ordovician genus recorded from Zone D (using the terminology of Ross, 1951) in the subsurface rocks of Montana (Lochman, 1965, pp. 478-480) but extending somewhat higher, into Zone F, in the Nevada-Utah region (Berg and Ross, 1959, pp. 113, 114). In western Newfoundland *Leiostegium* has been reported from boulders of Canadian, Gasconadian (see below), age in the Cow Head Group by Whittington (1968).

In North America the Canadian Series is generally regarded as being equivalent to the whole of the Arenig Series plus the Upper Tremadoc Series. Flower (1957, p. 18; 1964, p. 17) proposed the following four Stages as faunally-based subdivisions of the Canadian: Gasconadian (for the previously-used term Lower Canadian), Demingian (for Middle Canadian), and Jeffersonian and Cassinian (for Upper Canadian). Whittington (1968, p. 50) interpreted the Tremadoc Series as including the Gasconadian and most of the Demingian, and equated Zones D-F (the recorded vertical range of *Leiostegium*) of Nevada and Utah with the Demingian and part of the Gasconadian, that is, with strata that are essentially of Tremadoc age. In the same paper he drew the Arenig-Llanvirn boundary between the Cassinian and Whiterock Stages, but gave no precise line of demarcation between the Extensus and Hirundo Zones of the Arenig Series in terms of North American Stages, though the Hirundo Zone was equated broadly with the higher two-thirds or so of the Cassinian. The evidence, discussed above, for the Lower Arenig age of some of the trilobites from South Catcher Pond would thus be more in keeping with a Jeffersonian horizon as interpreted by Whittington, and it may be more than coincidence that he (1968, p. 50) has recorded from Jeffersonian boulders in the Cow Head Group of western Newfoundland a trilobite assemblage that includes, *inter al.*, *Geragnostus*, *Selenoharpes* and "cf. *Glaphurina*". One must note, however, that the same account records the first two genera also from boulders of Whiterock age in that area, and *Leiostegium* from Gasconadian boulders.

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PLATE I

Geragnostus sp.

Figure 1. Dorsal view of exfoliated cranidium, GSC 26245; X 10. GSC Loc. 42437.

Ischyrophyma marmorea sp. nov.

Figures 2, 11, 13. Anterior, left lateral and dorsal views of incomplete cranidium. Holotype, GSC 26246; X 2.5. GSC Loc. 42437.

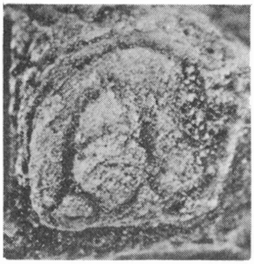
Figures 3, 7, 9. Anterior, plan and left lateral views of large cranidium lacking anterior border. Paratype, GSC 26247; X 2. GSC Loc. 41375.

Ischyrophyma deserta (Billings)

Figures 4, 8, 12. Left lateral, plan and anterior views of incomplete holotype cranidium, figured by Billings, 1865a, p. 333, Fig. 321. From the "Quebec Group", bed of Pike River, east side of Bedford, Quebec. GSC 873; X 2.5.

Selenoharpes? sp.

Figures 5, 6, 10. Plan, right lateral and anterior views of fragmentary internal mould of cranidium. GSC 26248; X 7. GSC Loc. 42437.



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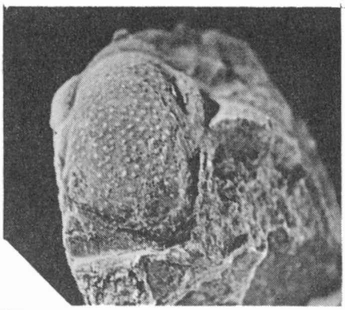

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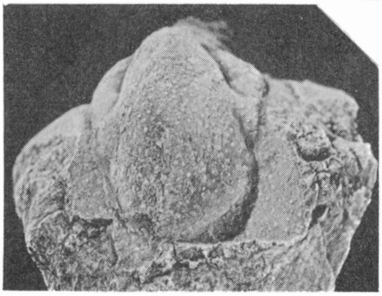

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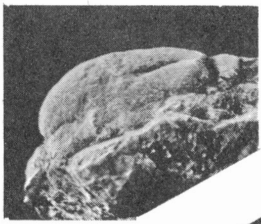

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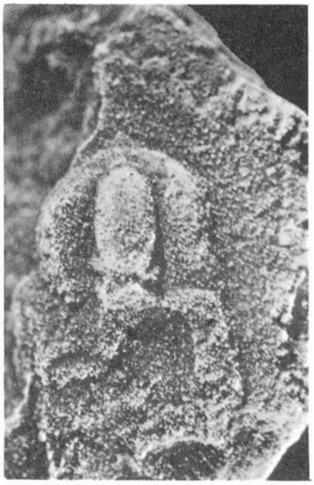

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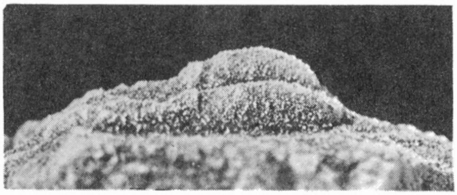

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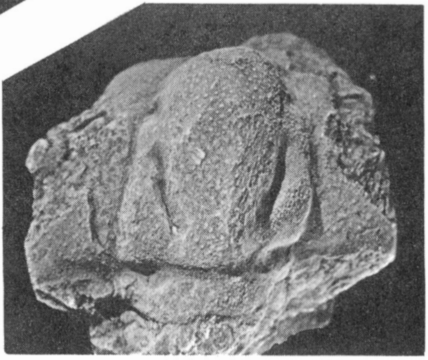

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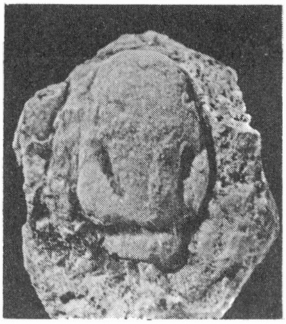

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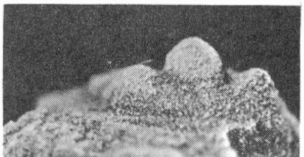

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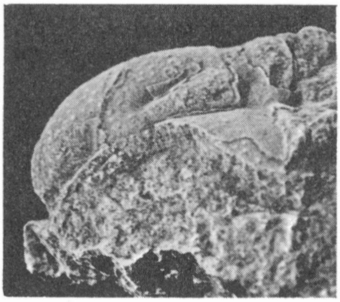

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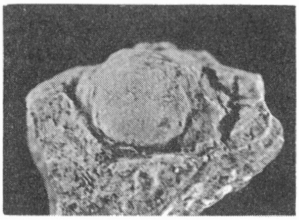

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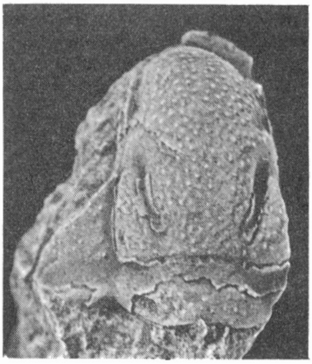

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PLATE II

All specimens from GSC Loc. 42437

Ischyrophyma marmorea sp. nov.

Figure 1. Incomplete thoracic segment. Paratype, GSC 26249; X 2.5.

Figure 2. Plan view of slightly distorted pygidium. Paratype, GSC 26250; X 2.5.

Figure 3. Anterior view of distorted cranidium to show anterior border. Paratype, GSC 26251; X 2.

Figure 5. Incomplete right librigena. Paratype, GSC 26253; X 2.5.

Figure 7. Plan view of small cranidium. Paratype, GSC 26254; X 6.

Figure 9. Plan view of fragmentary cranidium to show 1p and 2p lateral glabellar lobes. Paratype, GSC 26256; X 2.

Figures 10, 13. Dorsal views of hypostoma. Fig. 10, internal mould. Fig. 13, latex cast of fragment of external mould to show part of posterior margin. Paratype, GSC 26257; X 5.

Figure 12. Exfoliated incomplete cranidium showing part of anterior border and course of facial suture. Paratype, GSC 26258; X 2.5.

Leiostegium sp.

Figures 4, 6, 11. Left lateral, anterior and plan views of small, incomplete cranidium. GSC 26252; X 6.

Figure 8. Plan view of small exfoliated cranidium. GSC 26255; X 8.

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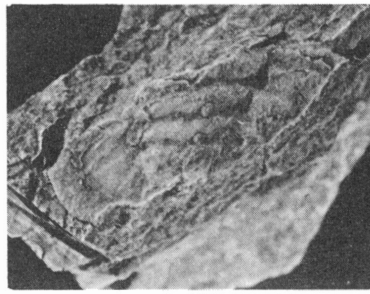

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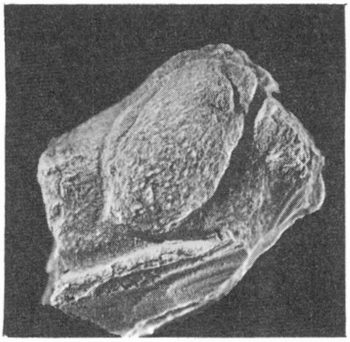

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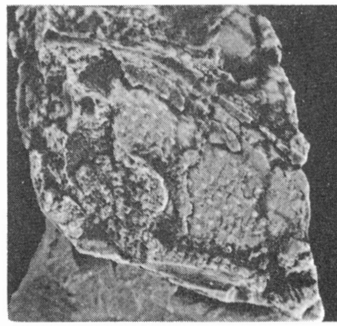

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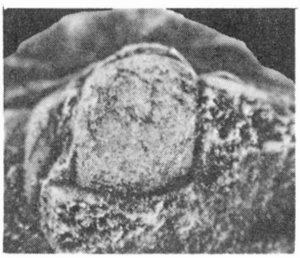

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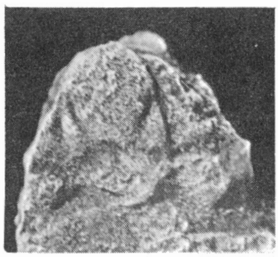

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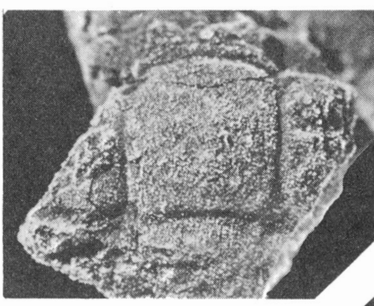

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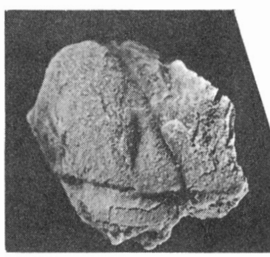

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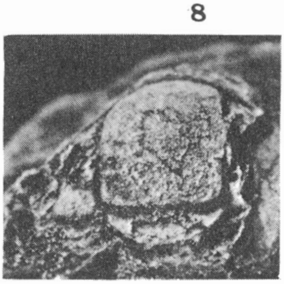

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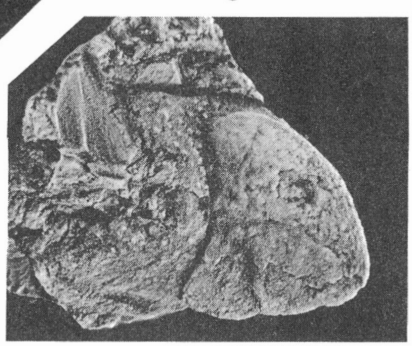

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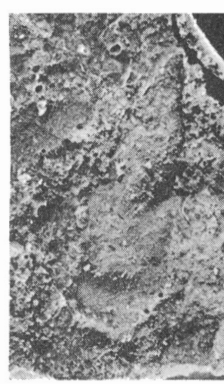

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