EURYPTERIDS, STRATIGRAPHY, LATE SILURIAN-EARLY DEVONIAN OF WESTERN NEW YORK STATE AND ONTARIO, CANADA

SAMUEL J. CIURCA, JR. - Rochester, New York

INTRODUCTION

The eurypterid horizons of the Bertie Group in New York State (Ciurca, 1973, 1978a) continue into adjacent Ontario, Canada bearing their distinctive eurypterid faunas (Ciurca, 1967a, 1976). In addition, Helderbergian strata (Clanbrassil Fm.), between Byng and Haggersville, show the presence of post Bertie-Akron strata in this region in a manner analogous to that of the Honeoye Falls Fm. described for similarly positioned strata discovered south of Rochester, New York (Ciurca, 1967b, 1973).

The purpose of this paper is to present a preliminary account of the stratigraphy and paleontology of this interesting eurypterid-bearing sequence of rocks and to stimulate research into the origin and significance of the waterlimes and associated lithologies in which eurypterids are peculiarly characteristic and abundant.

STRATIGRAPHY AND PALEONTOLOGY

Detailed field studies in New York and Ontario, Canada were undertaken with the hope of providing a better framework for understanding the occurrence and distribution of eurypterid faunas and waterlimes in the regions, and to facilitate correlation. In these studies, the waterlime units have been utilized as the basis of a stratigraphic framework. They have been given an importance similar to that given coal beds in cyclothemic sequences and it is hoped that this will help tracing and understanding of the cyclic sequences present in our Late Silurian-Early Devonian rocks. The distribution of the waterlimes of the Bertie Group, and of the new stratigraphically higher waterlimes, is shown in Figure 2. Heretofore, the only well known waterlime was that of the Williamsville from which much of the eurypterid material in collections was knowingly or unknowingly obtained (i.e. Eurypterus remipes lacustris Fauna).

The following units, beginning with the Salina Group, are present in western New York. At least some of these have been traced westward as far as Haggersville, Ontario, Canada.

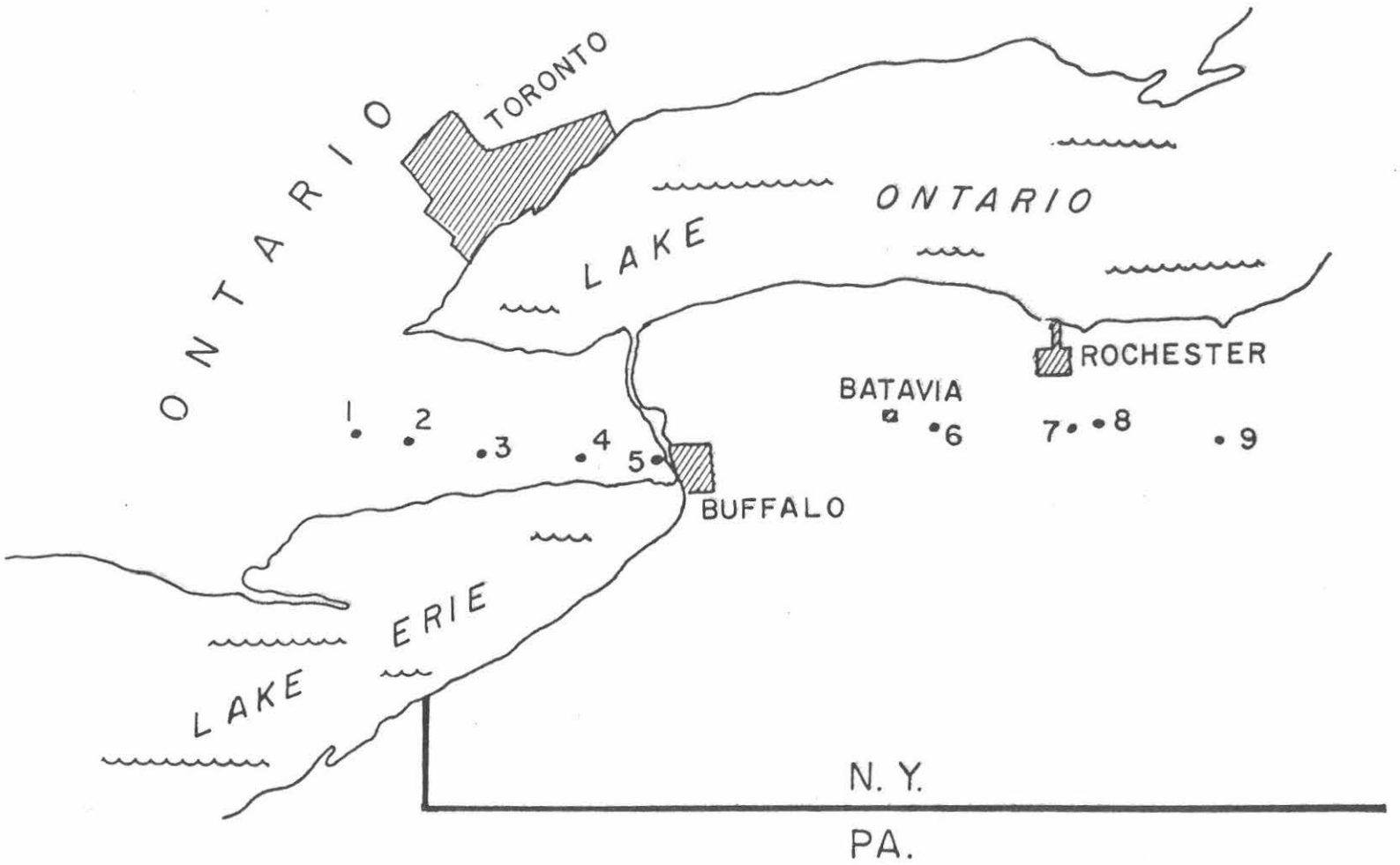

FIGURE 1 Areas (1-9) having exposures of Late Silurian-Early Devonian strata:

1. Haggersville
2. Cayuga
3. Dunnville
4. Port Colborne
5. Fort Erie
6. Le Roy
7. Honeoye Falls
8. East Victor
9. Phelps

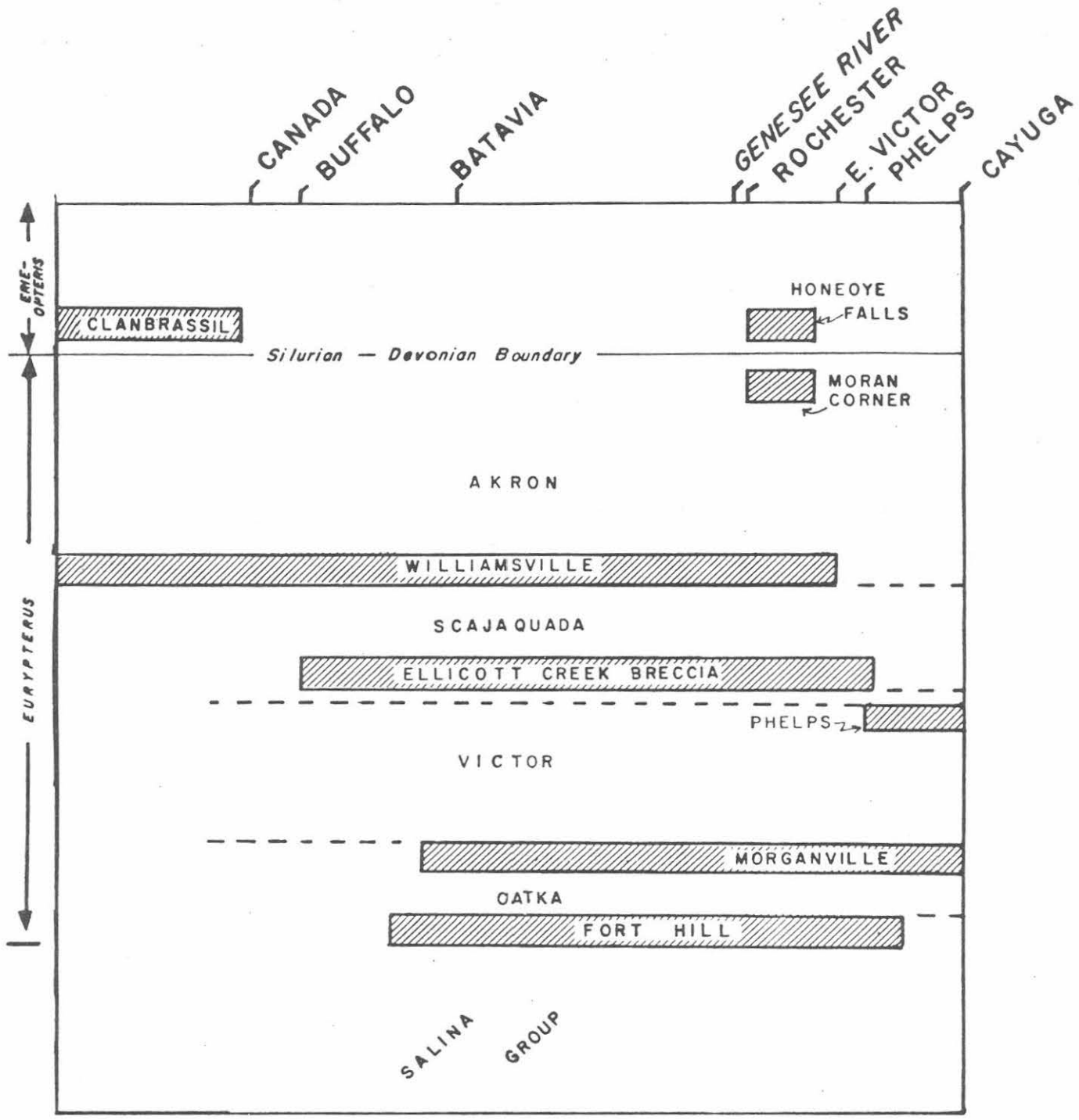

FIGURE 2 Distribution of Late Silurian and Early Devonian Eurypterid-bearing Waterlimes (not to scale).

Salina Group

Much of western New York is underlain by dolomitic rocks and evaporites of various types; red and green shales, halite, anhydrite, and gypsum, hematite, etc. The basal Vernon Fm., in its typical red and mottled facies, is well exposed along the Barge Canal at Pittsford, New York. Nothing is known of the outcropping of the Vernon Formation westward.

The Syracuse and Camillus Formations are exposed in the Oatka Creek area north of Le Roy, at Black Creek near Batavia, and along Tonowanda Creek on the Tonowanda Indian Reservation. In Canada the Salina Group is rarely exposed and this interval ought to be studied further.

Except for the eurypterid fauana of the Pittsford Shale, which is found between the underlying Lockport Dolostone and the typical red Vernon Fm. near Rochester, little is known about the paleontology of the Salina Group in this region. The only eurypterids known are from the Syracuse Fm. near Batavia. Here Waeringopterus (see Figure 4d) occurs in resistant dolostones associated with salt hoppers.

Eurypterid fragments (Eurypterus? sp.) were observed in outcrops of waterlime (Syracuse Fm.) along the Oatka Trail, but again, outcrops are so few and so small that it is difficult to learn of the fauna contained in this interval.

The contact of the Salina Group with the underlying Lockport dolostones is not exposed in western New York. A study of the lithofacies and paleoenvironments of the Lockport Fm. was recently provided in a thesis by Domagala (1982).

Bertie Group

The Bertie Group is best known because of the eurypterids, i.e. the Eurypterus remipes lacustris Fauna, found in one unit, the Williamsville Formation. Because of the confusion attending the use of the terms "Bertie Waterlime" and "Bertie Limestone" in identifying the horizon from which the Eurypterus remipes lacustris Fauna was obtained, it is suggested that these quoted terms not be used. The Williamsville Fm. is only one of several waterlimes that are found within the Bertie Group. These Bertie waterlimes appear to carry distinctive faunas and every effort should be made to clearly identify the horizon from which specimens are obtained.

The oldest Bertie waterlime occurs in western New York and was termed the Fort Hill Waterlime (Ciurca, 1973). The youngest Bertie waterlime is represented by the Williamsville Formation.

Fort Hill Waterlime. The Fort Hill Waterlime carries an Eurypterus fauna associated with ostracods and large salt hoppers. It is a thin unit occurring at the base of the Oatka Shaly Dolostone. While this waterlime has been traced from Phelps, New York westward, it has not been observed in the Buffalo area and no outcrops exposing this interval have been seen in Ontario, Canada.

Oatka Formation. The Oatka Formation is an inconspicuous unit seen only where exposures descend below the massive Fiddlers Green Formation. It is thus far barren of fossils. Like the underlying Fort Hill Waterlime, little is known of its extent westward into the Buffalo or Ontario, Canada areas.

Fiddlers Green Formation. Throughout much of the outcrop belt east and west of Phelps, New York (type section of the Phelps Waterlime), the Fiddlers Green Fm. consists of a central unit of massive dolostone and limestone (Victor Mbr.) sandwiched between two eurypterid-bearing waterlimes. The upper waterlime (Phelps Member) contains the Eurypterus remipes remipes Fauna so well known from the Herkimer County area (Ciurca, 1965, 1973). The lower waterlime (Morganville Member) also contains an Eurypterus fauna. These waterlimes appear to be attenuated in a westerly direction, especially in Ontario, Canada. Exposures, especially of the lower parts of the sequence, are rare and make tracing difficult. Additionally, the massive Victor Member dominates most sections. Currently, both the Morganville and Phelps Waterlimes are believed to be present in Ontario, Canada. The eurypterid fauna of the Phelps Waterlime is listed in Table 1.

Ellicott Creek Breccia. In Ontario, below the Scajaquada Formation, occurs a peculiar brecciated waterlime. This waterlime was traced into the New York sections and is termed the Ellicott Creek Breccia. The type section is at Ellicott Creek at Williamsville, New York

The Ellicott Creek Breccia is a highly variable unit generally having a more massive middle unit. At the type locality it is 2.3-2.5 meters thick. Variously colored, banded and straticulate waterlimes occur and these are rich in eurypterid remains and cephalopods. In Canada the Ellicott Creek Breccia becomes much thinner but retains a tripartite structure. Eurypterids preserved in the upper waterlimes are quite flattened while those preserved in the lower waterlime appear to be uncrushed. Salt hoppers are common.

The more massive middle unit is probably the result of 'reefy' algal masses and the variability in the thickness of the unit is probably due to variation in algal mound development.

TABLE 1. ARTHROPODS OF THE BERTIE GROUP

Phelps Waterlime	Williamsville Waterlime
EURYPTERIDS	
Eurypterus remipes remipes DeKay	Eurypterus remipes lacustris Harlan
Acanthoeurypterus wellsi Kjellesvig-Waering	Acanthoeurypterus dekayi (Hall)
Pterygotus (Acutiramus) macrophthalmus macrophthalmus Hall	Pterygotus (Acutiramus) macrophthalmus cumminosi Grote & Pitt
Pterygotus (Pterygotus) juvenis Clarke & Ruedemann	Pterygotus (Pterygotus) cobbi Hall
Paracarcinosoma NEW SPECIES	Paracarcinosoma scorpionis (Grote & Pitt)
Dolichopterus herkimerensis Caster & Kjellesvig-Waering	Dolichopterus macrocherius Hall
Dolichopterus jewetti Caster & Kjellesvig-Waering	Dolichopterus siluriceps Clarke & Ruedemann
X	Buffalopterus pustulosus (Hall)
Alloeurypterus linsleyi Kjellesvig-Waering	X
Clarkeipterus testudineus (Clarke & Ruedemann)	X
SCORPIONS	
Proscorpius osborni (Whitfield)	
Archaeophonus eurypteroides Kjellesvig-Waering	
XIPHOSURANS	
Pseudoniscus clarkei Ruedemann	Bunaia* woodwardi Clarke
PHYLLOCARIDS	
Ceratiocaris aculeatus Hall	Ceratiocaris acuminata Hall
	Ceratiocaris maccoyana Hall

* may be junior synonym of Pseudoniscus
(list compiled by S. J. Ciurca, Jr. for Buffalo NYSGA, 1982)

Besides the type locality, the Ellicott Creek Breccia is well displayed in the quarries at Port Colborne, Ontario. At Phelps, New York it appears to overlie the Phelps Waterlime. However, it has not been recognized eastward. A large eurypterid-bearing slab of brecciated waterlime, found on the shore of Cayuga Lake near Cayuga Junction, may indicate the presence of the Ellicott Creek Breccia in this area.

At most localities chert and sphalerite are especially characteristic of this unit. In Ontario, a thin black shale occurs at the base and may represent a hiatus between the Ellicott Creek Breccia and the underlying Victor Dolostone (or Phelps Waterlime if present).

Scajaquada Formation. Underlying the Williamsville Formation is a unit of argillaceous dolostones containing small chert nodules, the Scajaquada Formation. This unfossiliferous unit appears to be, at least in part, an extension of the gypsiferous Forge Hollow Formation of central New York. In western New York and Ontario, the Scajaquada Fm. is distinctively different in lithology than the Forge Hollow Formation. Beds are thicker and more massive. Mudcracks are present and evaporite (crystal) casts have been observed.

The Scajaquada Fm. is about 1 meter thick at Williamsville, New York. The unit is also exposed at Scajaquada Creek, and in several quarries in Ontario, Canada, particularly in those at Port Colborne. See Figure 3.

Williamsville Formation. In the Buffalo-Williamsville area, and in adjacent Ontario, Canada, the Williamsville Fm. has been of considerable interest to those who appreciate the great variety and quantity of eurypteroid arthropods preserved in this unit.

While little attention has been given to the detailed stratigraphy of the eurypterid-bearing sequence of the region, it seems clear that in order to understand many facets of Late Silurian sedimentation, the migration of environments resulting in cyclic sequences, and the evolution of eurypterid faunas, much more information is needed.

Although a relatively large fauna has been reported from the "Bertie" over the years, little is known about the exact stratigraphic position from which much of the material was obtained. Even now material is still being labeled and sold as simply "Bertie Waterlime" or "Bertie Limestone" and there is no doubt that specimens currently in the 'marketplace' have been obtained from various horizons.

Fortunately, most material I've studied in museums and pri-

vate collections comes from the Williamsville Formation. The majority of specimens labeled Buffalo or Williamsville, New York came from the "waterlime" quarries and originated in the Williamsville Formation. Specimens labeled Black Rock or other localities need further study.

The type locality for the Williamsville Formation is the exposure in Ellicott Creek at Williamsville, N. Y., although originally, exposures just to the west in the waterlime quarries, were what was intended to represent this unit.

At Ellicott Creek the Williamsville Fm. forms part of the falls just north of NY 5 and part of the walls on both sides of the ravine. Here it is 1.58 m. to 1.8 m. thick and contains the characteristic Eurypterus remipes lacustris Fauna.

To the east the Williamsville Fm. is present at numerous localities where this interval is exposed. It is 2.2 m. thick at Akron Falls where only a single specimen of E. r. l. has been found in several years of searching. At Oakfield and at Batavia only a portion of the Williamsville Fm. is present, the unit being in direct contact with the Silurian-Devonian Unconformity at the base of the Onondaga Ls., or the Bois Blanc Ls. where present. Near Le Roy it is present at the Nied Road Quarry, but no eurypterid remains have been observed there, only phyllocarids (Ciurca, 1973).

In the Buffalo-adjacent Ontario region, the Williamsville Formation is basically a tripartite unit here termed A, B, and C. In addition, a transitional unit is also included and is termed Williamsville D.

Williamsville A and C are quite eurypterid-bearing and in the Fort Erie area, most of the specimens I have obtained were from Williamsville A. Early collections (e.g.) those preserved in the Buffalo Museum of Science) contain numerous specimens from the transitional unit D, in which large ostracods are often present, and probably from Williamsville C. The brachiopod Eccentricosta jerseyensis was found at Fort Erie in Williamsville B and this unit may be simply a tongue of a more marine phase present elsewhere.

The Williamsville Fm. is readily traced through Port Colborne to Byng where it is well displayed in a number of quarries. In this area the Williamsville Fm. is quite fossiliferous. Eurypterus remipes lacustris, Pterygotus macrophthalmus cummingsi, phyllocarids, ostracods, and other forms have been found. In the Port Colborne area, north to south facies changes appear to take place between the Scajaquada and Williamsville Formations. To the north the Williamsville Formation appears to be replaced by shaly dolostones typical

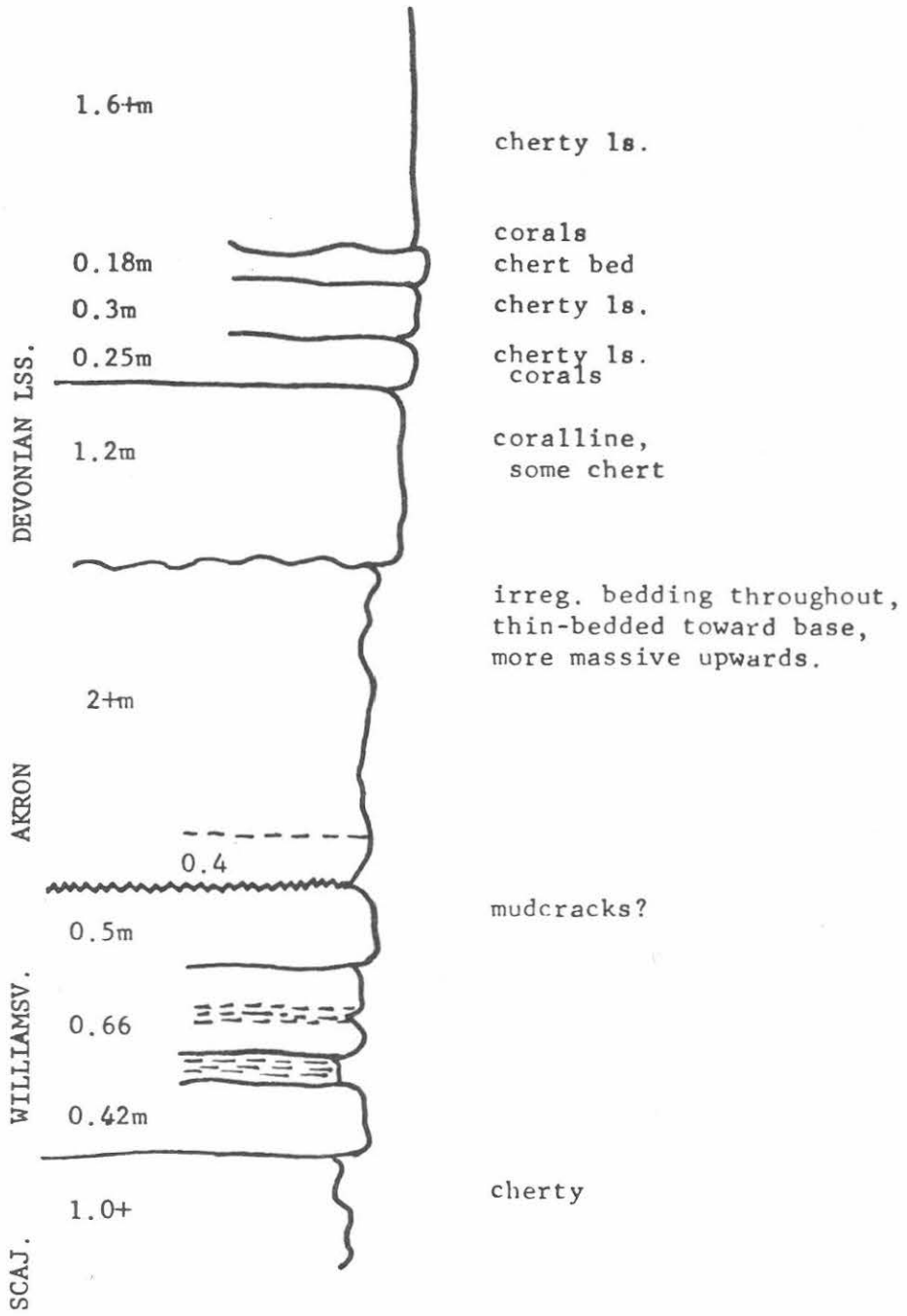

FIGURE 3 Section at Williamsville, New York, Ellicott Creek, west side, tributary showing Scajaquada through Akron Formational relationships.

of the Scajaquada Formation. The eurypterid fauna of the Williamsville Fm. is listed in Table 1.

Akron-Cobleskill Formations

Overlying the Williamsville Fm. is a unit of mottled, generally massive dolostone referred to as the Akron Formation. The thickness of this unit is usually assigned eight feet. However, in the area of the type locality, an unconformity occurs at the top of the unit. Had another area been chosen, it would have been realized that the unit is actually thicker. In eastern New York, the type Cobleskill Fm. has been assigned 6 to 9 feet of fossiliferous strata and workers have generally tried to maintain this uniformity in thickness across the state in relating the Cobleskill/Akron units.

There is no doubt that the two units are related, however the exact relationship is still unknown (Ciurca, 1978a). I believe that the Akron Fm. in western New York is younger than the Cobleskill Fm. of the type area. This suggests that the type Williamsville Fm. correlates with some portion of the Cobleskill Fm. of eastern New York.

In Ontario, the Akron Fm. is relatively unfossiliferous. Ostracods and brachiopods are the most common forms found. Salt hoppers, not yet seen in western New York exposures of this unit, occur in the Akron Fm. near Fort Erie and indicate a much more restricted 'marine' influence in this region.

Recently, Belak (1978, p. 5, Fig. 3) studied the Cobleskill Fm. and attempted to define "lithologic units" A, B, C, across the state. Unfortunately, the Cobleskill Fm. is a complex unit not amenable to such a simple subdivision. As pointed out previously, a variety of facies resulting from reef-associated sedimentation, is present in the Cobleskill/Akron units (Ciurca, 1978a). Additionally, the limestones occur at various stratigraphic positions and are of various types. It seems probable that eurypterid and cephalopod-bearing dolostones, usually assigned to the Williamsville Fm., grade eastward into eurypterid and cephalopod-bearing limestones so that at Forge Hollow, N. Y. only the Oxbow Waterlime of Rickard (1962) remains between the Forge Hollow and Cobleskill Formations.

Belak (1978, p. 152, 153) misidentified strata at several sections. No Williamsville Fm. is known to occur at the Chittenango Falls exposures, nor at the stream bed to the north. The Forge Hollow Fm. he identified is Chrysler Fm., and the Williamville Fm. above this is actually a waterlime bed in the Chrysler Formation (see Ciurca, 1978a, Figure 5).

Also, Williamsville Fm. (Belak, pp. 157-158) equals the uppermost Cobleskill Fm. (transitional to Chrysler Fm.); Williamsville Fm. (Belak, 1978, p. 167) equals Cobleskill Fm.; Cobleskill/Akron Fm. (Belak, p. 162) equals the Fiddlers Green Fm.; Rondout/Chrysler (Belak, p. 162) equals the Phelps or Williamsville Waterlime (both are exposed in the vicinity).

Clanbrassil Formation

In the region from Byng to Haggersville, Ontario, a sequence of fine-grained dolostones, the Clanbrassil Fm., overlies the Akron Formation. These rocks were formerly referred to the Bertie Group by many authors (e.g. Hewitt, 1971) but are stratigraphically higher and do not occur in the area of the type Bertie Group.

The type section at Clanbrassil exhibits an eurypterid-bearing facies that can be confused with other units because of lithologic similarities. The stratigraphic position, and the occurrence of the genus Erieopterus, distinguish this sequence from the rocks below.

The Clanbrassil Fm. is present at Cayuga and at Haggersville in the large quarries. At these localities, Erieopterus is abundant, particularly in the lower half of the unit. No other fossils have yet been found.

Erieopterus-bearing units with which the Clanbrassil Fm. correlates, at least in part, include the Honeoye Falls Fm. south of Rochester, N. Y., the Chrysler and Olney Formations of central New York, and only the Erieopterus-bearing portions of the sequence exposed on the Bass Islands of Lake Erie.

EURYPTERID BIOSTRATIGRAPHY

In New York State it is quite clear that recurring eurypterid-bearing lithologies, the result of Late Silurian cyclic sedimentation (Ciurca, 1973, 1978a), appear at numerous stratigraphic levels. More importantly, each contains at least one characteristic eurypterid or eurypterid fauna that should eventually prove useful in regional correlations. In western New York, two eurypterid horizons have been well known for about 80 years. One, the lowest, contains the Hughmilleria socialis Fauna near the base of the Vernon Shale (Salina Gp.). The other well known horizon, the Williamsville Fm. (Bertie Gp.), bears the Eurypterus remipes lacustris Fauna and, while many specimens continue to be misidentified, or their exact stratigraphic horizon recorded inaccurately, it remains an important horizon that is geographically widespread.

To these faunas and horizons for western New York and

Ontario, Canada can be added several new ones. The current status of forms and distributions follow. Eurypterid zonation is shown in Figure 4. Several characteristic forms are shown in Figure 5.

Tylopterella boylei Fauna

In 1884, Whiteaves described a peculiar eurypterid from the Guelph Fm. of Ontario, Canada (Clarke and Ruedemann, 1912). The eurypterid, Tylopterella boylei, is known only from a single specimen. It is important because it is a very distinctive form and is not known from succeeding rocks. It is hoped that more material from this horizon will be found in the future.

Hughmilleria socialis Fauna

In green, greenish-black and black shales in the Pittsford Shale near the base of the Vernon Fm. (Salina Gp.) occur abundant specimens of Hughmilleria socialis Sarle and an associated fauna of rarer forms including Eurypterus pittsfordensis, Pterygotus, and Mixopterus. Recent excavations at Pittsford have provided hundred of specimens for study and illustrate the richness of this stratigraphic interval in this portion of New York State. The extended geographic distribution of at least the Eurypterus pittsfordensis portion of this fauna was recently described (Ciurca, 1978b; Hamell, 1978).

Waeringopterus cumberlandicus apfeli Fauna

Little is known about the surface outcropping of rocks of the Salina Group in western New York. However, a fine exposure of massive dolostone and waterlime at Black Creek, east of Batavia, undoubtedly represents a portion of the Syracuse Formation. From these beds I obtained several specimens of the characteristic genus, Waeringopterus. This form was previously described from the Syracuse Fm. in central New York (Leutze, 1961; Kjellesvig-Waering and Leutze, 1966). As is often the case, the new specimens are intimately associated with salt hoppers.

Eurypterus sp. Fauna

The Fort Hill Waterlime at the base of the Oatka Formation has yielded numerous specimens pertaining to a small Eurypterus sp. associated with salt hoppers up to several inches on a side (Ciurca, 1973). This horizon remains unknown in the Buffalo area and westward and little is known at present of the associated fauna.

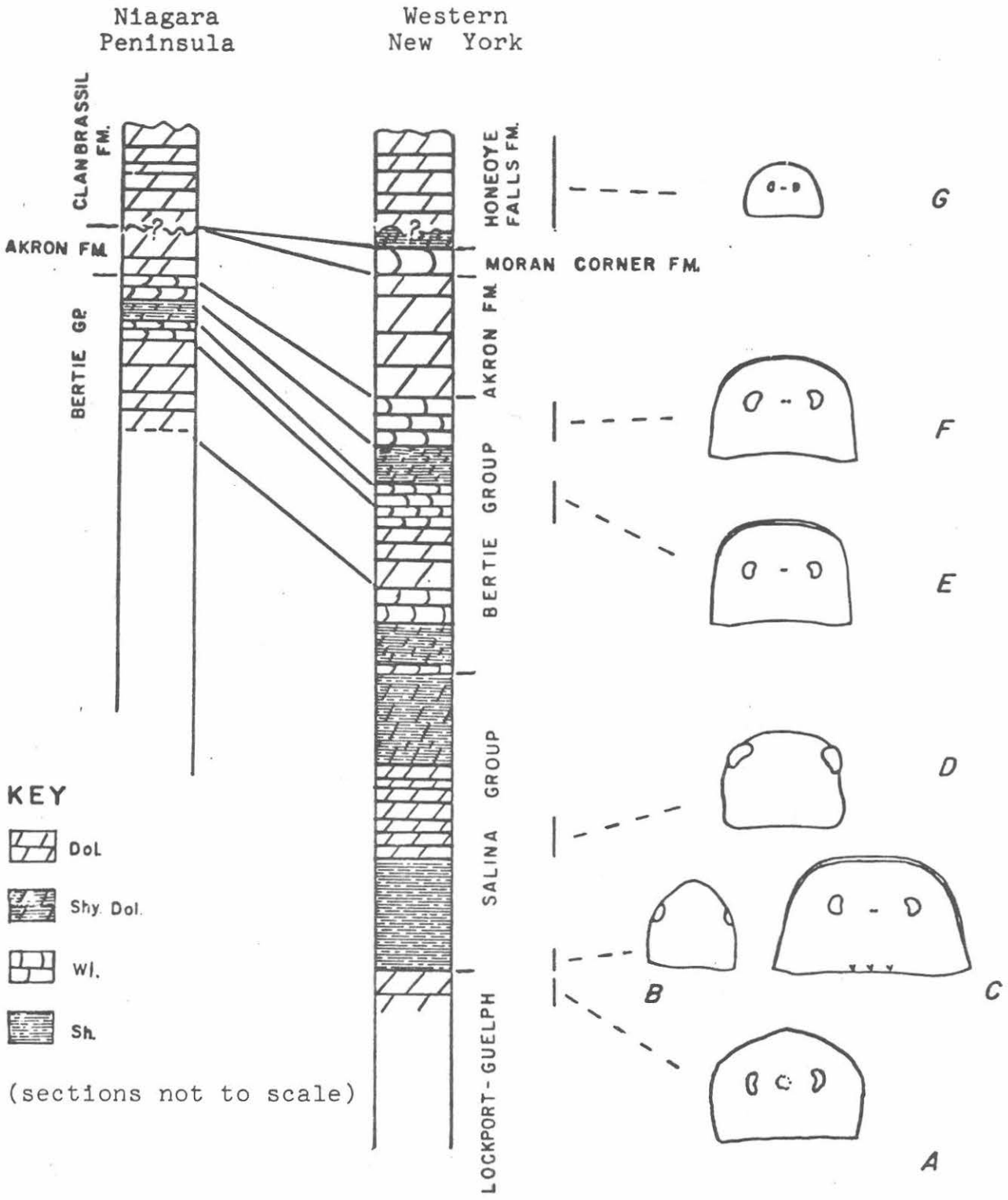

FIGURE 4 Eurypterid Biostratigraphy: Zonation based on stratigraphic distribution of characteristic Silurian and Devonian eurypterids, a) Tylopterella, b,c) Hughmilleria socialis, Eurypterus pittsfordensis (respectively), d) Waeringopterus, e) Eurypterus remipes remipes, f) Eurypterus remipes lacustris, and g) Erieopterus.

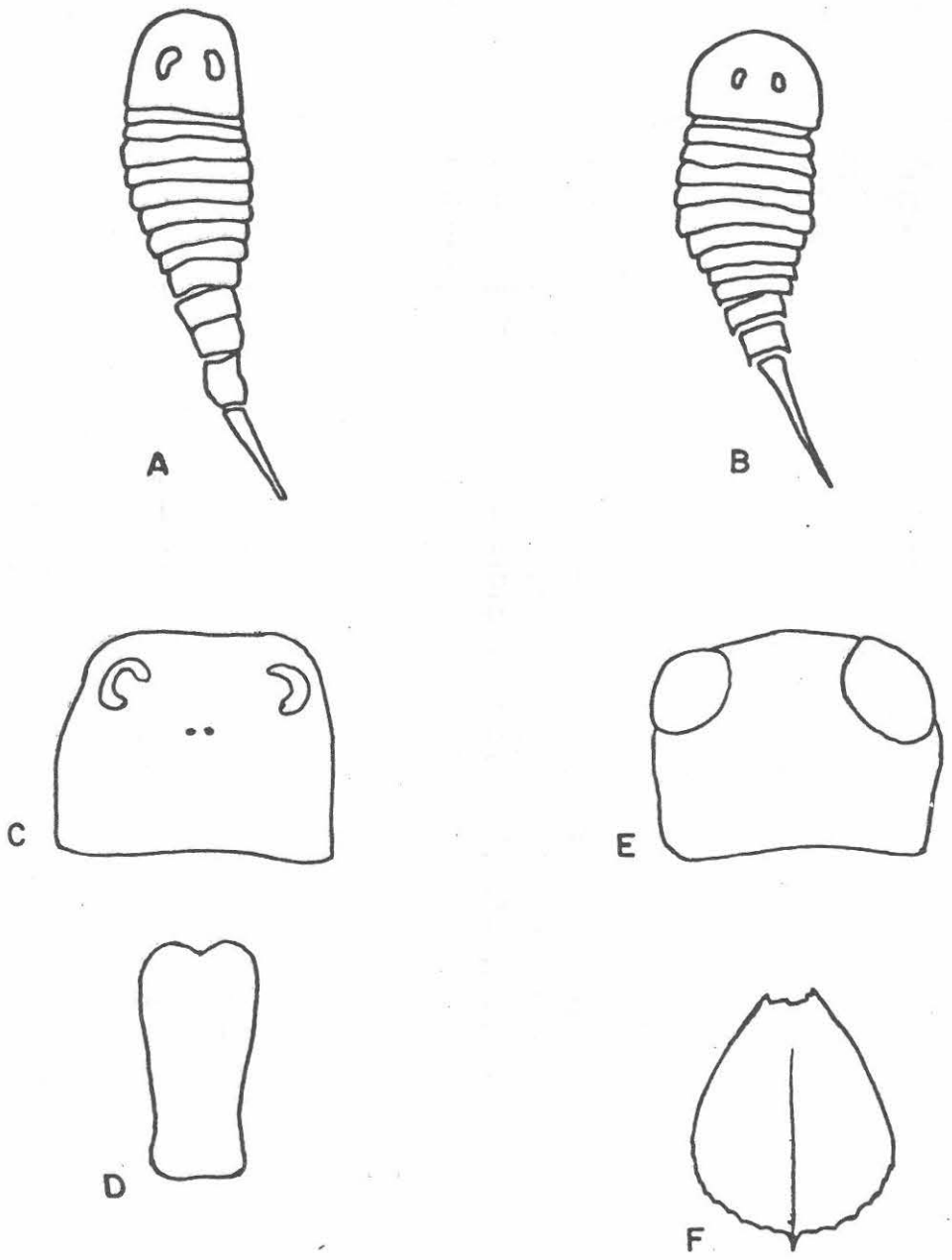

FIGURE 5 Characteristic Eurypterids of Southern Ontario (Niagara Peninsula), a) Eurypterus remipes remipes, Ellicott Creek Breccia, Port Colborne, Ontario; b) Erieopterus microphthalmus ssp., Clanbrassil Fm.; c,d) carapace, metastoma, Dolichopterus macrochirus, Williamsville Fm., Fort Erie, Ontario; e,f) carapace, telson, Pterygotus macrophthalmus cummingsi, Williamsville Waterlime, Fort Erie, Ontario.

Eurypterus remipes remipes Fauna

The well known Eurypterus remipes remipes Fauna of central-eastern New York is apparently represented in the Ellicott Creek Breccia of western New York and in Ontario, Canada. It may also be present in a thin waterlime just below this unit. Associated forms include Dolichopterus sp., Pterygotus sp., and in Canada, probably Clarkeipterus (Ciurca and Gartland, 1976). This fauna is intimately associated with casts and impressions of halite crystals.

Eurypterus remipes lacustris Fauna

The best known fauna in the region is that of Eurypterus remipes lacustris. The eurypterid collections of the Buffalo Museum of Science are rich in specimens of this characteristic species. The associated fauna includes Pterygotus macrophthalmus cummingsi, Dolichopterus sp., and Paracarcinosoma sp. (Table 1). The E. r. l. Fauna has been found as far west as Haggersville, Ontario and as far east as East Victor, southeast of Rochester, New York (Ciurca, 1973). Paracarcinosoma scorpionis, if the species is correctly identified, continues to be represented eastward in the Williamsville Waterlime as far as Jamesville, N. Y., southeast of Syracuse, where it is still associated with Lingula and phyllocarids (Ciurca, 1978a).

It is important to note that this fauna is associated, via Williamsville B, with Eccentricosta jerseyensis and other brachiopods. The brachiopod E. jerseyensis characterizes beds of Latest Pridoli age in New York, Pennsylvania, New Jersey, Maryland, and West Virginia (Berry and Boucot, 1970). E. jerseyensis has been found in the Williamsville Fm. at East Victor (Ciurca, 1973) and was also found just east of Clarence, New York. In Canada only Williamsville B has yielded this brachiopod at Fort Erie, Ontario.

Erieopterus Fauna

As pointed out previously, Erieopterus continues to be known from rocks believed to be Early Devonian in age and associated with the Manlius Group of central-eastern New York (Ciurca, 1978a). Erieopterus has been found abundantly near the base of the Honeoye Falls Fm. in the area south of Rochester (Ciurca, 1967b, 1973) and in Ontario, Canada, it occurs in the Clanbrassil Fm. (Ciurca, 1976). Both the Honeoye Falls and Clanbrassil Formations correlate with the Chrysler-Olney sequence of central New York and it appears that all occurrences of Erieopterus, from Thacher Park (near Albany, New York) westward to Ontario, Canada and Ohio, occur near or at the base of the Early Devonian.

EURYPTERIDS IN ONTARIO, CANADA

Like New York, Ontario rocks record the presence of a substantial variety of eurypterids during the Silurian. Both regions, however, need much more exploratory work, particularly in the Early and Medial Silurian rocks. Occurrences of Carcinosomatids and Pterygotids in the Niagaran rocks of Ontario are noteworthy, but generally based on scant remains. Particular attention needs to be focused on these earlier stratigraphic occurrences.

Copeland and Bolton (1960) have reviewed the occurrence and distribution of Canadian arthropods including eurypterids. For the Bertie Group, however, they note only the occurrence of the typical Eurypterus remipes lacustris (Williamsville Fm.). Careful tracing of the New York eurypterid horizons into Ontario and extensive collecting of fossils shows the presence in Ontario of most of the forms known from the Late Silurian (Cayugan) rocks of New York.

The following forms were recognized in the Ellicott Creek Breccia: Eurypterus remipes remipes, Pterygotus, Dolichopterus, Clarkeipterus, ostracods, cephalopods (common in the upper bed), and brachiopods (lowermost bed).

The following forms were found in the Williamsville Fm. in Ontario: Eurypterus remipes lacustris, Pterygotus macrophthalmus cummingsi, Dolichopterus macrochirus, Eurypterus dekayi, Ceratiocaris, Lingula, gastropods, cephalopods, and the brachiopod Eccentricosta jerseyensis.

The Clanbrassil Fm. has provided only one form, Erieopterus microphthalmus, that is common in the lower half of the unit.

Fragments of eurypterids and abundant ostracods and brachiopods occur in the massive dolostones of the Victor Member (Fiddlers Green Fm.), especially at Port Colborne, but little is known of the fauna.

UNCONFORMITIES

The nature of outcropping rocks is quite variable below the unconformity at the base of the Onondaga Limestone (or the Early Devonian Bois Blanc Fm. where present). See Ciurca, 1973, Figure 2, p. D-8A.

The effect of the unconformity on the nature of exposed strata for part of Ontario, Canada and western New York State is depicted in Figure 6. The contact of the Akron Dolostone with the Clanbrassil Fm. is indicated as probably unconformable. A biostratigraphic unconformity is suggested because

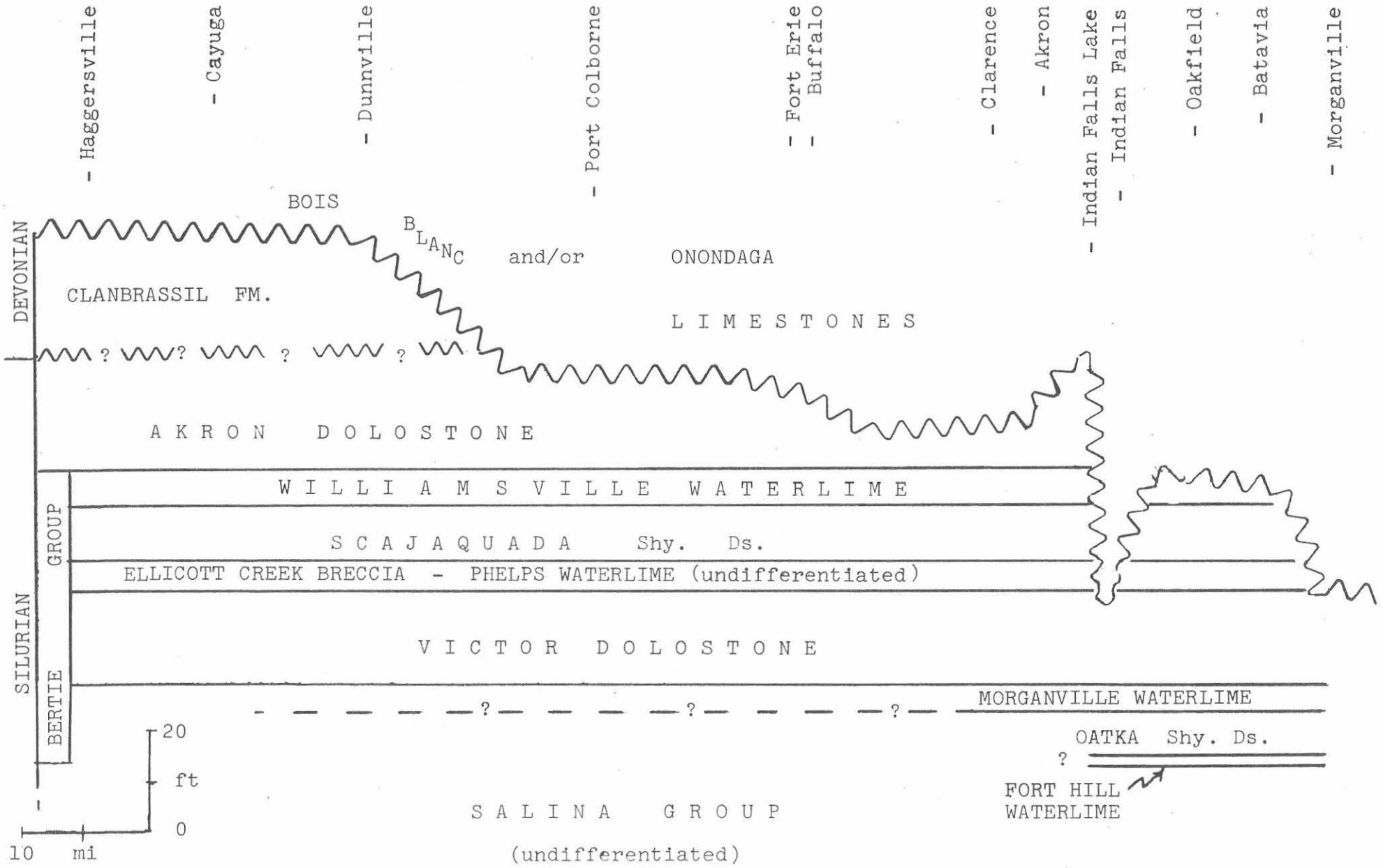

FIGURE 6 Lithostratigraphic cross section. Note the position and distribution of the Clanbrassil Fm., and also the effect of the unconformity on the nature of outcropping rocks (continuation of Fig. 2, Ciurca, 1973, p. D-8A).

of the replacement of an Eurypterus Fauna by an Erieopterus Fauna across this interval.

EURYPTERID COLLECTIONS

New York is fortunate in having a number of repositories in which large eurypterid collections are housed and, hopefully are readily available to anyone wishing to study this fascinating and problematical group of arthropods.

The Eurypterus remipes lacustris Fauna is particularly concentrated in the collections of the Buffalo Museum of Science (Clarke and Ruedemann, 1912; see also Bastedo, 1979), while the Eurypterus remipes remipes Fauna, especially material from the early collectors (see Clarke and Ruedemann, 1912) are concentrated in the New York State Museum at Albany. Collections from the Pittsford Shale horizons are maintained primarily at the New York State Museum and the Buffalo Museum of Science (see Clarke and Ruedemann, 1912).

Recent collections are rare. The largest is the Ciurca Eurypterid Collection (Ciurca, in preparation) at Rochester, New York which contains not only the E. r. l. and E. r. r. Faunas of the type areas (Buffalo and Herkimer "Pools" of early authors), but the entire interval geographically and vertically between these two extremes as well as considerable material from adjacent Ontario, Pennsylvania, Ohio, and Indiana.

Still another collection which has recently received attention is a collection emphasizing the E. r. l. Fauna of Ontario, Canada and the Buffalo area. The collection was assembled by Tony and Mike Sojka beginning in 1954 and was recently purchased by C. M. Seyfert (Seyfert and Seyfert, 1981).

Significant collections for study are also contained in the Smithsonian Institution, the American Museum of Natural History, and the Field Museum at Chicago. See also Fossil Invertebrates-Collections in North American Repositories 1976 (Paleontological-Society, 1977).

SUMMARY AND REMARKS

Eurypterid remains are found at several horizons in Late Silurian and Early Devonian strata of western New York and these have been traced into adjacent Ontario, Canada.

The Eurypterus remipes remipes Fauna occurs in the Ellicott Creek Breccia and the Eurypterus remipes lacustris Fauna occurs in the Williamsville Fm. as far as Haggersville, Ontario, Canada.

The replacement of an Eurypterus Fauna by and Erieopterus Fauna may indicate an unconformity at the Silurian-Devonian boundary in this region (Ciurca, 1978a, p. 245).

Examination of Late Silurian-Early Devonian strata in Ontario, Canada, and nearby states (Ohio, Indiana, Pennsylvania) indicates that cyclic sedimentation took place in these areas also. It is expected that several new eurypterid horizons and localities will be discovered in the future.

Recent use of cyclic sedimentation to interpret paleoenvironments within the Bertie Group has been provided by Hamell (1981). The research of Carl Stock (1979) on the stromatoporoids of the Cobleskill-Akron was recently published by the Paleontological Research Institution at Ithaca, New York. A study of the Cobleskill Fm. was attempted by Belak (1978, 1980). Eurypterus remipes remipes DeKay has been proposed as the State Fossil of New York (Fisher, 1982).

ACKNOWLEDGEMENTS

Richard D. Hamell helped considerably with the preparation of the manuscript and drafting of most of the figures. Steve Jarose provided help in drafting Figure 5.

Gene Gartland gave valuable field assistance, especially in Ontario, Canada.

Mark Domagala showed me outcrops in the 'jungle' near Oakfield, New York that I would never have found. These are important in showing the continuity of the Bertie Group in this area. I found the Onondaga Ls. to be in contact with the Williamsville Fm. in this area.

I thank those who have given me encouragement through the past several years and with whom I have had the benefit of many interesting discussions, especially the late Erik N. Kjellesvig-Waering.

REFERENCES

Bastedo, J. C., 1979, New York's Eurypterids. Collections, Buffalo Mus. Soc., v. 59, nos. 1-2, p. 33-36.

Belak, R., 1978, Stratigraphy, and sedimentology of the Cobleskill Formation (Upper Silurian), New York State. Unpubl. Master Thesis, Indiana Univ., Bloomington, Ind., 191p.

-----1980, The Cobleskill and Akron Members of the Rondout Formation: Late Silurian carbonate sedimentation in the Appalachian Basin. Jour. Petrol., v. 50, no. 4, p. 1187-1204.

Berry, W. B. N. and Boucot, A. J., 1970, Correlation of the North American Silurian Rocks. Geol. Soc. Amer. Spec. Paper 102.

Ciurca, S. J., Jr., 1965, Eurypterids at Passage Gulf. Earth Sci., v. 18, no. 1, p. 28-29.

-----1967a, In search of fossil sea scorpions. Rochester Academy of Sci. Bull., v. 21, no. 2 (Feb.).

-----1967b, The Honeoye Falls Dolostone Beds. Preliminary Rept., Mus. Petrified Wood, Rochester, N. Y., 8p.

-----1973, Eurypterid horizons and the stratigraphy of the Upper Silurian and Lower Devonian of Western New York. in N. Y. S. Geol. Assoc. 45th Ann. Mtg. Guidebook, Monroe Community College-Brockport State College, New York, p. D1-D14.

-----1976, A new Lower Devonian Eurypterid-bearing formation in the Grand River area, Niagara Peninsula, Ontario, Canada. in Geol. Soc. Amer. Abst. w/programs, North-Central Section, v. 8, no. 4 (Mar.), p. 472.

-----1978a, Eurypterid horizons and the stratigraphy of Upper Silurian-Lower Devonian rocks of Central-Eastern New York State. in N. Y. S. Geol. Assoc. 50th Ann. Mtg., Syracuse Univ., Syracuse, New York, p. 225-249.

-----1978b, Geographic distribution of the Eurypterus pittsfordensis Eurypterid Fauna, Pittsford Shale, Upper Silurian of Western New York. in Rochester Acad. Sci. Proceedings, 1980, v. 13, nos. 2-4, p. 148.

Ciurca, S. J., Jr. and Gartland, E. F., 1976, An Upper Silurian brecciated waterlime unit bearing Eurypterids, Niagara Peninsula of Ontario, Canada. in Geol. Soc. Amer. Abst., North-Central Sect., 10th Ann. Mtg., v. 8, no. 4, p. 472.

Clarke, J. M. and Ruedemann, R., 1912, The Eurypterida of New York. N. Y. S. Mus. Mem. 14, 2 vols., 628p.

Copeland, M. J. and Bolton, T. E., 1960, Canadian Fossil Arthropods: Eurypterida, Phyllocarida, and Decapoda. Geol. Surv. Canada, Dept. Mines and Techn., Surveys Bull. 60, 84p.

Domagala, M. A., 1982, Lithofacies and paleoenvironments of a peritidal carbonate setting: Lockport Formation (Middle Silurian) East-Central New York. Unpubl. Master Thesis, Fredonia State College, Fredonia, N. Y., 94p.

Fisher, D. W., 1982, Why not a State Fossil for New York? Conservationist, v. 36, no. 4, (Jan.-Feb.), p. 8-13.

Hamell, R. D., 1978, A new occurrence of the Silurian Eurypterid: Eurypterus pittsfordensis. in Rochester Acad. Sci. Proceedings, 1980, v. 13, nos. 2-4, p. 149.

-----1981, Stratigraphy, petrology, and paleoenvironmental interpretation of the Bertie Group (Late Cayugan) in New York State. Unpubl. Master Essay, Univ. Rochester, Rochester, N. Y., 89p.

Hewitt, D. F. and Vos, M. A., 1972, The limestone industries of Ontario. Ontario Div. of Mines, IMR 39, 76p.

Kjellesvig-Waering, E. N. and Leutze, W. P., 1966, Eurypterids from the Silurian of West Virginia. Jour. Paleont., v. 40, no. 5, p. 1109-1122.

Leutze, W. P., 1961, Arthropods from the Syracuse Formation, Silurian of New York. Jour. Paleont., v. 35, p. 49-64.

Rickard, L. V., 1962, Late Cayugan (Upper Silurian) and Helderbergian (Lower Devonian) stratigraphy in New York. N. Y. S. Mus. Bull. 386, 157p.

Seyfert, K. M. and Seyfert, C. M., 1981, Eurypterid collecting: a family affair. in Lapidary Jour., v. 35, p. 146.

Stock, C. W., 1979, Upper Silurian (Pridoli) Stromatoporoidea of New York. Bull. Amer. Paleont., no. 308, 101p.

FIELD TRIP

The following stops are planned for the field trip but are subject to change if permission cannot be obtained. Please bring hard hats if you have them.

STOP 1 Dunnville Rock Products, Ltd.

Quarry at Byng, Ontario, Canada. This quarry produces "crushed aggregates-concrete stone, Armour rock for shoreline protection, clay fill".

STOP 2

Port Colborne Quarries, Ltd., Quarze at Port Colborne just north of Route 3.

STOP 3

Ellicott Creek at Williamsville, just north of NY 5 (called Glen Park).