

CONTRIBUTIONS FROM THE MUSEUM OF PALEONTOLOGY

UNIVERSITY OF MICHIGAN

VOL. X, No. 6, pp. 101-157 (12 pls., 1 map)

MARCH 25, 1953

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TRILOBITES OF THE DEVONIAN  
TRAVERSE GROUP OF MICHIGAN

BY

ERWIN C. STUMM



UNIVERSITY OF MICHIGAN PRESS  
ANN ARBOR

**CONTRIBUTIONS FROM THE MUSEUM OF PALEONTOLOGY**

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OF MICHIGAN

By  
ERWIN C. STUMM

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## INTRODUCTION

THIS paper contains the results of a detailed study of the trilobites that occur in the Middle Devonian Traverse group of Michigan and in beds of the same age along the margin of the Michigan Basin. The marginal beds include the Arkona shale, the Hungry Hollow formation and the Widder formation of southwestern Ontario, the Plum Brook shale and Prout limestone of north-central Ohio, the Silica formation and Ten Mile Creek dolomite of northwestern Ohio and southeastern Michigan, and the Milwaukee dolomite of eastern Wisconsin.

*Acknowledgments*

The author wishes to thank Dr. G. A. Cooper, Curator of Invertebrate Paleontology and Paleobotany of the United States National Museum, for the loan of the complete collection of trilobites from the Traverse group

preserved in that institution, and Mr. John D. Sargent, Curator of Geology of the Buffalo Museum of Science, for the loan of excellently preserved specimens of *Dechenella* (*Basidechenella*) *rowi* (Green), *Dechenella* (*Monodechenella*) *macrocephala* (Hall), and *Phacops rana alpenensis* Stumm from the museum collections. In addition, he expresses appreciation to Mr. Irving G. Reimann for the gift of several trilobites from his personal collection, to Mr. A. E. Worline for the loan of a beautifully preserved specimen of *Phacops rana milleri* Stewart from the Ferron Point formation, and to Mr. and Mrs. E. P. Wright for the gift of several trilobites from the Hamilton group of southwestern Ontario.

#### *Previous Work*

Previous work on trilobites of the Traverse group has been very limited. Hall and Clarke (1888, pp. 71–72) described *Ancyropyge romingeri* from the Gravel Point formation of the Little Traverse Bay region. Grabau (1902, pp. 185, 194, 196) noted the occurrence of species of *Proetus* and *Phacops* in the Genshaw formation and of species of *Phacops* in the Norway Point formation and the Thunder Bay limestone in the Thunder Bay region. Pohl (1930, pp. 9, 15, 28) recorded the presence of undescribed species of *Proetus*, *Phacops*, and *Greenops* in the Gravel Point and Petoskey formations in the Little Traverse Bay region, and noted the occurrence of *Phacops rana milleri* Stewart in the Bell shale and the Ferron Point formation in the Thunder Bay region. Cooper and Cloud (1938, p. 459) described the new variety *Scutellum tullium depressum* from the middle part of the Petoskey limestone in the Little Traverse Bay region. Delo (1940, p. 18) noted the occurrence of *Phacops iowensis* in the upper part of the Traverse group. Cooper and others (1942, p. 1786) recorded the presence of *Dipleura dekayi* Green in the Thunder Bay limestone at Partridge Point.

With regard to the areas on the margin of the Michigan Basin, Whiteaves (1898, p. 418) listed the occurrence of *Crassiproetus* "*crassimarginatus*" (Hall), *Dechenella rowi* (Green), *Greenops boothi* (Green), and *Phacops rana* Green from strata of the Hamilton group in the Thedford-Arkona region of southwestern Ontario. Stewart (1927, pp. 58–60) described the subspecies *Phacops rana milleri* from the Silica formation of northwestern Ohio. Cleland (1911, pp. 142–43) recorded the occurrence of *Dechenella rowi* (Green), *Crassiproetus crassimarginatus* ? Hall, and *Phacops rana* Green from the Devonian rocks of the Milwaukee region, Wisconsin.

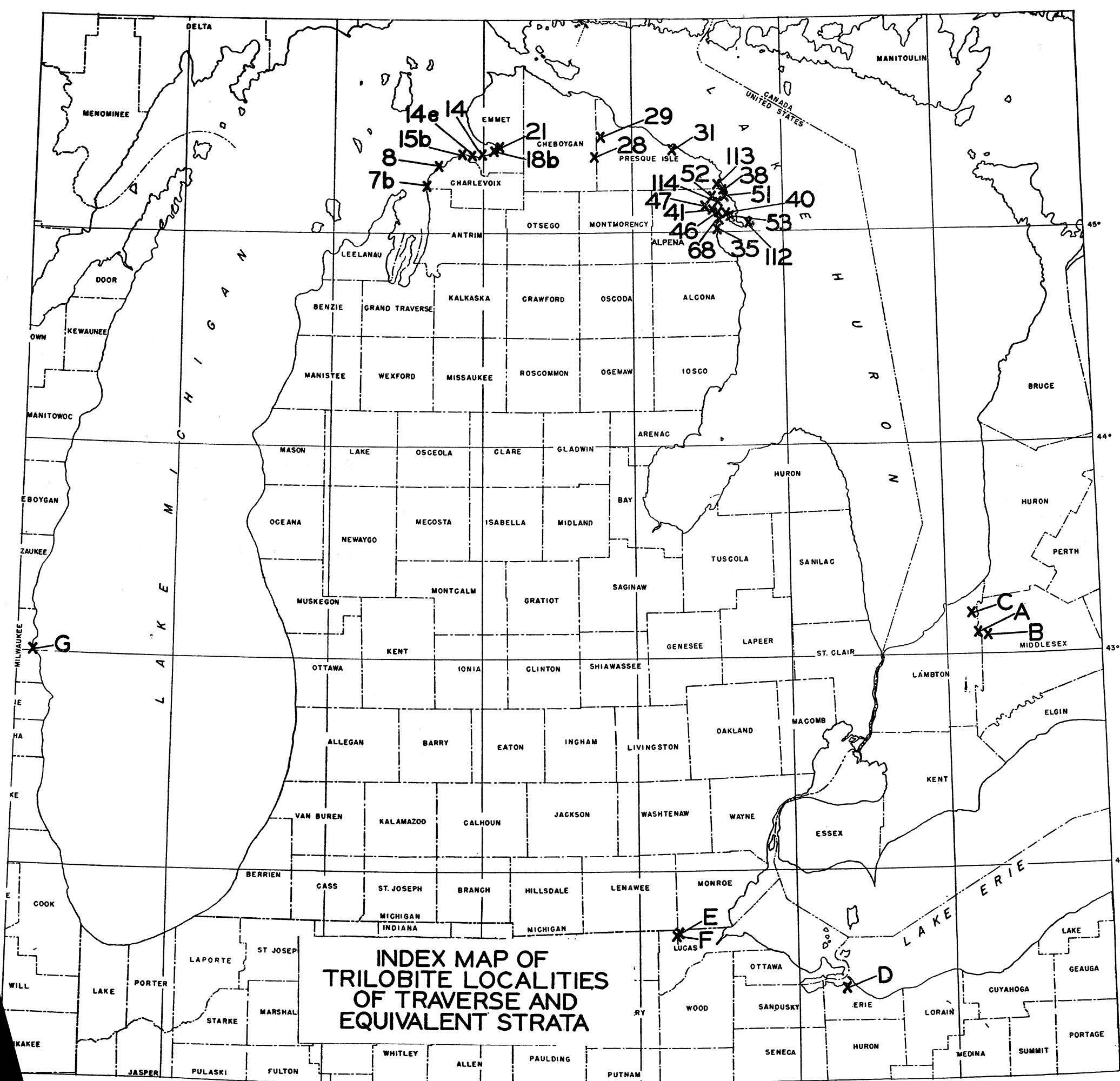
#### STRATIGRAPHY AND CORRELATION

The Traverse group is exposed in three regions in the northern part of the Lower Peninsula of Michigan. The easternmost of these outcrop areas

is in the vicinity of Thunder Bay in Alpena and Presque Isle counties. All formations of the Traverse group are exposed in this region, and the sequence has been described in an excellent paper by Warthin and Cooper (1943, pp. 571-95). The Thunder Bay region is the only area in which the lower part of the Traverse group is exposed. Correlation of the lower Traverse strata with the lower part of the Hamilton group exposed in southwestern Ontario and northwestern Ohio is facilitated by the distribution of the trilobites. *Phacops rana milleri* Stewart is present in the lower part of the Traverse group from the base of the Bell shale to the lower part of the Genshaw formation. The same form is characteristic of the Silica formation of northwestern Ohio and a closely related subspecies, *Phacops rana arkonensis* Stumm, occurs in the Arkona shale of the Thedford-Arkona region of southwestern Ontario. Another common trilobite, *Dechenella (Dechenella) alpenensis* Stumm, ranges from the base of the Bell shale to the basal part of the Genshaw formation of the Traverse group and is also present in the Arkona shale. The new subspecies *Phacops rana crassituberculata* Stumm occurs in the Ferron Point formation of the Traverse group and in the Silica formation of northwestern Ohio. The remainder of the trilobites in the lower part of the Traverse group are not known outside of Michigan.

With respect to the middle part of the Traverse group in the Thunder Bay region, the trilobite species occurring in the Newton Creek limestone and in the Alpena limestone are not known outside of Michigan. The common species *Phacops rana* (Green) is present in the Dock Street clay, the Four Mile Dam limestone, and the Norway Point formation. This species is also common in the Hungry Hollow and Widder formations of the Thedford-Arkona region of southwestern Ontario, and occurs in the Ten Mile Creek dolomite of northwestern Ohio. In New York *P. rana* ranges through the Ludlowville and Moscow formations comprising the upper part of the Hamilton group. *Dechenella (Basidechenella) rowi* (Green) and *Dechenella (Monodechenella) macrocephala* (Hall) both occur in the Four Mile Dam limestone of the middle part of the Traverse group in the Thunder Bay region. These two species are characteristic of the Ludlowville and Moscow formations of western New York. *Dipleura dekayi* Green is found in the Norway Point formation and ranges from the Skaneateles to the Moscow formation in western and central New York.

In the upper part of the Traverse group in the Thunder Bay region the species *Phacops iowensis* Delo is present in the Potter Farm formation and in the Thunder Bay limestone. This species is characteristic of the Cedar Valley limestone of Iowa. *Dipleura dekayi* Green occurs in the Thunder Bay limestone.



**INDEX MAP OF  
TRILOBITE LOCALITIES  
OF TRAVERSE AND  
EQUIVALENT STRATA**





The exposures of the Traverse group in the central part of the outcrop area are located in the Afton-Onaway region in Cheboygan County. The stratigraphy of these beds has been well described by Kelly and Smith (1947, pp. 447-69). The exposures in this region are poor and scattered and only a few fragmentary trilobite remains have been found.

The outcrops of the Traverse group in the western area are located along the south shore of Little Traverse Bay and southwestward along the shore of Lake Michigan to the north end of the eastern shore of Grand Traverse Bay, in Emmet and Charlevoix counties. The stratigraphy of this region has been studied by Pohl (1930, pp. 1-34). The middle and upper parts of the Traverse group are exposed in this region. The lowest stratigraphic unit, the Gravel Point formation, has been correlated with the Alpena limestone of the Thunder Bay region. The presence of the trilobites *Dechenella (Basidechenella) pulchra* Stumm and *Phacops rana alpenensis* Stumm in both these formations serves to strengthen this correlation. The species *Greenops traversensis* Stumm and *Greenops aequituberculatus* Stumm are found in the highest part of the Gravel Point formation and occur also in the Dock Street clay which caps the Alpena limestone in the Thunder Bay region.

The Gravel Point formation is overlain by the Charlevoix limestone in which no trilobites have been found. Above the Charlevoix limestone is the Petoskey formation which contains three distinct faunal assemblages (see Cooper and others, 1942, pp. 1776-77). The lower part of the Petoskey formation contains the trilobite species *Phacops iowensis* Delo, which is present in the Potter Farm and Thunder Bay formations in the Thunder Bay region and in the Cedar Valley limestone of Iowa. The middle part of the Petoskey formation contains the unusual trilobite *Scutellum tullium depressum* Cooper and Cloud which is also in the equivalent of the Cedar Valley limestone in Calhoun County, Illinois. The upper part of the Petoskey formation contains the new subspecies *Phacops rana norwoodensis* Stumm which is also found in the upper part of the Milwaukee dolomite of Wisconsin.

Unless otherwise designated the type specimens are in the Museum of Paleontology, University of Michigan.

## REGISTER OF LOCALITIES

## MICHIGAN

## LOCALITY

- 7b. Limestone ledges along shore of Lake Michigan, from 1 1/10 to 1½ miles north of Norwood, Charlevoix County, near center of North line, sec. 26, T. 33 N., R. 9 W.

8. Ledges and bluffs on shore of Lake Michigan at Gravel Point (Pine River Point, South Point),  $1\frac{1}{2}$  to 2 miles west of Charlevoix, Charlevoix County; on line between secs. 28 and 29, T. 34 N., R. 8 W.
14. Quarry of Petoskey Portland Cement Company, about  $1\frac{1}{2}$  miles west of Petoskey, Emmet County, SW.  $\frac{1}{4}$  sec. 2 and SE.  $\frac{1}{4}$  sec. 3, T. 34 N., R. 6 W.
- 14e. Abandoned "Bell" quarry and ledges on shore about 2 miles east of Bay Shore, Emmet County, near NE. corner sec. 8, T. 34 N., R. 6 W.
- 15b. Shore of Little Traverse Bay from Nine Mile Point to  $2\frac{1}{2}$  miles west, Charlevoix County, T. 34 N., R. 7 W.
- 18b. Section exposed, in 1933, in ditch on east side of Encampment Avenue, Bay View, Emmet County (ditch paved over before 1938), section extended from termination of Encampment Avenue on U.S. Highway 31, in front of Pennsylvania Railroad depot, to point about 50 yards south.
21. Kegomic quarry on south shore of Mud Lake just east of Harbor Springs road (Michigan Highway 131), about  $\frac{1}{4}$  mile north of its termination on U.S. Highway 31, one mile east of Bay View, Emmet County, SE.  $\frac{1}{4}$  SW.  $\frac{1}{4}$  sec. 27, T. 35 N., R. 5 W.
28. Ledges below dam on Black River  $\frac{1}{2}$  mile NE. of Tower, Cheboygan County, near center sec. 3, T. 34 N., R. 1 E.
29. Abandoned quarry of Onaway Limestone Company on shore of Black Creek, Presque Isle County, NW.  $\frac{1}{4}$  sec. 7, T. 35 N., R. 2 E.
31. Quarry of Michigan Limestone and Chemical Company at Calcite, near Rogers City, Presque Isle County, 10 sections in SE. part T. 35 N., R. 5 E. and adjacent townships.
35. Bluffs on northeast shore of Partridge Point, 4 miles south of Alpena, Alpena County, extends from center into SE.  $\frac{1}{4}$  sec. 11, T. 30 N., R. 8 E.
38. Abandoned quarry of Kelley's Island Lime and Transport Company, Rockport, Alpena County, sec. 6, T. 32 N., R. 9 E.
40. Quarry of Michigan Alkali Company, eastern edge of Alpena, Alpena County, sec. 13, T. 31 N., R. 8 E.
41. Exposures on banks and in bed of Thunder Bay River below Four Mile Dam, Alpena County,  $\frac{1}{4}$  mile S. of center, sec. 7, T. 31 N., R. 8 E.
46. Shale bank on south side of Thunder Bay River on Potter Farm about 1 mile below Four Mile Dam, Alpena County, center of E. line sec. 18, T. 31 N., R. 8 E.
47. Exposures on banks and in bed of Thunder Bay River below Norway Point Dam, Alpena County, NE.  $\frac{1}{4}$ , sec. 12, T. 31 N., R. 7 E. This dam is also known currently as the Six Mile or Seven Mile Dam. The waters ponded by the dam cover former dam sites farther up the river in section 2 of the same township, where Trowbridge's Mills, the Boom Company Dam, and the original Seven Mile Dam were located.
51. Abandoned shale pit of Alpena Portland Cement Company, about 1 mile east and  $\frac{1}{8}$  mile north of Genshaw School and 8 miles NE. of Alpena, Alpena County, SE.  $\frac{1}{4}$ , sec. 18, T. 32 N., R. 9 E.
52. Ledges along road cut on French Road,  $\frac{1}{4}$  to  $\frac{1}{2}$  mile south of Killian's Resort, Long Lake, Alpena County, center of East line, sec. 8, T. 32 N., R. 8 E.
53. Abandoned quarry of the Thunder Bay Limestone Company, eastern edge of Alpena, Alpena County, SE.  $\frac{1}{4}$ , sec. 14, T. 31 N., R. 8 E.

68. Small shale pit at the northwest corner of the Alpena Cemetery (Evergreen Cemetery), west city limits of Alpena, Alpena County, SW.  $\frac{1}{4}$  sec. 21, T. 31 N., R. 8 E.
112. Thunder Bay Island in Lake Huron about 4 miles east of North Point, Alpena County.
113. Rabiteau's farm, along west line of sec. 35, T. 33 N., R. 8 E., halfway between Long Lake and Grand Lake, Presque Isle County.
114. Ledges along Long Lake Road, near junction with Bell Road, south of Long Lake, Alpena County, sec. 22, T. 32 N., R. 8 E.

## ONTARIO

- A. Rock Glen on the Aux Sable River, 1 mile east and  $\frac{3}{4}$  mile north of Arkona, Lambton County, Ontario.
- B. Hungry Hollow on the Au Sable River, 2 miles north and  $\frac{3}{4}$  mile east of Arkona, Lambton County, Ontario.
- C. Brick and Tile Yard,  $\frac{1}{2}$  mile north of Thedford, Lambton County, Ontario.

## OHIO

- D. Ledges along tributary of Pipe Creek,  $\frac{1}{4}$  mile east of Bloomingville, Erie County, Ohio.
- E. Quarry of the Medusa Portland Cement Company at Silica,  $1\frac{1}{2}$  miles southwest of Sylvania, Lucas County, Ohio.
- F. Ten Mile Creek,  $\frac{1}{2}$  mile south of Silica, Lucas County, Ohio.

## WISCONSIN

- G. Milwaukee, Wisconsin.

## OCCURRENCE OF TRILOBITES

The distribution of the trilobites of the Traverse group and marginal beds of the Michigan Basin are summarized in Table I.

## SYSTEMATIC DESCRIPTIONS

## Phylum ARTHROPODA

## Class CRUSTACEA

## Subclass TRILOBITA

## Order OPISTHOPARIA

## Superfamily Proetacea

## Family Proetidae Salter

Proetidae Salter, 1864, p. 2 (see Richter and Richter, 1950a, p. 152).

*Diagnosis.*—Opisthoparoid trilobites with very weakly to strongly segmented glabella and free cheeks with holochroal eyes, rounded genal angles or genal spines. Thorax of 8 to 10 segments, typically 10. Pygidium segmented with rounded margin.





## Subfamily Proetinae Salter

*Diagnosis* (Pfibyl, 1946, pp. 93-94).—

Proetidae with 2-4 pairs of glabellar furrows on spherical or quadrilateral glabellae; the preglabellar fields relatively small. (Tropidium is invariably missing.) Eyes vary in size. Facial sutures are opisthoparoid. Thorax of 8(?)–10 segments. Pygidia relatively broad, with margins rounded off. Small number of pygidial rings and ribs.

Genus *Proetus* Steininger

*Proetus* Steininger, 1831, p. 355.

*Genotype*.—By original designation, *Calymene concinna* Dalman, 1827, p. 149 (see Richter and Richter, 1923, p. 340).

*Diagnosis*.—Glabella moderately to highly convex, subquadrate, longer than wide, with subparallel sides. Glabellar furrows lacking or indicated by faint shallow depressions, by color markings, or by impressions on internal molds. Free cheeks with a convex ocular platform and rounded genal angles. Occipital lobes small. Occipital ring with or without axial node. Thorax of 10 unornamented segments, axis and pleurae of about equal width. Pygidium large or small, strongly or weakly segmented, with or without a distinct brim.

*Proetus (Proetus)* Steininger

*Diagnosis*.—Cephalon subtrigonal to semilunate, brim distinct. Glabella with parallel or subparallel sides and rounded anterior margin, about one half as wide as long. Glabellar lobes weakly defined or lacking. Pygidium short and wide with a few well-defined axial segments and a few weakly defined pleural segments.

**Proetus (Crassiproetus)** Stumm, subgen. nov.

*Subgenotype*.—*Proetus (Crassiproetus) traversensis* Stumm, sp. nov.

*Diagnosis*.—Cephalon semicircular, typically with a narrow brim. Glabella smooth, highly convex, nearly as wide as long. Glabellar furrows obsolete except as very faint depressions or as color markings on some species. Free cheeks with a convex ocular platform, of large size in some species, and with rounded genal angles. Pygidium long, highly convex, and with many weakly defined segments on axis and pleurae. Test punctate or minutely granulose.

*Remarks*.—Several previously described North American species are characteristic of this subgenus. *Proetus folliceptus* Hall and Clarke (1888, pp. 101-4), from the Onondaga limestone of New York, is a representative species. *Proetus crassimarginatus* Hall (1843, p. 172), described and illustrated by Hall and Clarke (1888, pp. 99-101), is a composite of several

species. The original pygidium illustrated by Hall (1843, p. 172, Fig. 5) from the Onondaga limestone of New York, however, is that of a *Crassiproetus*. The free cheek described and illustrated as belonging to this species by Hall (1876, Pl. 20, Figs. 23–24) and by Hall and Clarke (1888, p. 99, Pl. 20, Figs. 23–24) is believed, in reality, to be the free cheek of a species of *Dechenella*. The species *Proetus searighti* Walter (1925, pp. 299–301) from the Cedar Valley limestone of Iowa is a species of *Crassiproetus*. *Proetus arietinus*, *P. occidentis*, and *P. bumastoides* described at the same time by Walter are probably species of *Crassiproetus*, but the types are too incomplete for accurate classification. The species described as *Cornuproetus calhounensis* Cooper and Cloud (1938, pp. 455–57) is a representative of *Crassiproetus*. The genotype species of *Proetus* (*Cornuproetus*) is *Gerastos cornutus* Goldfuss (1843, p. 558, Pl. 5, Fig. 1), a heavily tuberculate form with very long genal spines and a very short wide pygidium having a flat posterior border.

***Proetus* (*Crassiproetus*) *microgranulatus* Stumm, sp. nov.**

(Pl. I, Figs. 3, 8, 19)

*Description*.—Cephalon semicircular in outline with a relatively short flat brim having well-developed longitudinal striae on the border. Glabella subquadrate in outline, relatively highly arched, descending anteriorly almost vertically to the brim. Glabellar furrows lacking on test. Occipital lobes small, subrounded. Occipital furrow narrow, deeply incised. Occipital ring low convex, broad in the axial region. Palpebral lobes small, relatively flat, semilunate in outline. Free cheeks with arched ocular platforms and broadly rounded genal angles. Eyes of medium size, lenticular, from two to three times as long as high. Anterior part of glabella marked with fine wavy ridges. Entire cephalon faintly and finely granulose. Granules best developed on free cheeks.

Thorax with moderately convex axis and low-convex pleurae. Axial segments more elevated posteriorly; pleural segments with narrow pleural furrows. All segments closely and finely granulose.

Pygidium moderately convex with a distinct, steeply inclined brim. Axis arched, tapering posteriorly, composed of about 15 weakly defined, low-convex segments separated by relatively broad, shallow furrows. Pleurae with 10 to 12 weakly defined low-convex segments which become obsolete posteriorly. Segments and brim finely granulose with granules more distinct on the brim.

*Remarks*.—*Proetus* (*C.*) *microgranulatus* is similar to *P.* (*C.*) *calhounensis* (Cooper and Cloud) (1938, pp. 455–57), but differs in its com-

plete lack of glabellar furrows, more broadly rounded genal angles, lack of an axial node on the occipital ring, and finer granulation.

*Occurrence.*—Middle Devonian (Traverse group, Newton Creek limestone and Alpena limestone); localities 40 and 53, Alpena County, Michigan.

*Types.*—Holotype No. E13351, Buffalo Museum of Science; paratypes Nos. 27080 and 28676, Museum of Paleontology, University of Michigan.

***Proetus (Crassiproetus) traversensis* Stumm, sp. nov.**

(Pl. I, Figs. 1-2, 10-15, 17)

*Description.*—Cephalon semicircular with a narrow brim having a thick, upturned, longitudinally striated border. Glabella subquadrate, moderately to strongly convex, nearly as wide as long, with parallel sides and a rounded anterior margin. Glabellar furrows lacking or very faintly indicated by difference in color. In one specimen observed, posterior pair of glabellar furrows represented by faint shallow depressions. Occipital lobes low convex, subrounded. Occipital furrow relatively narrow, moderately incised. Occipital ring broad, low convex, with a small axial node. Palpebral lobes small, barely convex. Free cheeks with a broad, low-convex ocular platform and rounded genal angles. Eyes of moderate height, lenticular, about twice as long as high.

Thorax with low- to medium-convex axis and medium-convex pleurae. Axial segments broad, flat-topped; pleural segments with narrow, deep pleural furrows.

Pygidium about as long as wide, medium to high convex, with a broadly arched, posteriorly tapering axis composed of about 14 to 16 low-convex segments separated by broad, very shallow furrows. Pleurae with 9 to 11 very indistinct segments becoming obsolete posteriorly. Brim inclined, moderately broad, indistinctly separated from pleurae in some specimens.

Entire test minutely punctate. Punctae very distantly spaced and visible only with favorable preservation.

*Remarks.*—*Proetus (C.) traversensis* resembles *P. bumastoides* Walter (1925, pp. 301-2) in general outline, but differs in having occipital lobes and lacking wavy ridges on the anterior part of the glabella.

*Occurrence.*—Middle Devonian (Traverse group, Gravel Point formation and Four Mile Dam limestone); localities 8, 41, and 53, Emmet, Charlevoix, and Alpena counties, Michigan.

*Types.*—Holotype No. 117876, paratypes Nos. 117865a, 117865b, United States National Museum; paratypes Nos. 25446, 25447, 25449, 28673, and 28674, Museum of Paleontology, University of Michigan.



**Proetus (Crassiproetus) canadensis** Stumm, sp. nov.

(Pl. I, Figs. 6-7)

*Description.*—Cephalon semicircular with a very narrow brim having a strongly upturned, longitudinally striated anterior border. Glabella highly convex, subquadrate, nearly as wide as long, descending vertically to the anterior brim. Anterior part of glabella with faint, wavy transverse striae. No trace of glabellar furrows present. Occipital lobes of medium size, moderately arched, subtrigonal in outline. Occipital furrow deeply incised. Occipital ring wide and relatively flat. Palpebral lobes very small, crescentic, relatively flat. Free cheeks with relatively short, moderately convex ocular platforms and narrowly rounded genal angles.

Thorax with moderately arched axis and pleurae. Axial segments relatively broad and flat-topped; pleural segments with moderately deep, narrow pleural furrows.

Pygidium almost as long as wide, moderately to highly convex. Axis relatively narrow, broadly arched, tapering posteriorly, composed of about 15 very weakly defined segments of which the posterior ones are indistinct to obsolete. Pleurae with steeply inclined peripheral margins and composed of about 10 weakly defined segments which become obsolete posteriorly. Brim relatively wide, very steeply inclined.

*Remarks.*—*Proetus (C.) canadensis* can be distinguished from *P. (C.) traversensis* by its much shorter and more highly convex ocular platforms and lack of an axial node on the occipital ring. It can be distinguished from *P. (C.) microgranulatus* by its smooth test, less broadly rounded genal angles, and relatively longer, more weakly segmented pygidium.

*Occurrence.*—Middle Devonian (Hamilton group, Widder formation), locality B, Thedford-Arkona district, southwestern Ontario, Canada.

*Types.*—Holotype No. 27090, paratype No. 28672, and unfigured paratype No. 28677, Museum of Paleontology, University of Michigan.

**Proetus (Crassiproetus) alpenensis** Stumm, sp. nov.

(Pl. I, Figs. 4-5, 20)

*Description.*—Cephalon semicircular with a relatively narrow brim and a thick, longitudinally striated border. Glabella about as wide as long, subquadrate, low convex. No glabellar furrows visible. Occipital lobes lacking. Occipital furrow relatively wide and shallow. Occipital ring wide, low convex. Palpebral lobes very small, low convex, subcrescentic in outline. Free cheeks with relatively narrow, moderately arched ocular platforms and rounded genal angles. Eyes lenticular, about one half as high as long.

Thorax with moderately arched axis, composed of relatively wide, flat-topped segments which are elevated posteriorly. Pleurae unknown.

Pygidium moderately arched with a relatively wide, rapidly tapering axis composed of very weakly indicated, almost indistinguishable segments. Pleurae with anterior 3 segments moderately well defined, remainder obsolete.

*Remarks.*—The only other species which agrees with *Proetus* (*Crassiproetus*) *alpenensis* in the lack of occipital lobes is *P. (C.) bumastoides* Walter (1925, pp. 301–2) from the Cedar Valley limestone of Iowa. But that species differs from *P. (C.) alpenensis* in the possession of a highly arched glabella.

*Occurrence.*—Middle Devonian (Traverse group, Potter Farm formation and Thunder Bay limestone); localities 35 and 68, Alpena County, Michigan.

*Types.*—Holotype No. 25501 and paratypes Nos. 27088 and 27089, Museum of Paleontology, University of Michigan.

***Proetus* (*Crassiproetus*) *norwoodensis* Stumm, sp. nov.**

(Pl. I, Fig. 18)

*Description.*—Cranidium with a narrow deeply sulcate brim having a vertical anterior margin and a broad, anteriorly sloping border. Sub-trigonal, broadly arched, anterolateral, preglabellar fields present. Glabella medium convex, about as wide as long, sides tapering anteriorly, anterior border rounded. Occipital lobes very small, indistinct. Occipital furrow relatively wide and deep. Occipital ring wide, low convex. Palpebral lobes of medium size, crescentic in outline, low convex.

Free cheeks, thorax, and pygidium unknown.

*Remarks.*—The unusual cephalic brim and border and the development of anterolateral preglabellar fields make *Proetus* (*C.*) *norwoodensis* distinct from all other species referred to *Crassiproetus*.

*Occurrence.*—Middle Devonian (Traverse group, upper part of Petoskey formation, *Schizophoria* bed), locality 7b, ledges along shore of Lake Michigan, 1 1/10 miles north of Norwood, Charlevoix County, Michigan.

*Type.*—Holotype No. 25444, Museum of Paleontology, University of Michigan.

*Proetus* (*Crassiproetus*) sp. A

(Pl. I, Fig. 16)

*Description.*—Cephalon and thorax unknown. Pygidium large, highly convex, almost as long as wide. Axis relatively wide, broadly arched, tapering rapidly posteriorly, number of segments unknown. Pleurae highly convex, peripheral parts nearly vertical. Anterior 5 pleural segments wide,

flat-topped, separated by moderately wide, distinct furrows. Remainder of pleural segments unknown. Brim relatively wide, steeply inclined.

*Remarks.*—The pygidium of *Proetus* (*C.*) sp. A is similar to that of *P. (C.) traversensis* Stumm but differs from it in having flat-topped pleural segments.

*Occurrence.*—Middle Devonian (Traverse group, Ferron Point formation); at or near locality 29, vicinity of Black Lake, Presque Isle County, Michigan.

*Figured specimen.*—No. 28675, Museum of Paleontology, University of Michigan.

*Proetus (Crassiproetus) sp. B*

(Pl. I, Fig. 9)

*Description.*—Cephalon and thorax unknown. Pygidium low convex, slightly wider than long. Axis convex, relatively narrow, tapering posteriorly, composed of about 15 distinct segments. Posterior border of axis distinctly elevated. Pleurae with about 12 distinct segments, which are elevated posteriorly in their peripheral part, and separated by distinct, broad furrows. Brim well developed, moderately inclined peripherally. Segments and brim finely granulose.

*Remarks.*—The pygidium of *Proetus (C.) sp. B* is similar to that of *P. (C.) microgranulatus* Stumm, but differs from it in having more distinct segmentation and in having the posterior margin of the axis elevated.

*Occurrence.*—Middle Devonian (Traverse group, Genshaw formation), locality 112, Thunder Bay Island, Thunder Bay, Alpena County, Michigan.

*Figured specimen.*—No. 25448, Museum of Paleontology, University of Michigan.

Subfamily Dechenellinae Pfiibyl

Dechenellinae Pfiibyl, 1946, p. 121.

*Diagnosis* (Pfiibyl, 1946, p. 121).—

Proetidae with 3–4 pairs of glabellar furrows. Glabella conical or of cloverleaf form (Kleeblattförmig, according to R. Richter, 1912), i.e., with a broad base and a pair of very markedly projecting basal lobes, the frontal lobe being considerably narrowed. The anterior border is often bent inwards with a rounded-off rim. Facial sutures opisthoparoid. Thorax consists of ten segments. Pygidia are large and broad, considerably drawn-out lengthwise. The rhachis is formed of a large number of axial segments (12–20). The lateral lobes display up to 16 ribs. The margin of the pygidium shows a well-marked border.

Genus *Dechenella* Kayser

*Dechenella* Kayser, 1880, p. 705.

*Genotype.*—By subsequent designation of Vogdes, 1890, p. 83, *Philipsia verneuili* Barrande, 1852, p. 478.

*Diagnosis.*—Cephalon semilunate with anteriorly tapering glabella; 3 to 4 pairs of glabellar furrows well developed on some species, the posterior pair only in other species, all pairs obsolete except as impressions on internal molds in others. Brim broad, flat in some species, with a distinct border in others. Fixed cheeks small, with flat, well-defined palpebral lobes. Free cheeks with convex ocular platforms and genal spines of variable length. Eyes elongate, convex, rising almost to glabellar height. Occipital lobes typically well defined; occipital ring smooth or with axial node.

Thorax with 10 segments; axial parts convex, with axial nodes on some species; pleural parts distinctly furrowed.

Pygidium with moderately to strongly convex, segmented axial lobe, ornamented with axial nodes in some species. Pleural lobes with well-defined segments with median grooves present in some species. Brim relatively wide, smooth, and flat.

Test punctate or tuberculate.

#### Subgenus *Dechenella* (*Dechenella*) Kayser

*Diagnosis.*—*Dechenella* with 3 pairs of well-defined glabellar furrows and with glabella distinctly constricted in the position of the peripheral ends of the anterior pair of glabellar furrows. Occipital lobes small. Thorax segments smooth, unornamented. Pygidium long, distinctly segmented, with low-convex axial lobe and wide flat brim. Test punctate.

#### *Dechenella* (*Dechenella*) *alpenensis* Stumm, sp. nov.

(Pl. II, Figs. 1–15)

*Description.*—Cephalon semilunate, with a wide flat brim. Glabella moderately convex, tapering rapidly anteriorly to the position of the anterior pair of glabellar furrows, then at a lesser angle, producing an unequally trilobate appearance. Glabellar furrows subparallel, distinct, directed axially and posteriorly from the dorsal furrows. Anterior pair short, extending about two thirds the distance to the axis, medial pair slightly longer, posterior pair extending almost to the occipital furrow. First and second pair of glabellar lobes subrectangular in outline; third pair subtrigonal. Palpebral lobes crescent-shaped, smooth, and relatively flat. Cheeks with moderately arched ocular platforms and slender genal spines extending to the fourth or fifth thoracic segment. Eyes low, convex, elongate. Occipital lobes small, subtrigonal in outline; occipital furrow narrow, deeply incised; occipital ring smooth, distinct.

Thorax smooth with low-convex axial segments and relatively flat pleurae; pleural segments with distinct medial furrows.

Pygidium long with a wide flat brim. Axis low convex with about 15

distinct segments of which the posterior 3 or 4 are more faintly defined. Pleurae with 12 broad, flat-topped, ungrooved segments separated by narrow furrows.

Entire test finely punctate.

*Remarks.*—*Dechenella (D.) alpenensis* is characteristic of the typical subgenus and is similar to *D. (D.) verneuili*, the genotype species, but differs from it in lacking the fourth pair of glabellar furrows and in having the posterior pair terminate anterior to the occipital furrow. It differs from *D. (D.) planimarginata* (Meek), from the Middle Devonian Dundee limestone of Michigan and northwestern Ohio, in having a much smaller, unridged ocular platform, and shorter posterior glabellar furrows.

*Occurrence.*—Middle Devonian (Traverse group, lower part of Bell shale), locality 31, Rogers City, Presque Isle County; (upper part of Bell shale and lower part of Ferron Point formation), locality 38, Rockport, Alpena County; (upper part of Ferron Point formation), locality 51, Alpena County; (basal part of Genshaw formation), localities 28, 51, 52, and 113, Alpena, Presque Isle, and Cheboygan counties, Michigan. (Arkona shale), locality B, Thedford-Arkona region, southwestern Ontario, Canada.

*Types.*—Holotype No. 27082 and paratypes Nos. 25503, 25510, 25511, 25513, 25515, 27071, 27077, and 28679, Museum of Paleontology, University of Michigan; paratypes Nos. 117867, 117870, and 117873, United States National Museum.

*Dechenella (Dechenella) sp. A.*

(Pl. V, Figs. 1-2)

*Description.*—Species known only from 2 incomplete specimens, one showing a fragmentary cephalon and the anterior part of the thorax and the other the imperfect pygidium of a smaller individual. Left margin of the glabella well-enough preserved to show the peripheral parts of 3 very deeply incised distinct glabellar furrows. Brim, exposed on the left free cheek, concave with an upraised border. Ocular platform with a distinct, wide furrow along the axial margin just below the eye, narrowly arched between furrow and brim. The anterior 6 left pleurae and the fifth and sixth axial segments form the only preserved parts of the thorax. Segments smooth, closely resembling those of *Dechenella (D.) alpenensis*. Pygidium resembling that of *D. (D.) alpenensis* except for a narrower, less distinct brim. Entire test finely punctate.

*Occurrence.*—Middle Devonian (Traverse group, Potter Farm formation), locality 68, Alpena County, Michigan.

*Figured specimens.*—Nos. 25508 and 28716, Museum of Paleontology, University of Michigan.

Subgenus *Dechenella* (*Basidechenella*) Richter

*Dechenella* (*Basidechenella*) Richter, 1912, p. 262.

*Subgenotype*.—By subsequent designation of Vogdes, 1925, p. 91, *Dechenella* (*Basidechenella*) *kayseri* Richter, 1912, pp. 278–81.

*Diagnosis*.—Glabella more highly convex than in the typical subgenus, with faint to obsolete glabellar lobes, and less constricted at the position of the anterior pair of glabellar lobes. Occipital lobes large, prominent. Thorax and pygidium with axial nodes in some species. Pygidium shorter and more highly convex than in the typical subgenus. Test tuberculate.

***Dechenella* (*Basidechenella*) *nodosa* Stumm, sp. nov.**

(Pl. II, Figs. 16–20)

*Description*.—Cephalon semilunate, with a moderately wide, flat, longitudinally striated brim. Brim with a proximally directed border in the preglabellar region. Glabella convex, tapering almost uniformly anteriorly, with a slight constriction at the position of the anterior pair of glabellar furrows. Anterior and medial pairs of glabellar furrows very faint to obsolete; posterior pair weakly developed, directed axially and posteriorly toward the occipital furrow; scarcely discernible on some specimens. Entire glabella covered with moderately coarse, rounded tubercles. Palpebral lobes relatively flat, finely tuberculate. Cheeks with wide, smooth, low-convex ocular platforms and broadly tapering genal spines extending to about the sixth or seventh thoracic segment. Eyes relatively high, convex, moderately elongate. Occipital lobes large, convex, weakly tuberculate, subtrigonal in outline. Occipital furrow relatively wide and deep. Occipital ring arched, elongate in the post glabellar region, weakly tuberculate; each bearing an axial node.

Thorax with highly arched axis and moderately convex pleurae. A posteriorly directed axial node present on each axial segment. Pleural segments with distinct medial furrows. Segments weakly tuberculate.

Pygidium relatively short and wide with a broad convex brim. Axis highly convex, composed of about 11 segments; the anterior 10 with axial nodes. Pleurae with about 7 convex segments, of which the anterior 2 or 3 bear faint median grooves. Segments separated by broad, shallow furrows.

*Remarks*.—*Dechenella* (*B.*) *nodosa* is distinguished from *D.* (*B.*) *curvilinearatus* (Hall), from the Pendleton sandstone of Indiana, by the less tapering glabella, the lack of distinct glabellar lobes, the presence of axial nodes on thorax and pygidium, and possession of a shorter, wider pygidium.

*Occurrence*.—Middle Devonian (Traverse group, upper part of Ferron Point formation), locality 51, Alpena County; (lower part of Genshaw

formation), localities 29 and 51, Alpena and Presque Isle counties, Michigan.

*Types*.—Holotype No. 28678 and paratypes Nos. 25509 and 25445, Museum of Paleontology, University of Michigan; paratype No. 117868, United States National Museum.

**Dechenella (Basidechenella) pulchra** Stumm, sp. nov.

(Pl. III, Figs. 1-8)

*Description*.—Cephalon semilunate with a relatively flat brim having one or two closely parallel ridges marking the posterior end of a narrow, flat or concave border, and one or two additional narrow, closely parallel ridges marking the anterior end of the border. Glabella convex, tapering anteriorly, with a slight constriction in the position of the median glabellar furrows; covered with fine, closely set tubercles. Glabellar furrows weakly defined, typically indicated by a lack of tuberculation, directed axially and posteriorly, extending about one half the distance between the dorsal furrow and the axis of the glabella, arranged as in *Dechenella (D.) alpenensis* but not incised on the glabella. Palpebral lobes flat, weakly tuberculate. Free cheeks with a relatively narrow, weakly tuberculate ocular platform having a distinct peripheral slope. Genal spines narrowly tapering, extending to about the seventh thoracic segment. Eyes of medium size, regularly convex and elongate. Occipital lobes relatively large, subtrigonal in outline, weakly tuberculate. Occipital furrow narrow, deeply incised. Occipital ring with an axial node.

Thorax with moderately convex axis and low-convex pleurae. Axial segments with distinct nodes. Nodes directed posteriorly to form short, blunt, horizontal spines. Pleural segments with distinct medial furrows. All segments weakly tuberculate.

Pygidium relatively short with a moderately wide, low-convex brim which is closely and finely tuberculate. Axis with about 12 segments, the anterior one with a prominent axial node; nodes on the remainder weakly developed, becoming indistinct posteriorly. Pleurae of about 8 broad, relatively flat, typically ungrooved segments separated by shallow, moderately wide furrows. All segments weakly tuberculate.

*Remarks*.—*Dechenella (B.) pulchra* is most nearly similar to *D. (B.) nodosa* from the lower part of the Traverse group but differs from this species in having more clearly defined glabellar lobes, a more strongly arched, tuberculate ocular platform, a more highly ornamented cephalic border, and more weakly developed axial nodes on the pygidium.

*Occurrence*.—Middle Devonian (Traverse group, Alpena limestone and

Dock Street clay), localities 40 and 53, Alpena County; (Gravel Point formation), localities 8 and 14, Emmet and Charlevoix counties, Michigan.

*Types*.—Holotype No. 28680 and paratypes Nos. 25505, 25514, 28681, and 28683, Museum of Paleontology, University of Michigan; paratypes Nos. 117866a, 117866b, and 117875, United States National Museum.

*Dechenella (Basidechenella) rowi* (Green)

(Pl. III, Fig. 11; Pl. IV, Figs. 1-2)

*Calymene rowi* Green, 1838, p. 406.

*Proetus rowi* Hall, 1861, p. 75.

*Proetus rowi* Hall and Clarke, 1888, pp. 119-22.

*Dechenella* (subg.?) *rowi* Richter and Richter, 1926, p. 24.

*Remarks*.—It is unnecessary to repeat Hall and Clarke's excellent description of this species. A cranidium from the Four Mile Dam limestone is indistinguishable from typical examples from the Ludlowville formation of western New York. The three pairs of glabellar furrows are indistinct, discernible mainly by a difference in color. The glabellar tubercles are small and sparsely scattered. The axial node on the occipital ring is low and indistinct.

*Occurrence*.—Middle Devonian (Hamilton group), New York and northern Appalachians; Middle Devonian (Traverse group—Four Mile Dam limestone), locality 53, Alpena County, Michigan.

*Types*.—Hypotype No. 117861, United States National Museum; hypotypes Nos. E5433 and E8440, Buffalo Museum of Science.

*Dechenella (Basidechenella) rowi arkonensis* Stumm, subsp. nov.

(Pl. III, Figs. 9-10)

*Description*.—Cephalon as in *Dechenella (B.) rowi* except glabella without trace of glabellar furrows, genal spines longer, reaching to about the sixth or seventh thoracic segment, and occipital ring with a distinct axial node which is spinose in some individuals.

Thorax as in *Dechenella (B.) rowi* except for indistinct axial nodes on the anterior 5 or 6 segments and prominent axial nodes on the posterior four or five segments.

Pygidium differing from that of *D. (B.) rowi* in possession of a prominent axial node on anterior segment and in lack of tuberculation.

*Remarks*.—The subspecies *D. (B.) rowi arkonensis* is easily recognized by the more prominent axial ornamentation of the thorax and anterior part of the pygidium.

*Occurrence*.—Middle Devonian (Hamilton group, Hungry Hollow



formation and Widder formation), localities A, B, and C, Thedford-Arkona region, southwestern Ontario.

*Types*.—Holotype No. 25541; paratype No. 28682, Museum of Paleontology, University of Michigan.

***Dechenella* (*Basidechenella*) *reimanni* Stumm, sp. nov.**

(Pl. V, Figs. 6-7)

*Description*.—Cephalon with outline similar to that of *Dechenella* (*B.*) *rowi*, with a broad flat rim. Glabella convex, tapering anteriorly, coarsely tuberculate. No trace of glabellar furrows visible. Palpebral lobes of moderate size, relatively flat. Free cheeks with convex, tuberculate ocular platforms with broad furrows at their axial margins. Genal spines rapidly tapering, extending to about the fifth thoracic segment. Occipital lobes large, suboval in outline. Occipital furrow narrow, distinct. Occipital ring wide along the posterior end of the glabella, narrow along the posterior ends of the free cheeks; with a low axial node.

Thorax with a moderately convex axis and low-convex pleurae. Axial nodes prominent on first and second segments, low and indistinct on third to sixth segments, prominent and terminating in posteriorly directed spines on seventh to tenth segments. Segments distinctly tuberculate.

Pygidium short and wide with a relatively broad flat brim. Axis moderately arched with about 11 segments, of which the anterior 3 bear prominent axial nodes with posteriorly directed spines. Pleurae with 8 broad, low-convex, ungrooved segments, separated by broad, shallow furrows. Entire pygidium tuberculate.

*Remarks*.—*Dechenella* (*B.*) *reimanni* differs from *D.* (*B.*) *rowi* in the strong tuberculation of the glabella, in the development and arrangement of the axial nodes, and in the possession of ungrooved pygidial pleural segments. From *D.* (*B.*) *rowi arkonensis* it differs in the possession of a tuberculate pygidium and in the greater number of axial nodes. The species is named in honor of Mr. I. G. Reimann of the University of Michigan Museums, who has contributed a great deal to the knowledge of the Traverse group.

*Occurrence*.—Middle Devonian (Traverse group, Thunder Bay limestone), locality 35, Alpena County, Michigan.

*Types*.—Holotype No. 27075 and paratype No. 28718, Museum of Paleontology, University of Michigan.

***Dechenella* (*Basidechenella*) sp. A.**

(Pl. V, Figs. 8-11)

*Description*.—Cranidium similar to that of *Dechenella* (*B.*) *pulchra*

except for a broader, flatter brim and one concentric ridge on the posterior edge of the border. Glabella arched, tuberculate, tapering as in *D. (B.) pulchra* but without glabellar furrows. Free cheeks similar to those of *D. (B.) pulchra* except for single ridge on inner edge of border.

Thorax unknown.

Pygidium indistinguishable from that of *D. (B.) pulchra*.

*Occurrence*.—Middle Devonian (Traverse group, Norway Point formation), locality 47, Alpena County, Michigan.

*Figured specimens*.—Nos. 25506, 28719, and 28721, Museum of Paleontology, University of Michigan.

*Dechenella (Basidechenella) sp. B*

(Pl. V, Figs. 4-5)

*Description*.—Cranidium similar to that of *Dechenella (B.) sp. A* except for relatively narrow concave brim, separated from a wide, steeply inclined border by two parallel, concentric ridges. Glabella shorter and wider than that of *D. (B.) sp. A*. No glabellar furrows visible. Lateral preglabellar fields distinctly convex. Free cheek similar to that of *D. (B.) pulchra* except for shorter and wider ocular platform and distinct furrow along inner margin of ocular platform. Pygidium similar to that of *D. (B.) sp. A* except for lack of axial nodes.

*Occurrence*.—Middle Devonian (Traverse group, Potter Farm formation), locality 68, Alpena County, Michigan.

*Figured specimens*.—Nos. 27076 and 28717, Museum of Paleontology, University of Michigan.

*Dechenella (Basidechenella) sp. C*

(Pl. V, Fig. 3)

*Description*.—A single specimen from the Thunder Bay limestone lacking the cephalon, except for a small part of the occipital ring, and the posterior part of the right free cheek. It differs markedly from the typical species found in these beds.

Axial part of occipital lobe smooth, low convex, weakly tuberculate. Posterior part of ocular platform of right free cheek moderately flat, tuberculate. Genal spine wide, thick, gradually tapering, directed at right angles to the plane of the cheek, extending to the sixth thoracic segment.

Thorax with a wide, low-convex, unornamented axis and moderately convex pleurae.

Pygidium short and wide, with a moderately wide, convex brim. Axis narrow, low convex, and very weakly segmented. Pleurae with 6 low-convex, weakly defined segments.

*Occurrence.*—Middle Devonian (Traverse group, Thunder Bay limestone), locality 53, Alpena County, Michigan.

*Figured specimen.*—No. 72554, United States National Museum.

**Dechenella (Monodechenella) Stumm, subgen. nov.**

*Subgenotype.*—*Proetus macrocephalus* Hall, 1861, p. 77.

*Diagnosis.*—Glabella broad, moderately to highly convex, barely tapering anteriorly. Anterior pairs of glabellar furrows typically obsolete, rarely faintly defined; posterior pair well developed, deeply incised, extending in an axially convex direction from the dorsal furrow to the occipital furrow, isolating two posterolateral, subtrigonal glabellar lobes. Occipital lobes of medium size, elongate, suboval in outline. Thorax with wide, convex axis and convex pleurae having deeply sulcate segments. Pygidium with arched axis and highly convex, distinct segments. Entire test heavily tuberculate, tubercles on pygidial segments in two parallel rows.

*Dechenella (Monodechenella) macrocephala* (Hall)

(Pl. IV, Figs. 3–6)

*Proetus macrocephalus* Hall, 1861, p. 77.

*Proetus macrocephalus* Hall and Clarke, 1888, pp. 116–19.

*Dechenella* (subg.?) *macrocephala* Richter and Richter, 1926, p. 24.

*Remarks.*—Hall and Clarke's excellent description of this species need not be repeated here. The species is represented in the Traverse group by a number of cranidia and pygidia from the Four Mile Dam limestone. The glabellae agree very well with those from the Hamilton group of New York and show the posterior glabellar furrow very distinctly. The pygidia are undistinguishable from those of typical specimens from the Ludlowville shale of western New York.

*Occurrence.*—Middle Devonian (Hamilton group, New York and northern Appalachians); Middle Devonian (Traverse group, Four Mile Dam limestone), locality 41, Alpena County, Michigan.

*Types.*—Syntypes Nos. 13994/1–5, New York State Museum; hypotypes Nos. 27079 and 28715, Museum of Paleontology, University of Michigan; hypotype No. 117877, United States National Museum; hypotype No. E4253, Buffalo Museum of Science.

Family Otarionidae Richter and Richter

Otarionidae Richter and Richter, 1926, p. 314.

*Diagnosis.*—(Prantl and Pfibyl, 1950, p. 437).—

Opisthoptarian trilobites of small to medium measurements, with a medium to considerably transversally convex cephalon. The glabella is medium to strikingly convex and carries 1–3 pairs of lateral glabellar furrows, but only one (basal) pair of perfectly strangulated lateral glabellar lobes. Preglabellar area usually well developed, broad.

Eyes small. Thorax of 11–22 segments. Pygidium of small measurements, usually broader than long, with a smooth, more rarely denticulated posterior margin. Surface of the cephalon, especially of the glabella, characteristically granulated.

### Genus *Cordania* Clarke

*Cordania* Clarke, 1892, pp. 442–43.

*Genotype*.—By original designation, *Phaethonides cyclurus* Hall and Clarke, 1888, pp. 137–39, Lower Devonian, Helderberg group, New York.

*Diagnosis* (Clarke, 1892, p. 442).—

The American species have a cephalon with a thickened, usually elevated margin, continued into short genal spines. The surface of the ante-lateral limb is concave, the eyes well forward and close together as in *Cyphaspis*. The glabella has the form of that in *Arethusina*, is short, ovoid, has two conspicuous basal lobes, and bears the trace of a pair of short lateral furrows, which are situated at about the mid-length of the glabella, and under favorable circumstances in an internal cast, are seen to bifurcate slightly at their proximal extremities. The number of the thoracic segments has not been ascertained, but specimens found of *Ph. gemmaeus*, of the Hamilton group indicate that the number was not more than ten, and that the forms were proetoid in this respect. The pygidium is always relatively large, subsemicircular in outline, the rhachis and pleura abundantly annulated, from 7 to 12, on the former and from 6 to 8 on the latter. The pleural annulations are subequally duplicate. The rhachis does not extend to the margin. The surface is tubercled, the tubercles being irregularly scattered over the cephalon, and arranged in regular rows on the segments and annulations. These tubercles sometimes take the form of spinules (*Ph. arenicolus*, *Ph. gemmaeus*) and extend beyond the margin of the pygidium, but they seem never to have their insertion on the margin itself.

### *Cordania rara* Stumm, sp. nov.

(Pl. VI, Fig. 3)

*Description*.—Cranidium semicircular with a broad brim, a moderately convex glabella, and narrow, slightly elevated fixed cheeks. Brim concave with frontal margin elevated almost to glabellar height. Glabella about twice as long as wide, tapering anteriorly and posteriorly. Frontal lobe moderately arched, subquadrate in outline. Anterior glabellar furrows shallow, directed posterolaterally, extending about one half the distance to the axis. Second glabellar lobes elongate, moderately arched. Posterolateral glabellar furrows wide and deep. Occipital lobes large, elongate, subtrigonal in outline, moderately arched, each with an indistinct tubercle at the center. Occipital furrow moderately wide, shallow, becoming indistinct axially. Occipital ring relatively flat. Fixed cheeks of moderate width, distinctly elevated. Palpebral lobes moderately elevated. Free cheek unknown. Glabella, brim, fixed cheeks, and palpebral lobes covered with tubercles, those on the posterior margin of the brim, the free cheeks, and the palpebral lobes being of much larger size.

Thorax and pygidium unknown.

*Remarks.*—*Cordania rara* resembles *C. pulchra* Cooper and Cloud (1938, pp. 457–58), but differs in the following ways: In *C. pulchra* the occipital lobes are completely separated from the glabella by the postero-lateral glabellar furrows, whereas in *C. rara* the furrows are shorter causing the occipital lobes to be incompletely detached from the posterior part of the glabella. And the anterior glabellar furrows in *C. rara* are deeper and longer than those of *C. pulchra*. *Cordania rara* is similar to *C. varicella* (Hall and Clarke) from the Onondaga limestone of New York, but differs from this species in the possession of longer and deeper glabella furrows. The relationship between *C. rara* and *C. gemmaea* (Hall and Clarke) from the Hamilton group of western New York is unknown, as *C. gemmaea* is known only from pygidia and an incomplete thorax.

*Occurrence.*—Middle Devonian (Traverse group, Four Mile Dam limestone), locality 41, Alpena County, Michigan.

*Type.*—Holotype No. 117869, United States National Museum.

*Cordania* sp. A

(Pl. VI, Fig. 4)

*Description.*—Cephalon and thorax unknown. Pygidium incomplete, very small, about twice as wide as long, with a narrow, convex axis bearing 6 prominent segments. Pleurae with 8 distinct segments. Each pleural segment with a large, strongly convex anterior limb and a faintly defined posterior limb. Axial and pleural segments covered with sharply conical tubercles in uniserial rows.

*Remarks.*—The pygidium bears a strong resemblance to that of *Cordania pulchra* Cooper and Cloud (1938, pp. 457–58), from the upper Middle Devonian strata of Calhoun County, Illinois, but the Traverse specimen is too incomplete for accurate comparison.

*Occurrence.*—Middle Devonian (Traverse group, lower part of Petoskey formation), locality 18*b*, Bay View, Emmet County, Michigan.

*Figured specimen.*—No. 28895, Museum of Paleontology, University of Michigan.

Superfamily Odontopleuracea

Family Odontopleuridae Burmeister

Odontopleuridae Burmeister, 1843, p. 71.

*Diagnosis* (Prantl and Přibyl, 1949, p. 131.)—

Opisthoparian trilobites of smaller size with a strikingly spinous carapace. Cephalon semicircular, parabolic, subtetragonal to subtrapezoid, with marginal and supra-marginal genal spines. The preglabellar lobes are mostly lacking. Glabella broad, with a well developed central lobe and 2–3 lateral glabellar lobes. Free cheeks generally well

developed, small, sometimes pedunculate. Ocular ridge always present. Occipital ring often inflated and generally provided with characteristic occipital spines. Thorax of 9–10 segments. Thoracic pleurae either with raised or broad, flattened ridge always running out into long, hollow, main spines. Terminal spines starting from the anterior margin of the thoracic pleurae usually developed. Rings of the thoracic axis carrying usually 1–2 pairs of characteristic granules. Sometimes these granules show a characteristic arrangement also on the pleurae. Pygidium small, with a spinous margin and 2–3 rings on the pygidium. Usually a raised ridge on the pygidial lobes, which connects the first ring of the pygidial axis with the main pygidial spines.

#### Genus *Ancyropyge* Clarke

*Ceratocephala* (*Ancyropyge*) Clarke, 1891, p. 68.

*Genotype*.—By original designation, *Acidaspis romingeri* Hall and Clarke, 1888, pp. 71–72.

#### *Ancyropyge romingeri* (Hall and Clarke)

(Pl. VI, Figs. 1–2)

*Description* (Clarke, 1891, p. 68).—

Pygidium with a short, unsegmented, bullate axis, flanked on the lateral margins by two elongate nodes. Border broad and flattened, its margin bearing twelve long curved spines, four on each side and four behind; the lateral members strongly recurved, the posterior being straight and less divergent. From the surface of the posterior border arise two other spines just above and within the fourth of the lateral marginal spines; these rise at an angle of nearly 45° and were probably nearly of the same length as the rest.

*Remarks*.—An additional specimen of *Ancyropyge romingeri* collected by G. A. Cooper has the spines almost completely preserved. The length of the spines is about the same as on Hall and Clarke's reconstruction of the original type, but the lateral spines are much more recurved posteriorly. The spines are ornamented by a closely set series of oblique costellae. These extend from the axes of the spines posterolaterally to the peripheries, producing the appearance of closely set, nested cones. The median grooves present on some of the spines are a result of crushing. The tuberculate bullate axis of the pygidium is not preserved on the hypotype. Because of the unique structure of the pygidium, *Ancyropyge romingeri* is removed from the genus *Ceratocephala* and the subgenus *Ancyropyge* is here erected to full generic standing.

*Occurrence*.—Middle Devonian (Traverse group, Gravel Point formation, *Longispina emmetensis* zone), locality 8, Gravel Point (Pine River Point), 2 miles west of Charlevoix, Charlevoix County, Michigan.

*Types*.—Holotype No. 4934, Museum of Paleontology, University of Michigan; hypotype No. 117862, United States National Museum.

Genus *Acidaspis* Murchison

*Acidaspis* Murchison, 1839, p. 658.

*Genotype*.—By monotypy, *Acidaspis brighti* Murchison, 1839, p. 658.

*Diagnosis* (Prantl and Pfibyl, 1949, p. 140).—

Cephalon semielliptic, short, broad, strongly convex. Glabella with two pairs of well developed lateral glabellar lobes. The medial glabellar lobe is distinctly strangulated at the height of the first pair of lateral lobes and quickly widens out backwards. The lateral margin of the cephalon is hemmed by short, strong spines placed perpendicularly to it. Genal spines marginal, strong, long. Eyes on low stalks, shifted backwards. Occipital ring inflated and continuing in a strong, odd, medial occipital spine, which is inclined backwards. In the middle of the occipital ring is a characteristic, odd, medial granule. Occipital furrow shallow, slightly marked. Thorax of (?) 10 segments. Pygidium of *Odontopleura* type.

*Acidaspis* (?) sp. A

(Pl. V, Figs. 14–15)

*Description*.—Species known only from two incomplete free cheeks. Brim convex, ornamented with irregularly spaced, sharp, spinose tubercles. Peripheral part of ocular platform with a deep furrow paralleling the brim; remainder of platform low convex. Genal spine rounded, of moderate length, peripherally convex, covered with coarse tubercles.

*Remarks*.—The free cheeks are distinct from those of any known species of the *Odontopleuridae*. The irregular arrangement of the marginal spinose tubercles make *Acidaspis* (?) sp. A easily distinguishable from *A. callicera* Hall and Clarke (1888, p. 69), from the Onondaga limestone of New York and Ontario.

*Occurrence*.—Middle Devonian (Traverse group, lower part of Bell shale), locality 31, quarry of the Michigan Limestone and Chemical Company, at Calcite, near Rogers City, Presque Isle County, Michigan.

*Figured specimens*.—Nos. 28921 and 28922, Museum of Paleontology, University of Michigan.

## Superfamily Corynexechidea

## Family Scutellidae Richter and Richter

Scutellidae Richter and Richter, 1925, p. 241.

*Diagnosis*.—Opisthoparoid trilobites with a semicircular cephalon. Glabella triareal, wide anteriorly, narrow posteriorly, bearing 3 to 4 glabellar furrows. Cheeks wide, low convex. Eyes relatively small, semilunate. Genal angles typically produced to form short stout spines. Thorax of 10 segments. Pygidium large, semicircular, with a very short axis and 6 to 8 pleural ribs on either side of a medial simple or compound rib.

Genus *Scutellum* Pusch

*Scutellum* Pusch, 1833, p. 119.

*Brontes*, Goldfuss, 1839, p. 360 (*non* Fabricius, 1801, p. 97) homonym.

*Goldius*, DeKoninck, 1841, p. 5.

*Bronteus*, Goldfuss, 1843, p. 548.

*Genotype*.—By monotypy, *Scutellum costatum* Pusch, 1833, p. 119?, Middle Devonian, Europe.

*Diagnosis* (Hall and Clarke, 1888, p. xxvi).—

Body broadly oval. Cephalon semicircular, with sharp, often somewhat produced genal angles. Glabella closely appressed to the cheeks, broad anteriorly, and extending to the frontal margin. Lateral furrows indistinct or obsolete. The facial sutures begin on the posterior margin, and in front of the eyes run nearly parallel to the margin of the glabella, being continuous on the frontal margin. Eyes lunate, homocorneal, and situated somewhat posteriorly. Thorax slightly larger than the cephalon, and composed of ten segments, which upon the pleurae are simple and sharply pointed. Pygidium very large, depressed-convex, parabolic in outline, with a very short sub-triangular axis. The pleurae each bear seven or eight simple ribs, arranged on each side of a larger median simple or compound rib.

*Scutellum tullium depressum* Cooper and Cloud

(Pl. V, Figs. 12–13)

*Scutellum tullium depressum* Cooper and Cloud, 1938, pp. 458–59.

*Remarks*.—The excellent description of this subspecies by Cooper and Cloud (1938, pp. 458–59) need not be repeated here. In addition to Cooper and Cloud's specimen, a free cheek that appears to belong to this subspecies was recovered by Robert V. Kesling from washings obtained from a collection of loose decomposed shale from the bryozoa bed at the base of the Middle Petoskey limestone at Norwood, Charlevoix County, Michigan.

*Occurrence*.—Middle Devonian (Traverse group, Middle Petoskey formation), locality 7*b*, Norwood, Charlevoix County, Michigan. The subspecies is also present in the upper Middle Devonian strata of Calhoun County, Illinois.

*Types*.—Holotype No. 95201*a*; paratypes Nos. 95201*b–g* and 95203, United States National Museum.

## Order PROPARIA

## Superfamily Calymenidea

## Family Homalonotidae Chapman

Homalonotidae Chapman, 1890, p. 117.

*Diagnosis*.—Large trilobites with a broad preglabellar brim, low-convex, subquadrate glabella, and rounded genal angles. Thorax with a wide axis



and narrow pleurae; typically composed of 13 segments. Pygidium large, subtrigonal, with segmentation distinct or obsolete. Entire test with closely set tubulipores.

Genus *Dipleura* Green

*Dipleura* Green, 1832, p. 78.

*Genotype*.—By monotypy, *D. dekayi* Green, 1832, pp. 79–80; Hall and Clarke, 1888, pp. 7–10.

*Diagnosis*.—Large trilobites with a subtrigonal cephalon having an extended axial brim and low-convex, subquadrate glabella which is unfurrowed in the ephebic stage. Cheeks wide with rounded genal angles. Thorax of 13 segments. Axial segments wide, flat-topped; pleural segments with distinct medial grooves. Pygidium subtrigonal with faint to obsolete segmentation in the ephebic stage. Entire test with relatively large tubulipores.

*Dipleura dekayi* Green

(Pl. VI, Figs. 5–9)

*Description* (Cooper, 1935, p. 4).—

Adult *D. dekayi* is a large and unique trilobite, averaging about 6 inches in length but attaining 9 inches in individual examples. The most characteristic features of the genus, of which *D. dekayi* is the type species, are the absence of segmentation of the glabella, loss of the thoracic axial lobe, and complete loss of segmentation and annulation of the pygidium. Young specimens resemble *Calymene* strongly in having the axis well developed on the thorax and tail and in having a strongly segmented glabella.

*Remarks*.—The specimens from the Norway Point and Thunder Bay formations are indistinguishable from typical specimens of *Dipleura dekayi* from the Hamilton group of New York. One specimen has been recovered from the Ipperwash limestone member of the Widder formation, near Stony Point, Lake Huron, Ontario. For a complete description of the species see Hall and Clarke (1888, pp. 7–10). Cooper (1935, pp. 3–5) gives an interesting discussion and illustration of growth stages of the species.

*Occurrence*.—Middle Devonian (Traverse group—Norway Point formation—shales just above the *Spinocyrtia* zone), locality 47, Seven Mile Dam, Thunder Bay River, about 5 miles northwest of Alpena, Alpena County, Michigan; (Thunder Bay limestone), locality 53, Partridge Point on Thunder Bay, about 4 miles south of Alpena, Alpena County, Michigan.

*Types*.—Hypotypes Nos. 117863, 117864a, 117864b, and 117874, United States National Museum; hypotype No. 25442, Museum of Paleontology, University of Michigan.

Superfamily Phacopidacea

*Diagnosis* (Delo, 1935, p. 404).—

Pararia with schizocroal eyes, large free cheeks, and 11 thoracic segments.

## Family Dalmanitidae Delo

*Diagnosis* (Delo, 1935, p. 410).—

Phacopidacea with flattened body form, well-defined glabellar lobation, large cephalon and pygidium, and, in most, large eyes.

## Subfamily Asteropyginae Delo

*Diagnosis* (Delo, 1935, p. 413).—

Dalmanitidae with relatively unmodified glabellar lobation and genal spines; pleural extremities progressively produced or spinose posteriorly. Pygidium with five pairs of marginal spines or lappets, which are continuations of the anterior branch of the pleural ribs; terminal spine or process may be present.

Genus *Greenops* Delo

*Cryphaeus* Green, 1837, p. 343 (*non* Klug, 1833, p. 177), homonym.

*Greenops* Delo, 1935, p. 415.

*Genotype*.—By original designation, *Cryphaeus boothi* Green, 1837, p. 217.

*Diagnosis* (Delo, 1935, p. 415).—

Asteropyginae with moderately convex cephalon, widely diverging dorsal furrows; glabella gently arched both transversely and longitudinally; frontal lobe transverse; first and second lateral lobes coalesced distally but not swollen; second lateral furrows reduced to rounded pits (elongate transversely on casts); third lateral lobes much reduced; third furrows short, deep, not entering dorsal furrows at their level (much deeper on casts); eyes of moderate size, visual area low, elevated to or slightly above glabellar level; genal spines large, compressed. Pygidium much like that of *Metacanthus* in outline and convexity; pleural ribs wide, flat, with narrow but distinct interpleural furrows.

*Greenops boothi* (Green)

(Pl. VII, Figs. 1-3)

*Cryphaeus boothi* Green, 1837, p. 217.

*Dalmanites* (*Cryphaeus*) *boothi* Hall and Clarke, 1888, pp. 42-45.

*Greenops boothi* Delo, 1940, p. 88.

*Description* (Delo, 1940, p. 88).—

Genal spines very wide, smooth, extending back to about the fourth thoracic segment. Nuchal ring with central spinose tubercle and small granules. Posterior marginal furrow ends abruptly at juncture of cheek and spine. Axial portion of glabella and frontal lobe marked by small tubercles. Remainder of cephalon and genal spines finely and uniformly granulose.

*Remarks*.—The fineness of the cephalic tuberculations and their concentration along the axis of the glabella is a diagnostic character of *Greenops boothi*. The flatness, pointed terminations, and fine tuberculation of the pygidial lappets is also diagnostic.

*Occurrence*.—Middle Devonian (Hamilton group), New York and

northern Appalachians. Middle Devonian (Hungry Hollow and Widder formations), localities A, B, and C, southwestern Ontario.

*Types*.—Hypotypes Nos. 25540, 25571, and 28665, Museum of Paleontology, University of Michigan.

***Greenops aequituberculatus* Stumm, sp. nov.**

(Pl. VII, Figs. 4-6; Pl. VIII, Figs. 5-9)

*Description*.—Cephalon with general outline as in *Greenops boothi*. Brim with anterior border extended axially to produce a crescentic appearance. Glabella widening rapidly anteriorly; frontal lobe moderately convex, about twice as wide as long. First glabellar furrows narrow, relatively deep, extending posterolaterally almost to the axis. First lateral glabellar lobes subtrigonal in outline. Second glabellar furrows narrow, horizontal, extending two thirds the distance to the axis; second glabellar lobes subrectangular, coalesced with first pair along periphery. Third glabellar furrows narrow, distinct, horizontally disposed, terminating axially about the same distance as the second pair of furrows. Third glabellar lobe narrow, continuous across axis of glabella. Occipital furrow narrow, distinct. Occipital ring convex, wide axially, narrow peripherally. Eyes reniform, higher than glabellar axis. Palpebral lobes low convex, descending toward lateral glabellar furrows. Genal spines flattened with blunt terminations. Glabella and palpebral lobes covered with low-convex, medium-sized tubercles.

Thorax with moderately convex axis and pleurae which are relatively horizontal axially and strongly inclined peripherally. Axial segments with low but distinct axial nodes. Pleural segments with distinct medial furrows. All segments crowded with small and medium-sized tubercles.

Pygidium with a low-convex axis composed of about 10 segments bearing low rounded axial nodes. Pleurae with 5 segments, each with a distinct medial furrow. Terminal lappets very low convex with relatively blunt proximal terminations. Posterior axial process spatulate, almost as long as lappets. Entire pygidium covered with small and medium-sized tubercles. Tubercles larger and more crowded on lappets and axial process.

*Remarks*.—*Greenops aequituberculatus* is distinguished from *G. boothi* (Green) by the distribution of the glabellar tuberculation, the better defined glabellar furrows, and the axial anterior extension of the glabellar border. It differs also in the possession of distinct thoracic axial nodes on all segments.

*Occurrence*.—Middle Devonian (Traverse group, Dock Street clay and Norway Point formation), localities 46 and 53, Alpena County; (Gravel Point formation), locality 8, Charlevoix County, Michigan.

*Types*.—Holotype No. 20165 and paratypes Nos. 25438, 25439, 25441, 27083, 28666, and 28669, Museum of Paleontology, University of Michigan; paratype No. 117872, United States National Museum.

***Greenops traversensis* Stumm, sp. nov.**

(Pl. VIII, Figs. 1-4)

*Description*.—Cephalon with general outline as in *Greenops boothi* (Green). Brim relatively wide, flat, with greatest diameter at axis. Glabella low convex; frontal lobe about twice as wide as long. First glabellar furrows wide, deep, extending posterolaterally almost to axis. First pair of lateral glabellar lobes elongate subtrigonal; second glabellar furrows represented by elongate periaxial pits. Second pair of lateral glabellar lobes elongate; third glabellar furrows horizontal, narrowly elongate. Third lateral glabellar lobe continuous across axis. Occipital furrow narrow, distinct. Occipital ring convex, greatly thickened and elevated in axial region. Palpebral lobes incompletely preserved, steeply inclined toward lateral glabellar furrow. Single preserved eye crushed but still retaining reniform shape. Ocular platforms steeply inclined toward brim. Genal spines not preserved. Entire cephalon covered with tubercles; those of the glabella, palpebral lobes, and ocular platforms large and conical; those on the brim small and low convex.

Thorax with moderately convex axis and axially flattened, peripherally depressed pleurae. Axial segments with prominent, posteriorly directed axial spines. Pleural segments with prominent medial furrows. Entire thorax coarsely tuberculate. Tubercles irregularly scattered on axial segments; in single rows on anterior and posterior limbs of pleural segments. Circular pits visible on thoracic segments of holotype (see Pl. VIII, Fig. 2) caused by weathering of coarse tubercles.

Pygidium with moderately convex axis composed of about 6 to 7 segments becoming indistinct posteriorly. Segments with low, rounded axial nodes. Pleurae with 5 segments each with a distinct medial furrow and produced into a moderately convex, thin, pointed lappet. Posterior axial process short, wide, upturned posteriorly, about one half as long as lappets. Entire pygidium covered with tubercles; those on axial segments small, irregularly scattered; those on pleurae large, arranged in single rows on anterior and posterior limb of each segment; those on lappets and axial process of medium size, irregularly scattered.

*Remarks*.—*Greenops traversensis* is easily distinguished from all other described species of *Greenops* by the coarseness and arrangement of the tubercles and by the possession of posteriorly directed axial spines on the thoracic segments.

*Occurrence.*—Middle Devonian (Traverse group, Gravel Point formation), locality 14e, Emmet County; (Dock Street clay), locality 53, Alpena County, Michigan.

*Types.*—Holotype No. 117871, United States National Museum; paratype No. 28668, Museum of Paleontology, University of Michigan.

***Greenops alpenensis* Stumm, sp. nov.**

(Pl. VII, Figs. 7-8)

*Description.*—Cephalon with general outline as in *Greenops boothi* (Green). Brim similar to that of *G. aequituberculatus* Stumm with expanded border in axial region. Glabella with broad frontal lobe similar to that of *G. traversensis* Stumm. First lateral glabellar furrows deeply incised, extending posterolaterally about two thirds the distance to the axis. First lateral glabellar lobes moderately convex, subtrigonal in outline. Second glabellar furrows short, horizontally directed, extending less than half the distance to the axis. Second lateral glabellar lobes narrow, elongate; third pair of glabellar furrows horizontally disposed, almost as long as second pair, but with pits at their axial ends. Third glabellar lobe imperfectly preserved. Occipital furrow narrow, deeply incised. Occipital ring narrow, convex, only preserved posterior to right palpebral lobe. Palpebral lobes low convex, moderately inclined axially. Eyes low, elongate reniform, rising slightly above glabellar height. Ocular platforms steeply inclined peripherally. Genal spines wide, flat, with a relatively blunt termination. Entire cephalon tuberculate; tubercles on glabella and palpebral lobes large and low convex; those on brim, ocular platforms, and genal spines small and granular.

Thorax unknown.

Pygidium only known from internal mold. Axis moderately convex; number of segments unknown. Posterior axial process short, triangular. Pleurae with 5 distinctly convex segments, each with a prominent medial furrow. Lappets relatively narrow, subspinose. Entire pygidium weakly and finely tuberculate.

*Remarks.*—In the size of the glabellar tubercles *Greenops alpenensis* resembles *G. traversensis*, but in that species the tubercles are sharply conical while in *G. alpenensis* they are very low convex. In the possession of a V-shaped axial process *G. alpenensis* resembles *G. barrisi* (Hall and Clarke) from the Cedar Valley limestone of Iowa, but that species is known only from pygidia.

*Occurrence.*—Middle Devonian (Traverse group, Thunder Bay limestone), locality 35, Alpena County, Michigan.

*Types*.—Holotype No. 25436 and paratype No. 28667, Museum of Paleontology, University of Michigan.

***Greenops arkonensis* Stumm, sp. nov.**

(Pl. VIII, Figs. 10–14)

*Description*.—Cephalon with general outline as in *Greenops boothi* (Green). Brim relatively narrow with a slight axial extension. Glabellar lobation and furrows similar to those of *G. aequituberculatus* Stumm except frontal lobe narrower and first lateral lobes distinctly wider. Occipital furrow well defined. Occipital ring with a low broad axial node. Palpebral lobes weakly arched, axially inclined. Eyes reniform, large, extending well above glabellar height. Eye facets from 50 to 70 in vertical rows with 4 to 5 facets to a row. Ocular platforms with a low peripheral slope. Genal spines not preserved. Entire cephalon tuberculate. Tubercles on glabella and palpebral lobes of moderate size, evenly distributed; those on ocular platforms small, widely scattered.

Thorax with a moderately arched axis; posterior 5 segments with low indistinct axial nodes. Pleural segments with distinct medial furrows. Entire thorax tuberculate; tubercles on axial segments irregularly scattered, concentrated in axial region; those on anterior pleural segments in single rows on each limb; and those on posterior axial segments irregularly scattered, becoming smaller peripherally.

Pygidium with a moderately convex axis composed of about 10 segments becoming indistinct posteriorly. Pleurae with 5 distinct segments bearing prominent medial grooves. Lappets and posterior axial process not preserved. Pygidium tuberculate; tubercles on axial segments irregularly scattered; those on pleurae in 2 poorly defined rows on each limb.

*Remarks*.—*Greenops arkonensis* resembles *G. aequituberculatus* in cephalic ornamentation but can be distinguished from that species by the difference in the proportions of the glabellar lobes and by the presence of tubercles on the ocular platforms. An additional difference is that *G. aequituberculatus* possesses axial nodes on the anterior thoracic segments.

*Occurrence*.—Middle Devonian (Hamilton group, Arkona shale), localities A, B, and C, Thedford–Arkona region, southwestern Ontario.

*Types*.—Holotype No. 28671 and paratypes Nos. 24174 and 28670, Museum of Paleontology, University of Michigan.

***Greenops* sp. A**

(Pl. VII, Fig 9)

A fragmentary pygidium from the Potter Farm formation can not be assigned to any known species of *Greenops*. The axis is not preserved. The

posterior axial process is short and blunt. The pleurae are composed of 5 weakly furrowed segments. The pleural lappets are very narrow and spinose. The preserved part of the pygidium is covered with small, irregularly spaced tubercles.

*Occurrence*.—Middle Devonian (Traverse group, Potter Farm formation), locality 68, Alpena County, Michigan.

*Figured specimen*.—No. 25437, Museum of Paleontology, University of Michigan.

#### Family Phacopidae Hawle and Corda

Phacopidae Hawle and Corda, 1847, p. 181.

*Diagnosis* (Delo, 1935, p. 404).—

Phacopidacea with reduced or obsolete glabellar furrows, compact body form, and, in most, a small rounded pygidium.

#### Subfamily Phacopinae Reed

Phacopinae Reed, 1905, p. 171.

*Diagnosis* (Delo, 1935, p. 404).—

Phacopidae with the two anterior pairs of glabellar furrows nearly or entirely obsolete, more or less swollen glabella, subcranial furrow, and, in most, rounded genal angles. Eyes vary in size, position; may be entirely absent.

#### Genus *Phacops* Emmrich

*Phacops* Emmrich, 1839, p. 18.

*Genotype*.—By subsequent designation of Barrande, 1852, p. 498, *Calymene latifrons* Bronn, 1825, p. 317.

*Diagnosis* (Delo, 1940, p. 15).—

Typical Phacopinae with rounded genal angles (short spines in a few species); glabella inflated, protuberant; subcranial furrow continuous, separated from facial suture by a narrow marginal ridge; hinder end of furrow sharp, the higher; cephalic doublure slightly convex.

#### *Phacops rana* (Green)

(Pl. X, Figs. 22–24; Pl. XI, Figs. 1–11, 22–23; Pl. XII, Fig. 11)

*Calymene bufo* var. *rana* Green, 1832, p. 42.

*Phacops rana* Hall and Clarke, 1888, pp. 19–26.

*Description* (Delo, 1940, p. 22).—

Glabella moderately inflated for the genus, slightly protruding with almost vertical frontal slope. Genal angles nonspinose. Eyes large, rising to glabellar level, averaging about 45 to 50 facets, with six in vertical rows. First lateral furrows obsolete; second apparent on some casts; third deep distally, continuous across glabella, curving forward mesally; nuchal ring long. Third lobe represented by two low distal nodes in the dorsal furrows, and a central, elliptical, tuberculated node which rises almost to the level of the glabellar surface. Posterior cheek field short. Ornamentation consists of

low tubercles, mostly rather elliptical, of various sizes, the larger centrally located on the glabella. Smaller tubercles elongate crosswise on nuchal ring and genal margins. Cheeks marked by large, low confluent pebbling.

Thororachis rather wide; annular crests covered with low, elliptical tubercles as on nuchal ring. Posterior surface of pleura granulated outside line of flexure.

Pygidium very broadly rounded, width equalling almost twice the length, convexity moderate. Rachis composed of six or seven annulations, the last indistinct, tapers uniformly and terminates at the margin. There are four distinct pairs of low, broad, unfurrowed ribs, with one or two additional indistinct pairs apparent on the test but not on casts. Entire surface sparsely pebbled.

*Remarks.*—A few additional characters, which make *Phacops rana* (a common species) more easily distinguishable from closely related species and subspecies, may be mentioned. The distance between the anterior end of the glabella and the posterior edge of the occipital ring averages three fifths of the distance between the genal angles. The tuberculation of the glabella is relatively fine and even, and extends all the way to the anterior margin. The eye facets are in vertical rows of 5 in some specimens. In all specimens the facets are bounded by sharp polygonal ridges.

*Occurrence.*—Middle Devonian (Hamilton beds or their equivalents), New York region, southwestern Ontario, Ohio Valley, and Michigan: Southwestern Ontario (Hungry Hollow formation, Widder formation), localities A, B, and C. North-central Ohio (Plum Brook shale, Prout limestone), locality D. Northwestern Ohio (Ten Mile Creek dolomite), locality F. Michigan, Thunder Bay region (Alpena limestone, Four Mile Dam limestone, Norway Point formation), localities 40, 41, 46, 47, and 53; Little Traverse Bay region (Gravel Point formation), localities 14 and 14e.

*Types.*—Holotype No. 13887/1, New York State Museum; hypotypes Nos. 24305, 25523, 25538, 25539, 25570, 27060, 27130, 28849, 28850, 28851, 28852, and 28853, Museum of Paleontology, University of Michigan.

***Phacops rana crassituberculata* Stumm, subsp. nov.**

(Pl. IX, Figs. 5–13; Pl. X, Figs. 19–21)

*Description.*—Glabella inflated, with a nearly vertical front. Genal angles rounded. Eyes large, with average of 77 facets in vertical rows with 6 to 7 facets in a row and an average of 17 rows in each eye. Number of facets ranging from 66 to 89 in eyes of different specimens. Facets separated by flat-topped polygonal ridges. Palpebral lobes as in *P. rana*. First and second glabellar furrows lacking except on internal molds; third glabellar lobe and occipital ring as in *P. rana*. Ornamentation of cephalon consisting of tubercles; those on posterior part of glabella being large,



rounded or flat-topped, averaging 1 mm. in diameter. Tubercles becoming progressively smaller toward anterior margin of glabella. Ornamentation of remainder of cephalon as in *P. rana*.

Thorax and pygidium as in *P. rana* except rachis of some specimens composed of as many as 9 annulations.

*Remarks.*—*Phacops rana crassituberculata* differs from typical *P. rana* in the large number of eye facets and in the tuberculation of the glabella. In *P. rana* the tubercles are relatively small, rounded, and evenly spaced. In *P. r. crassituberculata* they are large, becoming progressively smaller toward the anterior margin. Some of them are flat-topped in the posterior part of the glabella.

*Occurrence.*—Middle Devonian (Silica formation), northwestern Ohio, locality E; (Traverse group, Ferron Point formation), locality 38, Alpena County, Michigan.

*Types.*—Holotype No. 25537; paratypes Nos. 25519, 25534, 25535, and 27063, Museum of Paleontology, University of Michigan.

*Phacops rana milleri* Stewart

(Pl. IX, Figs. 1-4; Pl. X, Figs. 1-10)

*Phacops rana* var. *milleri* Stewart, 1927, pp. 58-60.

*Description.* (Stewart, 1927, p. 58).—

General form elongate, subelliptical, length equal to about twice the greatest width; cephalon semicircular or arc-like; frontal portion of the glabella and the genal extremities slightly protruding, the latter broadly rounded; frontal margin concealed by the overhanging glabella; glabella large, gibbous, subpentagonal, widening rapidly anteriorly; transverse furrows three, the anterior two rarely discernible, while the posterior one reaches across the entire width of the glabella; facial sutures not observed. Cheeks almost in a plane with the visual area, narrowing anteriorly and abruptly deflected ventrally to form the doublure.

Eyes large, schizocroal, hardly reaching the height of the glabella; palpebral lobe distinct, lower than the palpebrum, and extending to the occipital furrow; palpebrum crescentic; visual area separated from the cheek by a strong, smooth furrow; lenses abundant, from 80 to 130 for each eye.

Thorax subquadrate, the lateral margins gradually tapering to the pygidium; segments well defined, 11 to 12 in number. Axis convex, slightly narrower than pleural lobes, tapering posteriorly. Pleural segments horizontal for about one-third their width from the axis, thence bent abruptly ventrally; each segment marked by a furrow which continues only to the fulcrum.

Pygidium semicircular, easily distinguished from thorax; axis marked by 9 annulations which narrow posteriorly and terminate just within the posterior margin; pleurae broad, less convex than axis, usually with 7 annulations which are well defined for about two-thirds the distance to the margin, and then become entirely obsolete.

Entire surface of test more or less completely ornamented with numerous tubercles which are largest and most abundant upon the glabella.

*Remarks.*—A number of specimens of *Phacops rana milleri* from the type locality show the following eye characters: Average number of facets to a vertical row, 8; average number of rows of facets, 18; average number of facets to an eye, 114, with a minimum of 104 and a maximum of 124. Stewart's minimum of 80 is believed to have been the result of inclusion of a specimen of *P. rana crassituberculata* which occurs in the same beds. As noted by Stewart (1927, p. 59), the eyes of *P. rana milleri* are much larger than those of *P. rana* and the scleral cavities are much shallower. The shallowness of these cavities causes the lenses to protrude much more strongly than in any other subspecies and makes the polygonal boundaries between the facets very indistinct. The glabellar tuberculation of *P. rana milleri* is much coarser than that of *P. rana* and approaches that of *P. rana crassituberculata* in size and distribution. The structures of the eye are the only diagnostic features by which *P. rana milleri* and *P. rana crassituberculata* can be distinguished.

*Occurrence.*—Middle Devonian (Silica formation), locality E, northwestern Ohio; (Traverse group, Bell shale, Ferron Point formation, and lower part of Genshaw formation), localities 31, 51, and 114, Thunder Bay region, Michigan.

*Types.*—Syntype No. 16266, Department of Geology, Ohio State University; hypotypes Nos. 20296, 25520, 25521, 25536, and 28846; plastrotype No. 28845, Museum of Paleontology, University of Michigan.

### ***Phacops rana arkonensis* Stumm, subsp. nov.**

(Pl. X, Figs. 11–14)

*Description.*—Cephalon as in *Phacops rana* except in proportions, ornamentation, and eyes. Distance between genal angles averaging twice the distance between posterior side of occipital ring and anterior margin of glabella. Eyes similar to those of *P. rana milleri* in the possession of elevated facets, shallow pits, and obsolete polygonal boundaries. Facets in central portion of eye in vertical rows ranging from 6 to 7 facets to a row. Ornamentation consisting of fine tubercles on the posterior part of glabella, becoming obsolete where change of slope produces vertical frontal part. Tubercles faint to obsolete on cheeks and occipital ring.

Thorax and pygidium as in *P. rana* except without tuberculation. Pygidium faintly granular.

*Remarks.*—*Phacops rana arkonensis* is very easily recognized by the unusually short wide cephalon and by the lack of tuberculation except on the palpebral lobes and the posterior part of the glabella.

*Occurrence.*—Middle Devonian (Hamilton group, Arkona shale), localities A, B, and C; Thedford-Arkona region, Ontario, Canada.

*Type.*—Holotype No. 28847, Museum of Paleontology, University of Michigan.

***Phacops rana bellensis* Stumm, subsp. nov.**

(Pl. X, Figs. 15-18)

*Description.*—Cephalon as in *Phacops rana crassituberculata* except more nearly subtrigonal in outline. Tubercles of glabella coarser and more widely spaced, not decreasing materially in size anteriorly. Eyes small with 54 lenses in 4 vertical rows. Lenses separated by strongly developed polygonal walls.

Thorax and pygidium as in *P. rana crassituberculata* except more weakly tuberculate. Pleural ribs of pygidium much more strongly arched than in *P. rana crassituberculata*.

*Remarks.*—*Phacops rana bellensis* can be recognized easily by the subtrigonal cephalon, the very coarse, evenly spaced tubercles on the glabella, the unusually small eyes with lenses in 4 rows, and the strongly arched pygidial pleurae. The holotype and only known specimen has been etched, especially on the thorax and pygidium. Unweathered specimens will probably show a greater amount of tuberculation covering these areas.

*Occurrence.*—Middle Devonian (Traverse group, Bell shale), locality 31, Michigan Limestone and Chemical Company quarry at Calcite, near Rogers City, Presque Isle County, Michigan.

*Type.*—Holotype No. 28848, Museum of Paleontology, University of Michigan.

***Phacops rana alpenensis* Stumm, subsp. nov.**

(Pl. XI, Figs. 12-21)

*Description.*—Cephalon as in *Phacops rana* except glabella and ocular platforms more coarsely tuberculate. Eyes with 40 to 44 facets in 3 to 4 vertical rows.

Thorax similar to that of *P. rana* except axial segments with fewer and coarser tubercles.

Pygidium with axial and pleural segments much more strongly elevated than those of *P. rana*. All pygidial segments covered with coarse, sharply conical tubercles.

*Remarks.*—Although *Phacops rana alpenensis* is similar to typical *P. rana* in general outline and proportions, it can be easily distinguished by the coarser tuberculation, by the fewer number of eye facets, and by the more distinct pygidial segmentation.

*Occurrence*.—Middle Devonian (Traverse group, Alpena limestone and Gravel Point formation), localities 14, 14e, 15b, 40, and 53, Emmet, Charlevoix and Alpena counties, Michigan.

*Types*.—Holotype No. 25516, paratypes Nos. 25517 and 29559, Museum of Paleontology, University of Michigan; paratype No. E15211, Buffalo Museum of Science; paratype No. 117860, United States National Museum.

***Phacops rana norwoodensis* Stumm, subsp. nov.**

(Pl. XII, Figs. 6–10)

*Description*.—Cephalon as in typical *Phacops rana* except glabella relatively smaller and narrower, less expanding anteriorly, and covered with fewer, larger tubercles. Palpebral lobes gently arched, smooth. Eyes with 50 to 60 facets in 4 to 6 vertical rows.

Thorax with more weakly tuberculate axial segments than in that of *P. rana*, and with very weakly tuberculate to smooth pleural segments.

Pygidium with small, narrow, low convex axis and wide, flat pleurae. Pleural segments low, flat, becoming obsolete peripherally and posteriorly, covered with very low, weakly defined tubercles.

*Remarks*.—*Phacops rana norwoodensis* can easily be distinguished from typical *P. rana* by the narrow, less-expanding glabella and by the smooth pygidial pleurae.

*Occurrence*.—Middle Devonian (Traverse group, upper part of Petoskey formation, *Schizophoria* bed), locality 7b, ledges along shore of Lake Michigan, 1 1/10 miles north of Norwood, Charlevoix County, Michigan. Middle Devonian (upper part of Milwaukee dolomite), locality G, Milwaukee, Wisconsin.

*Types*.—Holotype No. 25524; paratypes Nos. 14727, 28856, and 28857, Museum of Paleontology, University of Michigan.

***Phacops iowensis* Delo**

(Pl. XII, Figs. 4–5, 12–15)

*Phacops iowensis* Delo, 1935, pp. 422–23.

*Description* (Delo, 1940, p. 18).—

Glabella narrowly curved in front, moderately convex for the genus; third pair of lateral furrows very distinct, curved anteriorly; second pair discernible; third pair of glabellar lobes broadened mesially, conspicuously tuberculate. Eyes large, with 35 to 40 facets; bounded posteriorly by a tuberculated, ridgelike swell in cheek area in front of posterior marginal furrow. Entire cephalon covered with sharp tubercles of various sizes.

Thorax strongly tuberculated.

Pygidium with six to seven moderately narrow, strongly arched pygorachial annulations, four to five pairs of pleural ribs. Rather prominent tuberculation on all ribs and annulations, and irregularly distributed around the posterior border.

*Remarks.*—*Phacops iowensis* is represented in the Traverse group by fragmentary specimens from the Potter Farm, Thunder Bay, and lower Petoskey formations. A well-preserved free cheek shows the elevated eye and the posterior tuberculate ridgelike swell. Three pygidia show the highly arched, heavily tuberculate pygorachial annulations and pleurae.

*Occurrence.*—Middle Devonian (Traverse group, Potter Farm formation and Thunder Bay limestone), localities 35 and 68, Alpena County; (lower Petoskey formation), locality 21, Emmet County, Michigan.

*Types.*—Holotype No. 9-266, Department of Geology, State University of Iowa; hypotypes Nos. 25527, 27055, 27061, 29229, and 29230, Museum of Paleontology, University of Michigan.

### ***Phacops iowensis southworthi* Stumm, subsp. nov.**

(Pl. XII, Figs. 1-3)

*Description.*—Cephalon semilunate in outline, almost twice as wide as long. Glabella broad, widening rapidly anteriorly, with a broadly curved anterior margin. Second pair of lateral glabellar furrows faintly visible; third pair and occipital furrow distinct. Palpebral lobes wide, arched almost to eye level. Eyes of medium size with an average of 47 facets in 4 vertical rows. Scleral pits deep; polygonal boundaries elevated, thick. Entire cephalon covered with sharp, conical tubercles highly elevated on glabella, palpebral lobes, and dorsal surfaces of eyes.

Thorax covered with rounded, elevated tubercles.

Pygidium with 7 well-defined axial segments and from 7 to 8 pairs of pleural segments of which the posterior 2 or 3 pairs are defined only by rows of tubercles. Anterior 5 pairs of pleural segments separated by deep furrows. Entire pygidium heavily tuberculate with 2 to 3 rows of elevated tubercles on each segment.

*Remarks.*—*Phacops iowensis southworthi* is similar to *P. iowensis* especially in the heavily tuberculate test and the deeply furrowed pygidium. It differs from *P. iowensis* in having a greater proportional width, a broadly curved anterior margin to the glabella, and in having much wider, more highly arched palpebral lobes. The subspecies is named in honor of Mr. Charles Southworth, of Thedford, Ontario, the well-known collector of Hamilton fossils of the Thedford-Arkona region.

*Occurrence.*—Middle Devonian (Hungry Hollow formation); localities A, B, and C, Thedford-Arkona region, Ontario.

*Types.*—Holotype No. 24313 and paratype No. 28854, Museum of Paleontology, University of Michigan.

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*Submitted for publication March 13, 1952*



**PLATES**

## EXPLANATION OF PLATE I

PAGE

- Proetus (Crassiproetus) traversensis* Stumm, sp. nov. . . . . 112  
 FIG. 1. Almost complete specimen, showing subquadrate glabella, free cheeks, and anterior thoracic segments. Holotype No. 117876, U. S. National Museum. Traverse group, Gravel Point formation, *Longispina emmetensis* zone; locality 8. × 1.  
 FIG. 2. Internal mold of pygidium, showing segmentation. Paratype No. 25447. Traverse group, Gravel Point formation; near Petoskey, Emmet County. × 2.
- Proetus (Crassiproetus) microgranulatus* Stumm, sp. nov. . . . . 111  
 FIG. 3. Pygidium. Paratype No. 27080. Alpena limestone; locality 53. × 2.
- Proetus (Crassiproetus) alpenensis* Stumm, sp. nov. . . . . 113  
 FIG. 4. Glabella, free cheek, and anterior part of thorax of crushed specimen. Holotype No. 25501. Traverse group, Thunder Bay limestone; locality 35. × 2.  
 FIG. 5. Pygidium, showing smooth axis and posterior part of pleurae. Paratype No. 27089. For horizon and locality see Figure 4. × 2.
- Proetus (Crassiproetus) canadensis* Stumm, sp. nov. . . . . 113  
 FIG. 6. Free cheek, showing broadly rounded genal angle. Paratype No. 28672. Hamilton group, lower Widder formation; locality B. × 2.  
 FIG. 7. Complete individual, showing glabella, thoracic segmentation, and relatively smooth pygidium. Holotype No. 27090. Horizon and locality (Fig. 6). × 2.
- Proetus (Crassiproetus) microgranulatus* Stumm, sp. nov. . . . . 111  
 FIG. 8. Complete individual. Holotype No. E13351, Buffalo Museum of Science. Traverse group, Newton Creek limestone; locality 40. × 2.
- Proetus (Crassiproetus) sp. B.* . . . . . 115  
 FIG. 9. Well-segmented pygidium. Figured specimen No. 25448. Traverse group, Genshaw formation; locality 112. × 1.
- Proetus (Crassiproetus) traversensis* Stumm, sp. nov. . . . . 112  
 FIG. 10. Free cheek, showing the narrowly rounded genal angle. Paratype No. 25446. Traverse group, Four Mile Dam limestone; locality 41. × 1.  
 FIG. 11. Complete cephalon, showing subquadrate glabella. Paratype No. 117865*b*, U. S. National Museum. For horizon and locality see Figure 10. × 2.  
 FIG. 12. Side of paratype (Fig. 11), showing convexity of cephalon. × 2.  
 FIG. 13. Inner mold of glabella, showing faint glabellar lobes. Paratype No. 28673. For horizon and locality see Figure 10. × 1.  
 FIG. 14. Incomplete glabella, well-preserved occipital ring with small axial node. Paratype No. 117865*a*, U. S. National Museum. Horizon and locality (Fig. 10). × 1.
- FIG. 15. Pygidium with much of crust preserved, showing segmentation. Paratype No. 28674. For horizon and locality see Figure 10. × 1.
- Proetus (Crassiproetus) sp. A.* . . . . . 114  
 FIG. 16. Pygidium. Figured specimen No. 28675. Traverse group, Ferron Point formation; vicinity of Black Lake, Presque Isle County. × 1.
- Proetus (Crassiproetus) traversensis* Stumm sp. nov. . . . . 112  
 FIG. 17. Small pygidium. Paratype No. 25449. Dock Street clay; locality 53. × 1.
- Proetus (Crassiproetus) norwoodensis* Stumm, sp. nov. . . . . 114  
 FIG. 18. Cranidium. Holotype No. 25444. Traverse group, upper Petoskey formation, *Schizophoria* bed; locality 7*b*. × 2.
- Proetus (Crassiproetus) microgranulatus* Stumm, sp. nov. . . . . 111  
 FIG. 19. Pygidium. Paratype No. 28676. Horizon and locality (Fig. 8). × 2.
- Proetus (Crassiproetus) alpenensis* Stumm, sp. nov. . . . . 113  
 FIG. 20. Pygidium with part of test preserved. Paratype No. 27088. Traverse group, Potter Farm formation; locality 68. × 2.

PLATE I

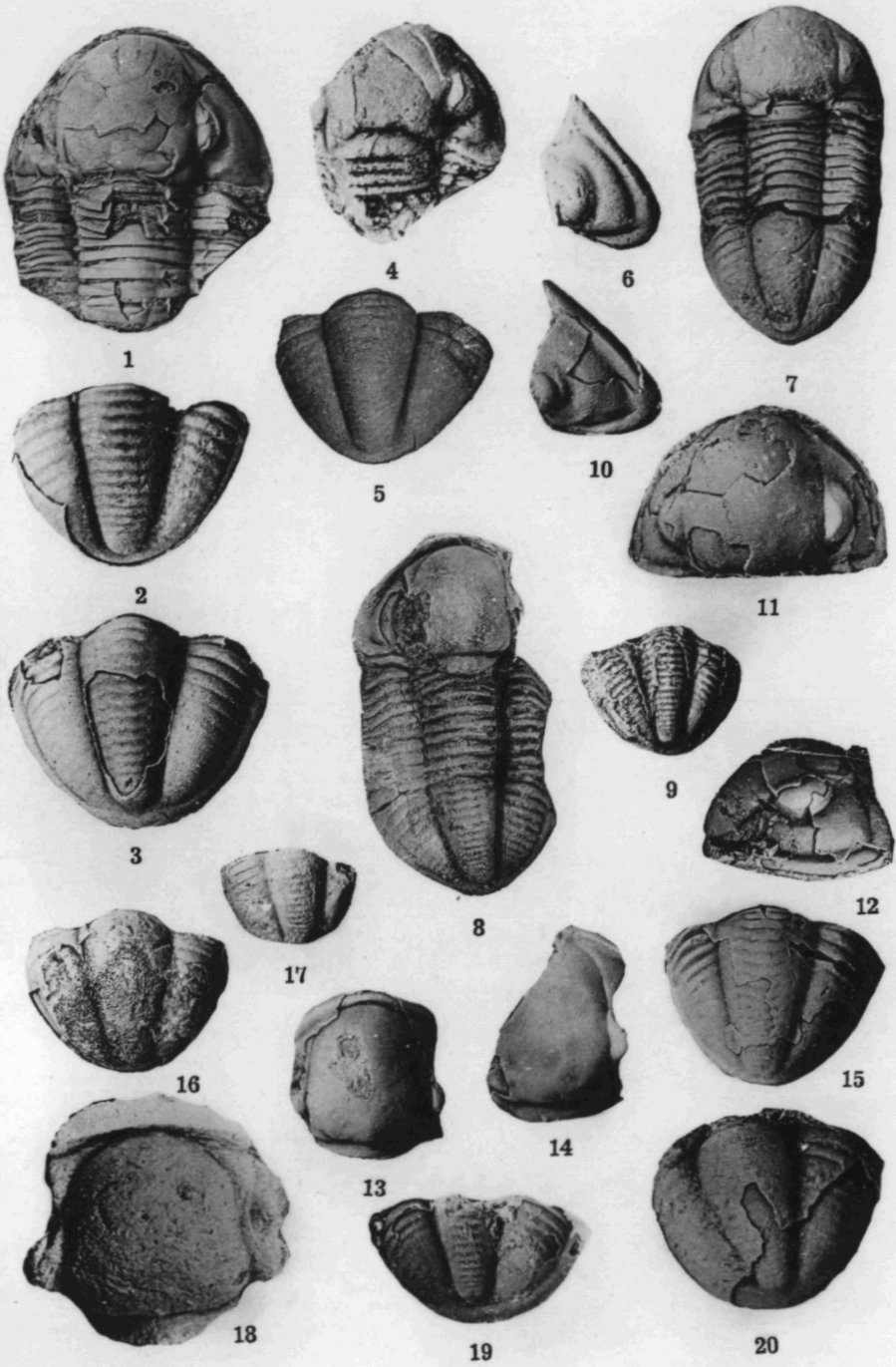
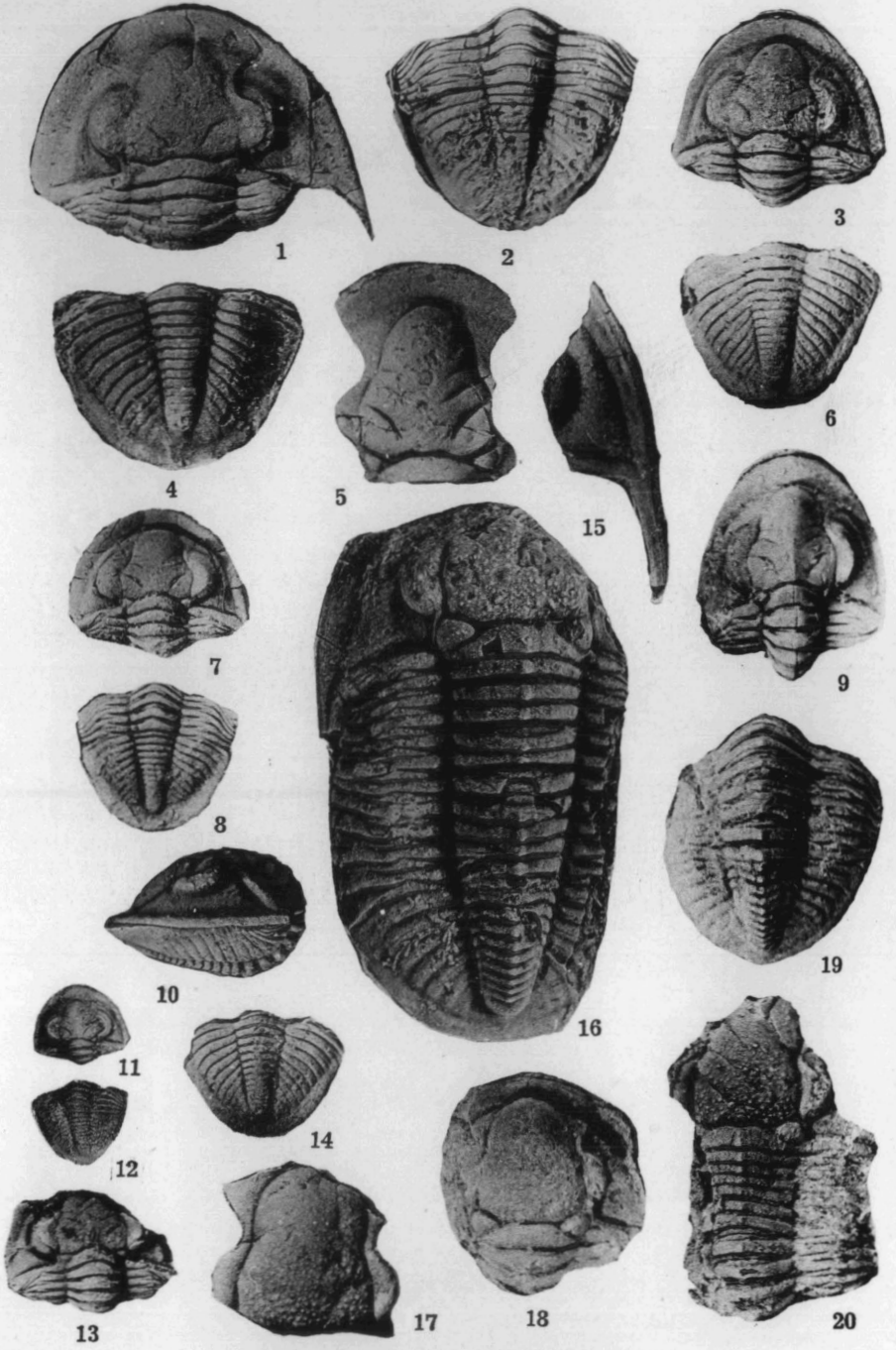


PLATE II



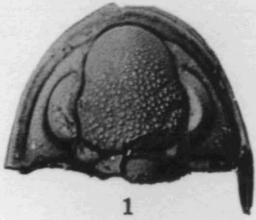
## EXPLANATION OF PLATE II

- |  | PAGE |
|--|------|
| <i>Dechenella (Dechenella) alpenensis</i> Stumm, sp. nov. ....   | 116  |
| FIG. 1. Cephalon and anterior of thorax, showing brim, glabella, and genal spine. Holotype No. 27082. Traverse group, base of Genshaw formation; locality 113. × 2.  |      |
| FIG. 2. Posterior of thorax and pygidium of enrolled specimen. Paratype No. 27077. Traverse group, upper Ferron Point formation; locality 51. × 2.   |      |
| FIG. 3. Cephalon and anterior of thorax with glabellar lobation well preserved. Paratype No. 117870, U. S. National Museum. Horizon and locality (Fig. 2). × 2.  |      |
| FIG. 4. Pygidium, showing distinct segmentation. Paratype No. 25511. Traverse group, upper Bell shale; locality 38. × 2.   |      |
| FIG. 5. Unusually large cranidium with deeply incised glabellar lobation. Paratype No. 25503. Traverse group, Ferron Point formation; locality 29. × 2.  |      |
| FIG. 6. Pygidium with well-preserved brim. Paratype No. 25513. Traverse group, Genshaw formation; locality 52. × 2.  |      |
| FIG. 7. Anterior of small enrolled specimen. Paratype No. 117867, U. S. National Museum. For horizon and locality see Figure 2. × 2.   |      |
| FIG. 8. Posterior part of paratype (Fig. 7), showing medial furrows on pleural segments of thorax. × 2.  |      |
| FIG. 9. Anterior of enrolled laterally compressed specimen with cephalic brim well preserved. Paratype No. 28679. For horizon and locality see Figure 2. × 2.  |      |
| FIG. 10. Side of paratype (Fig. 3), showing ocular platform. × 2.  |      |
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| FIG. 12. Posterior part of paratype (Fig. 11). × 2.  |      |
| FIG. 13. Anterior of small enrolled specimen. Paratype No. 117873, U. S. National Museum. Traverse group, upper Bell shale. For horizon and locality see Figure 4. × 2.  |      |
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| FIG. 17. Compressed glabella, showing tuberculation and palpebral lobes. Paratype No. 25445. For horizon and locality see Figure 2. × 2.   |      |
| FIG. 18. Anterior of enrolled specimen with cephalic brim well preserved. Paratype No. 25509. For horizon and locality see Figure 1. × 2.  |      |
| FIG. 19. Posterior part of paratype (Fig. 18), showing distinct, posteriorly directed axial nodes. × 2.  |      |
| FIG. 20. Crushed specimen with glabellar tuberculation well preserved. Paratype No. 117868, U. S. National Museum. Traverse group, lower Genshaw formation. For locality see Figure 2. × 2.  |      |

## EXPLANATION OF PLATE III

- |  | PAGE |
|--|------|
| <i>Dechenella (Basidechenella) pulchra</i> Stumm, sp. nov. ....  | 119  |
| FIG. 1. Well-preserved cephalon, showing tuberculate glabella with faint furrow. Holotype No. 28680. Traverse group, upper Alpena limestone; locality 53. $\times$ 2.  |      |
| FIG. 2. Anterior of enrolled specimen with well-preserved right ocular platform. Paratype No. 117866b, U. S. National Museum. Traverse group, Gravel Point formation; locality 14. $\times$ 2.   |      |
| FIG. 3. Free cheek with narrow genal spine. Paratype No. 25505. Traverse group, Dock Street clay; locality 53. $\times$ 2.   |      |
| FIG. 4. Small tuberculate glabella with relatively distinct furrows. Paratype No. 25514. Traverse group, Gravel Point formation, <i>Longispina emmetensis</i> zone; locality 8. $\times$ 2.  |      |
| FIG. 5. Almost complete individual with crushed cephalon, showing occipital nodes and ring and thoracic segmentation. Paratype No. 117875, U. S. National Museum. Traverse group, Alpena limestone, 1-foot shale bed 57 feet below top; locality 40. $\times$ 2. |      |
| FIG. 6. Nearly complete specimen, showing tuberculation of glabella and segmentation of thorax and pygidium. Paratype No. 117866a, U. S. National Museum. Traverse group, Gravel Point formation; locality 14. $\times$ 2.                                       |      |
| FIG. 7. Imperfectly preserved pygidium, showing axial nodes. Paratype No. 28683. For horizon and locality, see Figure 3. $\times$ 2.   |      |
| FIG. 8. Thorax of nearly complete, partly enrolled specimen, showing posteriorly directed, blunt axial spines. Paratype No. 28681. For horizon and locality see Figure 3. $\times$ 2.  |      |
| <i>Dechenella (Basidechenella) rowi arkonensis</i> Stumm, subsp. nov. ....   | 120  |
| FIG. 9. Specimen with well-preserved cephalon and thorax, showing glabella, ocular platforms, and genal spines. Holotype No. 25541. Hamilton group, Hungry Hollow formation, coral bed; locality B. $\times$ 2.  |      |
| FIG. 10. Posterior of an enrolled specimen, showing segmentation and axial nodes. Paratype No. 28682. For horizon and locality see Figure 9. $\times$ 2.   |      |
| <i>Dechenella (Basidechenella) rowi</i> (Green) .....  | 120  |
| FIG. 11. Cranidium, showing relatively smooth glabella, prominent occipital nodes, and occipital ring. Hypotype No. 117861, U. S. National Museum. Traverse group, Four Mile Dam limestone; locality 53. $\times$ 2.   |      |

PLATE III



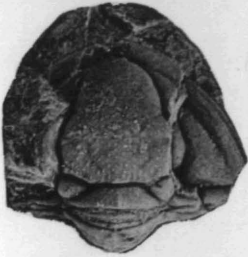
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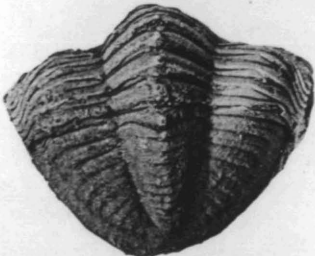
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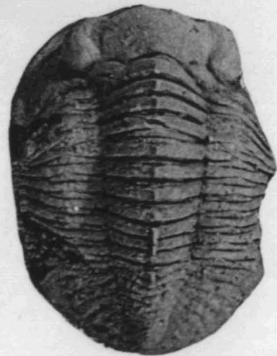
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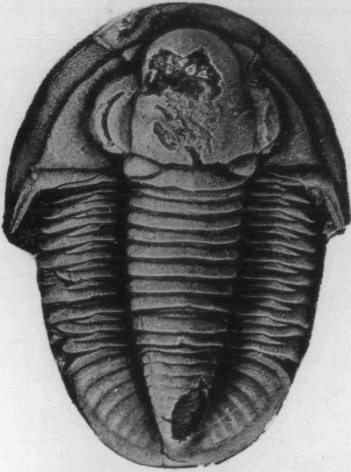


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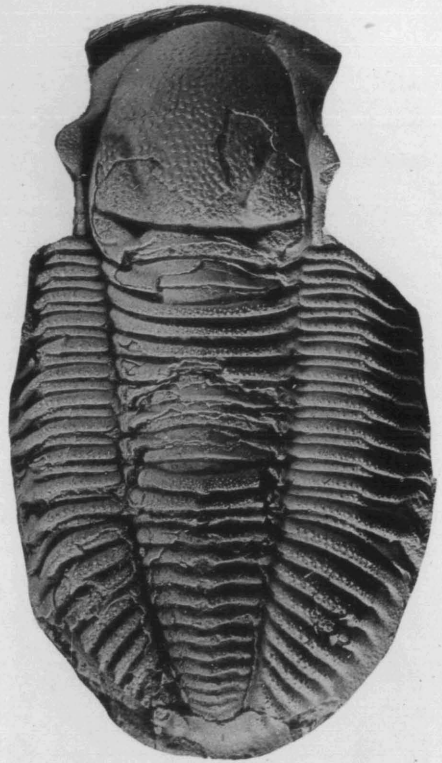


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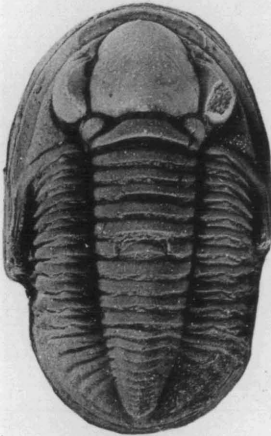
PLATE IV



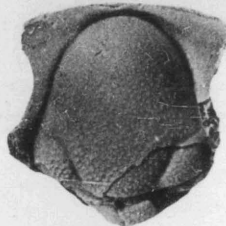
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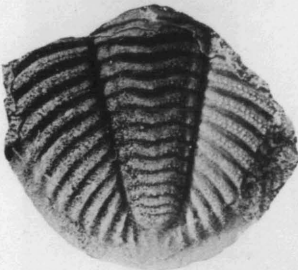
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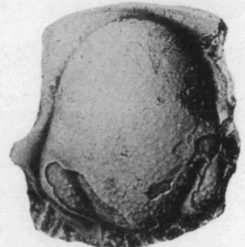
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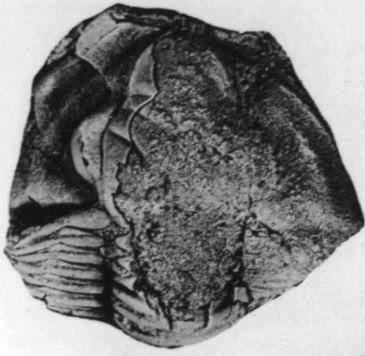
## EXPLANATION OF PLATE IV

	PAGE
<i>Dechenella (Basidechenella) rowi</i> (Green) .....	120
FIG. 1. Complete individual with free cheeks unusually well preserved. Hypotype No. E8440, Buffalo Museum of Science. Hamilton group, Ludlowville formation, Wanakah shale, trilobite bed; Wanakah Cliff Beach, Lake Erie shore, near mouth of Eighteen Mile Creek, Erie County, New York. $\times 2$ .	
FIG. 2. Complete individual with a well-preserved glabella. Hypotype No. E5433, Buffalo Museum of Science. Hamilton group, Ludlowville formation; East Bethany, Genesee County, New York. $\times 2$ .	
<i>Dechenella (Monodechenella) macrocephala</i> (Hall) .....	123
FIG. 3. Specimen, complete except for free cheeks, showing typical glabellar lobation. Hypotype No. E4253, Buffalo Museum of Science. Hamilton group, Moscow formation, Kashong shale; Bowen Brook, 2 miles northwest of Alexander, Genesee County, New York. $\times 2$ .	
FIG. 4. Cranidium, showing glabellar lobation and tuberculation. Hypotype No. 117877, U. S. National Museum. Traverse group, Four Mile Dam limestone; locality 41. $\times 2$ .	
FIG. 5. Pygidium, showing segmentation and parallel rows of tubercles. Hypotype No. 28715. For horizon and locality see Figure 4. $\times 2$ .	
FIG. 6. Cranidium with well-preserved glabella. Hypotype No. 27079. For horizon and locality see Figure 4. $\times 2$ .	

## EXPLANATION OF PLATE V

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<i>Dechenella (Dechenella)</i> sp. A. ....	117
FIG. 1. Anterior of incomplete specimen, showing deeply incised glabellar furrows. Figured specimen No. 25508. Traverse group, Potter Farm formation; locality 68. $\times 2$ .	
FIG. 2. Incomplete pygidium of small individual. Figured specimen No. 28716. For horizon and locality see Figure 1. $\times 2$ .	
<i>Dechenella (Basidechenella)</i> sp. C. ....	122
FIG. 3. Only known specimen, showing genal spine, thorax, and pygidium. Figured specimen No. 72554, U. S. National Museum. Traverse group, Thunder Bay limestone; locality 35. $\times 2$ .	
<i>Dechenella (Basidechenella)</i> sp. B. ....	122
FIG. 4. Free cheek, showing ocular platform and incomplete genal spine. Figured specimen No. 28717. Traverse group, Potter Farm formation; locality 68. $\times 2$ .	
FIG. 5. Glabella of individual, showing tuberculation. Figured specimen No. 27076. For horizon and locality see Figure 4. $\times 2$ .	
<i>Dechenella (Basidechenella) reimanni</i> Stumm, sp. nov. ....	121
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FIG. 7. Almost complete specimen with thorax and pygidium very well preserved. Holotype No. 27075. For horizon and locality see Figure 6. $\times 2$ .	
<i>Dechenella (Basidechenella)</i> sp. A. ....	121
FIG. 8. Free cheek, showing ocular platform and genal spine. Figured specimen No. 28719. Traverse group, Norway Point formation; locality 47. $\times 2$ .	
FIG. 9. Cranium, showing brim and tuberculate glabella. Figured specimen No. 25506. For horizon and locality see Figure 8. $\times 2$ .	
FIG. 10. Cranium with palpebral lobe well preserved. Figured specimen No. 28720. For horizon and locality see Figure 8. $\times 2$ .	
FIG. 11. Pygidium, showing segmentation and faint axial nodes. Figured specimen No. 28721. For horizon and locality see Figure 8. $\times 2$ .	
<i>Scutellum tullium depressum</i> Cooper and Cloud .....	128
FIG. 12. Dorsal view of imperfect cranium. Paratype No. 95203, U. S. National Museum. Traverse group, middle Petoskey formation; locality 7b. $\times 1$ (after Cooper and Cloud).	
FIG. 13. Cranium and free cheek, showing lobation, tuberculation, and genal spine. Paratype No. 95201b, U. S. National Museum. Cedar Valley limestone; SE. $\frac{1}{4}$ NE. $\frac{1}{4}$ sec. 20, T. 11 S., R. 2 W., first hollow south of Kritesville, Calhoun County, Illinois. $\times 1$ .	
<i>Acidaspis</i> (?) sp. A. ....	127
FIG. 14. Free cheek of small individual, showing spinose brim and curved genal spine. Figured specimen No. 28921. Basal Bell shale; locality 31. $\times 8$ .	
FIG. 15. Free cheek, showing irregular arrangement of spines on brim and spinose tubercles on genal spine. Figured specimen No. 28922. For horizon and locality see Figure 14. $\times 8$ .	

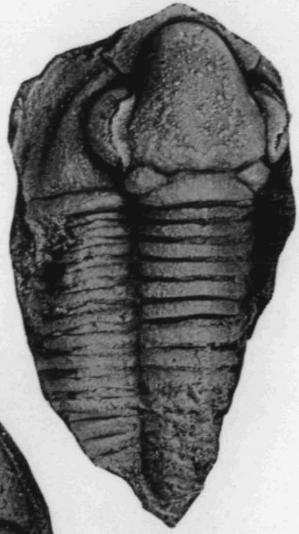
PLATE V



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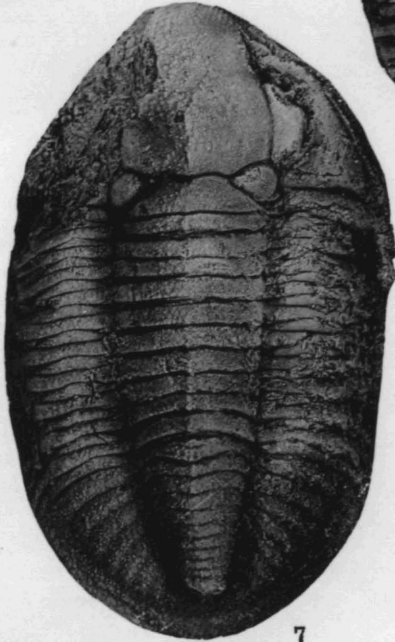
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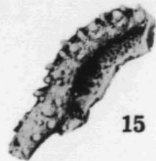
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PLATE VI



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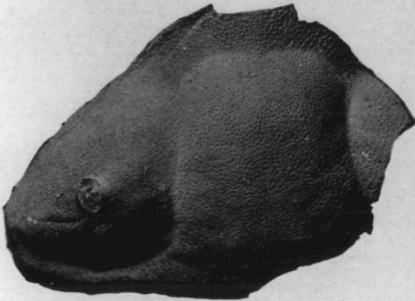
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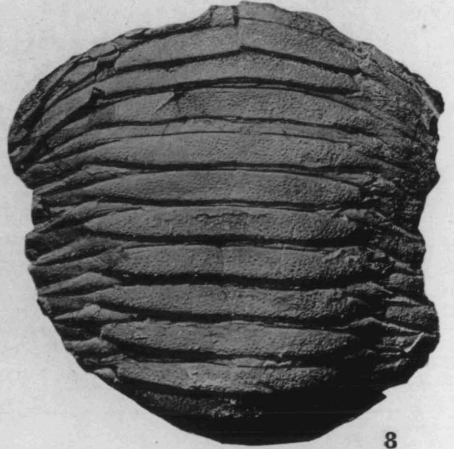
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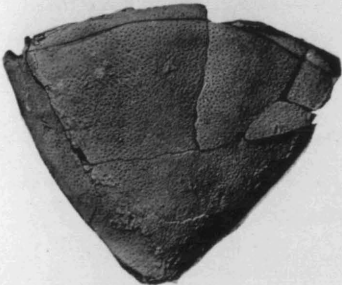
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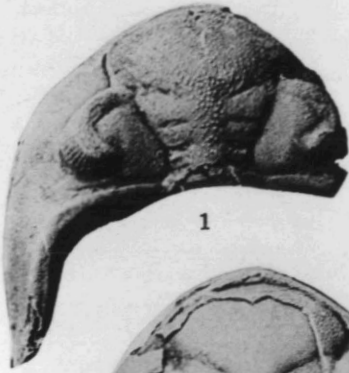
## EXPLANATION OF PLATE VI

- |  | PAGE |
|--|------|
| <i>Ancyropyge romingeri</i> (Hall and Clarke) .....  | 126  |
| FIG. 1. Pygidium, showing the posteriorly recurved pygidial spines. Hypotype No. 117862, U. S. National Museum. Traverse group, Gravel Point formation, <i>Longispina emmetensis</i> zone; locality 8. $\times$ 1. |      |
| FIG. 2. Pygidium, showing bullate tuberculate axis. Holotype No. 4934. For horizon and locality see Figure 1. $\times$ 1.  |      |
| <i>Cordania rara</i> Stumm, sp. nov. ....  | 124  |
| FIG. 3. Cranidium, showing the nature of glabellar lobation and wide tuberculate brim. Holotype No. 117869, U. S. National Museum. Traverse group, Four Mile Dam limestone; locality 41. $\times$ 2.               |      |
| <i>Cordania</i> sp. A. ....  | 125  |
| FIG. 4. Incomplete pygidium, showing distinctive segmentation. Figured specimen No. 28895. Traverse group, lower Petoskey formation; locality 18b. $\times$ 10.  |      |
| <i>Dipleura dekayi</i> Green .....   | 129  |
| FIG. 5. Cephalon of mature individual, showing quadrate unfurrowed glabella and broad cheek. Hypotype No. 117874, U. S. National Museum. Traverse group, Thunder Bay limestone; locality 35. $\times$ 1.           |      |
| FIG. 6. Pygidium of mature individual, showing trigonal outline and smooth surface. Hypotype No. 117863, U. S. National Museum. For horizon and locality see Figure 5. $\times$ 1.                                 |      |
| FIG. 7. Cephalon of small individual, brim well preserved. Hypotype No. 117864a, U. S. National Museum. Traverse group, Norway Point formation; locality 47. $\times$ 4.   |      |
| FIG. 8. Well-preserved thorax, showing wide, low-convex axis and anterior and posterior limbs of the pleurae. Hypotype No. 25442. For horizon and locality see Figure 7. $\times$ 1.                               |      |
| FIG. 9. Pygidium of small individual with incipient pleural segmentation faintly visible. Hypotype No. 117864b, U. S. National Museum. For horizon and locality see Figure 7. $\times$ 4.                          |      |

## EXPLANATION OF PLATE VII

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<i>Greenops boothi</i> (Green) .....	130
FIG. 1. Cephalon, showing glabellar lobation, axial concentration of glabellar tubercles, and well-preserved genal spines. Hypotype No. 25540. Hamilton group, lower Widdler formation; along Aux Sable River, about 3 miles southeast of Thedford, Ontario. $\times 3$ .	
FIG. 2. Complete individual with thoracic and pygidial segmentation and ornamentation well preserved. Hypotype No. 28665. For horizon and locality see Figure 1. $\times 3$ .	
FIG. 3. Side of enrolled specimen, showing eye lenses. Hypotype No. 25571. Hamilton group, Hungry Hollow formation, coral bed; locality B. $\times 2$ .	
<i>Greenops aequituberculatus</i> Stumm, sp. nov. ....	131
FIG. 4. Glabella, showing axial extension of brim, anterior lobation, and equally spaced tuberculation. Paratype No. 25438. Traverse group, Norway Point formation; locality 46. $\times 3$ .	
FIG. 5. Thorax and pygidium, showing axial nodes and tuberculation. Paratype No. 117872. U. S. National Museum. For horizon and locality see Figure 4. $\times 3$ .	
FIG. 6. Pygidium, showing segmentation, tuberculation, lappets, and posterior axial process. Paratype No. 28666. For horizon and locality see Figure 4. $\times 3$ .	
<i>Greenops alpenensis</i> Stumm, sp. nov. ....	133
FIG. 7. Cephalon, showing glabellar lobation and large flat-topped tubercles. Holotype No. 25436. Traverse group, Thunder Bay limestone; locality 35. $\times 3$ .	
FIG. 8. Pygidium showing V-shaped posterior axial process. Paratype No. 28667. For horizon and locality see Figure 7. $\times 3$ .	
<i>Greenops</i> sp. A. ....	134
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PLATE VII

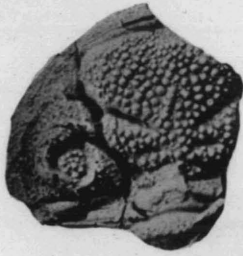


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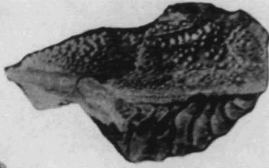
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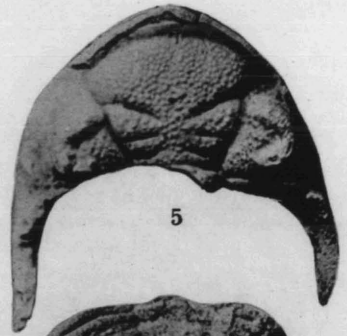
PLATE VIII



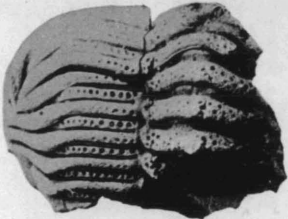
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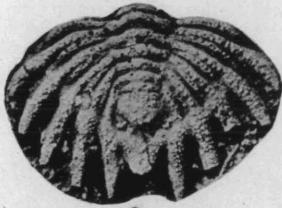
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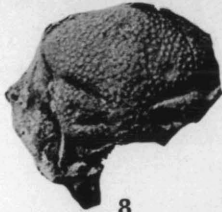
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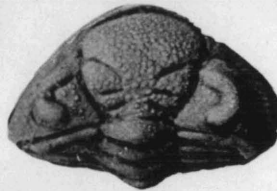
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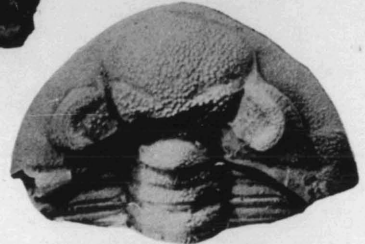
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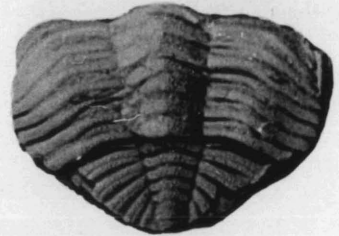
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## EXPLANATION OF PLATE VIII

- |  | PAGE |
|--|------|
| <i>Greenops traversensis</i> Stumm, sp. nov. ....  | 132  |
| FIG. 1. Cephalon, showing glabellar lobation and large conical tubercles. Holotype No. 117871, U. S. National Museum. Traverse group, Gravel Point formation, upper blue shale, Zone 6, Bed 3 of Pohl, 1930; locality 14e. × 3.      |      |
| FIG. 2. Thorax of holotype (Fig. 1), showing axial spines and weathered uniserial tubercles on limbs of pleural segments. × 3.   |      |
| FIG. 3. Pygidium, showing uniserial tubercles on limbs of pleural segments, narrow convex lappets, and short spatulate posterior axial process. Paratype No. 28668. Traverse group, upper Gravel Point formation; Emmet County. × 3. |      |
| FIG. 4. Side of holotype (Fig. 1), showing the coarsely tuberculate ocular platform. × 3.  |      |
| <i>Greenops aequituberculatus</i> Stumm, sp. nov. ....   | 131  |
| FIG. 5. Almost complete cephalon, showing glabellar lobation and tuberculation and genal spines. Holotype No. 20165. Traverse group, Dock Street clay; locality 53. × 3.   |      |
| FIG. 6. Pygidium, showing distinct medial pleural furrows, wide lappets, and fine tuberculation. Paratype No. 27083. Horizon and locality, see Figure 5. × 3.  |      |
| FIG. 7. Pygidium. Paratype No. 25439. Horizon and locality, see Figure 5. × 3.   |      |
| FIG. 8. Incomplete glabella, showing even tuberculation. Paratype No. 25441. Traverse group, Gravel Point formation, <i>Longispina emmetensis</i> zone; locality 8. × 3.   |      |
| FIG. 9. Pygidium with ornamentation well preserved. Paratype No. 28669. For horizon and locality see Figure 8. × 3.  |      |
| <i>Greenops arkonensis</i> Stumm, sp. nov. ....  | 134  |
| FIG. 10. Side of enrolled specimen, showing eye lenses and ocular platform. Paratype No. 24174. Hamilton group, Arkona shale; locality B. × 2.   |      |
| FIG. 11. Cephalon of enrolled specimen, with well-defined glabellar lobation and axial node on occipital ring. Paratype No. 28670. For horizon and locality see Figure 10. × 3.  |      |
| FIG. 12. Cephalon of paratype (Fig. 10), showing glabellar lobation, tuberculation, and well-preserved distal surfaces of eyes. × 3.   |      |
| FIG. 13. Cephalon of relatively large specimen, with tuberculation well preserved. Holotype No. 28671. For horizon and locality see Figure 10. × 3.  |      |
| FIG. 14. Posterior part of thorax and pygidium of holotype (Fig. 13). × 3.   |      |

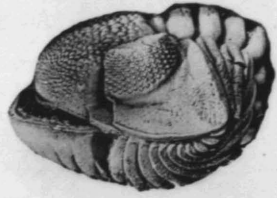
## EXPLANATION OF PLATE IX

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<i>Phacops rana milleri</i> Stewart .....	137
FIG. 1. Anterior of enrolled specimen, showing coarse glabellar tuberculation. Hypotype No. 25536. Lower Silica formation; locality E. × 1.	
FIG. 2. Posterior of hypotype (Fig. 1), showing segmentation and fine axial tuberculation. × 1.	
FIG. 3. Side of hypotype (Fig. 1), showing eye, ocular platform, and genal angle. × 1.	
FIG. 4. Eye of hypotype (Fig. 1), showing elevated lenses. × 1.	
<i>Phacops rana crassituberculata</i> Stumm, subsp. nov. ....	136
FIG. 5. Complete individual, showing glabella, segmentation, and ornamentation. Holotype No. 25537. For horizon and locality see Figure 1. × 1.	
FIG. 6. Anterior part of small, enrolled specimen. Paratype No. 25534. For horizon and locality, see Figure 1. × 1.	
FIG. 7. Side of paratype (Fig. 6), showing eye, ocular platform, and genal angle. × 1.	
FIG. 8. Posterior of paratype (Fig. 6), showing pygidial pleural segments with faint medial furrows. × 1.	
FIG. 9. Slightly weathered eye of paratype (Fig. 6), showing arrangement of facets. × 2.	
FIG. 10. Anterior of specimen with glabellar tuberculation well preserved. Paratype No. 25535. For horizon and locality, see Figure 1. × 1.	
FIG. 11. Side of paratype (Fig. 10). × 1.	
FIG. 12. Eye of paratype (Fig. 10), showing low lenses and elevated polygonal boundaries. × 2.	
FIG. 13. Pygidium, showing segmentation and tuberculation. Paratype No. 27063. For horizon and locality see Figure 1. × 1.	

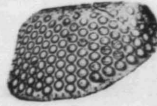
PLATE IX



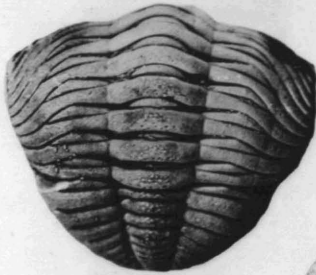
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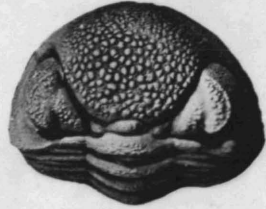
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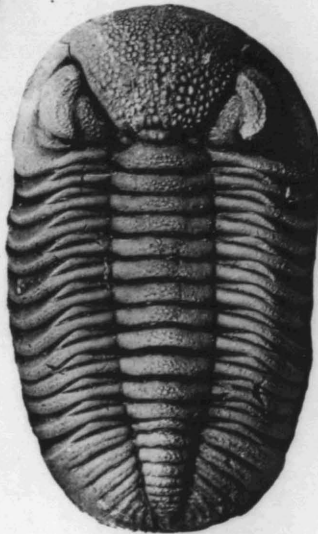
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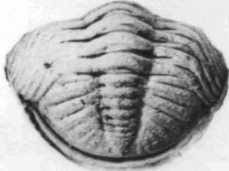
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PLATE X



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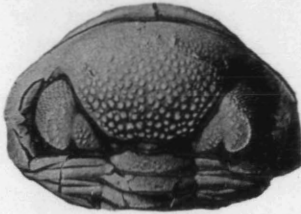
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## EXPLANATION OF PLATE X

PAGE

- Phacops rana milleri* Stewart ..... 137
- FIG. 1. Anterior of well-preserved enrolled specimen, showing glabellar tuberculation. Hypotype in possession of Mr. A. E. Worline; plastotype No. 28845 in Museum of Paleontology, University of Michigan. Traverse group, upper Ferron Point formation; locality 51.  $\times$  1.
- FIG. 2. Side of hypotype (Fig. 1), showing eye and genal angle.  $\times$  1.
- FIG. 3. Eye of hypotype (Fig. 1), showing elevated lenses.  $\times$  2.
- FIG. 4. Posterior of hypotype, showing segmentation and tuberculation.  $\times$  1.
- FIG. 5. Large specimen with well-developed palpebral lobes. Hypotype No. 20296. For horizon and locality see Figure 1.  $\times$  1.
- FIG. 6. Side of hypotype (Fig. 5), showing eye.  $\times$  1.
- FIG. 7. Posterior of relatively large specimen with well-preserved pygidium. Hypotype No. 28846. For horizon and locality see Figure 1.  $\times$  1.
- FIG. 8. Cephalon of slightly weathered specimen. Hypotype No. 25521. Traverse group, lower Genshaw formation; locality 114.  $\times$  1.
- FIG. 9. Side of cephalon with an unusually narrow genal angle. Hypotype No. 25520. Traverse group, lower Bell shale; locality 31.  $\times$  1.
- FIG. 10. Eye of hypotype (Fig. 9), showing arrangement of lenses.  $\times$  2.
- Phacops rana arkonensis* Stumm, subsp. nov. .... 138
- FIG. 11. Anterior of enrolled specimen showing short, wide cephalon and smooth frontal slope of glabella. Holotype No. 28847. Hamilton group, Arkona shale; locality B.  $\times$  1.
- FIG. 12. Posterior of holotype (Fig. 11), showing smooth pygidium.  $\times$  1.
- FIG. 13. Side of holotype specimen (Fig. 11), showing steeply inclined anterior part of glabella.  $\times$  1.
- FIG. 14. Eye of holotype (Fig. 11), showing elevated lenses.  $\times$  2.
- Phacops rana bellensis* Stumm, subsp. nov. .... 139
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- FIG. 16. Side of holotype (Fig. 15); ocular platform and genal angle.  $\times$  1.
- FIG. 17. Eye of holotype (Fig. 15), showing small number of lenses and strong polygonal boundaries.  $\times$  2.
- FIG. 18. Posterior of holotype (Fig. 15), showing thoracic and pygidial segmentation.  $\times$  1.
- Phacops rana crassituberculata* Stumm, subsp. nov. .... 136
- FIG. 19. Glabella, palpebral lobe, and eye of specimen with glabellar tuberculation well preserved. Paratype No. 25519. Traverse group, lower Ferron Point formation; locality 38.  $\times$  1.
- FIG. 20. Side of paratype (Fig. 19), showing glabellar convexity.  $\times$  1.
- FIG. 21. Eye of paratype (Fig. 19), showing lenses and strong polygonal boundaries.  $\times$  2.
- Phacops rana* (Green) ..... 135
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- FIG. 23. Almost complete individual, showing glabellar tuberculation and thoracic segmentation. Hypotype No. 28849. For horizon and locality see Figure 22.  $\times$  1.
- FIG. 24. Cephalon with glabellar lobation and palpebral lobes well preserved. Hypotype No. 28850. For horizon and locality see Figure 22.  $\times$  1.

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- Phacops rana* (Green) ..... 135
- FIG. 1. Cephalon of a relatively small individual. Hypotype No. 27060. Traverse group, Dock Street clay; locality 53.  $\times 1$ .
- FIG. 2. Unusually well-preserved cephalon, showing fine, relatively even tuberculation. Hypotype No. 27130. Hamilton group, Ludlowville formation, Wanakah shale, trilobite bed; Eighteen Mile Creek, Erie County, New York.  $\times 1$ .
- FIG. 3. Posterior of enrolled specimen, showing the thoracic and pygidial segmentation. Hypotype No. 28851. For horizon and locality see Figure 2.  $\times 1$ .
- FIG. 4. Side of incomplete cephalon with a well-preserved eye. Hypotype No. 28852. For horizon and locality see Figure 2.  $\times 1$ .
- FIG. 5. Eye of hypotype (Fig. 4), showing arrangement of lenses.  $\times 2$ .
- FIG. 6. Interior of enrolled specimen with well-preserved glabella and palpebral lobes. Hypotype No. 24305, Hamilton group, Hungry Hollow formation, coral bed; locality B.  $\times 1$ .
- FIG. 7. Posterior of hypotype (Fig. 6), showing segmentation.  $\times 1$ .
- FIG. 8. Side of large specimen, showing the granulose ocular platform. Hypotype No. 25570. For horizon and locality see Figure 6.  $\times 1$ .
- FIG. 9. Eye of hypotype (Fig. 8), showing lenses and polygonal borders.  $\times 2$ .
- FIG. 10. Anterior of hypotype (Fig. 8), showing fine tuberculation.
- FIG. 11. Nearly complete specimen, showing thoracic lobation and segmentation. Hypotype No. 28853. Hamilton group, lower Widder formation. For locality see Figure 6.  $\times 1$ .
- Phacops rana alpenensis* Stumm, subsp. nov. .... 139
- FIG. 12. Relatively complete, laterally compressed specimen, showing glabellar tuberculation and well-preserved thorax and pygidium. Holotype No. 25516. Traverse group, Alpena limestone; locality 40.  $\times 1$ .
- FIG. 13. Enrolled specimen lacking the pygidium; glabella and palpebral lobes well preserved. Paratype No. 117860, U. S. National Museum. Traverse group, Gravel Point formation, *Atrypa* zone near base); vicinity of Nine Mile Point, Charlevoix County, Michigan.  $\times 1$ .
- FIG. 14. Side of paratype (Fig. 13), showing glabellar convexity, ocular platform, and genal angle.  $\times 1$ .
- FIG. 15. Eye of paratype (Fig. 13), showing small number of facets.  $\times 2$ .
- FIG. 16. Anterior of enrolled specimen with well-preserved though compressed glabella and free cheeks. Paratype No. E15211, Buffalo Museum of Science. Traverse group, Alpena limestone; locality 53.  $\times 1$ .
- FIG. 17. Side of paratype (Fig. 16).  $\times 1$ .
- FIG. 18. Eye of paratype (Fig. 16), showing small number of facets in alternating vertical rows of 3 and 4.  $\times 2$ .
- FIG. 19. Posterior of thorax and pygidium showing segmentation and tuberculation. Paratype No. 29559. For horizon and locality see Figure 16.  $\times 1$ .
- FIG. 20. Anterior of specimen with partly exfoliated glabella. Paratype No. 25517. For horizon and locality see Figure 16.  $\times 1$ .
- FIG. 21. Side of paratype (Fig. 20), showing eye.  $\times 1$ .
- Phacops rana* (Green) ..... 135
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- FIG. 23. Eye of hypotype (Fig. 22), showing facets in alternating vertical rows of 4 and 5.  $\times 2$ .

PLATE XI

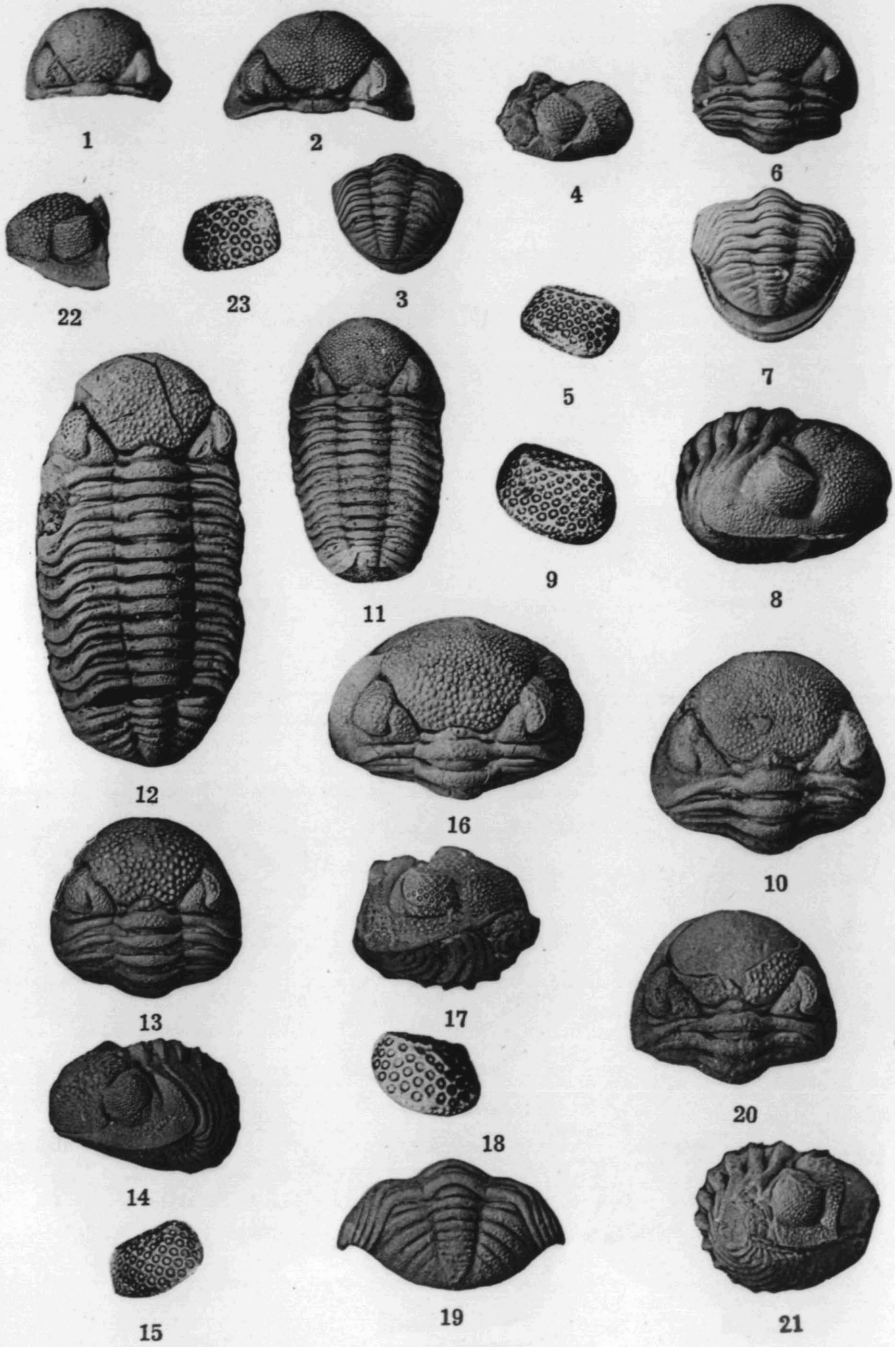
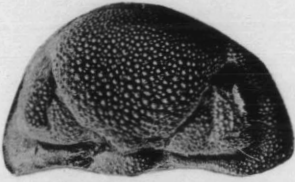


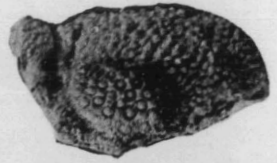
PLATE XII



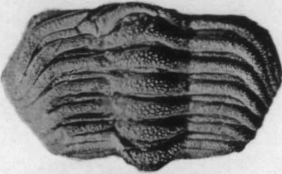
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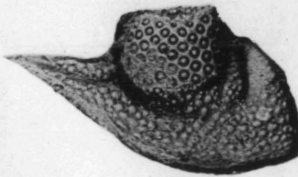
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## EXPLANATION OF PLATE XII

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FIG. 15. Pygidium, showing coarse, unequal tuberculation on highly arched segments. Hypotype No. 29230. For horizon and locality see Figure 13. $\times$ 2.	







## VOLUME X

1. Ostracods of the Families Leperditellidae, Drepanellidae, Glyptopleuridae, Kloedenellidae, Bairdiidae, Barychilinidae, and Thlip-suridae from the Genshaw Formation of Michigan, by Robert V. Kesling and John E. Kilgore. Pages 1-19, with 4 plates. Price \$.60.
2. Ostracods of the Families Leperditellidae, Primitiidae, Drepanellidae, Aechminidae, and Kirkbyidae from the Middle Devonian Bell Shale of Michigan, by Robert V. Kesling. Pages 21-44, with 5 plates. Price \$.75.
3. Ostracods of the Family Hollinidae from the Ferron Point Formation of Michigan, by Robert V. Kesling. Pages 45-57, with 2 plates. Price \$.50.
4. Echinoderms of the Middle Devonian Silica Formation of Ohio, by Porter M. Kier. Pages 59-81, with 4 plates. Price \$.70.
5. Ostracods of the Family Hollinidae from the Genshaw Formation of Michigan, by Robert V. Kesling and Norman R. Tabor. Pages 83-100, with 3 plates. Price \$.65.
6. Trilobites of the Devonian Traverse Group of Michigan, by Erwin C. Stumm. Pages 101-157, with 12 plates. Price \$1.50.

