GEOLOGICAL SURVEY OF CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

BULLETIN 60

# CANADIAN FOSSIL ARTHROPODA EURYPTERIDA, PHYLLOCARIDA AND DECAPODA

M. J. Copeland and Thomas E. Bolton

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# AND DECAPODA

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By
M. J. Copeland and Thomas E. Bolton

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# PREFACE

The four papers comprising this bulletin describe the occurrence and stratigraphic positions of several Palæozoic and Lower Mesozoic Arthropoda (Eurypterida, Phyllocarida and Decapoda) from widely scattered areas of Canada. The first paper records the occurrence of two phyllocarid genera of Upper Devonian and Lower Mississippian age from Western Canada. Species of these two genera may be used in local correlation.

The second paper contains a detailed stratigraphic and bibliographic account of the Eurypterida of Canada. All known Canadian occurrences of this group are recorded and several new occurrences are reported. The presence, in Upper Silurian strata of Cornwallis Island, of the typical north European *Eurypterus fischeri* fauna serves to extend the already wide geographical distribution of this circumpolar fauna.

The third paper describes three Upper Silurian and Middle Devonian phyllocarids from the Arctic. The similarity of these species to previously described European forms is clearly indicated.

The last paper records the occurrence of a new species of Mesozoic decapod from Borden Island. This is the first record of Jurassic Decapoda from the Arctic region.

J. M. HARRISON,
*Director, Geological Survey of Canada*

OTTAWA, September 3, 1959

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# CANADIAN FOSSIL ARTHROPODA EURYPTERIDA, PHYLLOCARIDA AND DECAPODA


## *Abstract*

Analysis of several relatively small but distinctive Palæozoic and Lower Mesozoic arthropod faunas from widely scattered areas in Canada has revealed numerous well-preserved specimens of Eurypterida, Phyllocarida and Decapoda. In all, twenty-four species are discussed, of which seven are new and twelve were previously unrecorded from Canada. Some general comments are made concerning the stratigraphic and geographic distribution of the Arthropoda, and a bibliographic index to Canadian Eurypterida is appended.

## *Résumé*

L'analyse de plusieurs représentants relativement petits de faunes d'arthopodes, dont l'origine remonte certainement au Paléozoïque et au Mésozoïque inférieur, recueillis dans des endroits disséminés au pays, a révélé la présence d'un bon nombre de spécimens d'Euryptéridés, de Phyllocarides et de Décapodes en parfait état de conservation. Au total, vingt-quatre espèces ont été étudiées, dont sept sont nouvelles et douze n'avaient pas encore été identifiées au Canada. Les auteurs formulent des observations d'ordre général sur la répartition stratigraphique et géographique des arthopodes et annexent à leur étude un index bibliographique des Euryptéridés canadiens.

# THE OCCURRENCE OF *ECHINOCARIS* AND *SPATHIOCARIS* (PHYLLOCARIDA) IN WESTERN CANADA

*M. J. Copeland*

## Introduction

Examination of strata of Upper Devonian and Lower Mississippian? age in Western Canada has revealed the presence of specimens of the arthropod genera *Echinocaris* and *Spathiocaris*. These genera are widespread in strata of Upper Devonian age throughout the Northern Hemisphere but are rare. Four species each of *Echinocaris* and *Spathiocaris* (a questionable arthropod) are reported, two of them being assigned to new species.

The author is grateful to Dr. C. H. Crickmay and the management of Imperial Oil Limited, Calgary, Alberta, for the gift of several specimens of *Spathiocaris* from their collections for study purposes. All other specimens are from the collections of the Geological Survey of Canada.

All specimens are catalogued and deposited in the type collection of the Survey.

## Localities

Upper Devonian

Lower Upper Devonian black shales

28319[1] Central Leduc Toad River No. 1 well, British Columbia, 59°21′N lat., 124°59′W long., depth 5,189 feet.

28320 Central Leduc Toad River No. 1 well, depth 5,177-5,178 feet.

32529 Central Leduc Toad River No. 1 well, depth 5,165-5,170 feet.

Duvernay formation

26850 Imperial Westlock No. 14-24 well (14-24-59-26-W4), Alberta, depth 5,095 feet.

33732 Imperial Paddle River No. 1 well (5-17-56-8-W5), Alberta, depth 7,730-7,743 feet (Imp. Oil No. 646).

Alexo formation

19606 "Beaver Ridge", approximately 15 miles east of Jasper, Alberta, 52°50′N lat., 117°45′W long., talus.

[1] Geological Survey of Canada Locality Catalogue number.

19610 "Beaver Ridge", Alberta, about 385 feet above base of Alexo (unit 41, McLaren, 1955, p. 47).

19637 "Beaver Ridge", Alberta, talus.

Mississippian

Banff? formation

24572 Imperial Zama Lake well (15-22-115-10-W6), Alberta, depth 1,355 feet.

## Stratigraphic Position

Specimens of *Echinocaris castorensis* and *E. consanguina* from "Beaver Ridge", were found associated with the Alexo zone brachiopods *Cyrtospirifer* cf. *C. portae* Merriam and *Nudirostra walcotti* (Merriam) (*see* McLaren, 1955, pp. 47, 48)[1]. The *Echinocaris* telson obtained from Imperial Westlock No. 14-24 well at 5,095 feet was closely associated with *Nudirostra insculpta* McLaren, a brachiopod characteristic of the Duvernay-Perdrix formation, occurring at 5,090 feet. No diagnostic fossils were found with the phyllocarids at the other localities and little stratigraphic information is available in the case of the Imperial Zama Lake well.

| System | Formation | Brachiopod zones | *Echinocaris* species (this paper) |
|---|---|---|---|
| Mississippian | Banff? | | *E. beecheri* n. sp. |
| Devonian (Upper) | Palliser | *Nudirostra seversoni* | |
| | Alexo | *Nudirostra walcotti* | *E. consanguina* Eller<br>*E. castorensis* n. sp. |
| | Mt. Hawk | *Nudirostra albertensis* | |
| | Perdrix (Duvernay in subsurface) | *Nudirostra insculpta* | *Echinocaris* sp. |
| | Flume (Upper) | *Nudirostra athabascensis* | |

The preceding table shows the generalized stratigraphic sequence in western Alberta, the zone brachiopods and the associated species of *Echinocaris*. The table is intended to indicate general superposition of beds rather than a detailed stratigraphic section.

[1] Names and/or dates in parentheses are those of references cited at the end of each paper.

## Systematic Palaeontology

### Genus *Echinocaris* Whitfield 1880

*Type species: E. sublevis* Whitfield 1880

Several species of *Echinocaris* have been described from strata of Devonian and Lower Carboniferous age in eastern North America. These species are listed below:

| | Devonian | | | Carboniferous |
|---|---|---|---|---|
| | Hamilton | Portage | Chemung | "Waverly" |
| *Echinocaris* sp. (teeth) | X | | | |
| *E. punctata* (Hall) 1863 | X | | | |
| *"E" wrightiana* (Dawson) 1881[1] | | X | | |
| *E. pustulosa* Whitfield 1880 | | X | X | |
| *E. sublevis* Whitfield 1880 | | X | X | |
| *E. multinodosa* Whitfield 1880 | | X | X | |
| *E. socialis* Beecher 1884 | | | X | |
| *E. condylepis* Hall and Clarke 1888 | | | X | |
| *E. consanguina* Eller 1935 | | | X | |
| *E. turgida* Eller 1935 | | | X | |
| *E. auricula* Eller 1935 | | | X | |
| *E. crosbyensis* Eller 1937 | | | X | |
| *E. randalli* Beecher 1902 | | | | X |
| *E. clarkei* Beecher 1902 | | | | X |

Numerous references to these species are listed in Van Straelen and Schmitz (1934, pp. 88ff). McLaren (1955, p. 47) was apparently the first to report the occurrence of species of this genus in Western Canada. Specimens collected by him from strata of Upper Devonian age near Beaver Lake are *Echinocaris consanguina* Eller and *Echinocaris castorensis* n. sp. More recently other specimens of this genus have been obtained from drill cores of Upper Devonian and Mississippian? age from western Alberta. These are *Echinocaris* sp. (telson) and *Echinocaris beecheri* n. sp. In all, four species of *Echinocaris,* two of which are new, are reported from Western Canada for the first time.

[1] *Stylonurus* (?) *wrightianus* (Dawson) of Clarke and Ruedemann, 1912, N.Y. State Mus., Mem. 14, p. 89.

*Echinocaris castorensis* n. sp.

Plate I, Nos. 1-5; Figure 1

*Description.* Species known from four carapaces and one telson. Valves auriculate, each with a distinct marginal ridge, hinge less than half as long as carapace, greatest length median, greatest height posterior. Antero-dorsal area bearing six nodes in two rows of three. Dorsal row near hinge, each node bearing a tubercle, anterior node circular, median node small and indistinct, posterior node ovate and oblique. Ventral row of nodes arcuate, concave ventrally, anterior ventral node large, indistinct, with a dorsal tubercle, median node small, circular, bearing a tubercle, posterior node elongate, oblique, apparently without a tubercle. Posterior lobe of carapace bounded above and below by carinae and bearing a short indistinct antero-median carina. Ventral carina sigmoidal, tuberculate at posterior end, extending two thirds of the length of the carapace, bounding the ventral side of the posterior lobe and the ventral posterior node and ending ventral to the anterior node. Median carina short, indistinct, extending parallel to the hinge and consisting of several tubercles, situated on the anterior median slope of the posterior lobe. Dorsal carina also parallel to hinge, bearing five or six tubercles and joined to posterior dorsal marginal ridge on median postero-dorsal slope. The ventral and dorsal carinae appear as furrows on the interior impressions of this species (Pl. I, Nos. 1, 2). Marginal ridge complete along free margin of valve, broadest posteriorly and bearing six small posterior spines evenly spaced from the base of the dorsal carina to the median posterior margin. Two small, apparently hooklike, appendages present on one specimen (Pl. I, No. 2) projecting from the antero-dorsal corner of each valve, each appendage broadest at the base (1.25 mm), tapering distally to a hook curved inwards towards the median line. These structures were interpreted as mandibles by Beecher (1902).

Abdominal segments of this species unknown.

Telson 4 mm wide at the anterior end, 10 mm long, cercopods 1 mm wide at juncture with the telsonal plate and 15 mm long with a slight distal inward curvature. Both telson and cercopods ridged medially.

*Remarks.* The carapace of this species appears somewhat similar to *E. auricula* Eller 1935. *E. castorensis* n. sp. bears a short median carina, a small median dorsal node, no tubercle(s) on the ventral posterior node and has an ovate anterior margin (except for No. 3). *E. auricula* shows a longer median carina, a larger median dorsal node, tubercles on the ventral posterior node and a quadrate anterior margin.

*Occurrence.* Alexo formation, Upper Devonian, "Beaver Ridge", Alberta, 52°50′N lat., 117°45′W long., from talus at the foot of the ridge. Collected by D. J. McLaren, 1951.

*Types.* Holotype, GSC No. 13782; paratypes, GSC Nos. 13778, 13779, 13780, 13781.

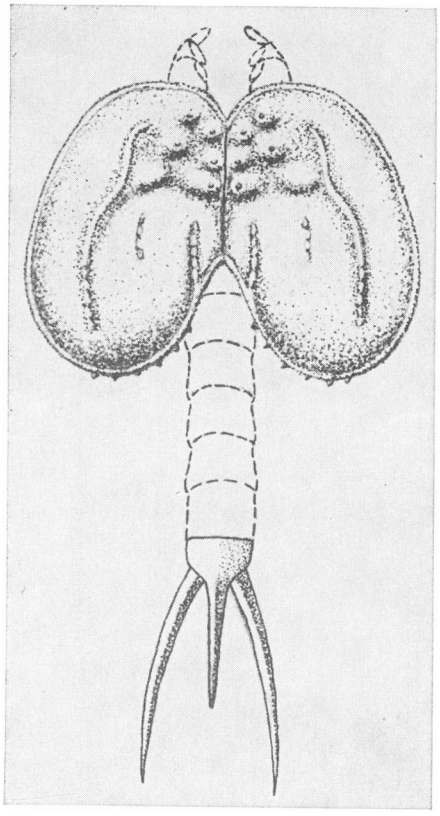

Figure 1. *Echinocaris castorensis* n. sp. Reconstruction X2.

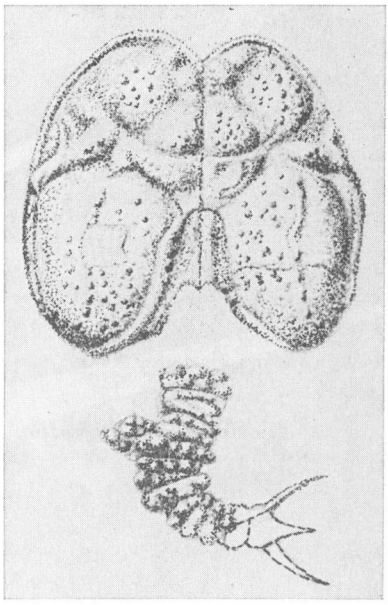

Figure 2. *Echinocaris beecheri* n. sp. Reconstruction X1½.

*Echinocaris consanguina* Eller 1935

Plate I, Nos. 6, a

*E. consanguina* Eller 1935, p. 268, pl. 3, figs. 1-4.

*Description.* The most prominent features of this species are as follows: carapace semi-ovate, marginal ridge broad, greatest height slightly posterior of median, greatest length median. Anterior dorsal area bearing six nodes aligned in two rows, each node bearing one or more tubercles. Dorsal row of three nodes near hingeline, anterior and median nodes small, posterior node large and triangular. Ventral row of nodes arcuate, concave ventrally, anterior node broad with indistinct tubercle, second node small, with a prominent tubercle, posterior node elongate, oblique, with two (?) small tubercles on the dorsal margin. Posterior dorsal lobe prominent, ovate, pustulose, bordered ventrally by the ventral carina. Carina slightly sinuate, concave on ventral side of posterior lobe, abutting the posterior ventral node and ending ventrally and slightly anteriorly to the median ventral node.

79803-3—2½

*Remarks.* This species is only distinguished with difficulty from *E. condylepis* Hall and Clarke 1888. The latter species, according to Hall and Clarke (1888, p. 174) bears an "obscure node extending obliquely backward" in the position of the posterior ventral node. No mention was made of this node being tuberculate as it is in *E. consanguina.* Also the anterior ventral node of *E. condylepis* is small and distinct whereas that of *E. consanguina* is large and flattened. Whether these minor morphological differences are sufficient for specific differentiation cannot be determined without an examination of both type specimens.

*Occurrence.* Alexo formation, Upper Devonian, "Beaver Ridge", Alberta, 52°50′N lat., 117°45′W long., from unit 41 (*see* McLaren, 1955, p. 47). Collected by D. J. McLaren, 1951.

*Type.* Hypotype, GSC No. 13783.

*Echinocaris* sp. (telson)

Plate I, No. 7

*Description.* One specimen has been found which cannot with certainty be assigned to any presently known species of *Echinocaris.* This specimen shows the dorsal impression of two posterior segments, the telson and cercopods. Abdominal segments straight sided, ridged posteriorly, posterior segment measuring 3.5 mm in width and 5.5 mm in length. Telson about 3 mm wide at the anterior, tapering distally, with a total length of 12.5 mm. The telsonal spine bears four or five pairs of minute spines on its lateral margins. These are concentrated on the anterior two thirds of its length, the posterior third of the telson having a serrated margin. Cercopods 1 mm in greatest width, 13 mm in length, tapering distally. The telson and cercopods strongly ridged medially.

*Occurrence.* Duvernay formation, Upper Devonian, Imperial Westlock No. 14-24 well (14-24-59-26-W4), Alberta, depth 5,095 feet. Collected by H. R. Belyea, 1955.

*Type.* Hypotype, GSC No. 13784.

*Echinocaris beecheri* n. sp.

Plate I, No. 8; Figure 2

*Description.* Valves subquadrate in outline, 31 mm in greatest length, approximately 15 mm in width. Hingeline 23 mm long. Anterior dorsal part of valves divided into six pustulose nodes aligned in two rows. Dorsal row parallel to hinge consisting of three nodes, anterior node small, circular; median node large, ovate-triangular, nearly equal-sided; posterior node broad, triangular, anterior edge making approximately a right angle with the hingeline. Ventral row of nodes inclined at about 40 degrees to the hinge, consisting of a small anterior node closely associated with the dorsal anterior node; a very broad, nearly square median lobe, one corner of which is inserted between the anterior and median dorsal lobes; and

a narrow, oblique posterior lobe contiguous posteriorly with the sinuous curve of the ventral carina.

Posterior lobe broadly rounded, pustulose, bearing three carinae. Dorsal carina consisting of six (?) tubercles joined posteriorly to the dorsal posterior marginal ridge. Ventral carina originating obscurely at the posterior ventral margin of the median ventral node, meeting the ventral margin of the posterior ventral node and passing posteriorly along the ventral shoulder of the posterior lobe as a tuberculate ridge. This carina extending parallel to the posterior carapace margin as a line of disconnected tubercles and bending anteriorly, parallel to the hinge, passing as a tuberculated ridge over the central part of the posterior lobe in the position of the median carina.

Marginal ridge continuous along the free margin with several small spines on the posterior edge. Six abdominal segments present, each bearing on the dorsal side two rows of large tubercles (four or more) parallel to the posterior margin. Telson unknown.

*Remarks.* This species somewhat resembles *E. whidbornei* Jones and Woodward 1889 as figured by those authors in 1899. The pustulose nature of the entire carapace of *E. beecheri,* the double row of tubercles on each abdominal segment and the continuity of the ventral and median carinae exclude the present specimen from *E. whidbornei. E. socialis* Beecher 1884 exhibits a nearly continuous ventral and median carina similar to *E. beecheri* but lacks the overall pustulose nature of the carapace and is much smaller. *E. randalli* Beecher 1902 is distinguished from the present species by its much smaller size and the lack of a dorsal carina on the posterior lobe.

*Occurrence.* Mississippian, Banff? formation, Imperial Zama Lake well (15-22-115-10-W6), Alberta, depth 1,355 feet. Collected by H. R. Belyea.

*Type.* Holotype, GSC No. 13785.

## Genus *Spathiocaris* Clarke 1882

*Cardiocaris* Woodward 1882 (part)

The systematic position of this genus has been repeatedly questioned by numerous workers. Clarke (1882), Woodward (1882) and Jones (1883) placed this genus within the Arthropoda, describing the shield-shaped specimens as phyllopod carapaces. Dames (1884) and others have referred this genus to the Ammonoidea as comprising a heterogeneous assemblage of goniatite anaptychi. A full discussion of these viewpoints is presented in Jones and Woodward (1892, p. 94), Clarke (1902) and Ruedemann (1916). The most recent discussion of this genus is by Matern (1931) who examined specimens of *Spathiocaris* and *Cardiocaris* from within the living chambers of the goniatites *Crickites* and *Manticoceras* indicating their possible relationships as anaptychi of these genera. This view has found general acceptance but, due to the lack of conclusive proof, species of *Spathiocaris* have been retained in most textbooks as questionable arthropods.

Mississippian spathiocarids have previously been reported from western North America in strata of the Woodford formation of Oklahoma (Cooper, 1932, pp. 346-352) and basal Banff (?) strata near Stettler, Alberta (Raasch, 1956, p. 113; Harker and Raasch, 1958, p. 228). Drill cores from the Upper Devonian Duvernay beds of central Alberta and unnamed black shales in northeastern British Columbia also have yielded many specimens of spathiocarid shields to the exclusion of all other fossil genera. No more detailed information has been obtained as to their systematic position, but the discovery of a disarticulated arthropod telson in these strata together with *Spathiocaris* shields may serve to indicate a possible arthropod affinity for at least some of the species that have been assigned to this genus. Examination of the strata containing these specimens indicates:

1. No ammonite or other cephalopod fragments are present.
2. A disarticulated part of an undoubted arthropod is present in strata containing spathiocarid shields.
3. The shields themselves apparently do not preclude either ammonite or arthropod affinities.

It is felt that no further information would be gained by redescribing species of *Spathiocaris* already published, two of these species are, however, re-figured on the accompanying plate. Specimens of this genus have previously been described with the notched area of the shield in an anterior position, the sides of the notch corresponding to the supposed cervical furrow. During the present study no evidence has been found to support this orientation. It appears more probable that the ovate part of the shield should be referred to as anterior, the posterior notched area serving as accommodation for the moveable parts of the posterior segments. The specimens figured on the accompanying plate are, therefore, oriented with the anterior end, as here described, directed towards the top.

*Spathiocaris* cf. *S. lata* (Woodward) 1882 (Pl. I, Nos. 9, 11, 12) is the most common species in these Upper Devonian black shales and Duvernay beds and represents about 80% of the observed specimens. *Spathiocaris* cf. *S. bipartita* (Woodward) 1882 (Pl. I, Nos. 10, 13) is found scattered throughout these beds where the Duvernay has been intersected in drill cores but, unlike *S.* cf. *S. lata,* has not been found in abundance at any one locality. *S. emersoni* Clarke 1882 (unfigured) is of rarer occurrence. A table showing some of the measurable characteristics of these specimens is as follows:

| | l/w | Notch angle | Angle of Median "Zone of flexure" |
|---|---|---|---|
| *S.* cf. *S. lata* | 1.1–1.2 | 80–90° | 10–15° |
| *S.* cf. *S. bipartita* | 1.6–1.7 | 70° | 20° |
| *S. emersoni* | variable (0.6–1.5) | variable (30–120°) | present? |

Examination of the shields of these various species has failed to yield information concerning their possible origin. Thin sections reveal them to be preserved as questionable pyritic films in most instances, however, some less compressed specimens (Pl. I, Nos. 10, 12, 13) exhibit a black substance with a glassy lustre, the composition of which has not been determined. X-ray analysis reveals only the composition of the associated rock, the shields being too thin and filmlike to give a discernible X-ray figure.

One specimen, *Spathiocaris* ? sp. (telson) is described in detail. The generic assignment of this specimen to *Spathiocaris* is questionable as it is assumed only on the basis of its association with *Spathiocaris* shields in the same strata. No previous description is available of the abdominal or post-abdominal segments of this possible arthropod genus, this specimen representing the only undoubted arthropod characteristics yet known. Should *Spathiocaris* (s.s.) be definitely proved to have ammonite affinities this specimen would necessarily be excluded from the genus though probably retained within the Phyllocarida.

*Spathiocaris* ? sp. (telson)

Plate I, No. 14

*Description.* Species described from one specimen showing the ventral aspect of the last abdominal segment, telson and cercopods. Abdominal segment nearly square, preserved in outline, about 3.5 mm wide, apparently with a convex posterior margin. Telson lanceolate, 12 mm in length, 3.5 mm in width at the anterior margin and tapering posteriorly. The telsonal plate bears several pairs (three or more) of spines up to 2 mm in length, set into sockets along the lateral margins. These spines may have been movable, with "ball and socket" points of articulation. Cercopods slightly more than 13 mm in length, 2 mm in width at their points of articulation on the ventral side of the telson. Articulation of the cercopods apparently by means of "ball and socket" joints similar to the telsonal spines. The entire specimen preserved as a glossy film or smear.

*Remarks.* The specimen is questionably assigned to this genus as it is fragmental and does not have the distinctive anterior parts preserved. It is, however, preserved in strata containing shields of *S.* cf. *S. lata, S.* cf *S. bipartita,* and *S. emersoni.* Whether the present specimen represents the telsonal segments of any of these species cannot be ascertained as no telson of any species of this genus has previously been described.

*Occurrence.* Upper Devonian black shales, Central Leduc Toad River No. 1 well, 59°21′N lat., 124°59′W long., British Columbia, depth 5,165-5,170 feet. Collected by H. R. Belyea, 1957.

*Type.* Hypotype, GSC No. 13791.

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# THE EURYPTERIDA OF CANADA

*M. J. Copeland and Thomas E. Bolton*

## Introduction

Among the rarest invertebrate fossils from Canadian Palæozoic rocks are the Eurypterida. Less than a score of species have been reported since W. E. Logan first recorded (1846) the occurrence of *Pterygotus problematicus* Agassiz from Devonian strata of the Gaspé peninsula. These species are distributed in rocks of Upper Ordovician to Upper Carboniferous age, with however, no true representative from the Lower Carboniferous (Table V). The purpose of this paper is to gather into one comprehensive publication new and previously described Canadian eurypterids together with their geographic and stratigraphic occurrences. To facilitate future investigations, a bibliographic list of all presently known Canadian Eurypterida is appended.

A reference work of this nature is desirable to record and tabulate information concerning new and previously known Canadian eurypterids and also, in a minor way, to augment as a Canadian appendix, the monographic study of New York Eurypterida by Clarke and Ruedemann (1912). No attempt has been made to give detailed redescriptions of all Canadian species; however, additional notes are presented for existing species wherever necessary together with descriptions of several new and previously unrecorded specimens.

## Acknowledgments

The authors wish to express their thanks to Dr. Irmgard Weihmann of the British American Oil Company Ltd., Calgary, Alberta, for the gift of specimens of *Angustidontus weihmannae* n. sp. from Gulf Sachs No. 10 well, Alberta; to Dr. G. Henningsmoen and the Palaeontological Institute, Oslo, Norway, for information concerning specimens of *Eurypterus fischeri* Eichwald; and to Dr. C. W. Stearn, McGill University, Montreal, for photographs of *Pterygotus canadensis* Dawson.

## Stratigraphy

The eurypterids contained in this study were obtained from localities in Eastern Canada and in the Canadian Arctic. No undoubted specimens have yet been reported from west of the Great Lakes, however, it is presumably only a matter of time until they are known from Palæozoic strata of Western Canada. The present study represents collections from three major geographic areas (*see* Figs. 3-6) and several isolated occurrences (localities 4-7, Fig. 3). These collections and the generalized stratigraphy of the areas concerned are discussed in the order listed on Figure 3.

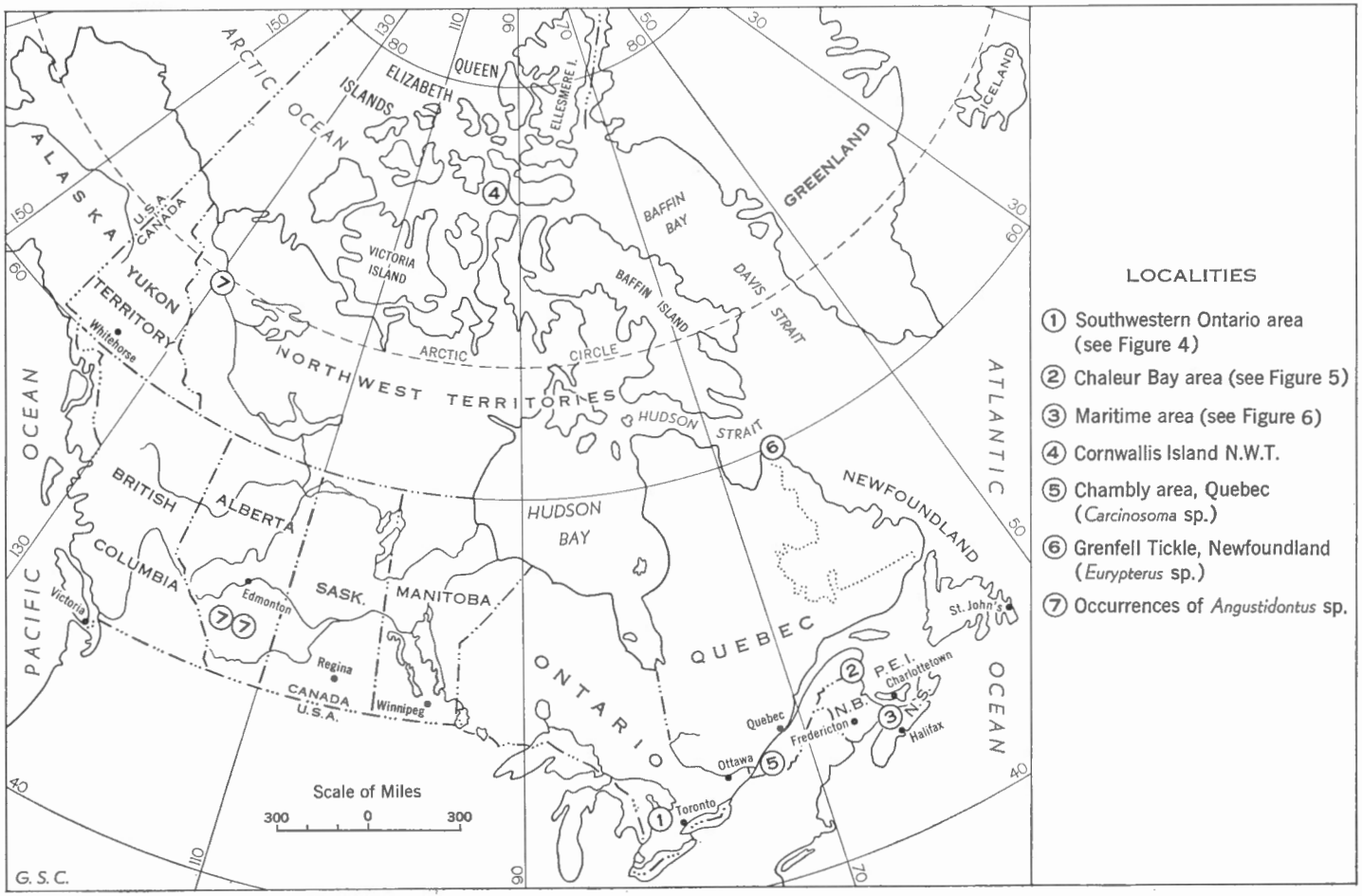



**Figure 3.** Map showing eurypterid localities.

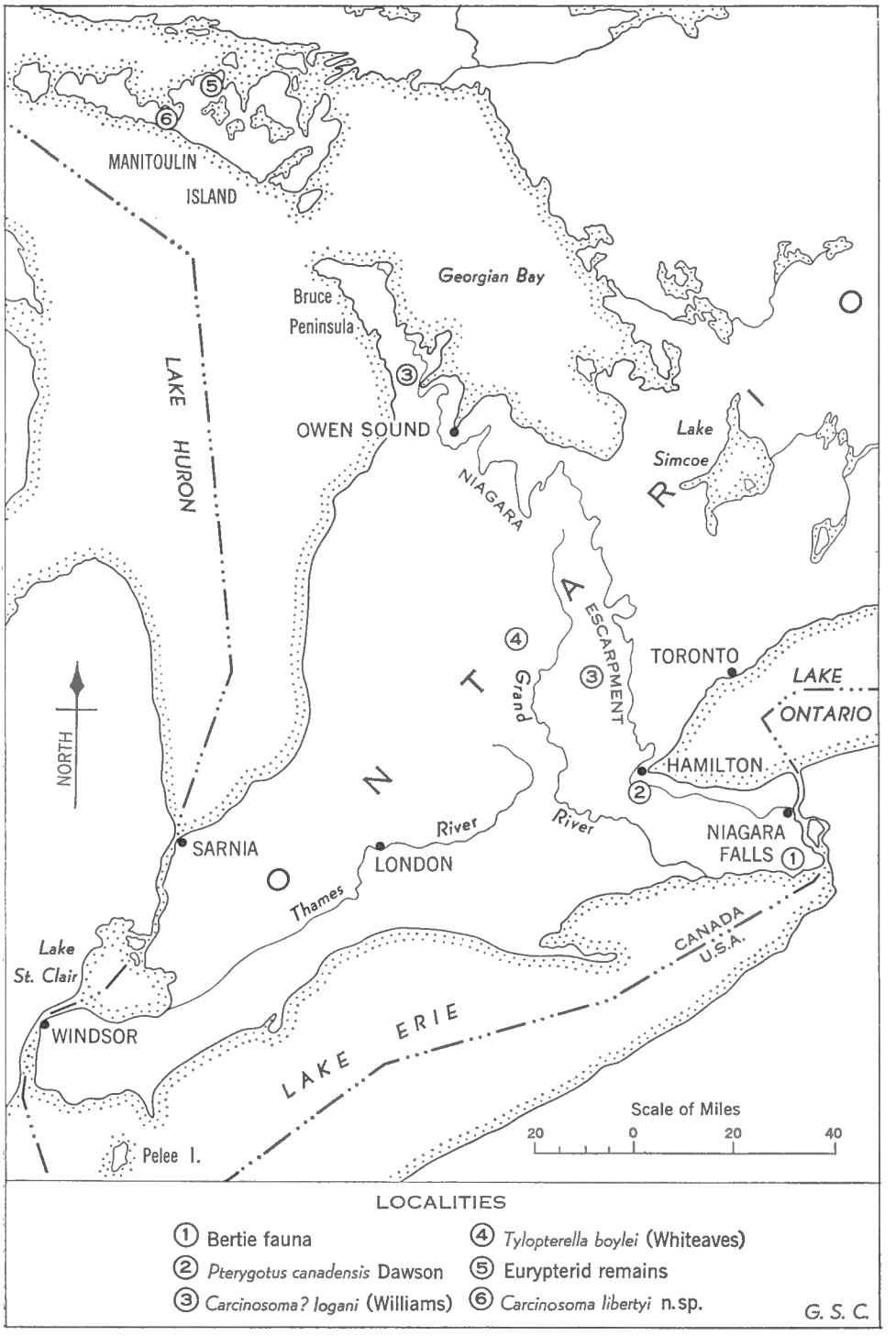
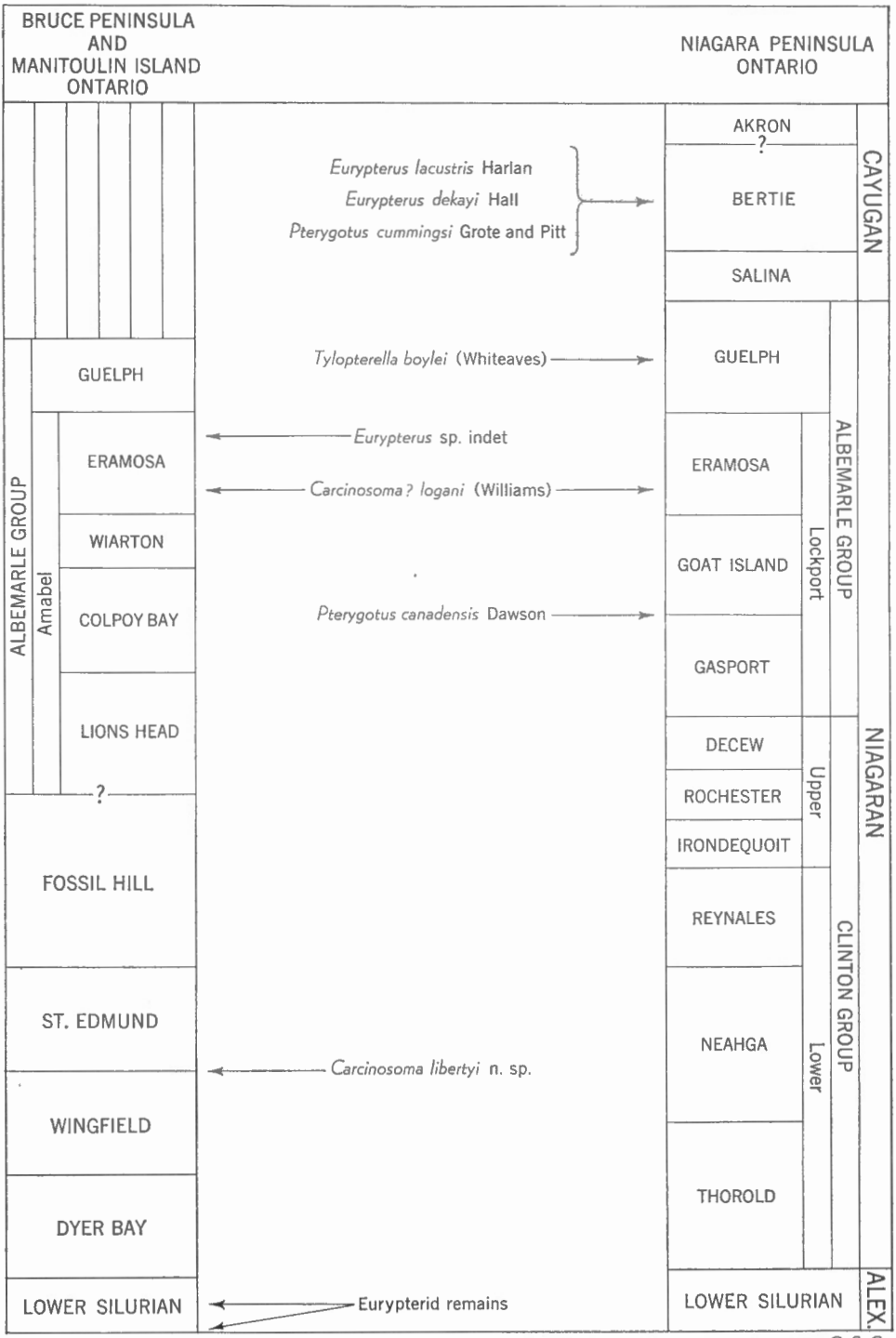



**Figure 4.** Eurypterid localities, southwestern Ontario.

## Table I

*Stratigraphic Distribution of Silurian Eurypterids, Southern Ontario*



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## Southwestern Ontario Area

(Figure 4, Table I)

The greatest number of well-preserved eurypterids from this area have been found in the Upper Silurian Bertie dolomite. In recent years, however, occasional specimens have been obtained from various localities in beds much lower in the Silurian sequence. The oldest fragments with eurypterid affinities are from a shaly dolomite bed near the Ordovician-Silurian contact exposed in a quarry off the main Gore Bay highway immediately west of Kagawong, Manitoulin Island (loc. 5, Fig. 4). The section at this locality is as follows (Liberty, personal communication; Bolton and Liberty, 1954, p. 29, *in part*):

| | Thickness |
|---|---|
| Lower Silurian Manitoulin formation | |
| 3. Thick- to thin-bedded, dark grey, fine-grained dolomite, weathering brown. *Palaeofavosites asper, Brockocystis tecumseth, Parmorthis eugeniensis, Stegerhynchus neglectum,* etc. | 22′ 0″ |
| 2. Thin-bedded, grey to green, finely granular argillaceous dolomite with eurypterid fragments | 0′ 6″ |
| Upper Ordovician Kagawong formation | |
| 1. Evenly bedded, bluish grey, crystalline dolomite with shale partings | 6′ 0″ |

With the exception of some "telsal spines? and appendage markings" (Way, 1936, p. 39) from the Manitoulin dolomite of Manitoulin Island, no other identifiable eurypterid remains have been reported from the Ontario Lower Silurian or the Middle Silurian Clinton strata of the Niagara peninsula. The known distribution of Middle Silurian eurypterids has been extended recently, however, with the discovery on Manitoulin Island of a well-preserved specimen of *Carcinosoma* (*C. libertyi* n. sp., p. 26, Pl. II, Nos. 1-4). This species was collected from the basal beds of the St. Edmund formation exposed west of Gore Bay village (loc. 6, Fig. 4). The Middle Silurian sequence in this region is as follows:

| | Thickness |
|---|---|
| Fossil Hill formation | |
| 5. Thin-bedded, brown, fine-grained to crystalline fossiliferous dolomite | 14′ 0″ |
| St. Edmund formation | |
| 4. Thin-bedded, brown, dense to semi-lithographic dolomite, white weathering, with more massive, brown, fine-grained dolomite interbeds containing *Clathrodictyon ostiolatum, Plectatrypa lowi,* and *Stegerhynchus* (?) *winiskensis* | 19′ 0″ |
| 3. Covered interval | 13′ 0″ |

| | Thickness |
|---|---|
| 2. Thinly laminated, fine-grained to crystalline, tan dolomite containing *Carcinosoma libertyi* and *Lingula* sp. in the uppermost foot | 4′ 0″ |
| St. Edmund and/or Wingfield formation | |
| 1. Covered interval | 20′ 0″ |
| Wingfield formation (not exposed) Greenish grey, dense dolomite, weathering brown. Grey and green, argillaceous dolomite with grey shale partings present elsewhere. Contains *Pterinea* cf. *undata, Bolbineossia punctata* ? and *Zygobolba williamsi.* | |

Eurypterid remains are more abundant in the late Middle Silurian strata of Ontario. Fragments of *Pterygotus canadensis* were collected from "the corporation quarry at Hamilton, in the lower cherty beds of the Niagara limestone" (Dawson, 1879, p. 104) associated with a large *Conularia* sp. and graptolites. At this locality (loc. 2, Fig. 4) the Ancaster chert beds form the basal unit of the Goat Island member of the Lockport formation (*see* Bolton, 1958, p. 49). Sponges, graptolites and brachiopods are abundant in these chert beds. The holotype, No. 1007, and paratype, No. 1008, of this species, as well as photographs of three additional specimens collected by Colonel Grant and labelled *Pterygotus canadensis* Dawson, were obtained from the Redpath Museum, Montreal, through the courtesy of Dr. C. W. Stearn, McGill University. All these fragments could be retained in the genus *Pterygotus* on the basis of their large size and semilunate scales.

Fragments of eurypterids are widely distributed in the Eramosa member of the Lockport formation (*see* Table I; loc. 3, Fig. 4). This member consists principally of thick- to thin-bedded, dark brown to black and grey, fine-grained bituminous dolomite and represents a transitional inter-reef facies deposited during late Lockport-Amabel and early Guelph sedimentation. Brachiopods and cephalopods are commonly associated with the eurypterid remains. *Eusarcus logani* was described by Williams (1915) from poorly preserved fragments (GSC syntypes Nos. 3759, a-f) collected south of Eramosa, Ontario. Somewhat similar fragments have since been discovered in the upper beds of the Eramosa member exposed west of Wiarton and near Sky Lake on the Bruce peninsula. It is difficult to determine to what genus of Eurypterida these fragments should be assigned; in the present paper the species *Eusarcus logani* is only questionably referred to the genus *Carcinosoma* (Table V). The presence of eurypterids in the Eramosa was verified recently by the discovery of a poorly preserved specimen of the genus *Eurypterus* in the bituminous beds underlying the Guelph dolomite at Cook's quarry west of Wiarton. This specimen, 7 inches in length, lacks only the telson and appendages. *Tylopterella boylei* (Whiteaves) (Pl. VI, No. 3), represented by one well-preserved specimen collected from the buff, porous Guelph

dolomite exposed at Elora, Ontario (loc. 4, Fig. 4), completes the Middle Silurian record of Eurypterida in Ontario.

The Upper Silurian Bertie eurypterid fauna of western New York and the adjacent part of Ontario has been the subject of numerous studies (Clarke and Ruedemann, 1912; O'Connell, 1916; Williams, 1919). The fauna figured in the present paper, collected from the grey, fine-grained, finely laminated Bertie dolomite exposed in Bertie township, Ontario, consists principally of *Eurypterus lacustris* Harlan[1] and one specimen of *E. dekayi* Hall. *Pterygotus cummingsi* Grote and Pitt is represented in the Geological Survey collection by one specimen from North Buffalo, New York. The Bertie eurypterids have been demonstrated by the several authors listed above as occurring in two separate geographic localities or "pools". This explanation was necessitated by the apparent lack of strictly comparable species between the "Buffalo" and "Herkimer" eurypterid faunules of New York State. Apparently minor morphological variations between comparable elements of both faunules have given rise to a multiplicity of specific names. Attempted explanation of this speciation has been given by Clarke and Ruedemann (1912, p. 92, footnote 1), O'Connell (1916, pp. 20, 21) and Caster and Kjellesvig-Waering (1956, pp. 19-21). The eurypterid fauna from Bertie township, Ontario, as stated by Clarke and Ruedemann, represents an extension of the "Buffalo pool", containing specimens of *E. lacustris* and *E. dekayi* to the exclusion of "Herkimer" species.

## Chaleur Bay Area

(Figure 5, Table II)

Eurypterids of Silurian and Devonian age occur in widely separated parts of the area (Fig. 5). Kindle (1934) obtained one specimen that he identified as *Eurypterus remipes* Dekay from the Middle Silurian Gascons formation near Port Daniel, Quebec. This is the lowest stratigraphic occurrence of eurypterid remains from the area. The specimen (GSC hypotype No. 9145) does not appear to be similar to *E. remipes;* until sufficient material is obtained it will be referred to as *Eurypterus* sp.[2] A specimen of early Upper Silurian age has recently been found in central Gaspé (loc. 4, Fig. 5). This poorly preserved specimen described here as *Pterygotus* sp. 2 is only questionably referred to the genus (*see* p. 34, Fig. 8).

Lower and Middle (?) Devonian strata (Gaspé Limestone and Sandstone groups) of the Chaleur Bay area have yielded the genera *Eurypterus* and *Pterygotus* (loc. 1-3, Fig. 5). Unfortunately only two species, *Pterygotus atlanticus* and *P. gaspesiensis* can be validated, the remaining specimens are only mentioned in literature. *P. atlanticus* (GSC syntypes Nos. 3239, a-c) from the Dalhousie shales near Dalhousie, New Brunswick, is of early Lower Devonian age; *P. gaspesiensis* (GSC paratype No. 10326) from Gaspé Bay probably is of Middle Devonian age although this has not been definitely proved.

[1] =*E. remipes lacustris* (Harlan), Kjellesvig-Waering, 1958b, p. 1127.
[2] =*E. remipes quebecencis,* Kjellesvig-Waering, 1958b, p. 1130, pl. 146, fig. 2.

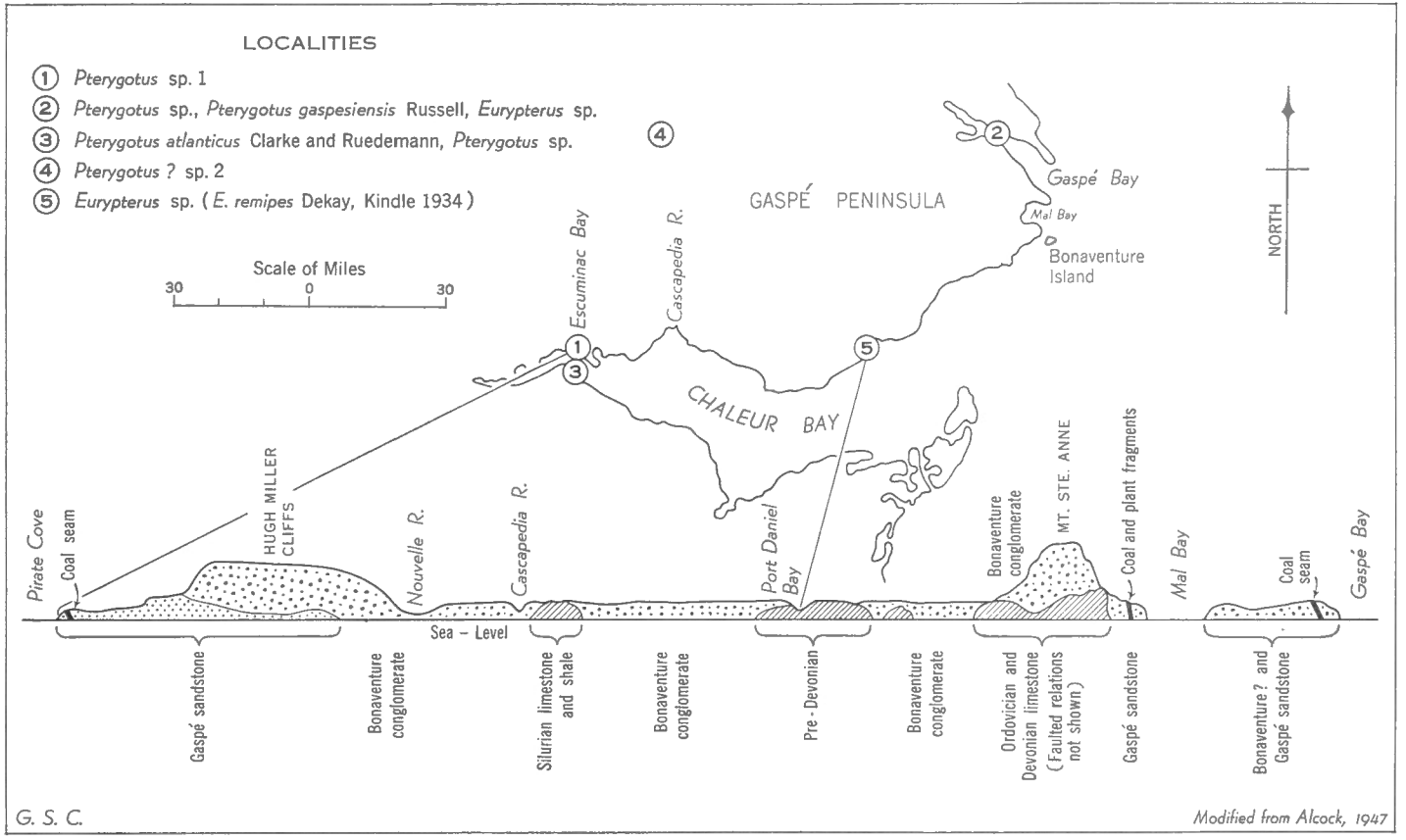



Figure 5. Map showing eurypterid localities, and generalized geological section, Chaleur Bay area, Quebec and New Brunswick.

## Table II

### *Generalized Stratigraphy, Gaspé-Northern New Brunswick*

| | | | | |
|---|---|---|---|---|
| DEVONIAN | UPPER | | | |
| | | | ESCUMINAC FORMATION | *Pterygotus* sp. 1 |
| | | | FLEURANT FORMATION | |
| | | | PIRATE COVE FORMATION | |
| | MIDDLE | | | |
| | —?— | | GASPÉ SANDSTONE GROUP | *Eurypterus* sp.<br>*Pterygotus* sp.<br>*Pterygotus gaspesiensis* Russell |
| | LOWER | GASPÉ LIMESTONE GP. | GRANDE GRÈVE FORMATION | *Pterygotus problematicus* Agassiz |
| | | | CAPE BON AMI FORMATION (Dalhousie shales) | *Pterygotus* sp.<br>*P. atlanticus* Clarke and Ruedemann |
| | | | ST. ALBAN FORMATION | |
| SILURIAN | UPPER | | | |
| | —?— | | INDIAN POINT FORMATION | *Pterygotus ?* sp. 2 |
| | MIDDLE | | WEST POINT FORMATION | |
| | | | BOULEAUX FORMATION | |
| | | | GASCONS FORMATION | *Eurypterus* sp. |
| | | | LA VIEILLE FORMATION | |
| | | | ANSE CASCON FORMATION | |
| | | | CLEMVILLE FORMATION | |
| | LOWER | | | |

A recent discovery of eurypterid remains similar to some from the Gaspé Sandstone group has been made in the Upper Devonian Escuminac formation on Scaumenac Bay. At this locality an unusual specimen of *Pterygotus* (*see* p. 33, Pl. IX, Nos. 2, 3) was obtained near the middle of the formation in beds described by Arnold (1936). This is the youngest presently known occurrence of eurypterids in the Gaspé area.

## Table III

### *Generalized Stratigraphy, Nova Scotia-Southern New Brunswick*

| | | | |
|---|---|---|---|
| CARBONIFEROUS | UPPER | PICTOU GROUP | *Lepidoderma brasdorense* (Bell) |
| | | CUMBERLAND GROUP (Fern Ledges, Saint John N.B.) | *Eurypterella ornata* Matthew<br>*Eurypterus* sp.<br>*E. pulicaris* Salter<br>*Hastimima* sp. |
| | | RIVERSDALE GROUP | *Eurypterus* sp.<br>*E.* cf. *E. scouleri* Hibbert |
| | | CANSO GROUP | |
| | LOWER | WINDSOR GROUP | |
| | | HORTON GROUP | |
| DEVONIAN | U<br>M<br>L | | |
| | LOWER | KNOYDART FORMATION | *Pterygotus* sp. |
| SILURIAN | UPPER | STONEHOUSE FORMATION | *Pterygotus* sp. |
| | MIDDLE | MOYDART FORMATION | |
| | | McADAM FORMATION | |
| | | ROSS BROOK FORMATION | *Eurypterus* sp. |
| | L | BEECHHILL FORMATION | |

G. S. C.

## Maritime Area

(Figure 6, Table III)

Rare specimens of *Stylonurus* ? sp., *Pterygotus* sp., and *Eurypterus* sp. have been reported from rocks of Silurian and Lower Devonian age at Arisaig and Messenger Brook, Nova Scotia, by Ami (1892, 1901, 1906) and Twenhofel

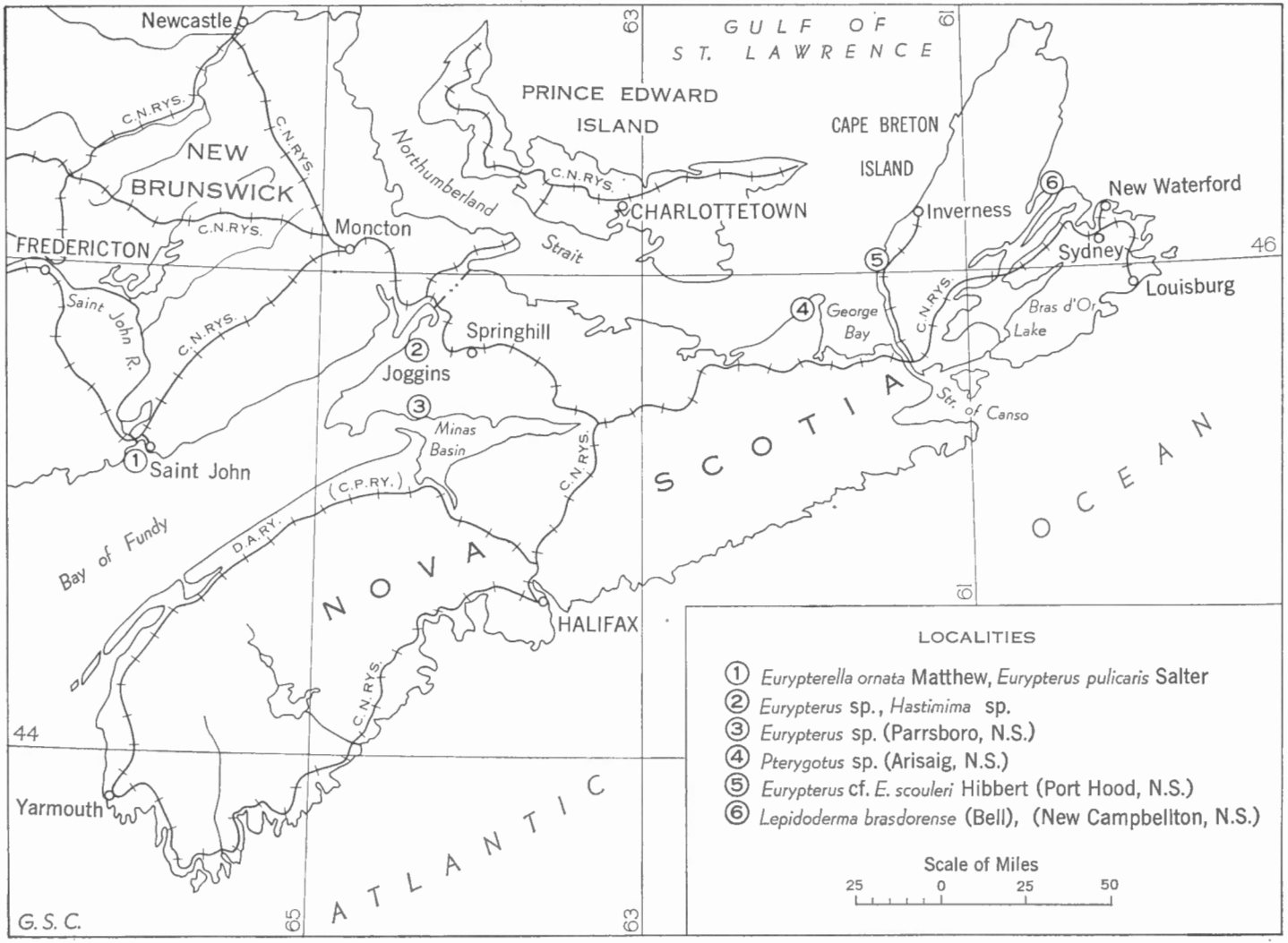



**Figure 6.** Eurypterid localities, Maritime Provinces.

(1909) but no further information concerning them is available. Unlike the southwestern Ontario and Chaleur Bay areas, where respectively Silurian and Devonian species are more common, the Maritime area has yielded a prominent eurypterid fauna from the Upper Carboniferous. This is the youngest eurypterid fauna yet found in Canada.

The Upper Carboniferous species presently known are from strata of the Riversdale, Cumberland and Pictou groups (loc. 1-3, 5, 6, Fig. 6; Table III). Specimens have been found near Parrsboro and Port Hood, Nova Scotia (loc. 3, 5), in strata of the lower Upper Carboniferous Riversdale group. These have been described by Salter (1862, 1863), Dawson (1868, *et seq.*,), Bell (1922) and Copeland (1957). Specimens from rocks of the middle Upper Carboniferous Cumberland group have been found at Joggins, Nova Scotia, and at Saint John, New Brunswick (loc. 1, 2, Fig. 6). The Joggins species include *Hastimima* cf. *H. whitei* White and *Eurypterus* sp. body segments (GSC hypotypes Nos. 12827 a-c). Strata at the Saint John locality were variously reported as Silurian and Devonian by Matthew (1888, 1894). Stopes (1914) and subsequent workers have considered the Saint John "Fern Ledges" strata as Upper Carboniferous in age and equivalent in part to the section exposed at Joggins. The Saint John species, *Eurypterella ornata* Matthew and *Eurypterus pulicaris* Salter, are only questionably referred to the Eurypterida as their morphologies are not accurately known. Only one specimen, *Lepidoderma brasdorense* (Bell) (GSC holotype No. 9649), has been reported from strata of the Pictou group (Bell, 1922). This specimen is the youngest eurypterid yet found in Canada.

## Cornwallis Island

(Figure 3, Table IV)

Numerous specimens of *Eurypterus* have been obtained from Middle and Upper Silurian strata on Cornwallis Island in the Canadian Arctic. These strata have been divided into two major facies (northern and southern) by Thorsteinsson (1958). A generalized stratigraphic section taken from Fortier and Thorsteinsson (1953) and Thorsteinsson (1958) is given in Table IV.

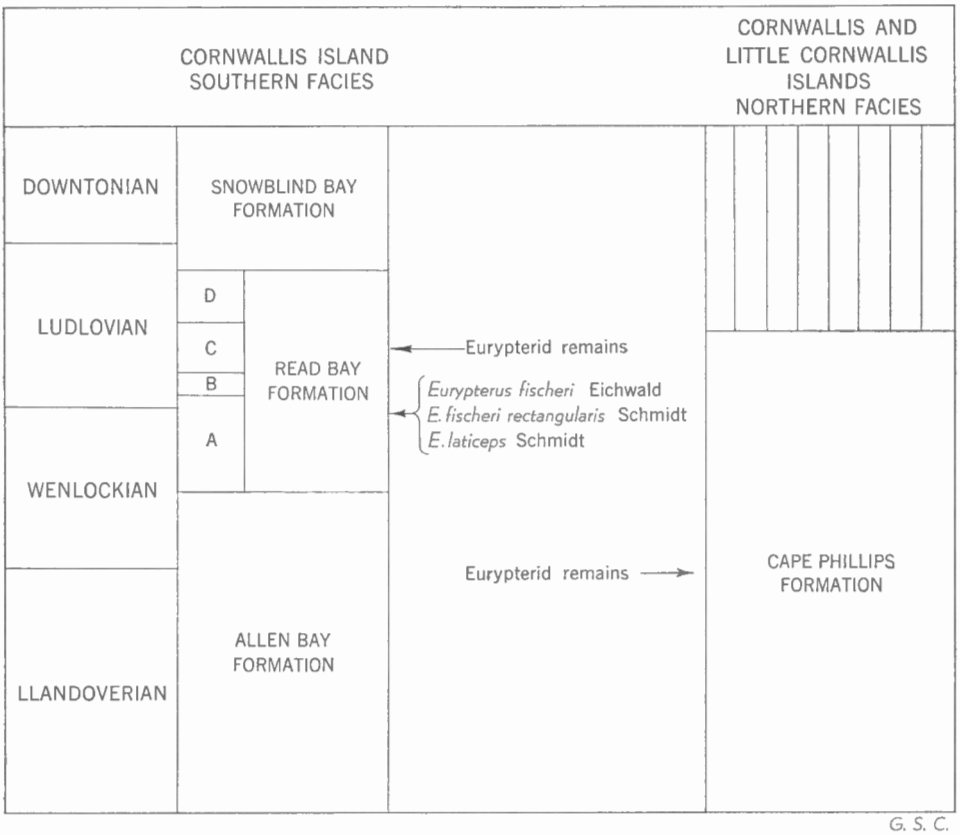
The oldest eurypterid remains yet encountered are from the type section of the Cape Phillips formation. Disarticulated eurypterid body plates (tergites and/or sternites) were discovered during maceration to obtain graptolites. The graptolites recovered were identified by R. Thorsteinsson as *Cyrtograptus* sp. and *Stomatograptus grandis* (Suess). This fauna indicates an uppermost Upper Llandoverian age for these strata.

A most remarkable eurypterid discovery was made by Thorsteinsson (1958, p. 54) on the eastern coast of Cornwallis Island. There, on Goodsir Creek, the first North American representatives of the northern European *Eurypterus fischeri* fauna were obtained from member A of the Read Bay formation. This fauna contains *E. fischeri* Eichwald[1], *E. fischeri rectangularis* Schmidt[1] and *E. laticeps*

[1] =*E. remipes tetragonophthalmus* Fischer 1839, Kjellesvig-Waering, 1958b, p. 1135.

## Table IV

*Distribution of Silurian Eurypterids, Cornwallis Island, Northwest Territories*




Schmidt[1], species previously recorded from strata of Ludlovian age in the Baltic region. Associated with this fauna are fish remains (Cyathaspididae) similar to those that occur elsewhere on Cornwallis Island, associated with the youngest Upper Wenlock graptolites *Monograptus testes* and *Cyrtograptus trilleri.* A further age determination is possible based on the occurrence of *M. nilssoni* in slightly higher beds along Goodsir Creek. This would indicate the possible assignment of the eurypterid-bearing beds to the Lower Ludlow (*M. vulgaris* zone).

Stratigraphic relationships of the Baltic specimens of the *Eurypterus fischeri* fauna have been described by Størmer (1935). In the Baltic region this fauna appears to range from basal Ludlow (Sweden) to slightly higher beds in Podolia (Poland), Island of Oesel ($K_1$) (Estonia), and Norway (zones 9b-c). The Cornwallis Island and reported Swedish occurrences would appear, therefore, to agree very closely in age.

[1] =*Erieopterus laticeps* (Schmidt), Kjellesvig-Waering, 1958b, p. 1114.

A still younger eurypterid occurrence was noted by Thorsteinsson (1958, p. 68) on Snowblind Bay, Cornwallis Island, in beds of member C of the Read Bay formation. This fauna consists of questionable eurypterid limb segments and is known to overlie the youngest graptolite assemblage yet obtained from the formation. It is dated by Thorsteinsson as Middle Ludlow.

### Other Localities

Eurypterid specimens have been reported from several isolated localities (5, 6 and 7, Fig. 3). Foerste (1916) recorded the presence of *Carcinosoma* (*Eusarcus*) sp. near Chambly, Quebec (loc. 5) from the Richmond formation of Upper Ordovician age. Additional specimens have been obtained from this and another locality by Clark (1955, pp. 30, 35). Another specimen, *Eurypterus* sp., has been recorded (Little, 1936) from the Upper (?) Ordovician of northern Labrador (loc. 6) in black shale beds of so-called Collingwood type. Two species of the genus *Angustidontus* Cooper 1936 (of unknown affinity) have been recorded from Upper Devonian (Ireton formation) and lowermost Mississippian (Banff formation) strata of Alberta and Yukon territory (loc. 7).

## Systematic Palaeontology

*Carcinosoma libertyi* n. sp.

Plate II, Nos. 1-4; Figure 7

*Description.* Species is known from a single specimen preserved in a fine-grained brownish dolomite as a ventral impression retaining some of the delicate anterior structures and much of the brown papillose integument. It lacks the dorsal prosoma, distal joints of several walking limbs, three posterior metasomal segments and the telson. Overall length of the preserved parts is about 3 inches.

All prosomal appendages are known at least in part. Chelicerae represented only by parts of the second and third joints ("chela") which are small (2½ mm in length), elongate and ovate. Only one chela (Pl. II, No. 3"a"), well-preserved, shows the pincer-like character of this appendage. The first walking limb (II) is represented only by the coxa (Pl. II, No. 3"b"). This limb is probably shorter and weaker than those following. The walking limbs (III-V) are flat, stout and bear strong spine bases on their anterior sides (Pl. II, Nos. 3"c", "d", "e"). No spines are preserved, their bases indicate that they were directed anteriorly except for a presumed spine on the posterior margin of the third joint of the fourth limb. A maximum of two spines per segment was observed; on several joints no spine bases were seen.

The coxae of limbs III to V bear distinct gnathobases, the denticles apparently becoming larger towards the posterior margin of each coxa. Each coxa bears a weak postero-distally directed oblique ridge. The walking limbs (III-V) are similar in shape but appear to decrease slightly in size from III to V. Joints 1 and

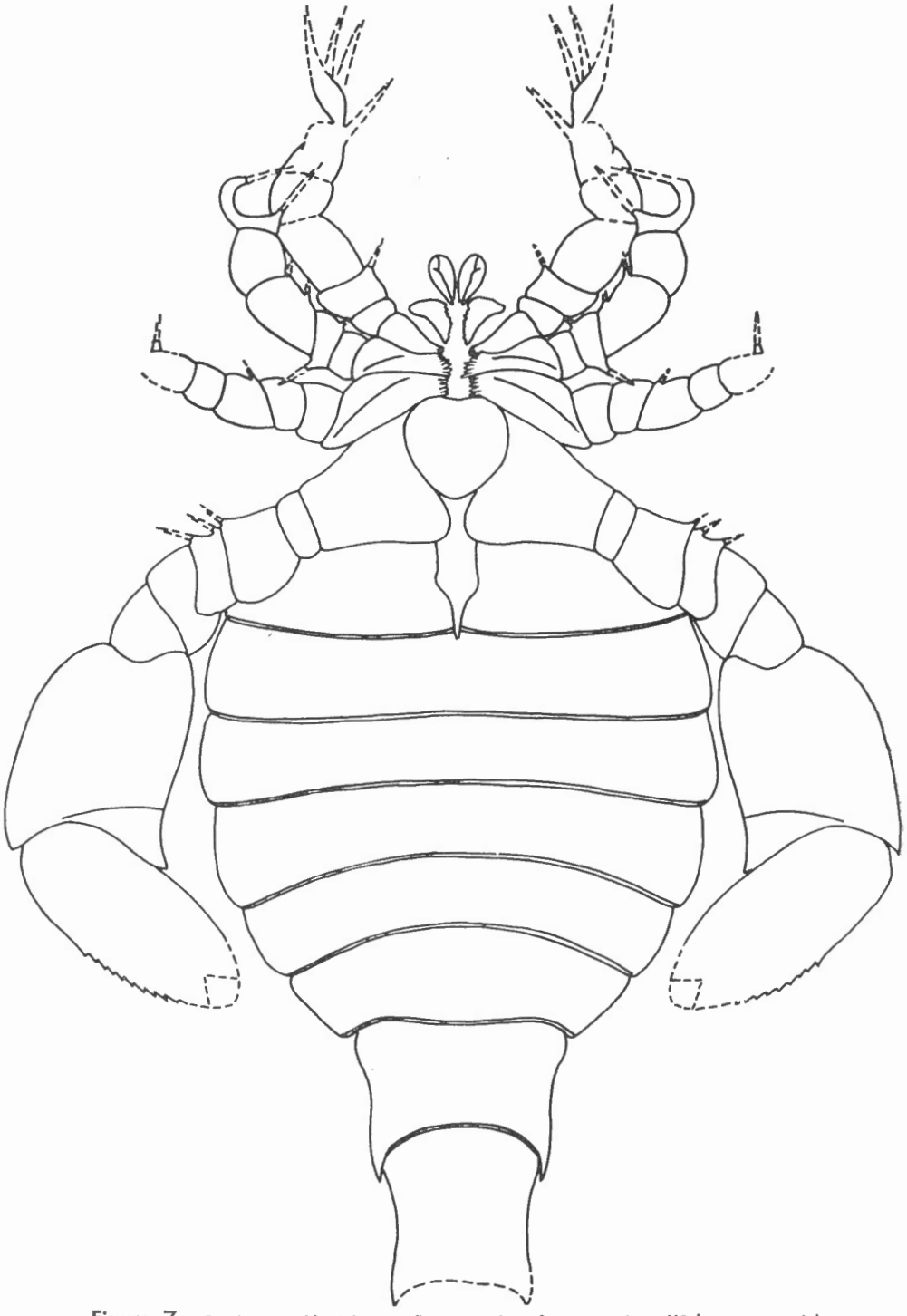


Figure 7. *Carcinosoma libertyi* n. sp. Reconstruction of type specimen X2 (approximately).

2 on each limb are generally short and broad; joint 3 is narrower than joint 2 but may be twice as long as wide. Joint 3 is the largest on each of these limbs. The fourth, fifth and more distal joints of the walking limbs are incompletely known; it is probable, however, that the fifth joint of the fourth limb as shown on Figure 7 is incomplete. Number and distribution of spines on the more distal joints are incompletely known.

Swimming limb (VI) is a long and exceedingly strong structure consisting of a large basal coxa and eight (only seven preserved) joints (Pl. II, No. 2). Coxa is very large, trapezoidal in outline, and narrowing distally to its juncture with joint 1 (Pl. II, No. 3 "f"). Joints 1 to 5 are wide and relatively short, the first four apparently being rectangular and the fifth triangular in outline. Joints 6 and 7, which compose most of the paddle, are very long and broad. Joint 8 (the tip of the paddle) unknown but is presumed to be large—a characteristic of the genus. Ornamentation of this limb (VI) consists of three (?) spines situated on the anterior margins of joints 2 and 3 (only bases preserved), and the serrated outer margin of the distal half of joint 7.

Metastoma well-preserved, heart-shaped and slightly longer than wide, as contrasted to the shield-shaped metastomata present on *C. newlini* (Claypole) and *C. scorpioides* (Woodward). As preserved on the present specimen it covers the anterior two thirds of the proximal margins of the coxae of the swimming limbs (Pl. II, No. 1).

Only the ventral aspect of the mesosoma is known, comprised of the wide operculum and the four narrower succeeding sternites. These, together with the first segment of the metasoma form the circular median part of the animal. Operculum is divided along the mid-venter by the elongate genital appendage. This appendage is poorly preserved on the present specimen but interpreted as shown on Figure 7 to be short and broad possibly indicating a female characteristic. The lateral margins of the mesosomal sternites are slightly lobate, plenate posteriorly, the fourth sternite being the widest. The posterior margin of each sternite bears a narrow doublure extending its entire width.

Only three segments of the metasoma are preserved. The first sternite is broad and short, similar to the preceding mesosomal sternites. Unlike specimens of *C. newlini,* no well-developed epimeral "horns" were observed on the posterior lateral margins of this sternite. The succeeding metasomal sternites comprise the scorpionid "tail" characteristic of the genus. Only the two anterior "tail" segments are preserved, both bear well-developed epimeral horns. Each of these sternites bears a slight median constriction on its lateral margins. Nothing is known of the three posterior metasomal sternites or the telsonal structures of this species.

The surface texture of this specimen is well exhibited (Pl. II, Nos. 3, 4) as distinct papillae, each of which bears on its apex a small posteriorly directed scale (not shown on the accompanying plate). Integument yellowish brown, grading

to darker brown on the papillae. Colour is also evident on the gnathobase denticles of the walking limbs. These are dark brown to black and probably chitinous.

*Remarks.* This species differs in several respects from *C. newlini* (Claypole) and *C. scorpionis* (Grote and Pitt), the two species with which it most closely agrees. The large size and shape of the walking limbs of *C. libertyi* differentiate this species from *C. scorpionis*. Similarity with *C. newlini* is much closer. The size and shape of the prosomal limbs of these two species, however, show several morphological differences. *C. libertyi* apparently does not possess spines on the walking limbs as large or as numerous as those demonstrated as occurring on *C. newlini* (*see* Kjellesvig-Waering, 1958a, pls. 42, 43). It is, however, in the construction of the swimming limb that the greatest difference occurs. The swimming limb (VI) of *C. libertyi* has a proportionately larger coxa and joints 6 and 7 are broader than those of *C. newlini.* As stated previously, the metastoma of *C. libertyi* is also of a slightly different shape than that of *C. newlini. C. libertyi* is also much smaller than *C. newlini,* but size alone is not a safe criterion for speciation.

*Occurrence.* Manitoulin Island, Ontario, west of Gore Bay village (loc. 6, Fig. 4) in basal beds of the St. Edmund formation of the Middle Silurian Clinton group, associated with *Lingula* sp. (*see* p. 17 *supra*). Collected by B.A. Liberty, 1957.

*Type.* Holotype, GSC Nos. 13984, a.

## *Eurypterus dekayi* Hall

Plate VI, No. 2

*E. dekayi* Hall 1859, Pal. New York, III, p. 411*, pl. 82, fig. 1.
*E. dekayi,* Clarke and Ruedemann 1912, Eurypterida of New York, N.Y. State Mus., Mem. 14, pp. 181-184, pl. 19, fig. 2, pl. 20, fig. 1.

This is the first reported occurrence of the species from Canada. Only the prosoma, mesosoma and two segments of the metasoma are preserved. The prosoma is partly exfoliated, the anterior and left side show the dorsal surface, the right side is broken away and exhibits the impression of the coxa of the swimming limb. The mesosoma and metasomal segments are preserved as ventral impressions.

The specimen exhibits several morphological features characteristic of the species—a broad, short prosoma, compressed mesosoma and wide paddles on the swimming limbs. Part of the proximal end and two spines of one walking limb are preserved on this specimen but it cannot be determined whether the distinctive "four or five long spines on each segment of the endognathites" (Clarke and Ruedemann, 1912, p. 181) are present.

*Occurrence.* Canadian Southern Railway, Bertie, Welland county, Ontario. Collected by J. DeCew, 1861.

*Type.* Hypotype, GSC No. 13996.

## *Eurypterus fischeri* Eichwald[1]

Plate VII, Nos. 1-5, 7, 8; Plate VIII, Nos. 5"a", "b", "d";
Plate IX, No. 1

*E. remipes* Dekay, Thorsteinsson, 1958, p. 54 (part).

This species is closely allied to species of the *E. remipes- E. lacustris* faunas of New York State. If size is any criterion for differentiation, a similarity between *E. fischeri* and *E. remipes* is immediately evident, *E. lacustris* apparently being larger. A point of differentiation between *E. remipes* and the present specimens is the shape of the pretelson which in *E. fischeri* bears wider, more pronounced epimeral "horns". The ventral prosomal structures and appendages of the present specimens are for the most part incomplete, precluding examination of these features for possible comparative purposes. Length/width measurements of numerous prosomata of the present specimens failed to reveal any discernible variation or to distinguish them from either *E. remipes* or *E. lacustris*. Similarly, variation in the size or shape of the swimming limbs (VI) is equally inconclusive.

Some of the figured specimens appear to be more abruptly tapering posterior to the first metasomal segments, segments VIII to XII have convexly curved lateral margins (Pl. VII, Nos. 1, 2, 4) with segments XII (pretelson) wider than the preceding segment. Other specimens (Pl. VII, No. 3; Pl. IX, No. 1) taper evenly posteriorly, the pretelson being slightly narrower than the preceding segment. Whether these differences are of any taxonomic importance or are due to preservation is not known.

*Occurrence.* Read Bay formation, member A, unit 14, Goodsir Creek, central east coast Cornwallis Island. The specimens occur in an argillaceous, flaggy, hard, dense, very finely to finely crystalline limestone in the basal 3.5 feet of the unit.

*Types.* Hypotypes, GSC Nos. 13997-14001, 14003, 14004, a, b, d.

## *Eurypterus fischeri rectangularis* Schmidt 1883 [1]

Plate VIII, No. 5 "c"

*E. remipes* Dekay, Thorsteinsson, 1958, p. 54 (part).

A single prosoma shows the distinctive lateral outline of this variety. It is associated with several specimens of *E. fischeri* on the same slab. The present specimen is similar in size to that figured by Schmidt but has more parallel lateral margins. The eyes of the Arctic specimen are smaller and less lunate than those of the type.

[1] =*E. remipes tetragonophthalmus* Fischer 1839, Kjellesvig-Waering, 1958b, p. 1135.

*Remarks.* The prosomal shape of this variety readily distinguishes it from *E. fischeri.* It may represent a distinct species but it does not seem desirable to erect a new species on the single prosoma available.

*Occurrence.* As for *E. fischeri.*

*Type.* Hypotype, GSC No. 14004c.

### *Eurypterus lacustris* Harlan

Plate III, Nos. 1-5; Plate IV, Nos. 1-3; Plate V, Nos. 1-3; Plate VI, No. 1

*E. lacustris* Harlan 1834, Trans. Geol. Soc. Penna., I, p. 918, pl. V (of authors).
*E. remipes* Dekay, Logan, 1863, "Geology of Canada", Geol. Surv., Canada, Rept. Prog., p. 354, fig. 464.

Complete descriptions of this species may be found in Hall (1859) and Clarke and Ruedemann (1912). Only general morphological characteristics exhibited by the figured specimens are mentioned here.

Several nearly complete specimens have been found showing dorsal or ventral views (Pl. III, Nos. 1, 3; Pl. IV, No. 1; Pl. VI, No. 1). These specimens exhibit the prosomal and tapering mesosomal and metasomal outlines supposedly characteristic of the species. Details of the prosomal appendages (limbs II-VI only) are well shown in several views (Pl. IV, No. 2; Pl. V, Nos. 1-3). These specimens, though lacking recognizable chelicerae, show the spinose walking limbs (II-IV), the elongate, distally spined "balancing" limbs (V), and the broad, strong swimming limbs (VI). Several specimens (Pl. V) show the strong coxae of the swimming limbs and the medially situated ovate-elliptical metastoma. Variation is evident in the shapes of the metastomata figured, most being elliptical in outline (Pl. III, No. 1; Pl. V, Nos. 2, 3) but one (Pl. V, No. 1) is ovate with the broader part anterior. Genital appendages are poorly preserved.

The dorsal aspects of the prosomata show the eyes and the median ocelli (Pl. VI, No. 1). Measurements of numerous prosomata have failed to show any distinctive features contrasting this species with *E. remipes* Dekay, the ranges of the length/width ratios of both species apparently overlap broadly. Apart from the greater size of most specimens of *E. lacustris,* little difference is evident between these species.

*Occurrence.* Bertie formation, southern Ontario. Localities as follows:

1. Lot 2, con. 13, Bertie tp., Welland co.
2. Lot 5, con. 10, Bertie tp., Welland co.
3. Lot 4, con. 10, Bertie tp., Welland co.
4. Canada Southern Railway, near Bertie, Welland co.
5. Quarry behind Ridgeway, Welland co.
6. Jones Tract, near Cayuga, on the south side of Grand River.

Specimens from localities 2 and 6 were recorded by Logan (1863, p. 354) as *E. remipes* Dekay. The specimen figured by Logan (ibid., fig. 464) is here reproduced as Plate IV, No. 1.

*Types.* Hypotypes, GSC Nos. 13985-13990, 13992-13995, 3224c.

## *Eurypterus laticeps* Schmidt[1]

Plate VII, No. 6

*E. laticeps* Schmidt 1883
not *Dolichopterus laticeps* (Schmidt), Holm 1898 and other authors nor *Dolichopterus laticeps* Holm, Størmer 1934=*D. størmeri* Caster and Kjellesvig-Waering 1956.
*E. laticeps* Schmidt, Størmer 1934 and other authors
(For a complete discussion of the synonomy of this species *see* Caster and Kjellesvig-Waering 1956, pp. 25, 26).
*E. remipes* Dekay, Thorsteinsson, 1958, p. 54 (part).

This species has previously been recorded from Oesel, Estonia, associated with the well-known *E. fischeri* fauna, and Ringerike, Norway (Størmer, 1935). Only the prosoma is known, its main characteristics being "a very wide prosoma which was margined by pustules and bore scattered pustules on the glabellar area" (Caster and Kjellesvig-Waering, 1956, p. 25). The specimens figured by Schmidt have their greatest prosomal width about two thirds the distance from the anterior margin. This is not evident from the present specimen which has the greatest width posterior, but it may be an adult characteristic, the Oesel specimens being of much greater size. Length/width relationships of the type figures range from .64 to .71, that of the present specimen is .63.

Surface ornamentation of the Arctic specimen consists of a double row of marginal tubercles, one at the outer edge of the prosoma and the other on the crown of the elevated marginal ridge which lies about 1 mm from the anterior edge of the prosoma and grades laterally into the genal angles. The glabellar area bears a few scattered, low, rounded pustules. Numerous pustules are crowded into two patches which lie parallel to the lateral margins and extend in an anterior direction from near the genal angles. The eyes and ocelli are not well preserved.

*Remarks.* The hemispherical lateral outline of its prosoma distinguishes this species of *Eurypterus* from most other eurypterid species. Størmer (1935, p. 122) pointed out its resemblance to *E. pustulosus* Hall (Clarke and Ruedemann, 1912, pl. 23, fig. 1). The present specimen is not as broad, bears larger eyes and is not as pustulose as the figures shown by Clarke and Ruedemann. It bears some resemblance to certain specimens of *E. fischeri,* some of the latter (i.e. Pl. VII, Nos. 5, 7) having slightly less angular prosomal outlines than are typical.

*Occurrence.* As for *E. fischeri.*

*Type.* Hypotype, GSC No. 14002.

## *Pterygotus cummingsi* Grote and Pitt

Plate IV, No. 4

*P. cummingsi* Grote and Pitt 1878, Am. Assoc. Adv. Sci., pp. 300-302.
*P. buffaloensis* Pohlman 1881, Bull. Buffalo Soc. Natural Hist., vol. 4, pp. 17-18, figs. 1-3.

[1] =*Erieopterus laticeps* (Schmidt), Kjellesvig-Waering, 1958b, p. 1114.

*P. cummingsi* Grote and Pitt, Pohlman, ibid., p. 18, fig. 4.
*P. acuticaudatus* Pohlman, ibid., p. 42, pl. 2, fig. 3.
*P. quadricaudatus* Pohlman, ibid., p. 43, pl. 3, fig. 1.
*P.* sp. indet. Pohlman, ibid., p. 44, pl. 3, fig. 2.

This species is known only from the Bertie formation near Buffalo, New York. The figured specimen was obtained from North Buffalo, New York, where it occurs with specimens of the ostracod *Leperditia* sp. Only the telson is preserved and, though half the size, corresponds in shape with the specimen figured as *P. cummingsi* Grote and Pitt by Pohlman (1881, p. 18, fig. 4). The specimen measures 47 mm in length and 43 mm in width, bears a median "keel", and is serrated marginally on its posterior half.

This species, together with *Eurypterus lacustris* Harlan 1834, represents the most characteristic species of the "Buffalo pool" fauna. Although specimens of *E. lacustris* are abundant in the Bertie formation exposed near Bertie, Ontario, examples of *P. cummingsi* have yet to be found in these strata.

*Occurrence.* Bertie formation, North Buffalo, New York.

*Type.* Hypotype, GSC No. 13991.

### *Pterygotus* sp. 1

### Plate IX, Nos. 2, 3

*Knorria* ? Dawson, J. W., 1859, Quart. J. Geol. Soc. London, vol. 15, p. 486, figs. 5a, b.

*Selaginites formosus* Dawson, J. W., 1861, Can. Naturalist and Geol., vol. 6, No. 3, pp. 175-177, 179, figs. 11, 12a, b; Dawson, J. W., 1862, Quart. J. Geol. Soc. London, vol. 18, p. 316; Dawson, J. W., 1863, *in* Logan, W. E., "Geology of Canada", Geol. Surv., Canada, Rept. Prog., pp. 394, 399, figs. 428a, b, c; Dawson, J. W., 1871, Geol. Surv., Canada, "Fossil Plants", pt. I, p. 65.

*Eurypterus* sp. Dawson, J. W., 1871, Geol. Surv., Canada, "Fossil Plants", pt. I, p. 66.

*Pterygotus* sp. Clarke, J. M., 1908, N.Y. State Mus., Mem. 9, pt. I, pp. 84, 243.

The figured specimen is an impression of the gnathobase and coxa of the swimming limb. The anterior margin bears twelve rounded teeth each about 1 mm in length. The surface is covered with shield-shaped scales apparently of three sizes, all with their concave margins directed distally. The largest scales are as much as 1.5 mm in length and appear to be roughly distributed in rows extending the length of the coxa. The remaining scales are intermediate and small in size being distributed at random on the surface between the largest scales. Scales of the smallest size range are also distributed on the surface of the largest scales.

*Remarks.* Apparently this is the first specimen of this species collected from Devonian strata of the Gaspé region to bear distinguishable eurypterid characteristics. Insufficient material, however, prevents its inclusion at present within a named species. As indicated in the synonomy, species collected from Devonian strata of Eastern Canada were originally assigned to plant genera. Figured specimens have shown only the surface ornamentation with no indication

of their structural relationships. Only at a later date were the eurypterid affinities of these specimens suggested (Dawson, 1871; Clarke, 1908). Specimens were reported from two localities on Gaspé Bay near the base of the Gaspé Sandstone formation. The type locality of *Selaginites formosus* Dawson is apparently near Little Gaspé on the north shore of the bay in shales above a coal seam and associated with several species of plants (*see* Logan, 1863, p. 394). Dawson (1871) recorded *Eurypterus* sp. from above a small coal seam at Tar Point on the south shore of the bay in approximately the same stratigraphic position as the *S. formosus* occurrence. Clarke (1908) assigned all these as well as others from the Dalhousie beds to *Pterygotus* sp. The type specimens cannot be traced, precluding comparison of specimens from both areas. It appears, however, that the specimens described by Dawson are similar to the definitely eurypterid specimen figured here on Plate IX, Nos. 2, 3, and is so indicated in the synonomy. Thus this undetermined species of *Pterygotus* should be assigned a Lower or more probably Middle Devonian (Gaspé Sandstone) to early Upper Devonian age (Escuminac formation; age established by Cooper, G. A., *et al.,* 1942, Bull. Geol. Soc. Amer., vol. 53, p. 1758, chart 4).

*Occurrence.* Scaumenac Bay on the north shore of Chaleur Bay midway between Miguasha Landing and Fleurant Point, in a sandstone layer 2 or 3 feet thick outcropping about 100 feet above high tide (*see* Arnold, 1936). Associated flora and fauna include *Archaeopteris obtusa* Lesquereux, *A. jacksoni* Dawson, *A. gaspiensis* Dawson, *Platyphyllum browni* Dawson, spores (type G of Lang, 1925), *Eusthenopteron foordi* Whiteaves (*from* Arnold, C. A., ibid.). Collected by L. M. Cumming and D. C. McGregor, 1958.

*Type.* Hypotype, GSC No. 14010.

### *Pterygotus* ? sp. 2

Figure 8

Eurypterid fragments, Cumming, 1959, Geol. Surv., Canada, Mem. 304, p. 31.

The specimen represents only the anterior and left (?) lateral margins of a prosoma. The entire margin is bordered by a rim about 1 mm in width. An ocular furrow is present on the anterior corner indicating an ovate optic area 1 cm in length and 4 mm in greatest width. The anterior part of the prosoma bears two horizontal furrows or undulations, possibly due to compression.

The specimen was found associated with *Monograptus nilssoni* a Lower Ludlovian graptolite, and is therefore assigned an early Upper Silurian age (*see* Cumming, L. M., 1959, pp. 31, 32).

*Occurrence.* Gaspé county, Quebec, on Lesseps Brook, 1050 paces downstream from the junction of the Lake Ste. Ann road; Gaspé National Park. Collected by L. M. Cumming, 1957.

*Type.* Hypotype, GSC No. 14012.

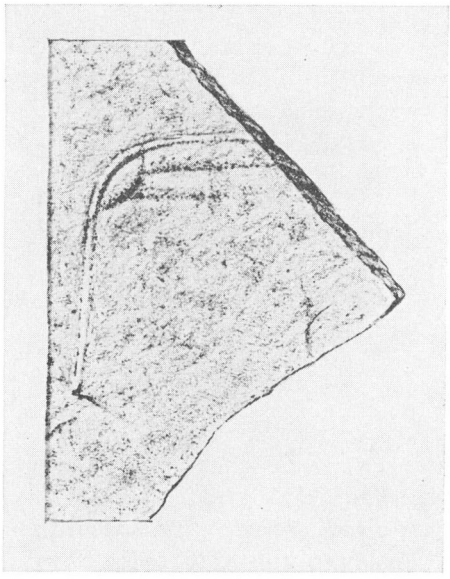


Figure 8. *Pterygotus* ? sp. 2.
Reconstruction of specimen X1.

*Tylopterella boylei* (Whiteaves)
Plate VI, No. 3

For synonomy of this species *see* appendix (p. 45).

This genus is known from only one specimen preserved as a dorsal impression in buff coloured, porous Guelph dolomite. It has been described by Whiteaves (1884) and Clarke and Ruedemann (1912), and no further description is considered necessary.

Morphologically, this is the most unusual of all Canadian eurypterids. The presence of bilobate median nodes on each of mesosomal segments 2-5, the elevated ocellar mound situated between the eyes and the distinctive prosomal surface ornamentation serve to distinguish it from any other presently described genus.

*Occurrence.* Elora, Ontario, Guelph formation, Middle Silurian.

*Type.* Holotype, GSC No. 2910.

Family ANGUSTIDONTIDAE Cooper 1936

This family was erected by Cooper to include specimens of denticulate "jaws" interpreted by him as belonging to actinopterygian fishes. Raasch (1956) and Harker and Raasch (1958) have considered Alberta specimens of the genus as belonging to the Merostomata and designated them as possibly allied to the "spinose chelae of such eurypterids as *Pterygotus*" (Raasch, 1956, p. 113) and "serrate chelae of *Pterygotus* or some closely allied eurypterid" (Harker and Raasch, 1958,



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p. 229). The present authors doubt that specimens of this genus can be assigned as Eurypterida without more definite proof than is presently available. The lack of additional eurypterid material in strata of the Mississippian Woodford formation of Oklahoma, the Cleveland and Sunbury shales of Ohio, and the scarcity of such supposed remains at the presently known Alberta occurrences of specimens of this family leads one to suspect that they may represent denticulate structures of otherwise non-preserved organisms (i.e. gill rakers of fishes, or raptorial claws similar to those on the second maxilliped of the stomatopod *Squilla*) rather than of "hard shelled" forms such as the Eurypterida. Likewise, the present specimens possess minute, needle-like denticles of varying sizes rather than the large, striated, conical "teeth" usually associated with the elongate chelicerae of the Pterygotidae.

Material obtained from basal strata of the Mississippian Banff formation indicates the probable association of two similar specimens of *Angustidontus* sp. in one individual. One such associated individual (hypotype 13449a) shows the two denticulate remains preserved in a "V", the curved anterior teeth nearly touching at the apex and the succeeding denticles directed laterally outwards. The other (hypotype 13449b) is preserved as two separate specimens lying parallel to each other and about 4 mm apart, each with the anterior end directed towards the left. This latter specimen and another separate individual show disarticulated proximal points of attachment. This was apparently a "ball and socket" type of articulation as indicated by the knob-like proximal process on each specimen. This structure was not present on the specimens described by Cooper.

If this grouping of denticulate specimens should be subsequently proved to definitely exhibit eurypterid characteristics it is felt by the present authors that they should be contained within the family Pterygotidae as they show a close affinity to the genus *Pterygotus (Pterygotus),* with possible subfamily designation (Angustidontinae) (genus *Angustidontus*).

## Genus *Angustidontus* Cooper 1936

The original description of this genus is as follows: "Dental plates long, narrow and thin. Teeth straight or very slightly curved, long, slender, gradually tapering to a sharp, needle-like point; usually several sizes, alternating in a regular manner." (Cooper, 1936, p. 92).

It was on the size and alternation of the teeth, however, that Cooper was able to distinguish two species, *A. seriatus* (the type species) and *A. gracilis*. No dental formula was given for either of these species, the teeth sizes of *A. seriatus* being likened to those of the divisions of a ruler. A more usable (though no more accurate) method of determining the dental distribution is to assign a number to all teeth of a similar size (i.e., 1 —all teeth of the largest size, 2 —all teeth of the next largest size, etc.). For descriptive purposes a further notation may be used when distinguishing the dentition of a particular part of a specimen (when known). This is the addition of a subscript designation to teeth of the largest size range. In this manner 1a is the curved terminal cusp, 1b the next posterior tooth of the largest

size range, etc. This is the procedure followed in the present paper. It should be noted, however, that whereas Cooper mentions these teeth as "alternating in a regular manner" such is not always the case, as variation occurs especially on the anterior and posterior parts of the specimens.

Using this method of differentiating the general dentition, it is possible to assign a dental formula to the species originally designated by Cooper; *A. seriatus* being described in general by the notation 1, 5, 4, 5, 3, 5, 4, 5, 2, 5, 4, 5, 3, 5, 4, 5, 1, and *A. gracilis* by 1, 4, 3, 4, 2, 4, 3, 4, 1.

### *Angustidontus* sp.

Plate X, No. 3

*Angustidontus seriatus* Cooper, (=*Pterygotus* ?) Raasch, G. O., 1956, J. Alberta Soc. Petrol. Geol., vol. 4, No. 5, p. 113.

*"Angustidontus" seriatus* Cooper, (=*Pterygotus* ?) Harker, P. and Raasch, G. O., 1958, "Jurassic and Carboniferous of Western Canada", Am. Assoc. Petrol. Geol., pp. 217, 228, 229, pl. 1, fig. 11.

Raasch (1956) was the first to point out the supposed eurypterid affinity of the Angustidontidae. He based his assumption on specimens of *Angustidontus* in cores of basal Banff strata from Rumsey No. 6-30 test well near Stettler, Alberta. Later, Harker and Raasch (1958), in erecting a Permo-Carboniferous faunal zonation in Alberta, used *"Angustidontus" seriatus* as a zone marker at the base of their Banffian series. Fauna associated in this zone are *"Sporangites" huronensis* Dawson, *Asmussia* sp., *Spathiocaris* sp., eurypterid and ganoid remains, and sponge spicules. In the Rumsey core, this zone comprises "25 feet of hard, fissile, gray-black, slightly calcareous shale [and] immediately overlies the Exshaw formation and constitutes the basal portion of the Banff formation." (ibid., pp. 228, 229).

The specimen figured by Harker and Raasch (herein reproduced, x 2) exhibits the gross characteristics of the genus. It is similar in size to those specimens figured by Cooper and apparently bears denticles of three (?) or four sizes. These Banff specimens, however, exhibit a random distribution of teeth precluding a definite specific assignment. They resemble *A. gracilis* Cooper more closely than *A. seriatus* Cooper in that they possess fewer denticles of only three (?) or four sizes as compared with *A. seriatus* which has numerous denticles of five sizes.

*Occurrence.* Specimens of this indeterminate species are widespread in Western Canada. They have been found at the following localities:

1. Gulf Rumsey No. 6-30 well (6-30-33-20-W4) Alberta, depth 5,200-5,225 feet.
2. Northeastern British Columbia (reported by Raasch, 1956).
3. Peel River, near the mouth of Calamities Creek, Yukon.
4. Mattson Creek, Fort Liard area, Northwest Territories.

Associated flora and fauna have been found at localities 1, 3, and 4 (above).

*Types.* Hypotypes, GSC Nos. 13449, a, b.



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*Angustidontus weihmannae* n. sp.

Plate X, Nos. 1, 2

*Description.* This species is characterized by the presence of teeth of four sizes and the regular deletion of teeth within the cycles posterior to 1c. The general dentition of this species is characterized by the second cycle and is 1b, 4, 2, 4, 3, 4, 1c. The complete dentition appears as follows: 1a, 2, 3, 4, 1b, 4, 2, 4, 3, 4, 1c, 4, 2, 3, 4, 1d, 4, 3, 4, 1e, 3, 4, 1f, 4, 1g, 4, 2, 3, 4, 4. As may be readily observed the loss of dentition begins with the middle tooth of cycle 3, progresses anteriorly in cycles 4 and 5 and posteriorly in cycles 6 and 7, finally leaving only one denticle in each of the posterior cycles.

*Remarks.* The general dentition of this species approaches that of *A. gracilis* Cooper 1936 but lacks the number of teeth in each cycle shown by that species. Both species are of approximately the same size.

*Occurrence.* Ireton formation, Woodbend group, Upper Devonian, Gulf Sachs No. 10 well (10-36-43-1-W5) Alberta, depth 7,717.5-7,720 feet.

*Types.* Holotype, GSC No. 14013; paratype, GSC No. 14013a (courtesy of British American Oil Company Ltd., Calgary, Alberta).

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# Appendix

This appendix is an alphabetic and generic listing of all references to Canadian specimens of Eurypterida known to the authors. It does not presume to include all mentions of Eurypterida from Canada but it is believed to indicate the descriptions and most subsequent references to all prominent Canadian occurrences. Numerous references were obtained from the following works: Diener, C., 1924, "Fossilium Catalogus", pars 25; Bassler, R. S., 1915, "Ordovician and Silurian Fossils"; and Nicolas, F., 1925, 1930, "Index to Palæontology", Geological Survey of Canada. Specimens deposited in the type collection of the Geological Survey of Canada (apart from those described above) are marked with an asterisk (*).

*Campylocephalus* d'Eichwald 1860 ("*Eidothea*" Scouler 1831, *non* Risso 1826)

*Campylocephalus* cf. *scouleri* (Hibbert) 1836

(Riversdale group, U. Carboniferous, Nova Scotia)

Salter, J. W., 1863, Quart. J. Geol. Soc. London, vol. 19, p. 78, fig. 5 (*Eurypterus* allied to *E. scouleri* (Hibbert)).

Dawson, J. W., 1868, 1878, 1891, "Acadian Geology", p. 208, fig. 50.

Weller, S., 1898, Bull. U.S. Geol. Surv., No. 153, p. 269 (allied to *E. scoeleri* (Hibbert)).

Bell, W. A., 1922, Trans. Roy. Soc. Can., ser. 3, vol. 16, sec. IV, p. 165.

Kjellesvig-Waering, E. N., 1948, State of Illinois, Sci. Paper, vol. 3, No. 4, p. 6 (*E. ? stevensoni, E. ? scouleri*).

*Carcinosoma* Claypole 1890

*C.* (*Eusarcus*) sp.

(Richmond fm., U. Ordovician, Quebec)

Foerste, A. F., 1916, Geol. Surv., Canada, Mem. 83, pp. 151, 265.

Dresser, J. A., and Denis, T. C., 1944, "Geology of Quebec", Quebec Dept. Mines Rept. 20, vol. 2, p. 269.

Clark, T. H., 1955, Que. Geol. Surv., Geol. Rept. 66, pp. 30, 35 (Lorraine group, Chambly member; Richmond group, Pontgravé River fm.).

*C. libertyi* n. sp.

*C.* ? (*Eusarcus*) *logani* (Williams)

(Eramosa fm., M. Silurian, Ontario)

*Williams, M. Y., 1915, Geol. Surv., Canada, Mus. Bull. 20, pp. 8, 9; pl. 3, figs. 2-6; pl. 4, figs. 1-2; pl. 5, figs. 1-5.

O'Connell, M., 1916, Contr. Dept. Geol., Columbia Univ., N.Y., vol. 26, No. 7, p. 16, table 1 (*also* Bull. Buffalo Soc. Natural Sci., 1916, vol. 11, No. 3).

Williams, M. Y., 1919, Geol. Surv., Canada, Mem. 111, pp. 63, 68.

Shaw, E. W., 1937, Trans. Roy. Can. Inst., vol. 21, pt. 2, p. 341.

Bolton, T. E., 1953, Geol. Surv., Canada, Paper 53-23, p. 17.

Bolton, T. E., and Liberty, B. A., 1955, Mich. Geol. Soc., Ann. Field Trip, Guidebook, p. 30.

Bolton, T. E., 1958, Geol. Surv., Canada, Mem. 289, p. 58 (1957).

*Eurypterella* Matthew 1888

*Eurypterella ornata* Matthew 1888

(Cumberland group, U. Carboniferous, New Brunswick)

Matthew, G. F., 1888, Trans. Roy. Soc. Can., vol. 6, sec. IV, p. 60, pl. 4, fig. 12 (Devonian "plant beds").

Miller, S. A., 1889, "North American Geology and Palæontology", p. 548 (*Eurypterella ornata*).

Matthew, G. F., 1894, Trans. Roy. Soc. Can., vol. 12, sec. IV, pp. 99, 100.

Clarke, J. M., and Ruedemann, R., 1912, N.Y. State Mus., Mem. 14, pp. 89, 93.

O'Connell, M., 1916, Contr. Dept. Geol., Columbia Univ., N.Y., vol. 26, No. 7, p. 25 (*also* Bull. Buffalo Soc. Natural Sci., 1916, vol. 11, No. 3).

*Eurypterus* Dekay 1825

*Eurypterus* sp.

Salter, J. W., 1862, Quart. J. Geol. Soc. London, vol. 18, p. 346 (*E.* allied to *E. scouleri* Hibbert and *E.* sp. *see* Salter, 1863) (Riversdale and Cumberland groups, U. Carboniferous, Nova Scotia).

Logan, W. E., 1863, "Geology of Canada", Geol. Surv., Canada, Rept. Prog., p. 353 (Bertie fm., U. Silurian, Ontario).

Salter, J. W., 1863, Quart. J. Geol. Soc. London, vol. 19, pp. 78, 80, fig. 4 (Cumberland group, U. Carboniferous, Nova Scotia).

Chapman, E. J., 1864, "Popular and Practical Exposition on the Minerals and Geology of Canada", p. 190 (Bertie fm., U. Silurian, Ontario).

Dawson, J. W., 1868, 1878, 1891, "Acadian Geology", pp. 208-209, fig. 51 (*Eurypterus* (?) Salter 1863; =*Hastimima* sp. Clarke and Ruedemann, 1912) (Cumberland group, U. Carboniferous, Nova Scotia).

Dawson, J. W., 1871, "Fossil Plants of the Devonian and Upper Silurian formations of Canada", Geol. Surv., Canada, pp. 9, 66 (Gaspé Ss. fm., L. or M. Devonian, Quebec).

Dawson, J. W., 1880, "Lecture Notes on Geology", p. 60 (U. Silurian, Canada, General).

Chapman, E. J., 1888, "Minerals and Geology of Central Canada", ed. 3, p. 261 (Oriskany (=Bertie?) fm., U. Silurian, Ontario).

Dawson, J. W., 1889, "Handbook of Geology", p. 77 (U. Silurian, Canada, General).

Schmidt, F., 1892, Bull. Geol. Soc. Amer., vol. 3, p. 59 (Bertie fm., U. Silurian, Ontario).

Selwyn, A. R. C., 1893, Geol. Surv., Canada, Sum. Rept. 1890, p. 76A (Bertie fm., U. Silurian, Ontario).

Weller, S., 1898, Bull. U.S. Geol. Surv., No. 153, p. 269 (Bertie fm., U. Silurian, Ontario).

Clarke, J. M., 1908, N.Y. State Mus., Mem. 9, p. 84 (Gaspé Ss. fm., L. or M. Devonian, Quebec).

Twenhofel, W. H., 1909, Am. J. Sci., ser. 4, vol. 28, pp. 151, 158 (Arisaig fm., L.-M. Silurian, Nova Scotia).

Clarke, J. M., and Ruedemann, R., 1912, N.Y. State Mus., Mem. 14, p. 87 (Arisaig fm., Silurian, Nova Scotia).

Twenhofel, W. H., 1913, Geol. Surv., Canada, Internat. Geol. Cong. Guidebook I, pt. II, p. 298 (Ross Brook fm., M. Silurian, Nova Scotia).

Bell, W. A., 1913, Geol. Surv., Canada, Internat. Geol. Cong. Guidebook I, pt. II, p. 343 (Cumberland group, U. Carboniferous, Nova Scotia).

Williams, M. Y., 1914, Geol. Surv., Canada, Mem. 60, pp. 66, 73 (Ross Brook and Stonehouse fms., M. and U. Silurian, Nova Scotia).

O'Connell, M., 1916, Contr. Dept. Geol., Columbia Univ., N.Y., vol. 26, No. 7, p. 15 (Arisaig fm., L.-M. Silurian, Nova Scotia) (*also* Bull. Buffalo Soc. Natural Sci., 1916, vol. 11, No. 3).

Little, H. P., 1936, Science, n.s., vol. 84, No. 2177, pp. 268-269 (Collingwood fm., M. or U. Ordovician, Labrador, Newfoundland).

Bolton, T. E., and Liberty, B. A., 1955, Mich. Geol. Soc., Ann. Field Trip, Guidebook, p. 30 (Eramosa fm., M. Silurian, Ontario).

*Copeland, M. J., 1957, Geol. Surv., Canada, Mem. 286, p. 50, pl. 16, figs. 11-13 (Riversdale group, U. Carboniferous, Nova Scotia).

Bolton, T. E., 1958, Geol. Surv., Canada, Mem. 289 (1957), p. 58 (Eramosa fm., M. Silurian, Ontario).

Copeland, M. J., 1959, Geol. Surv., Canada, Mem. 298, p. 27 (Cumberland group, U. Carboniferous, Nova Scotia).

Kjellesvig-Waering, E. N., 1958, J. Pal., vol. 32, No. 6, p. 1143 (*Eurypterus* ? sp.) (Silurian, Nova Scotia; Devonian, Gaspé; Carboniferous, Nova Scotia).

*E. lacustris* Harlan 1834

(Bertie fm., U. Silurian, Ontario)

Clarke, J. M., and Ruedemann, R., 1912, N.Y. State Mus., Mem. 14, pp. 89, 92.

O'Connell, M., 1916, Contr. Dept. Geol., Columbia Univ., N.Y., vol. 26, No. 7, table 1 (*also* Bull. Buffalo Soc. Natural Sci., 1916, vol. 11, No. 3).

Kjellesvig-Waering, E. N., 1958, J. Pal., vol. 32, No. 6, pp. 1127-28 (*E. remipes lacustris*).

*E. pulicaris* Salter 1863

(Cumberland group, U. Carboniferous, New Brunswick)

Salter, J. W., 1862, Quart. J. Geol. Soc. London, vol. 18, p. 346.

Salter, J. W., 1863, Quart. J. Geol. Soc. London, vol. 19, p. 78, figs. 9, 10.

Dawson, J. W., 1868, 1878, 1891, "Acadian Geology", p. 523, figs. 179a, b.

Geol. Surv., Canada, 1872, Rept. Prog. 1870-71, p. 172.

Miller, S. A., 1877, "American Palaeozoic Fossils", p. 217.

Miller, S. A., 1889, "North American Geology and Palæontology", p. 548.

Matthew, G. F., 1894, Trans. Roy. Soc. Can., vol. 12, sec. IV, pp. 99, 100, 105 (*E.* (?) *pulicaris*).

Clarke, J. M., and Ruedemann, R., 1912, N.Y. State Mus., Mem. 14, pp. 89, 93, 156 (*E.* (?) *pulicaris*; "probably not eurypterids").

O'Connell, M., 1916, Contr. Dept. Geol., Columbia Univ., N.Y., vol. 26, No. 7, p. 25 (*E.* ? *pulicaris*) (*also* Bull. Buffalo Soc. Natural Sci., 1916, vol. 11, No. 3).

Bell, W. A., 1922, Trans. Roy. Soc. Can., ser. 3, vol. 16, sec. IV, p. 165.

Kjellesvig-Waering, E. N., 1958, J. Pal., vol. 32, No. 6, p. 1142 (not an eurypterid).

*E. remipes* Dekay 1825

(Bertie fm., U. Silurian, Ontario)

*Logan, W. E., 1863, "Geology of Canada", Geol. Surv., Canada, Rept. Prog., p. 354, figs. 463a, b, 464.

Chapman, E. J., 1864, "Popular and Practical Exposition on the Minerals and Geology of Canada", p. 190, fig. 227.

Geol. Surv., Canada, 1872, Rept. Prog. 1870-71, p. 14.

Chapman, E. J., 1876, "An Outline of the Geology of Canada", pp. xxvi, 47, pl. V, fig. 69.

Chapman, E. J., 1888, "Minerals and Geology of Central Canada", ed. 3, p. 261, fig. 180.

Dawson, J. W., 1889, "Handbook of Geology", p. 173 ("Helderberg", U. Silurian, Ontario).

Geol. Surv., Canada, 1915, Sum. Rept. 1914, p. 85.
Knight, C. W., 1915, Ont. Bureau Mines, vol. 24, pt. II, p. 7.
*Kindle, E. M., 1934, Trans. Roy. Soc. Can., ser. 3, vol. 28, sec. IV, pp. 43-47, figs. 1, 2 (Gascons fm., M. Silurian, Quebec; Bertie fm., U. Silurian, Ontario) (*Euripterus remipes*).
Northrop, S. A., 1939, Geol. Soc. Amer., Sp. Paper 21, pp. 87, 104, 113, 119, 246-247 (Gascons fm., M. Silurian, Quebec).
Dresser, J. A., and Denis, T. C., 1944, "Geology of Quebec", Que. Dept. Mines, Geol. Rept. 20, vol. 2, p. 317 (Gascons fm., M. Silurian, Quebec).
Thorsteinsson, R., 1958, Geol. Surv., Canada, Mem. 294, p. 54 (Read Bay fm., Member A, M. Silurian, U. Wenlock, Cornwallis Island, Northwest Territories).
Kjellesvig-Waering, E. N., 1958, J. Pal., vol. 32, No. 6, pp. 1127, 1142 (*E. remipes lacustris; E. remipes quebecensis*) (U. Silurian, Ontario; M. Silurian, Quebec).

*Hastimima* White 1908

*Hastimima* sp. (cf. *H. whitei* White)
(Cumberland group, U. Carboniferous, Nova Scotia)

Clarke, J. M., and Ruedemann, R., 1912, N.Y. State Mus., Mem. 14, pt. 1, p. 405, fig. 94 (=*Eurypterus* (?) Salter, 1862, 1863).
Bell, W. A., 1922, Trans. Roy. Soc. Can., ser. 3, vol. 16, sec. IV, p. 165.
Kjellesvig-Waering, E. N., 1948, State of Illinois, Sci. Paper, vol. 3, No. 4, p. 6 (*Hastimima* ? sp.).
Kjellesvig-Waering, E. N., 1958, J. Pal., vol. 32, No. 6, p. 1143 (*Hastimima* ? sp.)

*Lepidoderma* Reuss 1855

*L. brasdorense* (Bell) 1922
(Pictou group, U. Carboniferous, Nova Scotia)

*Bell, W. A., 1922, Trans. Roy. Soc. Can., ser. 3, vol. 16, sec. IV, pp. 164-166, pl. 1, fig. 11 (*Eurypterus* (*Anthraconectes*) *brasdorensis*).
Pruvost, P., 1930, Mus. Roy. d'Hist. Natural Belg., Mem. 44, p. 193.
Kjellesvig-Waering, E. N., 1948, State of Illinois, Sci. Paper, vol. 3, No. 4, pp. 8, 31, 32, 33 (*Lepidoderma brasdorense*).
Van Oyen, F. H., 1956, Meded. Geol. Sticht. C-IV-3-No. 7, Uit-komsten, p. 59 (*Adelophthalmus imhofi* (Reuss)), pp. 12, 47, 51, 59, fig. 16 (*E.* (*A.*) *brasdorensis* Bell), p. 51 (*Lepidoderma brasdorense* (Bell)).
*Copeland, M. J., 1957, Geol. Surv., Canada, Mem. 286, p. 50, pl. 9, fig. 7 (*Eurypterus brasdorensis*).
Kjellesvig-Waering, E. N., 1958, J. Pal., vol. 32, No. 6, p. 1140 (*Adelophthalmus brasdorensis*).

*Pterygotus* Agassiz 1839

*Pterygotus* sp.

Logan, W. E., 1863, "Geology of Canada", Geol. Surv., Canada, Rept. Prog., p. 392 (Gaspé Ls. fm., L. Devonian, Quebec).
Dawson, J. W., 1871, "The Fossil Plants of the Devonian and Upper Silurian Formations of Canada", Geol. Surv., Canada, pp. 8, 9 (Gaspé Ss. fm., L. or M. Devonian, Quebec).
————1882, "Fossil Plants of the Erian (Devonian) and Upper Silurian Formations of Canada", pt. II, Geol. Surv., Canada, p. 97 (Gaspé Ss. fm., L. or M. Devonian, Quebec).

Ells, R. W., 1883, Geol. Surv., Canada, Rept. Prog. 1880-82, p. 10D (Dalhousie fm., L. Devonian, New Brunswick).

Whiteaves, J. F., 1883, Can. Naturalist and Quart. J. Sci., n.s., vol. 10, p. 100 (Dalhousie fm., L. Devonian, Quebec).

Chapman, E. J., 1888, "Minerals and Geology of Central Canada", ed. 3, p. 261 (Oriskany (=Bertie?) fm., U. Silurian, Ontario).

Schmidt, F., 1892, Bull. Geol. Soc. Amer., vol. 3, p. 59 (Bertie fm., U. Silurian, Ontario).

Ami, H. M., 1901, Bull. Geol. Soc. Amer., vol. 12, pp. 309-310 (Knoydart fm., L. Devonian, Nova Scotia).

————1906, Geol. Surv., Canada, Ann. Rept. 1904, p. 387A (L. ? Devonian, Messenger Brook, Nova Scotia).

Clarke, J. M., 1908, N.Y. State Mus., Mem. 9, pt. I, pp. 84, 243 (=*Selaginites formosus* (Dawson) *in* Logan, W. E., 1863, "Geology of Canada", pp. 394, 399, figs. 428a, b, c) (Gaspé Ss. fm., L. or M. Devonian, Quebec).

Twenhofel, W. H., 1909, Am. J. Sci., ser. 4, vol. 28, p. 158 (Stonehouse fm., U. Silurian, Nova Scotia).

Clarke, J. M., 1909, N.Y. State Mus., Mem. 9, pt. II, p. 18, pl. 1, fig. 8 (Dalhousie fm., L. Devonian, New Brunswick).

Williams, M. Y., 1911, Geol. Surv., Canada, Sum. Rept. 1910, p. 244 (Knoydart fm., L. Devonian, Nova Scotia).

Clarke, J. M., and Ruedemann, R., 1912, N.Y. State Mus., Mem. 14, pp. 89, 93, 357 (Gaspé Ss. fm., L. or M. Devonian, Quebec), p. 94 (Dalhousie fm. ?, L. Devonian, New Brunswick).

Twenhofel, W. H., 1913, Geol. Surv., Canada, Internat. Geol. Cong., Guidebook I, pt. II, p. 303 (Knoydart fm., L. Devonian, Nova Scotia).

Williams, M. Y., 1914, Geol. Surv., Canada, Mem. 60, pp. 21, 73, 75, 134 (Stonehouse fm., U. Silurian, Nova Scotia, and Knoydart fm., L. Devonian, Nova Scotia).

O'Connell, M., 1916, Contr. Dept. Geol., Columbia Univ., N.Y., vol. 26, No. 7, p. 23, table 1 (Dalhousie fm., L. Devonian, New Brunswick) (*also* Bull. Buffalo Soc. Natural Sci., 1916, vol. 11, No. 3).

Dresser, J. A., and Denis, T. C., 1944, "Geology of Quebec", Que. Dept. Mines, Geol. Rept. 20, vol. 2, p. 322 (Cape Bon Ami fm., L. Devonian, Quebec), p. 329 (Gaspé Ls. fm., L. Devonian, Quebec).

Russell, L. S., 1947, Contr. Roy. Ont. Mus. Pal., No. 12, p. 3 (=*P.* ? *atlanticus* =*P. gaspesiensis* Russell) (Gaspé Ss. fm., L. or M. Devonian, Quebec).

Russell, L. S., 1954, Nat. Mus., Canada, Bull. 132, pp. 86-87 (Gaspé Ss. fm., L. or M. Devonian, Quebec).

Denison, R. H., 1955, Fieldiana, Zoology, vol. 37, p. 461 (Knoydart fm., L. Devonian, Nova Scotia).

Raasch, G. O., 1956, J. Alta. Soc. Petrol. Geol., vol. 4, No. 5, May 1956, p. 113 (*Angustidontus seriatus* Cooper) (L. Banff fm., L. Carboniferous, Alberta).

Harker, P., and Raasch, G. O., 1958, "Jurassic and Carboniferous of Western Canada", Am. Assoc. Petrol. Geol., pp. 217, 229, 230 (*Angustidontus seriatus* Cooper) (L. Banff fm., L. Carboniferous, Alberta).

## *P. atlanticus* Clarke and Ruedemann 1912

### (Campbellton beds, L. Devonian, New Brunswick)

*Clarke, J. M., and Ruedemann, R., 1912, N.Y. State Mus., Mem. 14, pp. 89, 356-358, pl. 79, figs. 3-5 (*Pterygotus* sp. Whiteaves, 1883, =Eurypterid remains, Clarke and Ruedemann, 1912, p. 357).

O'Connell, M., 1916, Contr. Dept. Geol., Columbia Univ., N.Y., vol. 26, No. 7, p. 23, table 1 (*also* Bull. Buffalo Soc. Natural Sci., 1916, vol. 11, No. 3).

Russell, L. S., 1947, Contr. Roy. Ont. Mus. Pal., No. 12, p. 3 (*P.* ? *atlanticus*) (=*P. gaspesiensis* Russell, 1954).

*————1954, Nat. Mus., Canada, Bull. 132, p. 86, pl. 1, fig. 4; pl. 2, fig. 2.

*P. canadensis* Dawson, J. W. 1879

(Ancaster chert beds, Niagaran, M. Silurian, Ontario)

Dawson, J. W., 1879, Can. Naturalist and Quart. J. Sci., n.s., vol. 9, No. 2, pp. 103-105, June 23, 1879 (*Daily Witness*, Montreal, April 30, 1879—not found in "Last Edition").

*P. gaspesiensis* Russell 1954

(Gaspé Ss. fm., L. or M. Devonian, Quebec)

*Russell, L. S., 1954, Nat. Mus., Canada, Bull. 132, pp. 83-91, fig. 1; pl. 1, figs. 1-3; pl. 2, figs. 1, 3 (=*P. ? atlanticus* Russell 1947).

*P. problematicus* Agassiz 1839

(Gaspé Ls. fm., L. Devonian, Quebec)

Geol. Surv., Canada, 1846, Rept. Prog. 1844, p. 32.
Salter, J. W., 1852, Quart. J. Geol. Soc. London, vol. 8, p. 387.
Huxley, T. H., 1859, Mem. Geol. Surv., United Kingdom, British Organic Remains, Monog. 1, pt. I, p. 8.

*Stylonurus* Page 1856

*Stylonurus* ? sp.

(Upper Silurian, Arisaig, Nova Scotia)

Ami, H. M., 1892, Trans. Nova Scotian Inst. Sci., ser. 2, vol. 1, p. 192.

*Tylopterella* Størmer 1951

(*Tylopterus* Clarke and Ruedemann, 1912, *non* Capiomont 1863)

*Tylopterella boylei* (Whiteaves) 1884

(Guelph fm., M. Silurian, Ontario)

*Whiteaves, J. F., 1884, Geol. Surv., Canada, Palaeoz. Fossils, vol. 3, pt. 1, pp. 42-43, pl. 7, fig. 3 (*Eurypterus boylei*).
Miller, S. A., 1889, "North American Geology and Palæontology", p. 548.
Whiteaves, J. F., 1895, Geol. Surv., Canada, Palaeoz. Fossils, vol. 3, pt. 2, p. 109.
Whiteaves, J. F., 1906, Geol. Surv., Canada, Palaeoz. Fossils, vol. 3, pt. 4, p. 340.
*Clarke, J. M., and Ruedemann, R., 1912, N.Y. State Mus., Mem. 14, pp. 87, 98, 216-219, fig. 42 (*Tylopterus boylei*).
O'Connell, M., 1916, Contr. Dept. Geol., Columbia Univ., N.Y., vol. 26, No. 7, p. 15, table I (*also* Bull. Buffalo Soc. Natural Sci., 1916, vol. 11, No. 3).
Williams, M. Y., 1919, Geol. Surv., Canada, Mem. 111, p. 82 (*Eurypterus* (*Thylopterus*) *boylei*).
Shaw, E. W., 1937, Trans. Roy. Can. Inst., vol. 21, pt. 2, p. 335.
Størmer, L., 1951, Geol. Mag., vol. 88, p. 421 (*Tylopterella boylei*).
*Størmer, L., 1955, "Treatise on Invertebrate Paleontology, pt. P, Arthropoda, Geol. Soc. Amer., p. P34, fig. 29, 4a, b.
Kjellesvig-Waering, E. N., 1958, J. Pal., vol. 32, No. 6, p. 1143.

Eurypterid remains.

Clarke, J. M., and Ruedemann, R., 1912, N.Y. State Mus., Mem. 14, p. 357 (Dalhousie fm. ?, L. Devonian, New Brunswick).
Williams, M. Y., 1914, Geol. Surv., Canada, Mem. 60, p. 132 (Ross Brook fm., M. Silurian, Nova Scotia).
Williams, M. Y., 1919, Geol. Surv., Canada, Mem. 111, pp. 85-86 (Bertie fm., U. Silurian, Ontario).

Russell, L. S., 1947, Contr. Roy. Ont. Mus. Pal., vol. 12, pp. 1-3 (Gaspé Ss. fm., L. or M. Devonian, Quebec).

Bureau, R., 1948, Ann. Assoc. Can.-Français Adv. Sci., vol. 14, p. 65 (Gaspé Ss. fm., L. or M. Devonian, Quebec).

Thorsteinsson, R., 1958, Geol. Surv., Canada, Mem. 294, p. 68 (Read Bay fm., Member C, U. Silurian, Ludlow, Cornwallis Island, Northwest Territories).

Harker, P., and Raasch, G. O., 1958, "Jurassic and Carboniferous of Western Canada", Am. Assoc. Petrol. Geol., p. 228 (L. Banff fm., L. Carboniferous, Alberta).

Cumming, L. M., 1959, Geol. Surv., Canada, Mem. 304, p. 31 (Upper Silurian, Gaspé, Quebec).

## Forms with doubtful eurypterid affinities

### Angustidontidae Cooper 1936

*A. seriatus* Cooper 1936

(L. Banff fm., L. Carboniferous, Alberta-British Columbia)

Raasch, G. O., 1956, J. Alta. Soc. Petrol. Geol., vol. 4, No. 5, p. 113 (*Pterygotus*).

*Harker, P., and Raasch, G. O., 1958, "Jurassic and Carboniferous of Western Canada", Am. Assoc. Petrol. Geol., pp. 217, 228-230, pl. 1, fig. 11 (*Pterygotus*).

*A. weihmannae* n. sp.

## Table V

### *Stratigraphic Distribution of Canadian Eurypterida*

| Species | Ord. | | Silurian | | | Devonian | | | Carboniferous | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M | U | L | M | U | L | M | U | L | U | | |
| | | | | | | | | | | L | M | U |
| *Campylocephalus* cf. *scouleri* (Hibbert) | | | | | | | | | | X | | |
| *Carcinosoma* (*Eusarcus*) sp. | | X | | | | | | | | | | |
| *C. libertyi* n. sp. | | | | X | | | | | | | | |
| *C.* ? *logani* (Williams) | | | | | X | | | | | | | |
| *Eurypterella ornata* Matthew | | | | | | | | | | | X | |
| *Eurypterus* sp. | X | | X | XX | X | X | X | | | X | X | |
| *E. fischeri* Eichwald | | | | | X | | | | | | | |
| *E. fischeri rectangularis* Schmidt | | | | | X | | | | | | | |
| *E. lacustris* Harlan | | | | | | X | | | | | | |
| *E. laticeps* Schmidt | | | | | X | | | | | | | |
| *E. pulicaris* Salter | | | | | | | | | | | X | |
| *E. remipes* Dekay | | | | | ? | X | | | | | | |
| *Hastimima* sp. (cf. *H. whitei* White) | | | | | | | | | | | X | |
| *Lepidoderma brasdorense* (Bell) | | | | | | | | | | | | X |
| *Pterygotus* sp. | | | | | X | X | X | XX | X | | | |
| *P. atlanticus* Clarke and Ruedemann | | | | | | | X | | | | | |
| *P. canadensis* Dawson | | | | X | | | | | | | | |
| *P. gaspesiensis* Russell | | | | | | | | X | | | | |
| *P. problematicus* Agassiz | | | | | | | X | | | | | |
| *Tylopterella boylei* (Whiteaves) | | | | | X | | | | | | | |
| Eurypterid remains | | X | | X | | X | X | X | | | | |
| Angustidontidae spp. | | | | | | | | | X | X | | |

# NEW OCCURRENCES OF *CERATIOCARIS* AND *PTYCHOCARIS* (PHYLLOCARIDA) FROM THE CANADIAN ARCTIC

*M. J. Copeland*

## Introduction

During recent years geological investigations of the Canadian Arctic islands have revealed the presence of several unusual arthropods in strata of Upper Silurian and Middle Devonian age. These discoveries were made by R. Thorsteinsson on Cornwallis Island, and by D. J. McLaren, during the Geological Survey of Canada's "Operation Franklin" on Bathurst and Ellesmere Islands. Precise dating on the evidence of associated graptolites and brachiopods shows these arthropods to be comparable in age to species of these genera from Europe; no direct correlation is possible with faunas elsewhere in North America.

Three species, two of them new, representing two genera are included in this report. The species of *Ceratiocaris* (*C. cornwallisensis* n. sp., and *C.* sp. cf. *C. stygia* Salter) agree closely with British Ludlovian species recorded by Jones and Woodward 1888. The new species of *Ptychocaris* (*P. novaki*) is the second recorded occurrence of this genus; the first, from Bohemia, was made by O. Novák in 1885. The present occurrence from Ellesmere Island extends the range of this genus into the Middle Devonian.

## Systematic Palaeontology

Family CERATIOCARIDAE Salter

Genus *Ceratiocaris* McCoy 1849

*Ceratiocaris cornwallisensis* n. sp.

Plate VIII, Nos. 1, 2; Plate IX, No. 5

*Ceratiocaris* sp. cf. *C. acuminatus* Hall, Thorsteinsson, 1958, p. 101.

*Description.* Species based on four specimens of the posterior segments and caudal appendages, preserved in fine-grained calcareous siltstone. Only the four posterior abdominal segments known (Pl. IX, No. 5), tapering in width posteriorly from 35 mm to 22 mm, the three anterior ones having lengths of about 13 mm. The ultimate abdominal segment reaches an extreme length of 35 mm and bears, on its posterior end, the trifid caudal appendage. Patches of ornamentation are preserved on several of these abdominal segments consisting of faint anastamosing striae extending postero-ventrally from the dorsum.

Caudal appendage bears a long central telson and two shorter lateral cercopods (stylets). The telson of the holotype is 150 mm long and 23 mm wide near the base, tapering posteriorly to a sharp point. It was triangular in cross-section

and deeply grooved on its ventral surface to accommodate the articulation surfaces of the lateral cercopods. These two lateral elements similar in shape to the telson, but only two thirds as long, reach a maximum width of about 12 mm. Each is rounded on its anterior end to permit articulation with the ventral surface of the telson. The caudal appendage bears no distinctive ornamentation (i.e., pits, ridges, etc.) such as that present on numerous other species of the genus. Marginal ridges present on all three caudal elements possibly resulting from lateral compression. The anterior portion of the telson bears striations similar to the preceding abdominal segments.

*Remarks.* The known parts of this species indicate it to be one of the largest ceratiocarids yet described. It is surpassed in size by *C. ludensis* Woodward 1871 but has a much more strongly developed caudal appendage which does not bear the longitudinal ridges present on *C. ludensis.*

*Occurrence.* Specimens were found at two localities on northern Cornwallis Island, both from strata of member C of the Cape Phillips formation. The older occurrence, of lower Ludlovian age, is on Snowblind Creek, associated with specimens of *Monograptus nilssoni, M. tumescens* and *M.* cf. *M. uncinatus* (*see* Thorsteinsson, 1958, p. 101). The younger occurrence is from the type section at Cape Phillips above the highest graptolites (*Monograptus* n. spp. P and T *of* Thorsteinsson) and below the Upper Silurian shelly fauna. A middle Ludlovian or younger age is probable for this occurrence (Thorsteinsson, ibid., pp. 103, 104).

*Types.* Holotype, GSC No. 14006; paratypes, GSC Nos. 14005, 14011.

### *Ceratiocaris* sp. cf. *C. stygia* Salter 1860

Plate VIII, Nos. 3, 4; Plate IX, No. 4

*Synonomy: see* van Straelen and Schmitz, 1934, "Fossilium Catalogus", pars 64, pp. 68, 69.

Specimens are preserved as disarticulated, carbonized films in a highly indurated black siltstone. The shape of the carapace is unknown, only one example (Plate IX, No. 4) showing part of right valve preserved in outline. The postero-ventral part of this valve shows faint longitudinal striae paralleling the free margin. The abdominal segments are thrust forward upon each other, resulting in a series of oblique ridges marking the junctures of the segments. Apparently five exsert segments are present, the last being more than twice as long as wide. The trifid caudal appendage is imperfectly preserved, the cercopods being possibly half as long as the telson spine.

Supposed ceratiocarid "teeth" are preserved in these starta disarticulated from the other remains. They consist of a basal platform supporting five or six cusps which increase in size towards one extremity.

*Remarks.* These specimens are questionably referred to the British species, *C. stygia.* This identification is based on the extreme length of the last abdominal

segment which appears to be characteristic of *C. stygia* and *C. stygia* var? Jones and Woodward. The only ornamentation preserved on the present specimens consists of obscure longitudinal striae on one valve; similar striae are common on numerous other *Ceratiocaris* species (i.e., *C. acuminatus* Hall from the Upper Silurian Bertie formation of New York).

*Occurrence.* The specimens were obtained, together with orbiculoid brachiopods, from strata 1,300 feet above the base of the Cape Phillips formation exposed on Twilight Creek (Stuart River), Bathurst Island. The graptolite fauna from this section has been identified by R. Thorsteinsson. *Monograptus ultimus,* index graptolite of the basal middle Ludlovian, was obtained from strata in this section 970 feet above the base of the formation. *M. uncinatus uniformis* and *Monograptus* n. sp. B of Thorsteinsson aff. *M. angustidens,* index fossils of the two uppermost graptolite zones of the middle Ludlovian, were obtained at 1,500 and 1,510 feet respectively above the base of the formation. The latter species occurs with a poorly preserved specimen of *Ceratiocaris* sp. It is obvious, therefore, that the present occurrence of *Ceratiocaris* sp. cf. *C. stygia* is very reliably dated as middle Ludlovian.

*Types.* Hypotypes, GSC Nos. 14007, 14008, 14009.

## Family Echinocaridae Clarke

Genera contained within this family and enumerated by van Straelen and Schmitz (1934) include *Echinocaris, Eleutherocaris, Ptychocaris* and *Silesicaris.* Characteristic of the family is the presence of one sub-median longitudinal lateral carina of varying length dividing the valve into dorsal and ventral sectors, the anterior part of the dorsal sector bearing one or more distinct lobes. A key to the various echinocarid genera mentioned above is as follows:

1. Carina extending anterior and posterior to mid-length of valve ..... *Echinocaris*
2. Carina mostly anterior to mid-length of valve
   a. single anterior lobe ..... *Silesicaris*
   b. numerous anterior lobes and tubercles ..... *Eleutherocaris*
3. Carina mostly posterior to mid-length of valve ..... *Ptychocaris*

## Genus *Ptychocaris* Novák 1885

*Type species.* By subsequent designation, *P. parvula* Novák 1885.

Two species have previously been included within this genus—*P. parvula* Novák and *P. simplex* Novák, both known only from disarticulated valves (Fig. 9).



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Specimens of these species were collected from the Lower Devonian white Konjeprus limestone, étage F-f2 of Bohemia. Morphological characteristics of this genus are:

1. Three groups of dorsal lobes
   a. anterior group of three (?) partly confluent nodes arranged triangularly.
   b. single median node ("ocular" lobe of Novák), situated intermediate to the anterior and posterior lobes.
   c. one pair of posterior nodes bordered posteriorly and separated from each other by more or less pronounced furrows.
2. Median carina extending diagonally as either a straight or sigmoidally curved ridge from postero-ventrally of the median lobe towards the postero-ventral corner of the valve.
3. Valve variously ornamented with distinct longitudinal striae paralleling the free border.

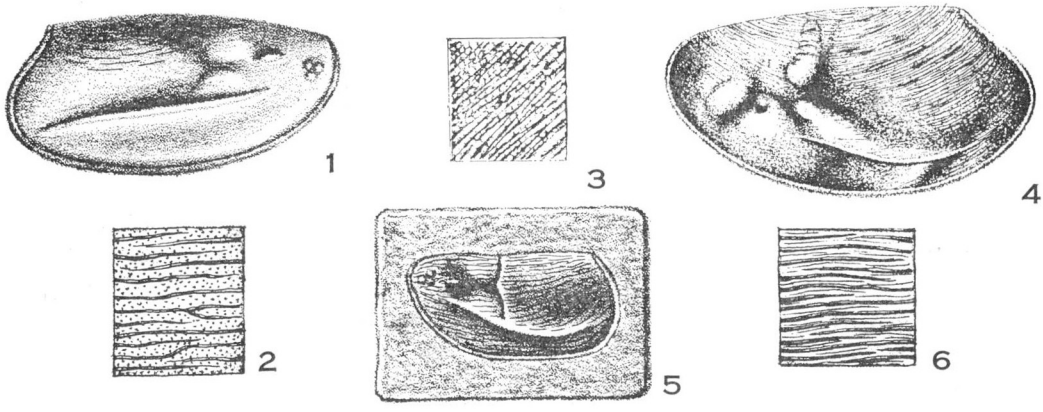


Figure 9. 1, 2. *Ptychocaris simplex* Novák, right lateral view and sculpture (*after* Novák, 1886, figs. 1, 2).
3, 4. *Ptychocaris novaki* n. sp., left lateral view and sculpture.
5, 6. *Ptychocaris parvula* Novák, left lateral view and sculpture (*after* Novák, 1886, figs. 5, 7).

*Ptychocaris novaki* n. sp.

Plate X, Nos. 4-6; Figure 9, Nos. 3, 4

*Echinocaris* sp. McLaren *in* Fortier *et al.*, "Operation Franklin" Report, Geol. Surv., Canada, MS. in preparation.

Species known only from incomplete valves. Valves ovate, posteriorly plenate, dorsum slightly convex, venter more broadly so, anterior and posterior margins narrowly rounded, ridged along entire free margin. Posterior-dorsal cardinal angle obtuse, angular (?). Longitudinal carina oblique, sub-median, curving parallel to the postero-ventral border.

Antero-dorsal sector divided into three major lobate areas. Anterior area indistinct with three (?) low rounded nodes, two posterior ones confluent and separated from the third (?) by a shallow furrow. Median lobe distinct, rounded, abruptly elevated above the valve surface, situated just posterior to the anterior lobate area, and separated from it by a shallow furrow. Posterior lobate area composed of two low, elongate, oblique nodes, one, directed antero-dorsally and lying dorsal to and along the anterior part of the sub-median carina, the other, more elevated, directed postero-dorsally, meeting the dorsal margin near the mid-length of the valve. These two posterior nodes separated from the broad posterior part of the valve by two deep, oblique, *en échelon* furrows extending in the form of a "Y" along their posteriorly facing margins.

Valve surface ornamented with longitudinal striae of two sizes lying roughly parallel with the free margin. Numerous minor striae present over the entire surface have the appearance of small confluent strings of beads (Pl. X, No. 6). The less numerous major striae widely separated and restricted to the postero-dorsal part of the valve. These consist of sharply defined smooth ridges or elongate tubercles extending parallel to the smaller striae or intersecting them at low angles. The lateral continuations of these major striae merge imperceptibly into the finer beaded striae.

The posterior segments of this species are presently unknown.

*Remarks.* This species is similar in lobation to both previously described species except for the relatively larger and more indistinct anterior nodes on *P. novaki.* Ornamentation on all species varies. The only striae present on *P. simplex* are restricted to the posterior dorsal part of the valve similar to the major striae on *P. novaki.* Minor striae are present over the entire surfaces of both *P. parvula* and the present species, those of *P. parvula* consisting of discreet anastamosing ridges whereas those of *P. novaki* are closely spaced confluent ridges having a distinctly beaded appearance.

*Occurrence.* The following information was given by D. J. McLaren who collected the specimens and identified the associated fauna.

> The specimens were collected on Southwestern Ellesmere Island, on the south side and about one mile inland from the eastern end of Eids Fiord. They occur in a small coral-stromatoporoid bioherm associated with species of *Productella, Atrypa* and *Scutellum.* This bioherm occurs 600 feet above the base of a sequence of fossiliferous, calcareous shales and argillaceous limestones with strongly developed coral and stromatoporoid biostromes. Fauna associated in these beds include species of *"Cymostrophia", Douvillina, Nervostrophia* (*"Sulcatostrophia"*), and *Schellwienella,* molluscs and trilobites. A species of *Lobobactrites* was collected from the beds above, associated with a similar fauna. The age of the formation is undoubtedly Middle Devonian, and possibly early Middle Devonian (Eifelian).

*Types.* Syntypes, GSC Nos. 12459, 12459a.



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# *ERYMASTACUS BORDENENSIS* A NEW MESOZOIC DECAPOD FROM THE CANADIAN ARCTIC

*M. J. Copeland*

## Introduction

This is the first reported occurrence of a fossil decapod from the Canadian Arctic. The species is known from a single specimen, preserved in a phosphatic nodule. Only the left lateral view of the cephalothorax and parts of both chelae of the first walking limbs are visible. It was collected by R. Thorsteinsson and E. T. Tozer during the summer of 1958.[1]

Sandstone strata from which the specimen was obtained are exposed on east-central Borden Island, Northwest Territories (approximately lat. 78°28′N, long. 110°07′W). These beds lie beneath fossiliferous strata of the Wilkie Point formation of Lower Jurassic (Toarcian) age and are underlain by strata bearing an Upper Triassic (Karnian) fauna (E. T. Tozer, personal communication). Fauna associated with the decapod are poorly preserved, however available evidence may indicate an Early Jurassic (Sinemurian) age (H. Frebold, personal communication).

The specimen is catalogued and deposited as GSC holotype No. 14496 in the type collection of the Geological Survey of Canada, Ottawa, Ontario.

## Systematic Palaeontology

### Genus *Erymastacus* Beurlen 1928

*Type species. Glyphea ornati* (pars) Quenstedt 1858.

The genus is known primarily from the chelate appendages of the first walking limbs (chelipeds) which are typically large and tuberculate with long, strong claws. The base of the chela is square to subquadrate and usually compressed along the interior side. Partly preserved or indistinct carapaces of *E. laedonensis* (Étallon), *E. ornatus* (Quenstedt), *E. villersi* (Morière) and *E. barbeaui* (Étallon) have been described. Characteristic of these species is the relatively small pre-cervical area, and the coarser tuberculation of the anterior two thirds of the carapace. In some instances this tuberculation becomes nodose or spinose (i.e., *E. laedonensis*). Little differentiation is evident between the carapaces of species of *Eryma* von Meyer and *Erymastacus,* the latter being relatively more pustulose and with a smaller pre-cervical area. The carapace of *Erymastacus* closely resembles that of *Pseudopemphix* Wüst 1903, however the chelae of the first walking limbs of these two genera are entirely different.

[1] Also, a specimen of *Glyphea stonesfieldiensis* van Straelen, of Bathonian age, was obtained from strata of the Wilkie Point formation north of Cape Canning, Prince Patrick Island.

*Erymastacus bordenensis* n. sp.

Plate XI, Nos. 1, 2; Figure 10

The holotype shows parts of the cephalothorax and chelae of the first walking legs.

The cephalothorax is anteriorly acuminate, with a long, denticulate rostrum and a pronounced antennal fold. The dorsal margin anterior to the post-cervical groove (c) is marked with several prominent, anteriorly directed spines. Only the anterior edge of the cephalothorax bears a marginal ridge, this is present only as a row of small tubercles on the antero-ventral part. Posteriorly the carapace is unknown.

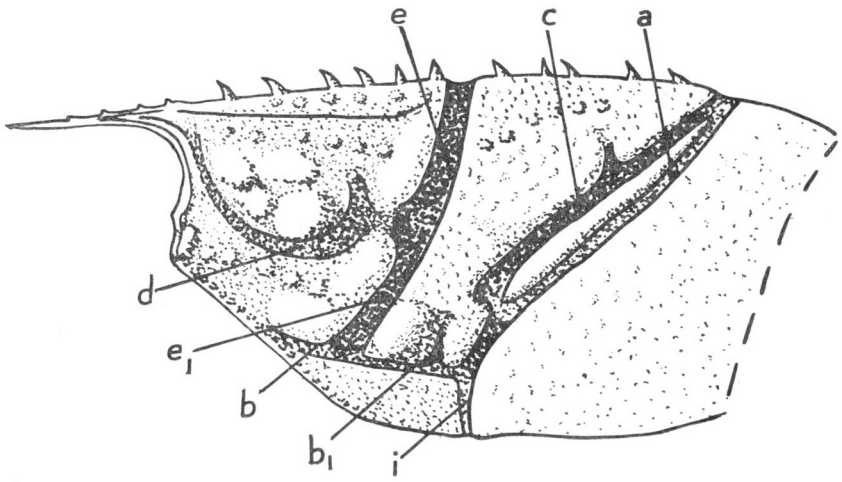


Figure 10. *Erymastacus bordenensis* n. sp., lateral view of cephalothorax, X2.

The lateral surface of the cephalothorax bears several well-defined grooves dividing the carapace into three major parts. The anterior part is bordered on its posterior edge by the deepest and most prominent groove, the cervical (e-e1), which extends from the mid-dorsal margin of the carapace almost to its antero-ventral corner. Midway it is intersected on its anterior edge by the shallow, inverted-sickle shaped gastro-orbital groove (d). This groove separates the anterior part of the carapace into dorsal and ventral areas. The dorsal area has two rows of six or seven tubercles each, lying dorsal to four large, low-rounded nodes situated in the curve of the gastro-orbital furrow. The ventral area bears a row of tubercles ending anteriorly at the antennal fold which bears a larger antennal tubercle. Posteriorly this area bears two low-rounded nodes. This anterior part of the cephalothorax is bordered ventrally by the short, horizontal antennal groove (b).

The triangular median part of the carapace is bordered posteriorly by the parallel post-cervical (c) and branchiocardiac (a) grooves, which are separated

by an elongate elevated ridge. The post-cervical groove extends ventrally more than half-way across the carapace and joins the shallower branchiocardiac groove at its junction with the posterior part of the hepatic groove ($b_1$). This latter groove makes an abrupt angle, limiting the ventral part of the median area and joining anteriorly with the antennal (b) and posteriorly with the inferior (i) grooves. The surface of the median area is finely pustulose, with a dorsal row of tubercles and a pronounced ventral node situated between the anterior hepatic and ventral cervical ($e_1$) grooves and bounded posteriorly by a depression possibly representing a remnant of the ruptured post-cervical groove.

The slightly elevated posterior part of the cephalothorax is finely pustulose but bears no distinctive features.

The chelae of the first walking limbs are very large, and bear numerous highly elevated tubercles of random orientation. The rectangular base of the chela is compressed along its inner edge. The strong claws, only partly preserved on the right limb, are apparently long and probably denticulate.

*Remarks.* The fundamental ornamentation of the cephalothorax of this species indicates its relationship to the Erymaidae van Straelen 1924, however, it does not appear to closely resemble any other species of the genus *Erymastacus* except in size, shape and ornamentation of the chelae. The presence of dorsal spines and pronounced tuberculation of the anterior part of the cephalothorax has not been previously reported for this genus. This type of ornamentation is present on species of the distantly related Triassic genera *Litogaster* von Meyer and *Pseudopemphix* Wüst, however the ultimate segments of the first walking limb of these Triassic genera differ greatly from the chelae of the present genus.

Species of the typically Jurassic genus *Eryma* von Meyer show many similarities to *Erymastacus* but the lack of pre-cervical ornamentation and the shape and smaller size of the chelae of *Eryma* preclude correlation of the two genera. Whether *Erymastacus* is a specialized offshoot of *Eryma* or of an older form (i.e., *Clytiopsis* Bill) is unknown. It seems probable, however, that the present species represents a highly specialized genus both in chela and carapace development. Whether this may be true of other species of *Erymastacus* cannot be shown as the carapace structures of these species is very imperfectly known.

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# PLATES I TO XI

## PLATE I

(All figures x2, except No. 8)

Nos. 1–5. *Echinocaris castorensis* n. sp. (Page 4)

1. Interior dorsal view; "Beaver Ridge", Alberta; paratype, GSC No. 13778.
2. Dorsal view; paratype, GSC No. 13779.
3. Carapace questionably referred to this species; paratype, GSC No. 13780.
4. Dorsal view of telson; paratype, GSC No. 13781.
5. Lateral view of left valve; holotype, GSC No. 13782.

Nos. 6, 6a. *Echinocaris consanguina* Eller 1935 (Page 5)

Lateral view of left valve and ventral view of right valve of one individual; "Beaver Ridge", Alberta; hypotype, GSC No. 13783.

No. 7. *Echinocaris* sp. (telson) (Page 6)

Dorsal impression of a well-preserved specimen; Imperial Westlock No. 14-24 well, Alberta, depth 5,095 feet; hypotype, GSC No. 13784.

No. 8. *Echinocaris beecheri* n. sp. (Page 6)

Dorsal view of nearly complete specimen; Imperial Zama Lake well, Alberta, depth 1,355 feet; holotype, GSC No. 13785.

Nos. 9, 11, 12. *Spathiocaris* cf. *S. lata* (Woodward) (Page 8)

9. Central Leduc Toad River No. 1 well, British Columbia, depth 5,189 feet; hypotype, GSC No. 13786.
11. Central Leduc Toad River No. 1 well, British Columbia, depth 5,177 feet; hypotype, GSC No. 13788.
12. Imperial Paddle River No. 1 well, Alberta, depth 7,730-7,743 feet; hypotype, GSC No. 13789.

Nos. 10, 13. *Spathiocaris* cf. *S. bipartita* (Woodward) (Page 8)

Imperial Paddle River No. 1 well, depth 7,730-7,743 feet; hypotypes, GSC Nos. 13787, 13790.

No. 14. *Spathiocaris* ? sp. (telson) (Page 9)

Ventral view; Central Leduc Toad River No. 1 well, depth 5,165-5,170 feet; hypotype, GSC No. 13791.

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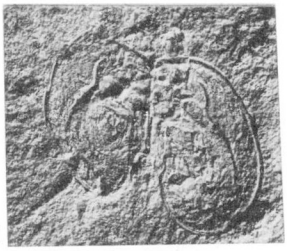

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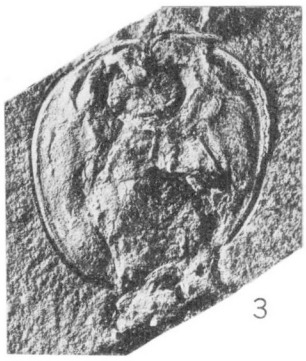

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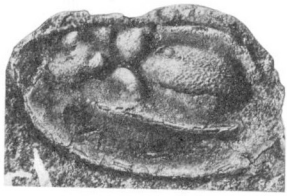

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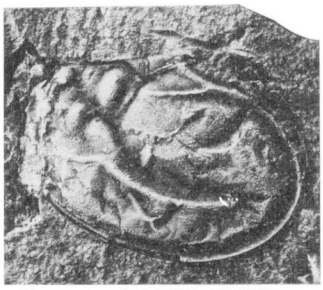

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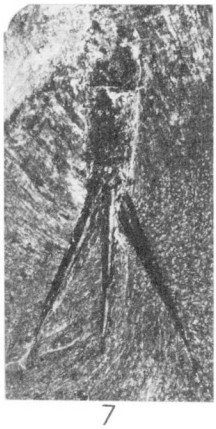

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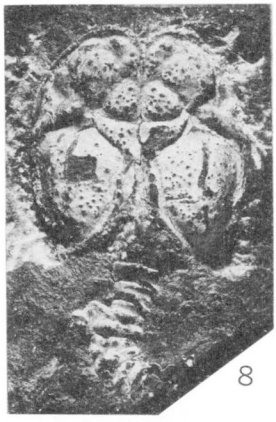

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## Plate II

Nos. 1-4. *Carcinosoma libertyi* n. sp. (Page 26)
Obverse and reverse impressions; Manitoulin Island, Ontario, west of Gore Bay village; Nos. 1 and 2 x1, Nos. 3 and 4 x5; holotype, GSC Nos. 13984, a.

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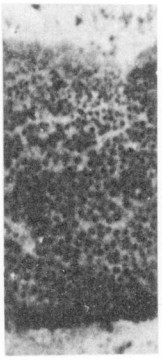

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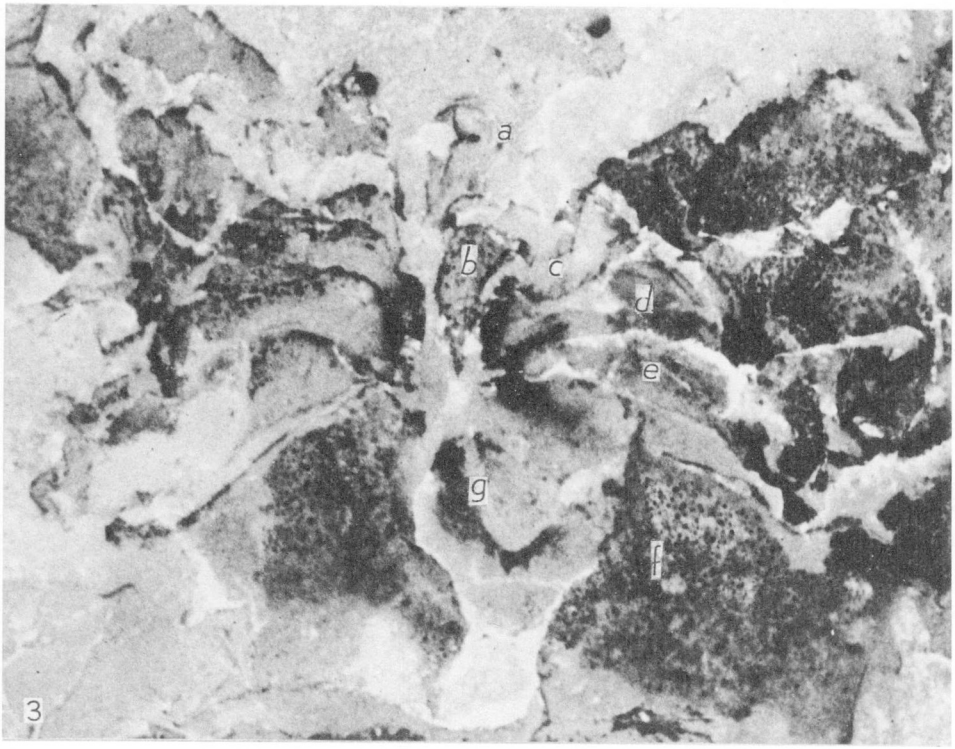


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## Plate III

No. 1. *Eurypterus lacustris* Harlan (Page 31)
Ventral view of well-preserved specimen; lot 5, con. 10, Bertie tp., Welland county, Ontario; x¾; hypotype, GSC No. 13985.

No. 2. *Eurypterus* cf. *E. lacustris* Harlan (Page 31)
Prosoma; lot 5, con. 10, Bertie tp., Welland county, Ontario; x1; hypotype, GSC No. 13986.

No. 3. *Eurypterus lacustris* Harlan (Page 31)
View of two specimens; lot 5, con. 10, Bertie tp., Welland county, Ontario; x½; hypotypes, GSC No. 13987,a.

No. 4. *Eurypterus lacustris* Harlan (Page 31)
Ventral view of a specimen; lot 5, con. 10, Bertie tp., Welland county, Ontario; x½; hypotype, GSC No. 13987a.

No. 5. *Eurypterus* cf. *E. lacustris* Harlan (Page 31)
Prosoma; lot 2, con. 13, Bertie tp., Welland county, Ontario; x2; hypotype, GSC No. 13988.


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b
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## Plate IV

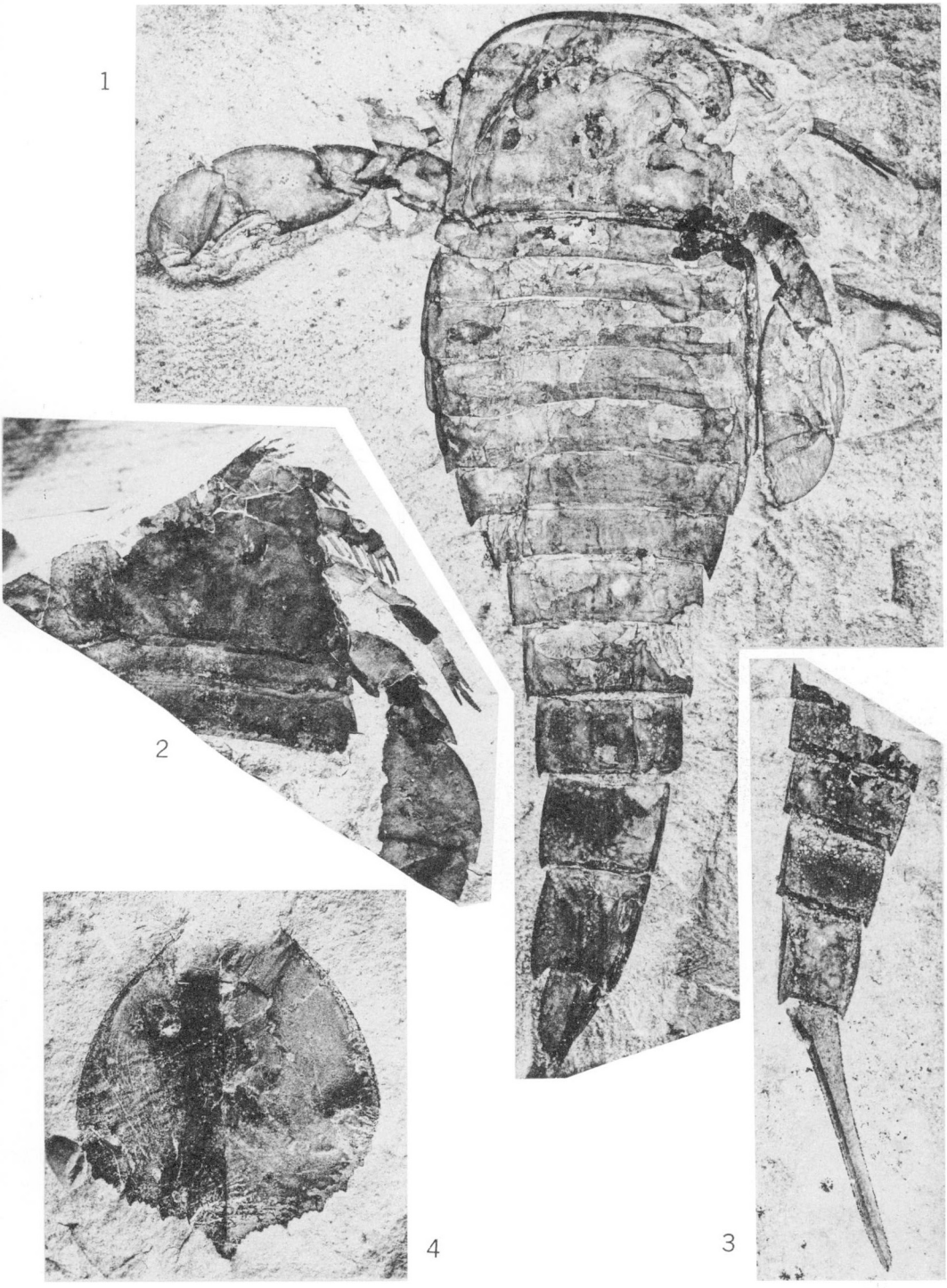
(All figures natural size except No. 1)

No. 1. *Eurypterus lacustris* Harlan (Page 31)
Dorsal view of nearly complete specimen; lot 5, con. 10, Bertie tp., Welland county, Ontario; x¾; hypotype, GSC No. 3224c.

No. 2. *Eurypterus lacustris* Harlan (Page 31)
Dorsal view of part of a prosoma with appendages; lot 5, con. 10, Bertie tp., Welland county, Ontario; hypotype, GSC No. 13989.

No. 3. *Eurypterus lacustris* Harlan (Page 31)
Posterior segments and telson; lot 4, con. 10, Bertie tp., Welland county, Ontario; hypotype, GSC No. 13990.

No. 4. *Pterygotus cummingsi* Grote and Pitt (Page 32)
Telson; North Buffalo, New York; hypotype, GSC No. 13991.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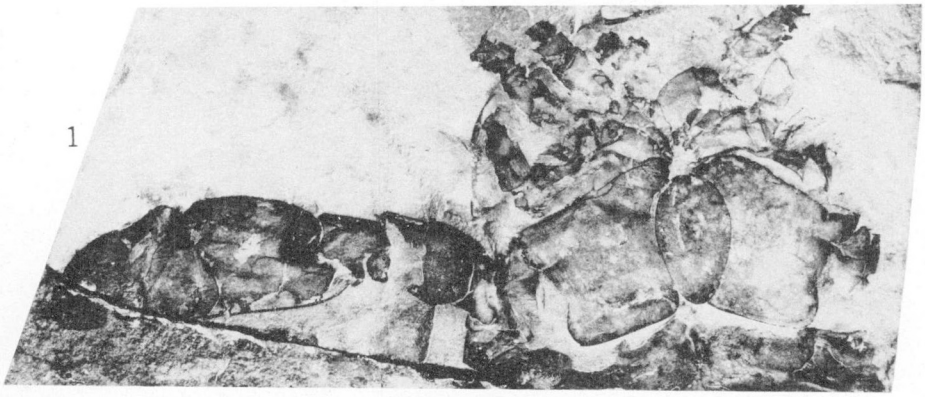
## PLATE V

(All figures natural size)

No. 1. *Eurypterus lacustris* Harlan (Page 31)
Ventral view of prosoma; Canada Southern Railway near Bertie, Welland county, Ontario; hypotype, GSC No. 13992.

No. 2. *Eurypterus lacustris* Harlan (Page 31)
Ventral view of prosoma; lot 5, con. 10, Bertie tp., Welland county, Ontario; hypotype, GSC No. 13993.

No. 3. *Eurypterus lacustris* Harlan (Page 31)
Ventral view of prosoma; quarry behind Ridgeway, Welland county, Ontario; hypotype, GSC No. 13994.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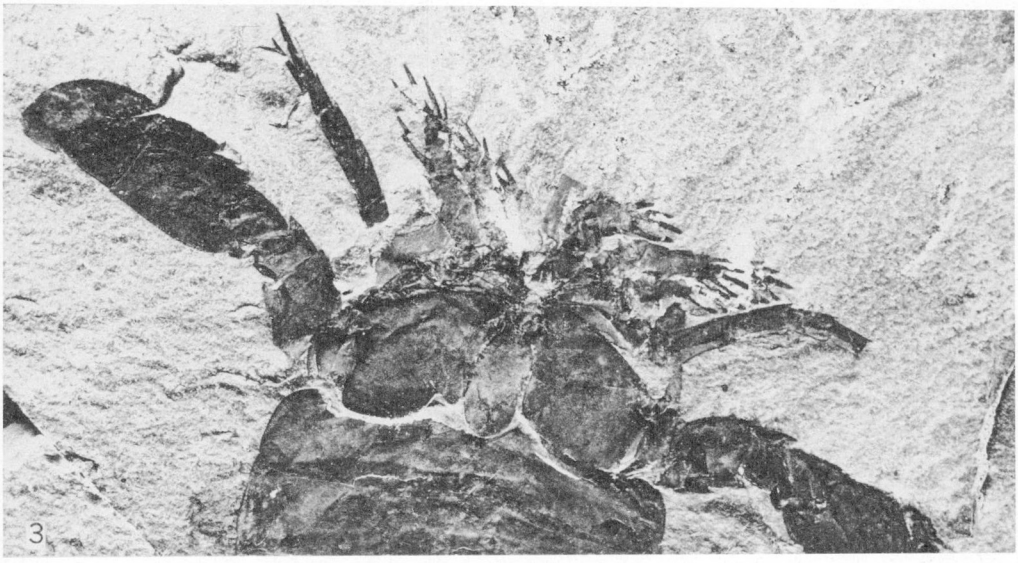
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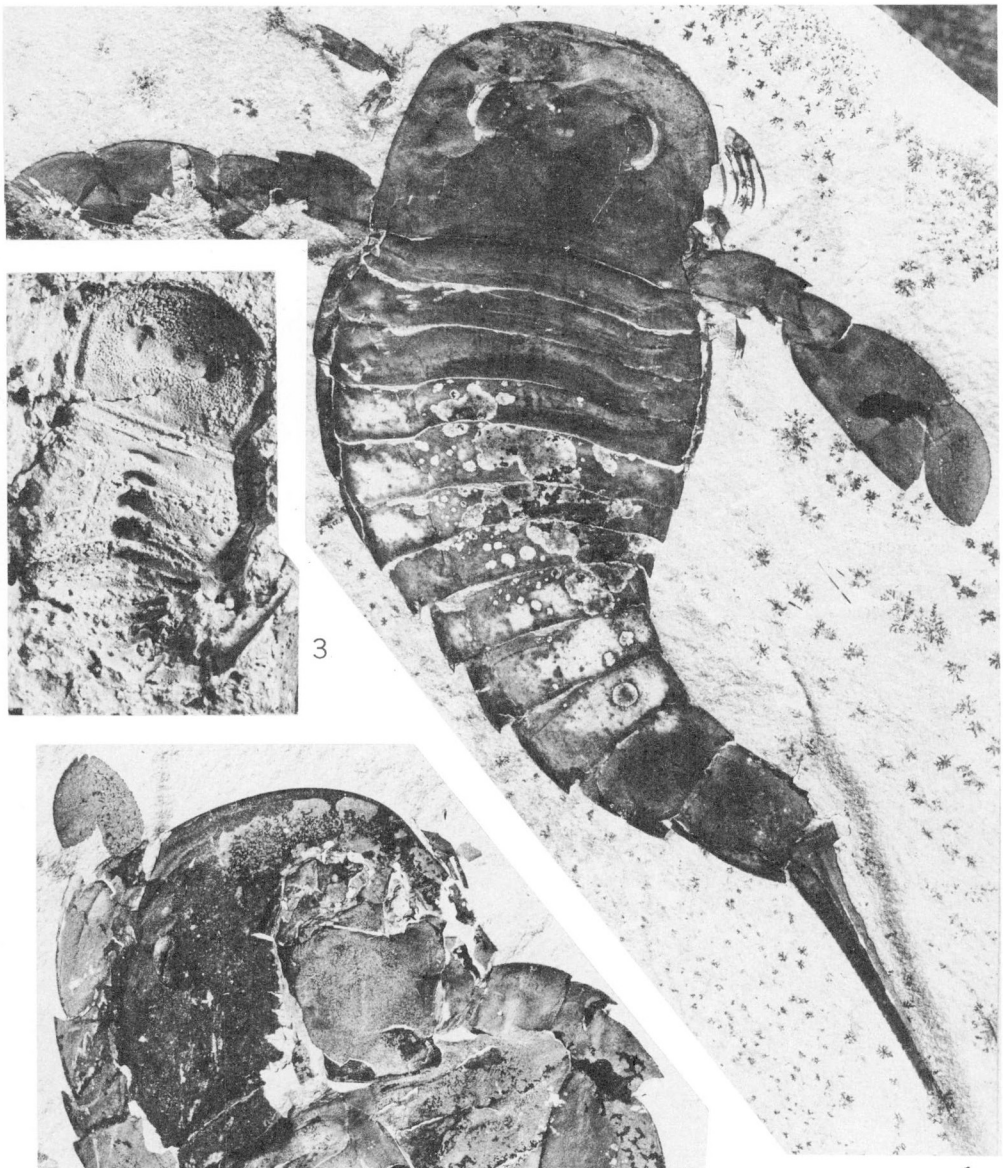
## PLATE VI

(All figures natural size)

No. 1. *Eurypterus lacustris* Harlan (Page 31)
Dorsal view of a nearly complete specimen; quarry behind Ridgeway, Welland county, Ontario; hypotype, GSC No. 13995.

No. 2. *Eurypterus dekayi* Hall (Page 29)
Anterior part of a specimen; Canada Southern Railway, Welland county, Ontario; hypotype, GSC No. 13996.

No. 3. *Tylopterella boylei* (Whiteaves) (Page 35)
View of type specimen; Elora, Ontario; holotype, GSC No. 2910.



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## PLATE VII

(All figures natural size)

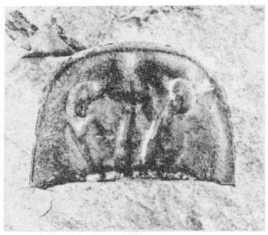
Nos. 1-5, 7, 8. *Eurypterus fischeri* Eichwald (Page 30)

Views of several prosomata and nearly complete specimens; Goodsir Creek, Cornwallis Island, Northwest Territories; hypotypes, GSC Nos. 13997-14001, 14003, 14004 (numbered consecutively).

No. 6. *Eurypterus laticeps* Schmidt (Page 32)

Dorsal view of a prosoma; same locality as above; hypotype, GSC No. 14002.

1



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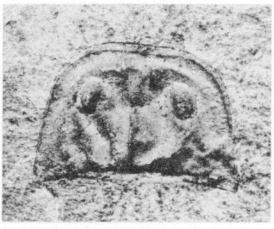

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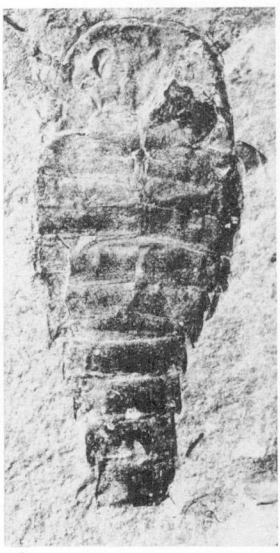

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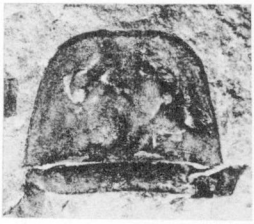

8

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4

## PLATE VIII

(All figures natural size except No. 4)

No. 1. *Ceratiocaris cornwallisensis* n. sp. (Page 49)
Posterior segment and telson; Cape Phillips, Cornwallis Island, Northwest Territories; paratype, GSC No. 14005.

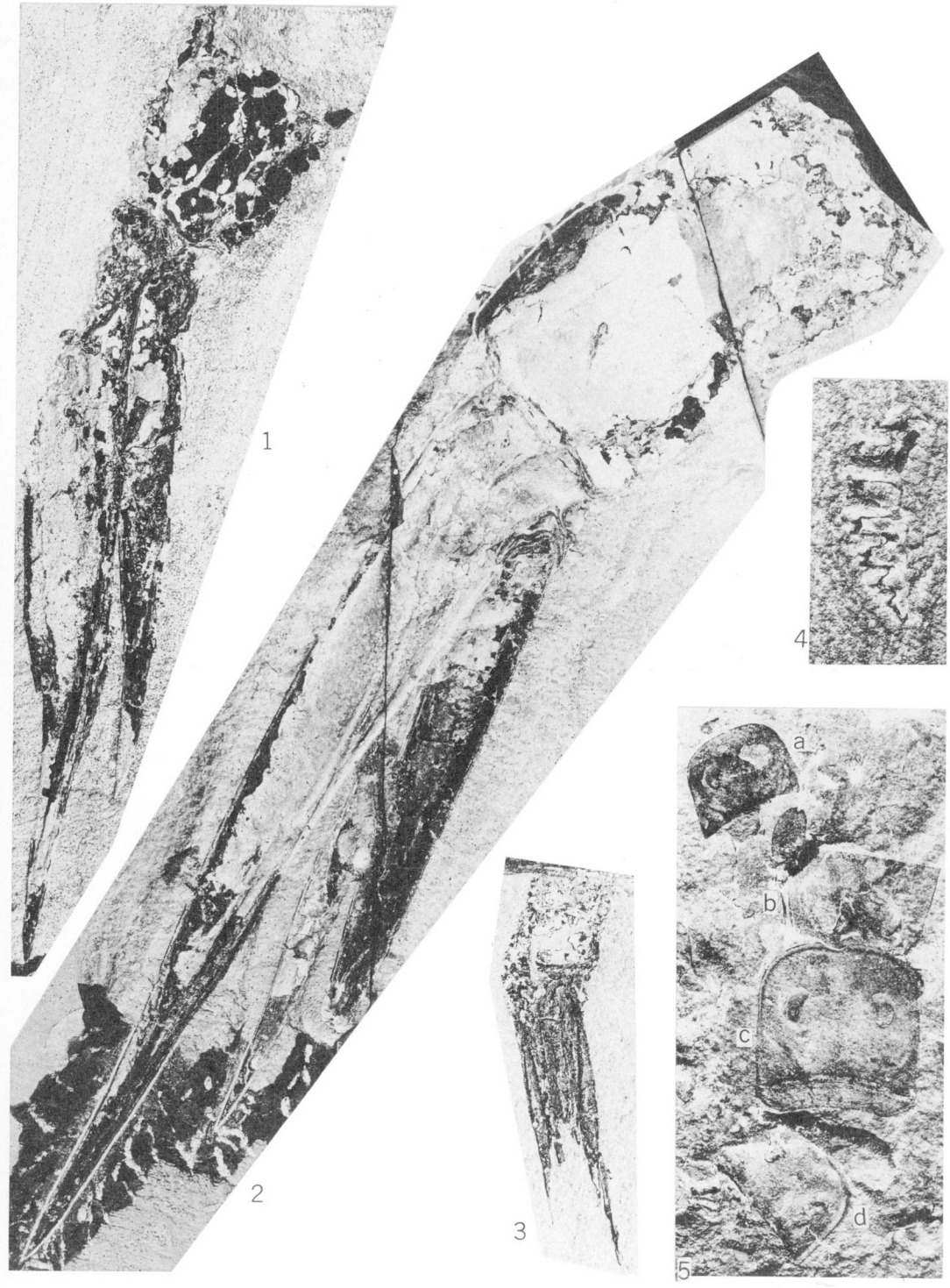
No. 2. *Ceratiocaris cornwallisensis* n. sp. (Page 49)
Posterior segments and telson; Cape Phillips, Cornwallis Island, Northwest Territories; holotype, GSC No. 14006.

No. 3. *Ceratiocaris* sp. cf. *C. stygia* Salter (Page 50)
Posterior segment and telson; Twilight Creek, Stuart River, Bathurst Island, Northwest Territories; hypotype, GSC No. 14008.

No. 4. *Ceratiocaris* sp. cf. *C. stygia* Salter (Page 50)
"Teeth"; Twilight Creek, Stuart River, Bathurst Island, Northwest Territories; x2; hypotype, GSC No. 14007.

No. 5. *Eurypterus fischeri* Eichwald (Page 30)
Prosomata; "a" hypotype, GSC No. 14004a; "b" hypotype, GSC No. 14004b; "d" hypotype, GSC No. 14004d.

*Eurypterus fischeri rectangularis* Schmidt (Page 30)
Prosoma; "c" hypotype, GSC No. 14004c.
Unit 14, Read Bay formation, member A, Goodsir Creek, Cornwallis Island, Northwest Territories.


1
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a
b
c
d
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PLATE IX

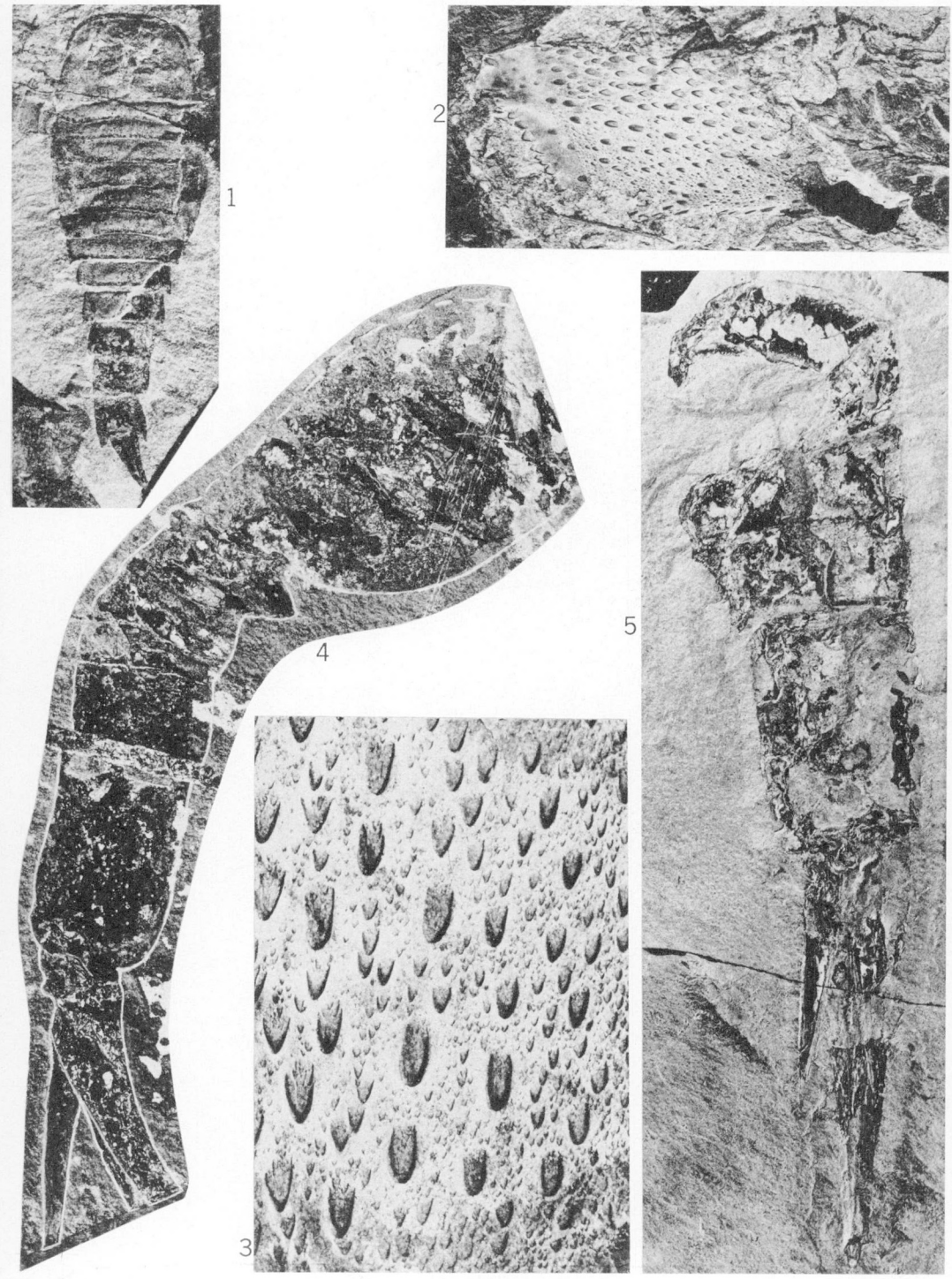
(All figures natural size except Nos. 2, 3)

No. 1. *Eurypterus fischeri* Eichwald (Page 30)
Dorsal view; Read Bay formation, member A, unit 14, Goodsir Creek, Cornwallis Island, Northwest Territories; hypotype, GSC No. 13998a.

Nos. 2, 3. *Pterygotus* sp. 1 (Page 33)
View of coxa of swimming limb; Scaumenac Bay, Chaleur Bay, Quebec; x1 and much magnified; hypotype, GSC No. 14010.

No. 4. *Ceratiocaris* sp. cf. *C. stygia* Salter (Page 50)
Twilight Creek, Stuart River, Bathurst Island, Northwest Territories; hypotype, GSC No. 14009.

No. 5. *Ceratiocaris cornwallisensis* n. sp. (Page 49)
Posterior segments and telson; Snowblind Creek, Cornwallis Island, Northwest Territories; paratype, GSC No. 14011.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## Plate X

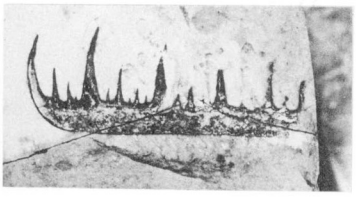
No. 1. *Angustidontus weihmannae* n. sp. (Page 38)
Lateral view; Gulf Sachs No. 10 well (10-36-43-1-W5) Alberta, depth 7,717.5-7,720 feet; x3; paratype, GSC No. 14013a.

No. 2. *Angustidontus weihmannae* n. sp. (Page 38)
Lateral view; Gulf Sachs No. 10 well (10-36-43-1-W5) Alberta, depth 7,717.5-7,720 feet; x3; holotype, GSC No. 14013.

No. 3. *Angustidontus* sp. (Page 37)
Impression; NE. British Columbia; x2; hypotype, GSC No. 13449.

No. 4. *Ptychocaris novaki* n. sp. (Page 52)
Lateral view of part of right valve; near Eids Fiord, southwestern Ellesmere Island, Northwest Territories; x2; syntype, GSC No. 12459.

Nos. 5, 6. *Ptychocaris novaki* n. sp. (Page 52)
Lateral view of part of left valve; near Eids Fiord, southwestern Ellesmere Island, Northwest Territories; x2 and much magnified; syntype, GSC No. 12459a.



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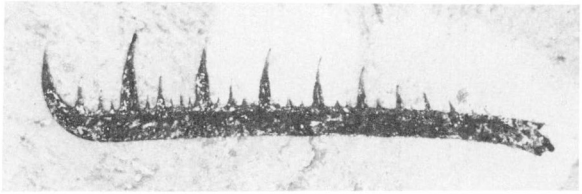

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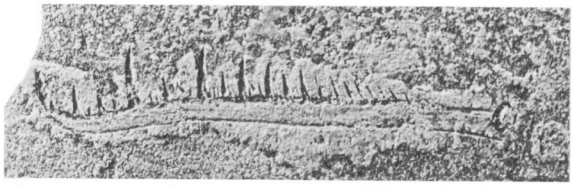

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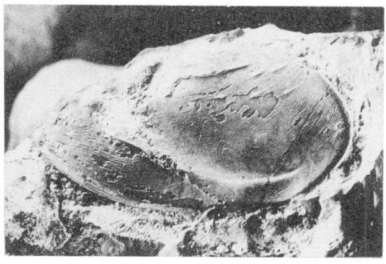

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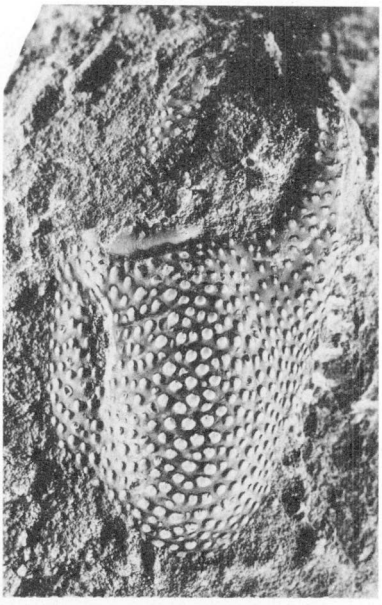
## Plate XI

Nos. 1, 2. *Erymastacus bordenensis* n. sp. (Page 56)

Left lateral view of cephalothorax and dorsal view of chela of first walking limb; Borden Island, Northwest Territories; x2; holotype, GSC No. 14496.



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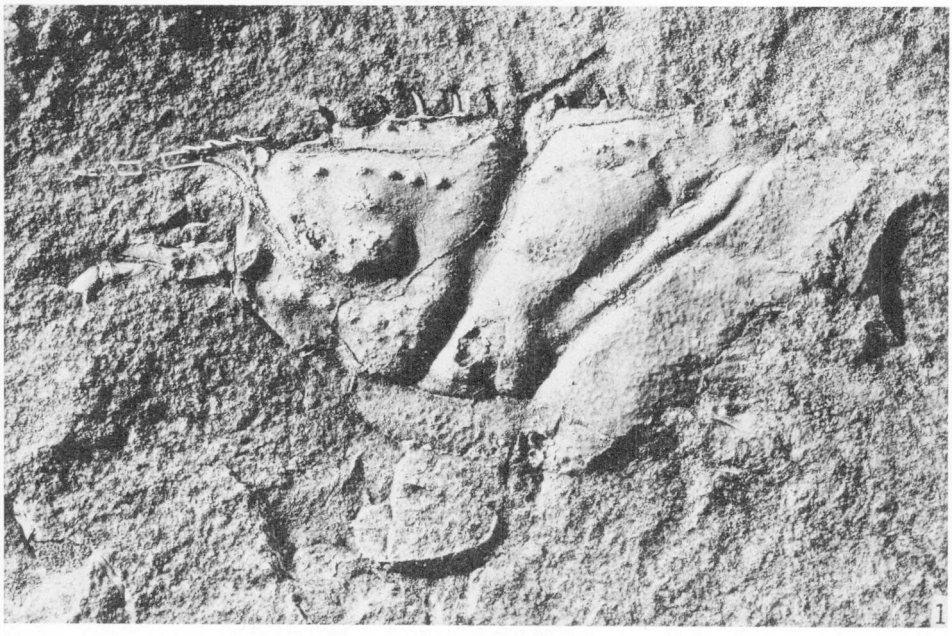

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