

# Eurypterid Horizons and the Stratigraphy of Upper Silurian and Lower Devonian Rocks of Central-Eastern New York State

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## INTRODUCTION

There are a number of famous faunas known from classic localities in North America. These include the "Mazon Creek" Fauna (Pennsylvanian) of Illinois, the Kokomo Eurypterid Fauna of Indiana, the Green River Fish Fauna (Eocene) of Wyoming, and the Burgess Shale Fauna (Cambrian) of western Canada. Each is characterized by an unusual abundance and variety of species.

In New York the so-called "Bertie" eurypterids are representative of one such fauna (Fig. 1). Although only one or two species of eurypterids dominate the fauna, a large number of species has been described through the years. Unfortunately, detailed stratigraphic studies of the eurypterid-bearing beds have been noticeably lacking. Until recently, the "Bertie" faunas, one from the Buffalo area (so-called "Buffalo Pool"), and the other from eastern New York (so-called "Herkimer Pool"), were thought to be contemporaneous deposits rather than distinct stratigraphic horizons.

The purpose of this paper and the associated field trip is to relate these and other eurypterid horizons to the stratigraphy of the areas. Several formations are discussed but special emphasis is given to the Chrysler Formation because it is the least known and only recently was well exposed for study.

## STRATIGRAPHY AND PALEONTOLOGY

### Salina Group

The Salina Group is considered here as consisting of three formations (in ascending order) the Vernon Formation, Syracuse Formation, and Camillus Formation (Treesh, 1972). These units will not be described in detail but will be observed briefly in the field (Fig. 2).

At least three eurypterid horizons are known currently to occur within the Salina Group. Two were described by Leutze (1956, 1959) from the Syracuse Formation, and one was described from the underlying Vernon (B) Formation (Kjellesvig-Waering and Caster, 1955). The overlying Camillus Formation has not yielded any eurypterid horizons.

The unifying features of the formations of the Salina Group are the "weak" beds (usually described as shaly) exhibited at the outcrop. These may be red and green shales, "shaly" dolostones, etc., containing the principle evaporite deposits (anhydrite, gypsum, halite, etc.) of New York State. Basinal and marginal dolostones of various textures and lithologies also are present. Abundant structures encountered in these rocks include salt hoppers and crystal molds or casts of other evaporite minerals.



Figure 1. Eurypterus remipes remipes De Kay, accumulation of this species preserved in very fine-grained dolostone (waterlime). Specimen No. 090564-1, Phelps Waterlime Member, Fiddlers Green Formation, Passage Gulf, New York (Ciorca Loc. No. 57, Stop 7).



The overlying beds of the Bertie Group, although retaining some features indicative of an evaporite sequence, differ in the nature of their rock strata. Much of the Bertie Group is composed of massive, mottled and straticulate dolostone and "shaly" or thin-bedded dolostones. Waterlimes and some limestone also are present. The Bertie Group also is more fossiliferous than the Salina Group, reflecting more progressive marine influences during the deposition of this unit.

### Bertie Group

The Bertie Group, in contrast to the underlying Salina Group, consists of several units of massive dolostones (including waterlimes), beds of limestone, shaly dolostones, and some gypsum and anhydrite. Indications of the former presence of crystalline halite also are present (salt hoppers).

Unlike the major portion of the Salina Group, the Bertie Group seems to be more fossiliferous, and indicates a greater marine influence during the deposition of the Bertie. This is even more true of succeeding units (Cobleskill and Manlius Formations).

The Bertie Group in the Syracuse area consists of three formations. Described in ascending order (Fig. 3) these are the Fiddlers Green Formation, Forge Hollow Formation, and Williamsville (Oxbow) Formation.

#### Fiddlers Green Formation

The Fiddlers Green Formation (Hopkins, 1914) is the lowest unit of the Bertie Group in central-eastern New York. The author (Cieurca, 1973) described the tripartite nature of the unit and suggested a cyclic origin for the sequence. Three members were named from western New York: a lower waterlime (Morganville Member), a middle unit of crystalline dolostone with some limestone (Victor Member), and an upper waterlime (Phelps Member). It is the Phelps Member which contains the abundant eurypterid remains described from eastern New York (Herkimer County - so called "Herkimer Pool" of early authors), and which yields the abundant eurypterid remains obtained from Passage Gulf (Stop 7).

#### Morganville Waterlime Member

Although not exposed at Passage Gulf, a waterlime occurs near the base of the Fiddlers Green Formation. This waterlime unit is only well developed in the Syracuse area and to the west as far as Morganville in western New York (type locality). The lower waterlime, the Morganville Waterlime (see Cieurca, 1973) is a persistent massive unit, which breaks with conchoidal fracture and exhibits other features typical of the waterlimes of New York. This unit contains an Eurypterus fauna which is particularly evident in the Cayuga Lake area, and also near Marcellus Falls southwest of Syracuse.

The upper contact of the Morganville Member with the overlying Victor Member may be sharp and irregular, and is noted by a change from very fine-

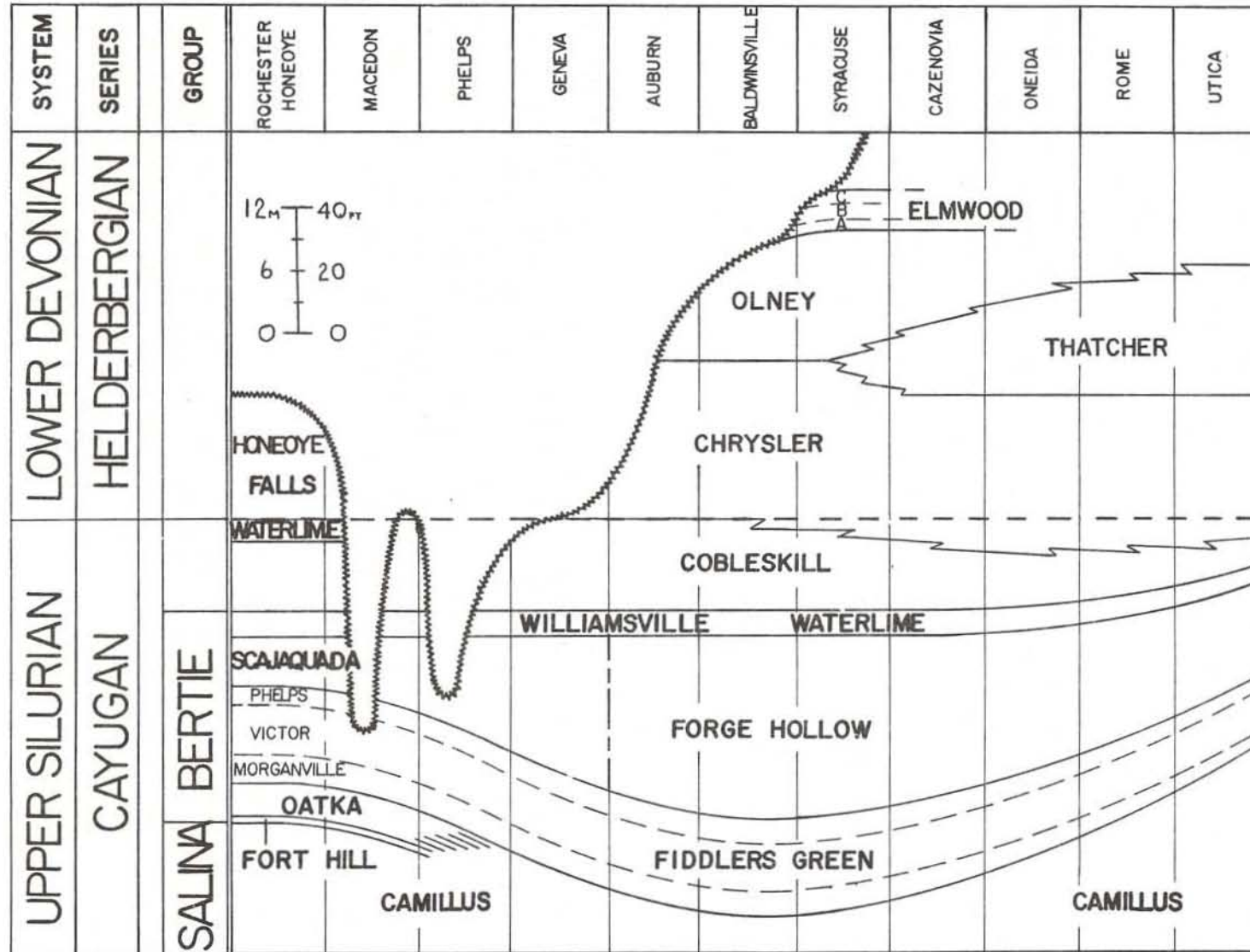


Figure 2. Lithostratigraphy of Eurypterid-bearing sequence. Silurian-Devonian boundary is used as baseline.

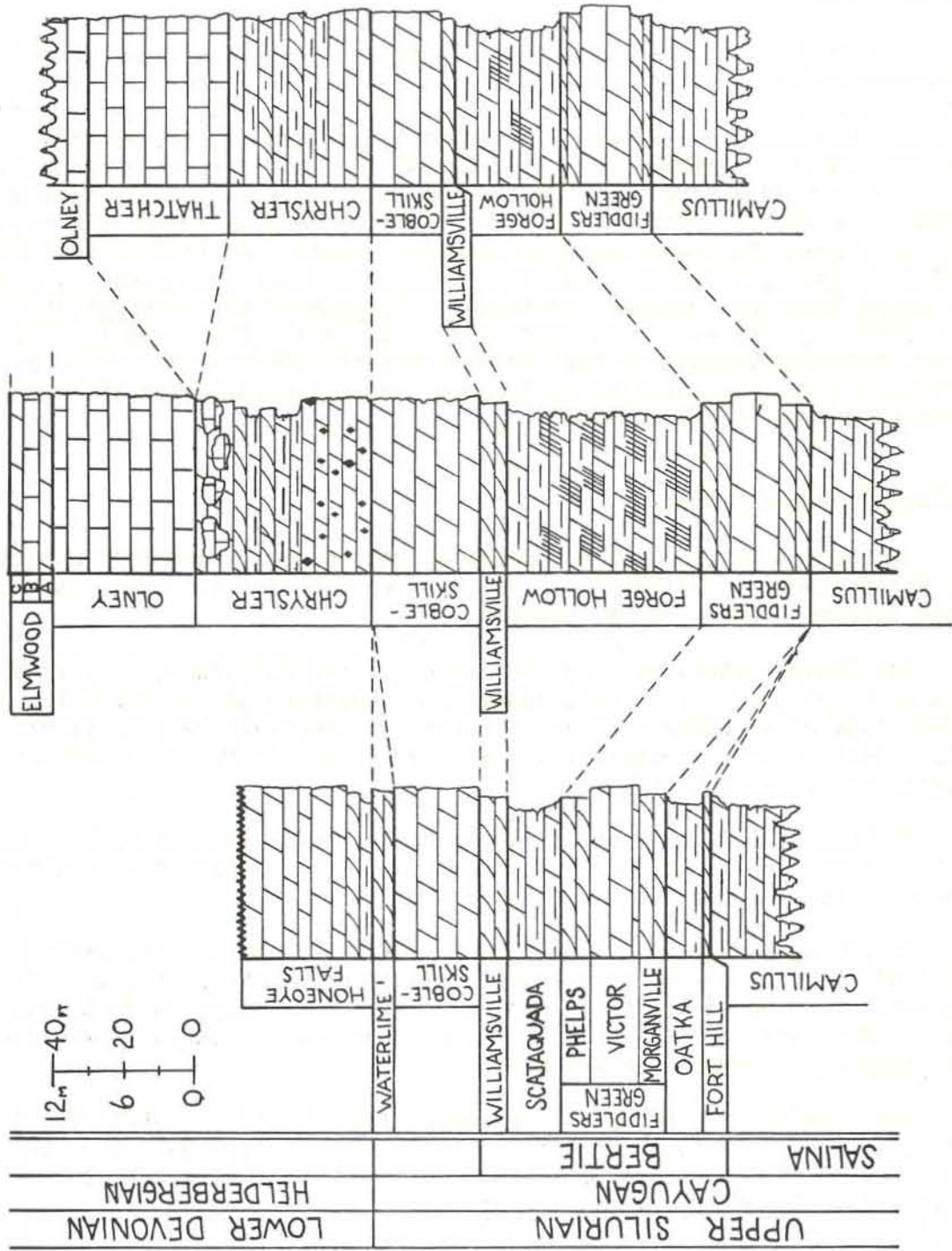


Figure 3. Stratigraphic sections for Syracuse area (center column) and comparable sections to west, south of Rochester (left column), and to east in Stockbridge Valley area (right column).



grained dolostone (Morganyville Member) to the coarsely grained and locally mottled dolostone or limestone (Victor A and B, Cieurca, 1973).

#### Victor Member

The thickest subdivision of the Fiddlers Green Formation, sandwiched between overlying and underlying waterlimes, is the Victor Member. It consists of massive, locally porous and pitted, irregularly bedded, crystalline dolostone and limestone. This unit is analogous lithologically to the stratigraphically higher Cobleskill Formation, and likewise represents more progressive marine conditions during the Late Silurian in this part of the State. The Victor contains abundant brachiopod and ostracod remains, and extends across the State and into Ontario, Canada. At Passage Gulf the Victor contains, besides abundant brachiopod and ostracod remains, Lingula sp. in at least one horizon, gastropods, Eurypterus sp., Pterygotus sp., and probably other species of eurypterids as well. The fauna is little known, probably because of the limited accessibility of this unit, as well as the obvious preoccupation of students and collectors with the overlying eurypterid "bed" (Phelps Member).

#### Phelps Waterlime Member

At the top of the Fiddlers Green Formation occurs a waterlime unit, the Phelps Member, well known in eastern New York for the countless eurypterid specimens which it has yielded.

The Phelps Waterlime is a very fine-grained dolostone, locally straticulate, usually gray to brown, and is best observed at Passage Gulf. Here it consists of an upper mudcracked waterlime underlain by massive waterlime which weathers into conchoidally fractured layers (eurypterid remains usually occur on the conchoids).

At Passage Gulf only one crystal impression (salt) has been observed by the author in the period 1963-1978. To the west, however, salt hoppers are characteristic of the Phelps Waterlime.

At the type section of the Fiddlers Green Formation (Butternut Creek north of Jamesville) the same features which occur at Passage Gulf are present. The top of the unit is covered with mudcracks. Beneath these are abundant salt hoppers, ostracods, and eurypterids characteristic of the Eurypterus remipes remipes Fauna.

The type section of the Phelps Waterlime Member in western New York (Cieurca, 1973) is a duplicate of the section at Passage Gulf over 100 mi to the east. Mudcracks occur at the top of the unit. Beneath these the eurypterids, Eurypterus remipes remipes De Kay, Pterygotus sp., Dolichopterus sp., and other species occur. Ostracods and cephalopods also are present. Salt hoppers are abundant, and occasionally are large (one specimen measured 5 in on one side).

Scorpions, representing at least four species, also occur in the Phelps Waterlime at Passage Gulf (Cieurca, 1965). Two species have been

described previously, Proscorpius osborni and Archaeophonus eurypteroides (Clarke and Ruedemann, 1912, Kjellesvig-Waering, 1966), and two new species, collected by the writer, will be described by E.N. Kjellesvig-Waering.

Other forms obtained from the Phelps Waterlime include cephalopods, rare land plants such as Cooksonia sp., and several unidentified forms. Lingula sp., and other brachiopods are rare or lacking, but do occur in lower beds at Passage Gulf (see Victor Member). A few miles to the west a phyllocarid also was obtained.

Passage Gulf has provided thousands of specimens of eurypterid remains from the Phelps Waterlime during the past 23 years; all from an areally small exposure. An explanation for this unique occurrence is needed. One explanation may be that the eurypterids, for the most part, seem to represent accumulations as windrows. This is not usually apparent when a single specimen is collected at random, but if a larger area is excavated, the orientation of eurypterid debris is more obvious. Telsons, for example, may be aligned parallel to each other (see Fig. 1).

#### Forge Hollow Formation

In the Syracuse area the Forge Hollow Formation consists of thick dark gypsum beds with a zone at the top consisting of a few feet of shaly dolostone and clayey beds lighter in color.

Exposures of this unit in the valley of Rock Cut Gorge southeast of Syracuse (Stop 3) were well displayed during 1977 because of the construction of Interstate 481. Although the lower contact with the Fiddlers Green Formation was not seen, the stratigraphic relationships of the various units from the Fiddlers Green Formation up to the Manlius Formation were well displayed in an almost continuous sequence.

The upper contact with the Williamsville (or Oxbow, see discussion under Williamsville Formation) Formation is particularly interesting. The mineraliferous shaly beds at the top of the Forge Hollow are succeeded abruptly by hard, fine-grained waterlimes which also are mineraliferous (celestite rather than gypsum?).

The Forge Hollow Formation seems to grade, laterally, possibly due to facies change, into the Scajaquada Formation of western New York (see Ciurca, 1973, p. D-5). The Scajaquada Formation is a thinner unit and consists of resistant beds of dolostone, shaly dolostone, and perhaps some thin intercalated waterlimes. Cherty horizons also are characteristic.

Duskin (1969) studied the gypsum deposits of the Forge Hollow Formation particularly in the Union Springs area. Unfortunately, he misidentified several units. In the Rock Cut Gorge (south side, behind trailer court), for example, his gypsum-bearing Forge Hollow is actually the lower shaly beds of the Chrysler Formation. The gypsum beds are masses of granular celestite in the Chrysler Formation near the upper contact with the cherty Cobleskill Formation. At Seneca Falls Duskin misidentified the Forge Hollow Formation in the banks of the Seneca River. Exposures of the resistant lower Fiddlers Green Formation (Morganville Waterlime) were



mistaken for the Williamsville, therefore, it suggests to the writer that Duskin's gypsum beds and Forge Hollow Formation in the banks of this river belong to the Camillus Formation of the Salina Group. Therefore, they are stratigraphically below, rather than above, the Fiddlers Green Formation.

#### Williamsville Formation

The type section of the Williamsville Formation (Waterlime) is at Williamsville, New York just east of Buffalo. The Williamsville Formation can be traced eastward easily to Mud Creek at East Victor where it contains the eurypterid characteristic of this unit in the Buffalo area, viz. Eurypterus remipes lacustris Harlan and other eurypterids (Pterygotus), as well as associated invertebrates, for example Lingula sp., gastropods, and phyllocarids (Czurca, 1973).

In central-eastern New York, a similar waterlime occurs beneath the highly variable Cobleskill Formation wherever this interval has been observed. Rickard (1962) termed this waterlime the Oxbow, but later (Rickard, 1975) referred the waterlime to the Williamsville. Presently, either name is appropriate because our knowledge of this interval is limited. There are lithological similarities, as well as differences, between various outcrops of this unit within central New York.

The term Williamsville Formation is preferred here and is defined as an eurypterid-bearing unit of differing characteristics across the outcrop belt. It always occurs (in what few outcrops that are accessible) above a shaly dolomitic interval containing evaporites (Scajaquada - Forge Hollow Formations), and below an extremely variable unit of massive, stromatoporoïd and coral bearing, dolostones and limestones (Cobleskill Formation).

No fauna has been described from the Williamsville Formation in the Syracuse area. Indeed, fossils are rare, but over the past several years the following forms were obtained from this unit in the old abandoned gypsum quarries north of Jamesville:

Paracarcinosoma scorpionis

Pterygotus (Acutiramus) macrophthalmus cummingsi

Phyllocarids

Orbiculoidea sp.

Lingula sp.

Cephalopods

Graptolites?

Eurypterus remipes lacustris, so characteristic of the Williamsville Formation of western New York, has not been observed in central-eastern New York (see discussion on correlation).

Other outcrops of the Williamsville Formation in the Syracuse area have provided Lingula sp., other brachiopods, and cephalopods (?), which need further study.



Time correlations of the Williamsville Formation are difficult to establish. It has been considered essentially a time-rock unit. See, for example, the Silurian correlation charts of Fisher (1960) and Rickard (1975). It is suggested here that the Williamsville Formation in the type area of western New York may be younger than the Cobleskill Formation of eastern New York. This interpretation is based on the distribution of eurypterid horizons across the State, the Williamsville-Cobleskill contact, and the occurrence of either an Eurypterus fauna (Late Silurian) or an Erieopterus fauna (Early Devonian) in these horizons. The possible application of this criteria in distinguishing the Silurian-Devonian boundary has been mentioned previously (Cieurca, 1975).

### Cobleskill Formation

The Cobleskill Formation needs redefinition as it is one of the most variable units encountered across the State from the type section in eastern New York, westward into Ontario, Canada (Cieurca, 1973). West of Syracuse, near Marcellus Falls, it exhibits a cherty facies, with reef or reef-flank facies containing stromatoporoids and corals. An eurypterid horizon occurs near the top and can be traced to near Jamesville. This horizon has not been recognized to the east.

At Syracuse the Cobleskill Formation consists of massive fine crystalline dolostone about 30-ft thick. Just to the east, north of Jamesville, a reefy facies is evident in the abandoned gypsum quarries. Here massive beds containing abundant stromatoporoids characterize this unit. Favosites and horn corals also are evident. The upper portion contains crystal molds of celestite, and rare eurypterid remains (?Dolichopterus sp.).

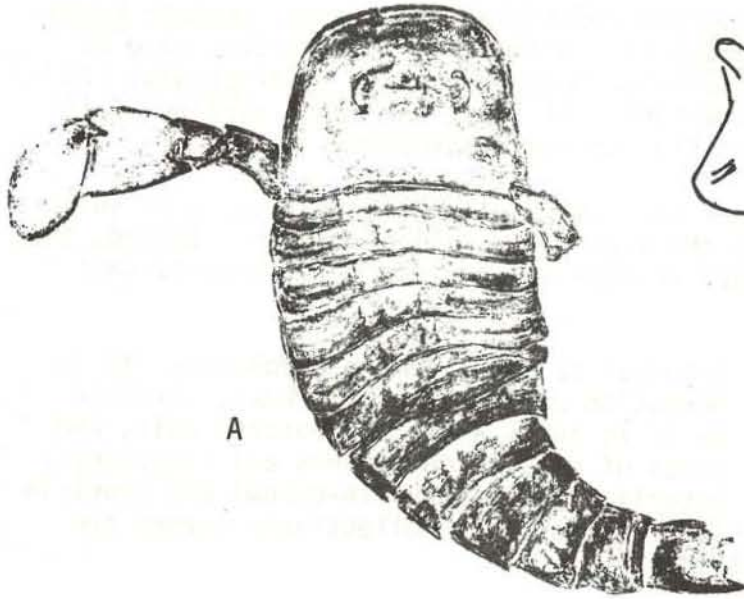
Near Clockville the Cobleskill Formation is a tripartite unit containing a lower massive dolostone, a middle fossiliferous and porous limestone, and an upper massive dolostone. The middle unit contains stromatoporoids, corals, Eccentricosta jerseyensis, and other brachiopods. A large eurypterid may be present in the lower dolostone (ornamented fragment found on a large block in talus). The upper dolostone has been excluded from the Cobleskill by previous writers in order to preserve a more reasonable thickness for this formation from the type locality. Here it is regarded as essentially a duplicate of the lower dolostone, and distinct from the various lithologies represented in the overlying Chrysler Formation, and therefore is placed in the Cobleskill Formation. Large stylolites are characteristic of the Cobleskill Formation at this locality.

In the Stockbridge Valley area additional facies are shown because the lithology and the fossils are different. A very fine-grained limestone is present and contains the brachiopod Howellella corallinensis ssp., associated with Pterygotus sp. (Fig. 4). Whether an Eurypterus is associated with this new occurrence of Pterygotus has yet to be determined.

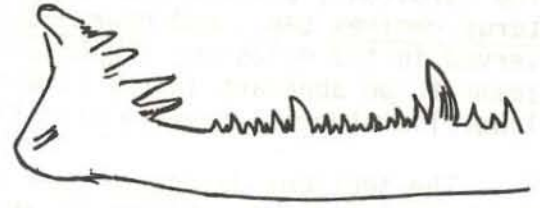
Just to the east, at Forge Hollow, the Cobleskill Formation displays a tripartite division different from that just described for the Clockville area. In the Forge Hollow area, the lower unit, about 15-ft thick, is a fossiliferous limestone and is succeeded by a dolostone containing possible algal masses. This unit is overlain by at least 3 ft of limestone.

Figure 4. Characteristic Eurypterids of Upper Silurian-Lower Devonian of central-eastern New York State. (A) Eurypterus remipes remipes De Kay, natural size, Spec. No. 040377-2, Phelps Waterlime Member, Fiddlers Green Formation, Passage Gulf (Circum Loc. No. 57). (B) Pterygotus sp., free ramus, enlarged. Cobleskill Formation (limestone facies), Stockbridge Valley, Circum Loc. No. 49. (C) Erieopterus microphthalmus ssp., natural size. Specimen no. 070477-18, Chrysler Formation (believed to have originated in F zone of Chrysler Formation), southeast Syracuse, Circum Loc. No. 68. (D) Erieopterus microphthalmus ssp., natural size. Spec. No. 041578-2, H zone of Chrysler Formation. Abundant Howellella vanuxemi (not shown) occur on specimen. Rock Cut Gorge southeast of Syracuse, Circum Loc. No. 70. (E) Erieopterus microphthalmus microphthalmus (Hall), large carapace, natural size. Spec. No. 102277-1, Uppermost Olney Limestone, Split Rock Quarry, Syracuse, N.Y., Circum Loc. No. 36. (F) Pterygotus sp., free and fixed rami, enlarged. Spec. No. 041578-4, from stromatoporoïd biostrome, Upper Olney Limestone, quarry on south side of Rock Cut Gorge, Circum Loc. No. 70.

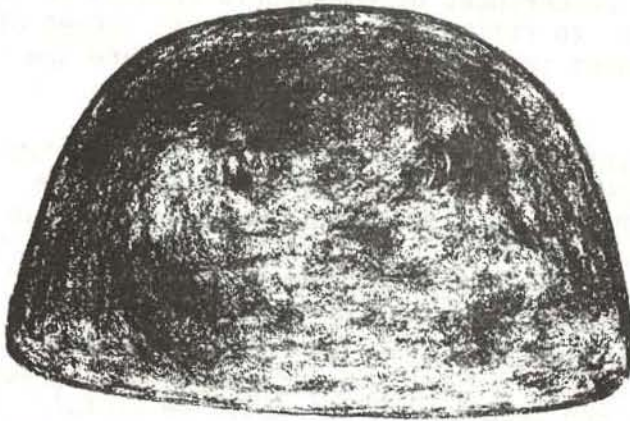




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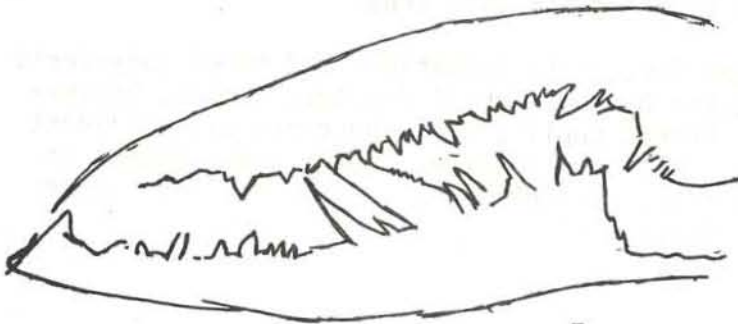
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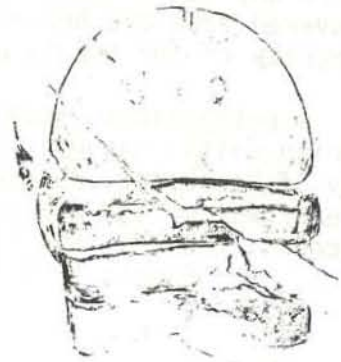
E



C



F



D

The dolostone, and the overlying and underlying limestones, contain Eurypterus remipes ssp., and Pterygotus sp. Although no brachiopods were observed in the dolostone the brachiopod Morinorhynchus? interstriatus (Hall) seems to be abundant in the limestone. At least the upper portion of the lower limestone is replete with high-spined gastropods.

The sections described here have been interpreted variously by authors and have little resemblance to the type Cobleskill Formation. Indeed, the sections just described may have no physical or time relationships whatever to the type Cobleskill.

Until this stratigraphic interval is studied more completely, it is best to regard the Cobleskill Formation as a unit of extremely variable character, ranging between 12 to 30 ft thick along the outcrop belt, and usually consisting of various types of massive dolostones and limestones. It seems to be underlain by a waterlime (Williamsville-Oxbow) and overlain by a series of various types of dolomitic rocks collectively termed the Chrysler Formation (30-50 ft thick).

Although a diverse fauna (brachiopods, corals, stromatoporoids, gastropods, crinoids, pelecypods, ostracods, cephalopods, etc.) has been described from the Cobleskill Formation, no eurypterids have been described before from this formation. The various occurrences of eurypterid remains in this formation, as described here, help to refine the stratigraphic ranges of these forms between their occurrences in the Bertie Group below and the Chrysler-Manlius sequence above.

An evolutionary study of eurypterids in the New York Upper Silurian-Lower Devonian sequence could be possible in the future, but many more specimens need to be recovered. Particular attention should be given in future endeavors to recover as much paleontological and stratigraphical data as possible in field studies of eurypterid-bearing strata and associated units. The exact horizon from which fossils are recovered must be recorded as precisely as possible. Orientation data on specimens recovered in situ could prove useful and to date have been largely neglected. Orientation data on associated fossils and structures also would be useful. As an example, excellently preserved ripplemarks were observed in the upper half of the Fiddlers Green Formation west of Cedarville. Unfortunately, before any measurements could be made, the outcrop was buried with wet sod recovered from ditches along area farm roads, no doubt to preserve the integrity of the beauty of the farmlands of this area.

A petrographic study of the Cobleskill Formation, and other eurypterid-bearing units, has been undertaken by R.D. Hamill (masters thesis, University of Rochester, in prep.). Recent publications concerned with at least some aspect of the Cobleskill Formation are Berdan, 1972 (brachiopods, ostracods); Cieurca, 1973 (stratigraphy, paleontology); Rickard, 1975 (correlation); and Stock, 1977 (stromatoporoids).

### Chrysler Formation

A prolific eurypterid horizon in the upper Chrysler Formation was discovered in the sixties in the Marcellus Falls area west of Syracuse (Cieurca,



1975). Erieopterus sp. and the brachiopod Howellella vanuxemi were the abundant forms in this horizon. A cephalopod, Geisonoceras? (one specimen) was obtained from a bed immediately overlying this horizon. Several years later, cephalopod remains also were obtained from a bed immediately underlying this horizon. This is the first fauna to be described from this generally unfossiliferous formation.

The Erieopterus bed occurs about 10 ft from the top of the Chrysler Formation which is about 50 ft thick in this area. The horizon could be traced only slightly to the east (not as far as Syracuse), and not to the west.

In 1977, excavations along the Rock Cut Gorge for the new Interstate 481 revealed an unusually complete section of the Chrysler Formation displaying characteristics not previously observed. This section also is important because it lies between the type section at Chrysler's Glen, and the appearance of Rickard's (1962) Thatcher Limestone to the east. Because the section was complete, and now is essentially destroyed, it is important to record the features observed during the summer of 1977 and in the spring of 1978.

The sequence (Fig. 5) revealed a lower portion of "weak" mineraliferous beds about 5-m thick, and an upper portion consisting of resistant dolomitic beds including waterlimes and limestone (about 6-8-m thick).

The lower weak unit is composed of two parts: the lower portion (A) consists of fine-grained dolostone, brown, and containing celestite, and an upper part (B) consisting primarily of shaly dolostone with celestite in masses - no crystals were observed. Chrysler A contains the more resistant beds, some of which seem to be transitional in lithology from the underlying Cobleskill Formation.

Chrysler A and B are intriguing because at Chittenango Falls (Ciurca, 1962) east of Syracuse collectors have for many years obtained abundant crystals of celestite and calcite in beds immediately overlying the Cobleskill Formation. Chittenango Falls was the only locality which yielded abundant celestite. Interestingly, near Jamesville, crystals of celestite occur in the upper beds of the Cobleskill Formation (facies change?). Chrysler A is at least 1-m thick. Its lower contact with the Cobleskill Formation is sharp to gradational. It seems gradational along the east end of the Rock Cut Gorge only because one can see a transition from massive, nonbedded, brown Cobleskill Formation into thin-bedded, brown dolostone containing celestite, which in turn are succeeded by the main mass of Chrysler B, that is the "weak" thin-bedded, shaly, dolomitic rocks. The contact appears sharp at the west end of Rock Cut Gorge because layers of granular celestite occur at the contact. The celestite in these beds was mistaken for gypsum by Duskin (1969) who thought these strata belonged to the Forge Hollow Formation.

No fossils were observed in Chrysler A. To clarify further the relationship of this unit with the underlying Cobleskill Formation, more detailed field work is necessary.

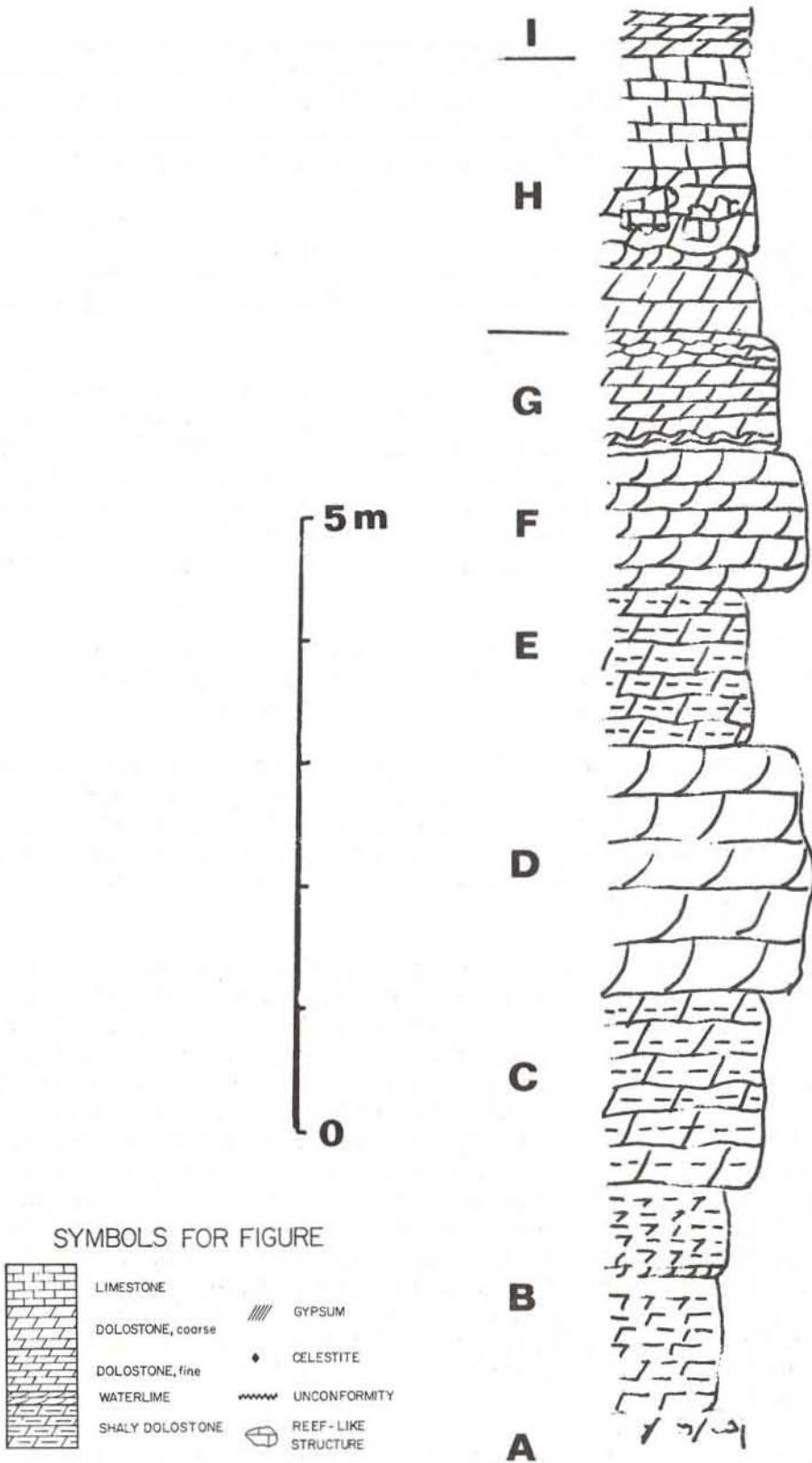


Figure 5. Stratigraphy of Chrysler Formation (based on new, but temporary, exposures near the east side of Interstate 81, south side of Rock Cut Gorge



Above Chrysler B is a unit of greenish, shaly dolostone 1.5-m thick. This unit (C) is a key horizon, repeated above in an obvious cyclic sequence. No fossils were observed (see Chrysler E).

Above Chrysler C occurs a "hard" waterlime 2-m thick. This waterlime (D) is somewhat irregularly bedded, straticulate, and appears crystalline in some beds. This massive waterlime may contain an eurypterid fauna, but no fossils have been observed to date. This unit must be studied further to determine whether it ultimately will reveal either an Eurypterus or an Erieopterus fauna. An Erieopterus fauna is suspected

Overlying Chrysler D is a greenish shaly dolostone (mudcracked?), 1.5-m thick. This unit (E) is the exact analog of Chrysler C, exhibiting the same appearance and approximately the same thickness. No fossils were found. Chrysler E seems to be a shallow-water deposit, and along with Chrysler C may have been formed in a hypersaline environment.

Above Chrysler E is a second thick waterlime (1.1 m) which is straticulate and brittle. This unit (F) is a mostly brown, very fine-grained dolostone with contrasting black laminations. A specimen of Erieopterus microphthalmus ssp. (Fig. 4) probably came from this unit. A portion of the carapace of a Pterygotus also may have originated from this unit. These fossils were obtained from large loose blocks near the outcrops. Although access to this waterlime unit allowed for the examination of countless pieces of the waterlime, no fossils were encountered in the bedrock.

Succeeding Chrysler F Waterlime is a contorted gray, bluish gray, and brown dolostone containing breccia. This unit (G) contains large mudcracks. Chrysler G is 1-m thick. At the base, and at the top, contorted layers and associated breccia delineate this unit. The remainder of the unit is dolostone with a more shaly appearance in the middle unit. This thin shaly layer, greenish in color, seems to be a recurrence of Chrysler C and E lithologies. No fossils were observed in this unit, but a carapace of an Erieopterus recovered from a large loose block of dolostone may have originated from this unit.

The rocks above Chrysler G are the most significant. Nothing to date, either to the east or west, resembles it. These rocks (Chrysler H) consist of various types of dolostone and limestone, mostly brown and crystalline, and are different in appearance from the units previously described (Chrysler A through G). Thin layers approaching waterlime occur at the base. These contain the eurypterid Erieopterus sp.

Chrysler H is characterized by reefrock (nonbedded) and interreef (bedded) strata (Fig. 6). The organic nature of the reefrock is not known at present, but the rock consists of nonbedded masses of fossiliferous limestone surrounded by brownish and bluish dolostone and limestone. Fossils which occur in both the reefrock and in the interreef strata include prolific Howellella vanuxemi, abundant Erieopterus, and poorly preserved cephalopods (four individuals to date).

The reef may have been constructed by a mixture of organisms or may be

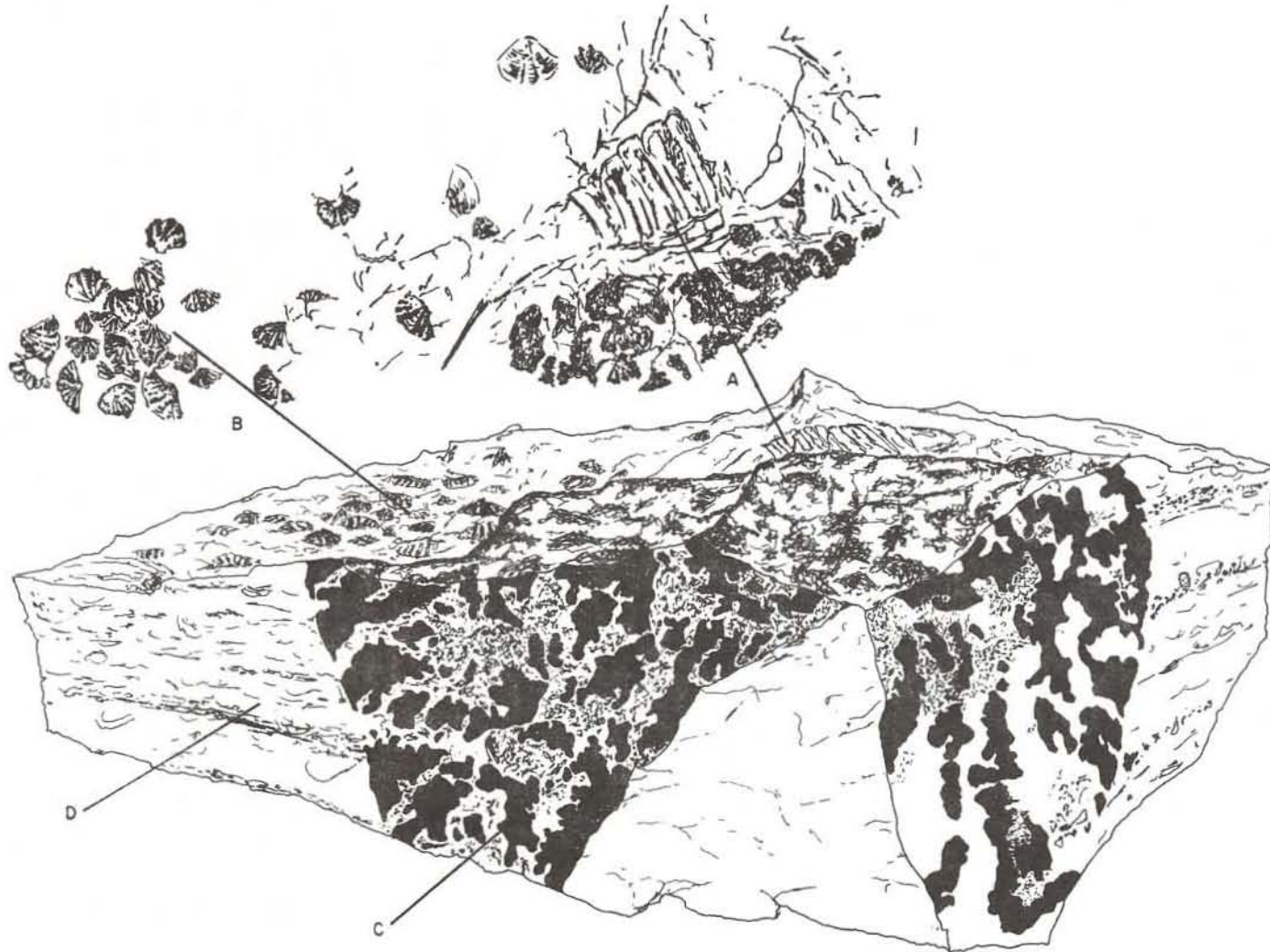


Figure 6. Block (apprx. 3/4 natural size) of Chrysler H showing (A) eurypterid Eriopteris microphthalmus ssp. associated with (B) prolific Howellella vanuxemi in rock consisting of (C) nonbedded reefrock, and (D) bedded interreef strata. Note: block is probably oriented upside down.



the result of a single organism. There is an unusual zone of algal stromatolites in the lower Thatcher (Sanders 1956, p. 18; Rickard 1962, p. 52), just above the Chrysler Formation, at Clockville, so a potential algal contribution to the reefrock must be kept in mind, however, bryozoans also should be considered.

The Erieopterus horizon (about 10 ft. below the upper contact of the Chrysler Formation) discovered several years ago near Marcellus Falls may be an extension of this horizon into the west. If so, this horizon exhibits an interesting facies change. At Marcellus Falls no such reefy masses have been observed. Although Howellella vanuxemi is abundant at Marcellus Falls, the rock is dolomitic with mudcracked zones. West of this locality no brachiopods have been observed. Erieopterus, however, occurs in the fine-grained dolostones farther west near Rochester (Honeye Falls Formation, Ciurca, 1973, p. D-7), and in Ontario, Canada (Clanbrassil Formation). In these areas no brachiopods have ever been observed associated with Erieopterus.

#### Thatcher Limestone

The Thatcher Member of the Manlius Formation (Rickard 1962) is a unit of varied lithology. Unfortunately, the type section is distant from those of the other members (or formations) of the Manlius.

At Clockville an eurypterid horizon (Erieopterus) was discovered in 1977 in strata termed Thatcher by Rickard (1962, p. 51, fig. 12). This is the first report of an eurypterid in this unit. The specimen was obtained from a stromatolite horizon (approximately at the level of the person's shoulder shown in Rickard's fig. 12).

The relationship of this new horizon with the stromatolites at this locality, and with exposures of the Thatcher to the east, is under study. A detailed study of what becomes of the Thatcher, westward in the Syracuse area, would be worthwhile, and would contribute to meaningful knowledge of eurypterid biostratigraphy.

#### Olney Limestone

The Olney Limestone in the area about Syracuse exhibits a number of variations from exposure to exposure, the most notable being the occurrence of, or lack of, the stromatoporoid biostromes. At its type section (Split Rock) only a few stromatoporoids were observed, usually as solitary individuals. Just to the east, however, they are well developed. At Interstate 81, and in exposures in quarries just to the east along the Rock Cut Road, an eurypterid horizon was discovered in 1977 within a stromatoporoid biostrome. Only one eurypterid, Pterygotus sp. (Fig. 4), was observed represented by three specimens (2 pincers, 1 metastoma). Erieopterus was not observed, although it is the typical form in the upper Olney Limestone at the type section at Split Rock to the west. Several years of collecting at Split Rock have yielded abundant specimens of Erieopterus, but none of Pterygotus.

The type Olney is characterized by prolific brachiopods (at least two

species) on many bedding planes, bryozoans, rare cephalopods (only one seen to date), crinoids, abundant ostracods, pelecypods, stromatoporoids, and stromatolites.

In the lower type Olney, beds of characteristic Chrysler aspect occur interbedded with the limestone. These transitional beds are currently under study. NOTE: QUARRIES AT SPLIT ROCK ARE NOW BEING USED AS A DUMP, THEIR FUTURE AVAILABILITY FOR STUDY MAY BE LIMITED.

For earlier discussions of the Olney Limestone and the Manlius Formation (see Logie, 1933; Sanders, 1956; Rickard, 1962, 1975).

#### CYCLIC SEDIMENTATION

All previous notions concerning the stratigraphy of the Upper Silurian Bertie (Group) were based on knowledge of the eurypterid-bearing waterlimes. In the Buffalo area, it was the Williamsville Waterlime which yielded the abundant eurypterid fauna described in so many early publications (Figs. 7 and 8). Specimens usually have the label "Bertie" or "Bertie Limestone".

In eastern New York (so-called "Herkimer Pool") it is the upper waterlime (i.e. Phelps Member) of the Fiddlers Green Formation which provided the abundant eurypterid remains recorded by early writers (see Clarke and Reudemann, 1912). These specimens have been labeled simply as "Bertie".

It is no wonder that these occurrences were regarded usually as being contemporaneous deposits. In fact, at one time or another, many other eurypterid faunas were equated with those within the Bertie (Group). For example, the eurypterid fauna of the Kokomo Formation of Indiana also was regarded as being of the same age as those in the Bertie, simply because the rocks in these areas contained eurypterids.

Actually, the two well known New York eurypterid faunas occur at stratigraphically different horizons. Furthermore, these horizons represent only two of approximately ten such horizons within the State.

These several eurypterid horizons are useful in correlating strata in different areas, especially strata lacking typical marine invertebrate fossils.

During the Late Silurian and Early Devonian, sedimentation occurred over an unusually broad but shallow area. Sediments were exposed frequently to dessication and erosion. For whatever reason, oscillation of environments occurred at frequent intervals during this time. These frequent oscillations resulted in the deposition of a cyclic sequence of carbonates which, when preserved, were lithified into the various strata observed on this trip. Recurrent lithological units usually resulted in recurrent faunas.

Although any one member in a cyclic sequence may be chosen for a reference unit, the waterlime is chosen here because of the persistent association of eurypterids with this lithology, and the writer's interest in these fossils.





Figure 7. Pterygotus macrophthalmus macrophthalmus, very large specimen (4 ft from front of carapace to telson). Specimen discovered Spring 1965, photograph circa 1965, Phelps Waterlime Member, Fiddlers Green Formation, Passage Gulf, Ciarca Loc. No. 57.



Figure 8. Silurian Scorpion (enlarged), rare form associated with Eurypterus remipes remipes Fauna, Spec. No. 031966-1, Phelps Waterlime Member, Fiddlers Green Formation, Passage Gulf, Ciarca Loc. No. 57.



An example of one cyclic sequence is provided by the Fiddler's Green Formation in western New York (Ciurca, 1973):

<u>LITHOLOGY</u>		<u>FORMATION or MEMBER</u>	<u>FAUNA</u>
shaly dolostone		Scajaquada Formation	barren
waterlime	Fiddlers Green Formation	Phelps Waterlime	eurypterids
crystalline dolostone & limestone		Victor Member	brachiopods, ostracods
waterlime		Morganville Waterlime	eurypterids
shaly dolostone		Oatka Formation	barren

In the Syracuse area, the youngest typical waterlime is Chrysler F (Fig. 5); the oldest is the Morganville Waterlime Member of the Fiddlers Green Formation (Fig. 3). Between these two waterlimes occur a variety of lithologies, including other waterlimes, indicative of the constant shift of hypersaline environments. Throughout this interval, the marine phase was only partially influential as revealed by the establishment of normal marine faunas, that is stromatoporoid biostromes, corals, numerous brachiopods, etc. in the Cobleskill. It was not until the deposition of the Manlius units, however, that a marine regime displaced the dominant evaporitic regime in central-eastern New York. To the west (western New York and adjacent Ontario, Canada) marine rocks of equivalent age are unknown.

In order to be useful in correlation, the eurypterid faunas occurring in the various horizons will have to be studied in more detail. This is especially true of eurypterid horizons in nearby states, for example, Pennsylvania, Ohio, Maryland, Indiana, West Virginia, and in adjacent Ontario, Canada. Preliminary observations in most of these areas, made by the writer, indicate that all of these areas are rich in potentially new eurypterid horizons reflecting cyclic sedimentational processes.

#### SUMMARY

Eurypterid remains occur at several horizons (zones) in Upper Silurian and Lower Devonian strata of central-eastern New York State. The genus Eurypterus is present in the Fiddlers Green Formation, Cobleskill Formation (which needs redefinition), and probably lower Chrysler Formation. The genus Erieopterus occurs in the upper Chrysler Formation, Olney Limestone, and Thatcher Formation. The replacement of an Eurypterus fauna by an Erieopterus fauna may indicate a disconformable boundary straddling the Silurian-Devonian boundary in this area.

Cyclic sedimentation dominated Upper Silurian-Lower Devonian deposition. This resulted, fortunately, in the formation of recurrent lithologies (eg. waterlime) and the preservation of recurrent faunas (eg. eurypterids).

Pterygotus, previously known only from the Fiddlers Green Formation,

Table 1. Eurypterids of Upper Silurian-Lower Devonian central-eastern New York<sup>1</sup>

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Olney Limestone	<u>Erieopterus microphthalmus microphthalmus</u> (Hall) <u>Pterygotus (Acutiramus) sp.</u> NEW
Thacher Limestone (lower)	<u>Erieopterus microphthalmus</u> ssp. NEW
Chrysler Formation (upper)	<u>Erieopterus microphthalmus</u> ssp. NEW <u>Pterygotus</u> sp. NEW
Cobleskill Formation (upper)	<u>Eurypterus remipes</u> ssp. NEW <u>Pterygotus</u> sp. NEW <u>Dolichopterus</u> sp. NEW
Williamsville-Oxbow Formation	<u>Paracarcinoma scorpionis</u> (Grote & Pitt) <u>Pterygotus (Acutiramus) macrophthalmus cummingsi</u> NEW
Fiddlers Green Formation	Phelps Waterlime Member <u>Eurypterus remipes remipes</u> DeKay <u>Pterygotus (Acutiramus) macrophthalmus macrophthalmus</u> <u>Pterygotus (Pterygotus) juvenis</u> Clarke & Ruedemann <u>Dolichopterus herkimerensis</u> Caster & Kjellesvig-Waering <u>Dolichopterus jewetti</u> Caster & Kjellesvig-Waering <u>Clarkeipterus testudineus</u> (Clarke & Ruedemann) <u>Paracarcinoma</u> sp. NEW
Victor Member (at Passage Gulf)	<u>Eurypterus remipes remipes</u> DeKay NEW <u>Pterygotus (Acutiramus) macrophthalmus macrophthalmus</u> NEW
Morganville Waterlime Member	<u>Eurypterus remipes</u> ssp. NEW
Syracuse Formation (upper)	<u>Eurypterus</u> sp.
Syracuse Formation (lower)	<u>Waeringopterus cumberlandicus apfeli</u> Leutze
Vernon B Formation	<u>Pterygotus (Acutiramus) floweri</u> Kjellesvig-Waering & Caster <u>Pterygotus (Pterygotus) wayland-smithi</u> Kjellesvig-Waering & Caster
Illion Shale	<u>Rhinocarcinoma vaningeni</u> (Clarke & Ruedemann) <u>Parahughmilleria</u> sp.? NEW

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<sup>1</sup>New occurrences are labeled NEW.



occurs in the Cobleskill Formation, Chrysler Formation, and Olney Limestone.

New exposures of the Chrysler Formation in the Syracuse area reveal an interesting sequence of various lithologies indicative of hypersaline environments in shallow waters. The formation is divided into several units, A through H. The upper portion contains the eurypterid Erieopterus. In Chrysler H this eurypterid is abundant and is associated with prolific Howellella vanuxemi, and cephalopods, in an unusual reefy facies.

Examination of Upper Silurian-Lower Devonian strata in adjacent states indicates that cyclic sedimentation also took place in these areas. It is expected that several new eurypterid horizons and localities will be discovered there in the future.

A summary of the eurypterids which characterize the stratigraphic horizons of central-eastern New York State is listed in Table 1. Several characteristic eurypterids and scorpions are shown in Figures 1, 4, 7, 8.

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## FIELD TRIP

- STOP 1 Cieurca N.Y. Eurypterid Locality No. 36. Quarry at Split Rock, southwest of Syracuse, N.Y. Syracuse West Quadrangle. Units exposed: uppermost Chrysler Formation, Olney Limestone (type section), Elmwood A, (unconformity), Onondaga Limestone.
- STOP 2 Cieurca N.Y. Eurypterid Locality No. 40. Butternut Creek north of Jamesville, N.Y. Jamesville and Syracuse East Quads. Units exposed: Fiddlers Green Formation (type section). The Cobleskill Formation is exposed on the hillside above the creek.
- STOP 3 Cieurca N.Y. Eurypterid Locality Nos. 69, 71. Hillside overlooking Interstate 81, beneath the Brighton Apts. (towers). Units exposed: Cobleskill Formation - Chrysler Formation contact.
- STOP 4 Cieurca N.Y. Eurypterid Locality No. 46. Large roadcut ascending the hill to the south of Clockville, N.Y., Oneida Quad. Units exposed: Fiddlers Green Formation, Forge Hollow Formation, Williamsville-Oxbow Formation, Cobleskill Formation, Chrysler Formation, Thatcher Formation, Olney Limestone.
- STOP 5 Cieurca N.Y. Eurypterid Locality No. 53. Roadcut and hillside at Forge Hollow along the west side of NY 315, Oriskany Falls Quad. Units exposed: Camillus Formation, Fiddlers Green Formation, Forge Hollow Formation (mostly covered), Williamsville-Oxbow Formation, Cobleskill Formation.
- STOP 6 Illion Gorge, NY 51 north of Illion, N.Y. Units exposed: Vernon and Syracuse Formations (Salina Group).
- STOP 7 Cieurca N.Y. Eurypterid Locality No. 57. Roadcut along Spohn Road in a ravine known as Passage Gulf, near Spinnerville, N.Y. Millers Mills Quad. Units exposed: Camillus Formation, Fiddlers Green Formation, Forge Hollow Formation (mostly covered).