# BOIS BLANC AND ONONDAGA FORMATIONS IN WESTERN NEW YORK AND ADJACENT ONTARIO

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## Introduction

The Devonian limestone sequence at Buffalo consists of the thin and discontinuous Bois Blanc Formation of Early Devonian age and the much thicker Onondaga Limestone of Middle Devonian age. The two formations are lithologically and faunally distinct and are separated by a disconformity; together they rest on local remnants of the Oriskany Sandstone or on rocks of Silurian age. The Bois Blanc Formation thickens rapidly to the west but thins and disappears just east of the Genesee Valley. In eastern New York its equivalent is the Schoharie Grit.

The Onondaga Limestone passes westward into the Detroit River and Columbus Formations and possibly the lower part of the Delaware Limestone in addition. Toward the east the upper part of the Onondaga (Seneca Member) grades laterally into the lower part of the overlying Marcellus Shale.

Coral faunas in the Bois Blanc and Onondaga Formations are distinct and can be used for correlating within the northeastern North American province.

## Geologic History

Little record of latest Silurian or Early Devonian history is preserved in the area between Hagarsville, Ontario, 60 miles west of Buffalo and the Genesee Valley, 60 miles east. In eastern New York, this interval is occupied by the Rondout Limestone, the Helderberg Group and the Oriskany, Esopus, Carlisle Center and Schoharie Formations (fig. 1). Patches of the Oriskany Sandstone are known 50 miles west of Buffalo and sand, presumably derived from the Oriskany, is locally preserved in the base of overlying formations. Schoharie time is represented by thin and discontinuous remnants of the Bois Blanc Formation.

In contrast, the Middle and Late Devonian record is well preserved; beginning with the Onondaga Limestone a reasonably continuous picture of the area during the Devonian can be developed.

The Onondaga represents a time of widespread shelf sedimentation in New York. A fauna dominated by corals is characteristic of the early Onondaga (Edgecliff Member). Locally, patch reefs were formed and lithology and fauna both suggest relatively clear, shallow marine conditions over a broad area.

| London-Woodstock Area, Ontario | Buffalo Area, Ontario-New York | Helderberg Area, Eastern New York | Series or Stage | |
|---|---|---|---|---|
| Delaware Ls.<br>"Columbus" Ls.<br>Detroit River Fm. | Hamilton Gr. | Hamilton Gr. | Cazenovia | Middle Devonian |
| | Onondaga Ls. | Onondaga Ls. | Onesquethaw | |
| Bois Blanc Fm. | Bois Blanc Fm. | Schoharie Ls. | | Lower Devonian |
| | | Carlisle Center Fm.<br>Esopus Fm. | | |
| | | Oriskany Ss. | Deer Park | |
| | | Helderberg Gr. | Helderberg | |
| Akron-Bertie Fms. | Akron-Bertie Fms. | Rondout Fm.<br>Cobleskill Ls. | Cayuga | Upper Silurian |

Figure 1. Correlation Chart for Bois Blanc and Onondaga Formations in Buffalo Area

Edgecliff time was closed by an influx of argillaceous material, presumably of terrigenous origin and possibly a result of uplift in borderlands to the east or north. Shaly limestone grading upward to massive limestone forms the Nedrow Member in Central and eastern New York. The argillaceous influx had less effect in what is now western New York where dark, cherty limestone prevails.

The Moorehouse Member represents a return to conditions of limestone deposition but with liberal admixture of noncarbonate mud. Less mud was deposited in western New York where lithology and fauna are more like those of the Edgecliff.

The Tioga Bentonite Bed at the base of the succeeding Seneca Member indicates volcanic activity, possibly to the southeast. In central New York, the limestone above the bentonite is darker and finer grained than the Moorehouse and contains markedly fewer fossils; the Seneca Member grades upward into the black shales of the lower part of the Hamilton Group.

The limestone-black shale contact is apparently younger to the west and older to the east, and limestone deposition persisted longer near Buffalo than in eastern New York. The top of the Onondaga (upper part of Seneca Member) near Buffalo is considered to be the approximate time equivalent of the Cherry Valley Limestone Member of the Marcellus Shale (Hamilton Group) in central and eastern New York. Near London, Ontario and in Michigan and northern Ohio, the Middle Devonian carbonate sequence is generally considered to include even younger rocks (Cooper and others, 1942).

## Age and Correlation

A rugose coral fauna, characterized by *Aemulophyllum exiguum*, *Acrophyllum oneidense*, *Edaphophyllum sulcatum* and several other species, occurs in the thin and discontinuous Bos Blanc Formation of western New York and adjacent Ontario. The corals are accompanied by a small species of *Amphigenia* and by many other brachiopods, some of which are characteristic of Schoharie age rocks in eastern New York and other areas of eastern North America.

The characteristic rugose corals occur in the Schoharie Grit of eastern New York, the Bois Blanc Formation of Innerkip, Ontario and Michigan, the lower 4 feet of the Jeffersonville Limestone at the Falls of the Ohio (Louisville, Kentucky), and the upper few feet of the Wildcat Valley Sandstone in southwestern Virginia. In addition, some of the corals described by Cranswick and Fritz (1958) from the Upper Abitibi River Limestone in the Hudson Bay Lowlands of Ontario, belong to the same fauna.

The distinctive Schoharie-Bois Blanc rugose corals are endemic to eastern North America and give little evidence of the age of the fauna, although they are very useful for correlating within their province. Other associated corals are of apparently long-ranging species or are unstudied.

The associated brachiopods are being studied by A. J. Boucot and J. G. Johnson, California Institute of Technology. They consider the brachiopods to indicate an early Emsian (late Early Devonian) age.

Conodonts from the Bois Blanc near Buffalo and from the Schoharie Grit in eastern New York are considered late Emsian by Dr. Gilbert Klapper, Pan American Petroleum Corporation, (personal communication, October, 1965).

The Onondaga rugose coral fauna is distinctly different from the Schoharie-Bois Blanc fauna. A variety of ptenophyllid, disphyllid and cystiphylloid genera are common; most of the species, numerous genera and some families are not known to occur lower in the section. The Onondaga rugose coral fauna is constant across New York and in the Niagara Peninsula of Ontario. It is found in the lower part of the Detroit River Formation near Woodstock and Gorrie, Ontario, and in the Jeffersonville Limestone of southern Indiana and Kentucky. In all of these areas the Onondaga fauna abruptly overlies the Schoharie fauna.

The Onondaga rugose coral assemblage is composed of distinctly Middle Devonian (Eifelian) types. Some specific differences between Edgecliff and Moorehouse faunas may eventually permit recognition of two or more Onondaga faunas and have already aided in detailed correlation with other areas.

No modern study of Onondaga brachiopods is known to me. Such study is badly needed to aid both inter- and intraregional correlations.

Rare goniatities from the Nedrow Member are of Eifelian age according to House (1962, p. 253).

Recent study of the Onondaga conodont succession by Klapper, (personal communication, November, 1965) also supports an Eifelian age for the Nedrow and later Onondaga; conodont evidence from the Edgecliff is inconclusive.

The sharp separation between the Schoharie and Onondaga faunas suggests a discontinuity of rather broad extent in eastern North America. Physical evidence for this in western New York is discussed below. The best available age estimates of the two faunas indicate that the unconformity may represent late Emsian time and mark the physical boundary between Lower and Middle Devonian rocks in eastern North America.

## Multiple Unconformity at Base of Devonian

Throughout western New York and most of the Niagara Peninsula of Ontario, rocks of Helderberg, Oriskany, and Esopus age are lacking and the Onondaga and Bois Blanc Formations rest directly on the Bertie or Akron Formations of Late Silurian age. Locally, in the Peninsula, and in central New York (east of Cayuga Lake) the Oriskany Sandstone fills part of this gap. Farther east, in the Hudson Valley, the section is much more complete and all major time units seem to be represented (fig. 1; and see Rickard, 1964).

In the Buffalo area rocks of Schoharie age are represented by the eastern featheredge of the Bois Blanc Formation. These rocks are discontinuous and the overlying Onondaga Limestone rests directly on Silurian rocks in many places.

The evidence for an unconformity between the Bois Blanc and Onondaga Formations, as well as beneath the Bois Blanc, is very strong. The physical evidence for such a break is the presence of sand in the base of the Onondaga at many localities, including some where the formation overlies the Bois Blanc. The sand may be present or absent in the base of both the Onondaga and Bois Blanc. As the Bois Blanc is discontinuous, there are six possible basal Devonian sequences (fig. 2) Figure 2 is diagramatic but all of the sequences shown do exist within the Buffalo area. Faunal evidence for a Bois Blanc-Onondaga unconformity is considered in an earlier section.

The basal sand, whether Bois Blanc or Onondaga, is commonly considered to have been formed by reworking of the Oriskany Sandstone that presumably covered the whole area at one time. The presence of sand at the base of the Onondaga where it overlies Bois Blanc (fig. 2, situation 4 and 6) suggest that some Oriskany still existed in the area after pre-Bois Blanc erosion and Bois Blanc deposition. Pre-Onondaga erosion left patches of Bois Blanc; sand was washed onto some of these and included in the base of the Onondaga.

Stauffer (1913, p. 85) proposed the name Springvaie Sandstone Member for the basal sandy beds of the "Onondaga" in Ontario, and Chadwick (1919, p. 42) extended the usage of this term to New York. The name has served to emphasize that the sands are not of Oriskany age, especially in areas where true Oriskany Sandstone does occur. However, in its type area near Hagarsville, Ontario, 60 miles west of Buffalo, the Springvale is a massive sandstone, at least 8 feet thick, at the base of the Bois Blanc Formation, there 20 or more feet thick. Farther east in Ontario and in western New York where the Bois Blanc is thinner and discontinuous, the sand may be at the base of either the Onondaga or Bois Blanc or both, but is nowhere so concentrated as to form a true sandstone. Locally in central New York, a true sandstone of Onondaga age has been called Springvale (Oliver, 1954; 1963). Because of age differences and the presence of two sands the use of the term Springvale in New York and nearby Ontario is misleading, and it is recommended that such usage be discontinued. A new name may be desirable for well developed basal Onondaga sandstones to avoid confusion with the Oriskany Sandstone.

## Summary

In the Buffalo area there is evidence of at least three unconformities in the interval between the Silurian formations and the Onondaga Limestone. Two unconformities are indicated by breaks at the base of the Bois Blanc and Onondaga Formations; a third unconformity representing pre-Oriskany erosion or nondeposition can be deduced from the residues of sand in basal portions of the limestone and by the presence of

Oriskany Sandstone both east and west of the area. Whether other rock units and unconformities present farther east in New York, were ever present in the area is unknown but it seems likely that some were and the pre-Onondaga Devonian history was even more involved than here indicated.

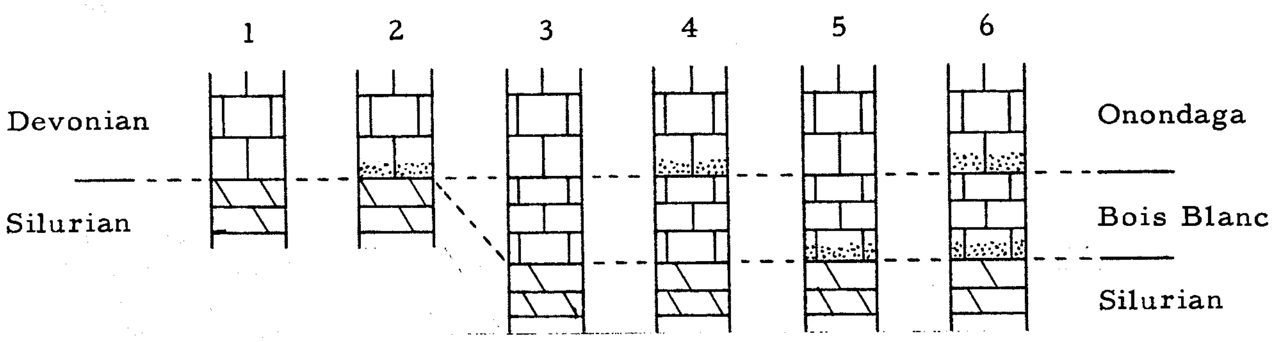


**Figure 2. Basal Devonian Sequences**

## Bois Blanc Formation

The Bois Blanc Formation in the Buffalo area is a medium dark gray, fine grained limestone with a fauna numerically dominated by brachiopods. The thickness varies from a few inches to four feet, but the formation is discontinuous and is absent in many places. Where the Bois Blanc is present, its lithology is in strong contrast to the overlying coarse crinoidal-coralline limestone that forms the lowest member of the Onondaga.

The Springvale Sandstone Bed at the base of the Bois Blanc, is several feet thick at Hagarsville. In New York and nearby Ontario, the sand is at most a few inches thick, but may be represented only by scattered sand grains in the lower part of the limestone or may be lacking entirely.

The Bois Blanc Formation was named by Ehlers (1945, p. 34, 80-109) for rocks in the Mackinac Straits region, and usage was extended into southwestern Ontario by Sanford and Brady (1955, p. 6). In both areas the name was used for cherty limestones underlying the Detroit River Group or Formation. The Detroit River Formation of the London-Woodstock area, Ontario, passes eastward into the Onondaga Limestone (see age and correlation discussion), whereas the underlying Bois Blanc Formation, over 100 feet thick in the Woodstock area (Stumm and others, 1956, p. 4), thins to 24 feet at Harasville, and approximately 15 feet at Port Colborne. Near Buffalo and extending to the Genesee Valley the Bois Blanc is thin and discontinuous. Only one remnant has been recognized east of the Genesee (west of Phelps) but the Schoharie Grit in eastern New York is of the same age and deposition may have been continuous over the intervening area.

The presence of rocks of Schoharie age in the Buffalo area was recognized by Cooper, et. al. (1942, p. 1774-1775). Their *Amphigenia* zone is indicated on figure 3 as the zone of "small" *Amphigenia*.

The Buffalo area Bois Blanc is the lower brachiopod unit of Stauffer (1915, p. 6) and Zone B or the *Amphigenia* Zone of Oliver (1954, p. 626, 632; 1960).

In the Buffalo area, the Bois Blanc can be seen in the abandoned quarry in Delaware Park (Buffalo), in the creek at Morganville (40 miles east of Buffalo) and in several quarries between Fort Erie and Port Colborne, Ontario.

## Onondaga Limestone

### INTRODUCTION

Overlying the Silurian rocks or the Bois Blanc Formation in the Niagara Peninsula and western New York is a complex of massive, cherty and argillaceous limestone, approximately 140 feet thick. In the early reports of the New York Geological Survey, the lower part of this complex (Edgecliff Member) was termed Onondaga, but the name was not commonly applied to the whole complex until late in the nineteenth century.

In the type area near Syracuse, the Onondaga Limestone has been subdivided into a sequence of four members and nine faunal zones. Traced laterally, lithic and faunal changes permit recognition of several facies in each member (Oliver, 1954, pl. i). In western New York, some of the changes are sufficient to warrant nomenclatorial recognition. Figure 3 shows generalized columns at the meridians of Buffalo and Leroy, New York.

### EDGECLIFF LIMESTONE MEMBER

Near Syracuse, the lowest member of the Onondaga is typically a light gray, coarse, crinoidal and coralline limestone, 8 to 20 feet thick. Towards the west this unit thins to 5 feet or less, becomes medium light gray and medium grained, and contains fewer fossils although corals are common. The lateral changes are gradual and the member can be easily recognized wherever exposed. Light gray chert is irregularly present in the upper half of the member in both the type area and near Buffalo.

The lower contact of the Edgecliff has been discussed. Sand grains, presumably derived from the Oriskany Sandstone, are present in the lower few inches of the member at some localities. The pre-Edgecliff unconformity may have several inches relief with basal sands attaining thicknesses of several inches in the bottom of "channels" and being thin or absent a few feet away on the "ridges". In the Buffalo area this is best seen in the abandoned quarry just east of the Bennett High School.

The upper contact is a sharp lithologic break in central New York. A one to two-foot gradation zone in the Buffalo area is included in the Edgecliff because of the contained corals.

Near Buffalo, the typical Edgecliff is accessible in Delaware Park (Buffalo), at the Casino in Williamsville, in the quarry northeast of Clarence and at Akron Falls. Innumerable other exposures occur along the Onondaga (actually Edgecliff) escarpment that can be traced on the topographic maps from Buffalo to the Genesee Valley.

EDGECLIFF REEF FACIES

Included in the Edgecliff Member but deserving special notice and separate discussion, are several small patch reefs or bioherms. These are largely composed of colonial and solitary rugose corals and tabulate corals in a matrix of coarse crinoidal debris that is both coarser grained and lighter colored than the typical Edgecliff. In a few exposrues a "core" of fine grained darker limestone (apparently deposited as a lime mud) is seen. "Core" fossils are delicate branching tabulates and a few other corals. Most reef exposures consist of the coarse crinoidal-coralline facies. Bedding is lacking or visible only at contacts between superimposed colonies. This facies seems to surround the core facies and is termed "reef flank" on figure 4. Away from the reefs, bedding becomes better defined, the rock is finer grained and the member thins; normal and reef flank beds interfinger for several hundred feet away from the reef.

Figure 4 is diagramatic and composite. Facies relationships are shown but no scale is used. In eastern New York, post-Edgecliff members are draped over the thicker reefs, the lower units pinching out and upper units thinning over the top of the reefs. Reef thicknesses up to 75 feet have been measured in areas where normal Edgecliff does not exceed 20 or 30 feet.

In the Buffalo area no complete reef thicknesses have been measured because all known reefs are deeply eroded. Exposed reefs measure 20 to 30 feet in thickness and estimates based on attitude of surrounding strata and areal extent of reef-rock suggest that thicknesses were at least 50 feet and probably much greater. This compares with off-reef thicknesses of 5 feet, although it is possible that the lower part of the overlying member in this area is actually Edgecliff in age. Reefs are round or elliptical in plane view, diameters in other parts of the state varying from 100 to 1,300 feet.

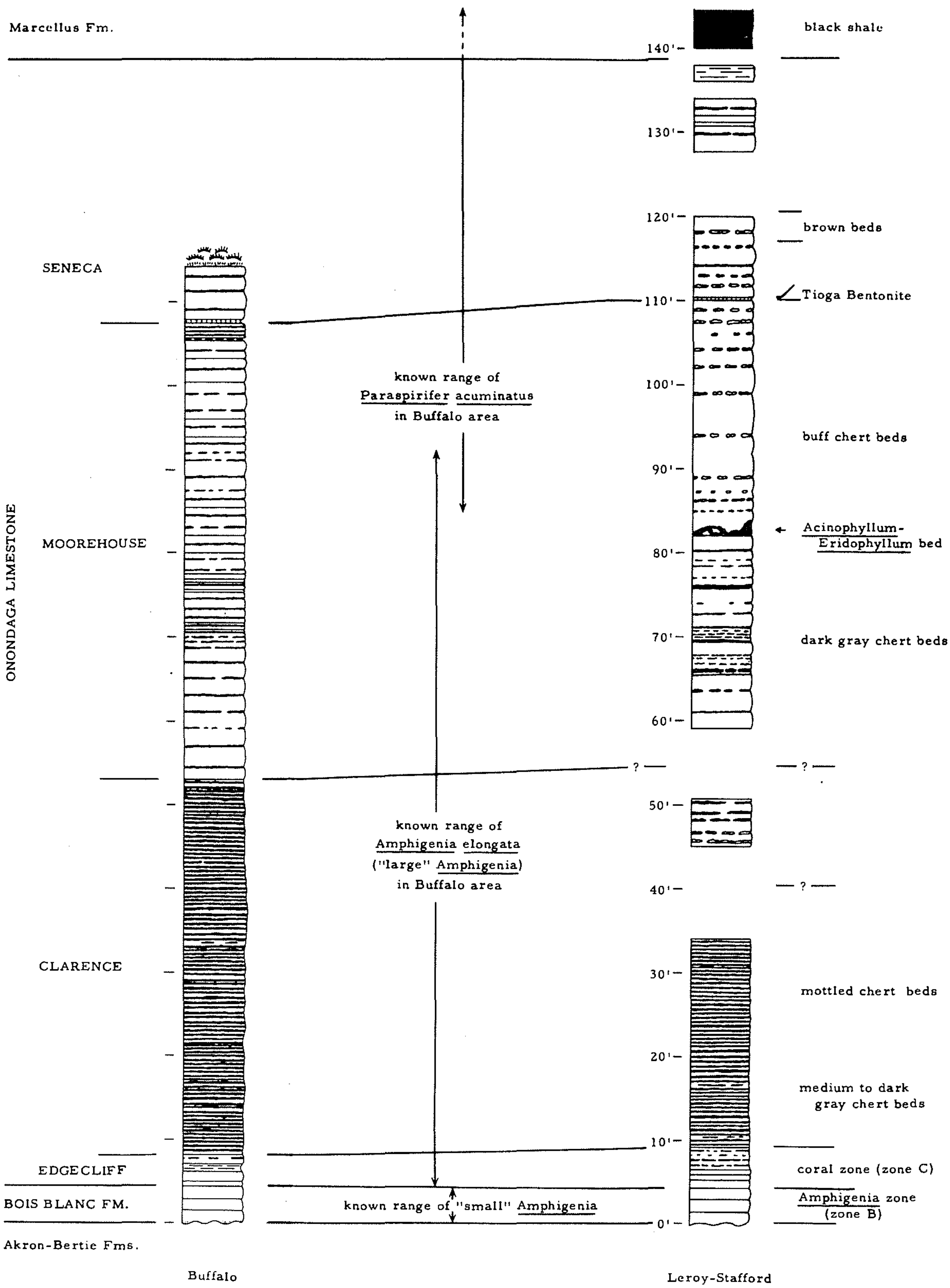


Figure 3. Composite Columnar Sections in Western New York

Although several reefs are now known in the Buffalo area, the best exposed is located northwest of Leroy, on the Byron quadrangle. The famous Fogelsanger Quarry at Williamsville provided reef specimens for collections all over the country, but has now been destroyed by Thruway construction. Other reefs are well exposed in the vicinity of Ridgeway, Ontario.

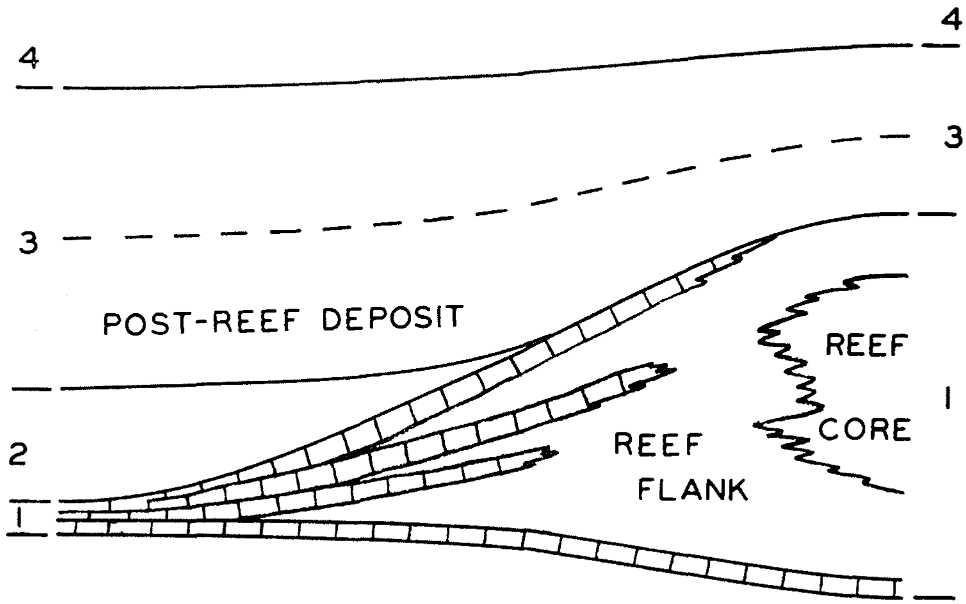


Figure 4. Composite and Idealized Reef Cross Section

1. Edgecliff
2. Clarence
3. Moorehouse
4. Seneca

CLARENCE MEMBER

Overlying the Edgecliff Member in the Buffalo area is 40 to 45 feet of fine grained limestone and dark chert, named the Clarence member of Ozol (1964; and unpublished Ph.D. thsis, Rennsselaer Polytechnic Institute, (1963).

In central New York, the Edgecliff Member is overlain by the Nedrow Member, 12 to 15 feet thick, consisting of a thin-bedded argillaceous unit with platyceratid gastropods, that grades upward to fine grained massive limestone. In western New York, the Nedrow is replaced by the much thicker Clarence Member that is distinctly different from the Nedrow, although in the same stratigraphic position.

The type section of the Clarence Member is in and near the village of Clarence (15 miles east of Buffalo) where the member is well exposed, especially along Route 5 just east of the village center. Dunn and Ozol (1962, p. 19) report a chert content of 45 to 70 per cent for the Clarence. This compares with 5 to 20 per cent figures for under- and overlying members and for the central New York Nedrow Member (Dunn and Ozol, 1962, p. 19). The high chert content defines the Clarence Member and makes it easily recognizable in surface exposures and many drilling logs.

The Clarence Member is only sparsely fossiliferous. As a result of this and inccomplete knowledge of sequences in intervening areas, exact correlation of the Clarence with the central New York Onondaga is uncertain. The Clarence is roughly equivalent to the Nedrow Member, but may include some of the lower Moorehouse and uppermost Edgecliff as well.

The Clarence Member can be conveniently seen in Clarence and at most of the mentioned Edgecliff localities. Between Buffalo and the mouth of the Grand River in Ontario the lower part of the member has been noted in only a few places, as most of the Clarence and all higher units are beneath Lake Erie. West of Dunnville, Clarence-Nedrow equivalents must be present but exposures are small and post-Edgecliff units are as yet undifferentiated.

MOOREHOUSE MEMBER

The Clarence is overlain by 55 feet of medium grained, light medium gray, massive limestone with a fauna composed of corals, brachiopods and a variety of other invertebrates. This is the western coral facies of the Moorehouse Member (Oliver, 1954; pl. 1). To the east, the Moorehouse thins to 20 to 25 feet at Syracuse, where it is a fine grained, medium gray massive limestone with an abundance and variety of brachiopods. Throughout New York, the Moorehouse contains varying amounts of light to dark gray chert. This is the rock presently being quarried at Bellevue and Harris Hill (both within the Lancaster quadrangle, just east of Buffalo) and at Stafford (6 miles east of Batavia).

The corals in the western Moorehouse are partly recurrent Edgecliff types but with some distinctive new forms that aid in the recognition of Moorehouse equivalents in the area south of Hagarsville, Ontario. The lithology and fauna indicate a return to Edgecliff-like conditions but without the development of so rich a coral fauna as to form reefs or biostromes.

TIOGA BENTONITE BED

Overlying the Moorehouse Member and forming the base of the Seneca Member of the Onondaga, is a four to ten inch clay bed that has long been recognized as volcanic in origin and utilized for local correlations (see Oliver, 1954, p. 629-630 for review of previous work on this bed). The bentonite bed has been recognized and used for correlations in the central Appalachians (Dennison, 1961) and as far west as Illinois (Meents and Swann, 1965). The bed is invaluable for local correlations and where supported by faunal data, for regional correlations as well.

SENECA MEMBER

Near Buffalo, the fourth and highest member of the Onondaga can be recognized only by its position above the Tioga Bentonite. Lower Seneca beds are exposed in several places and are lithologically and paleontologically like the underlying Moorehouse. Higher beds are rarely exposed but where seen are distinctly finer grained and darker.

The Seneca is 40 or more feet thick at Buffalo. Eastward the member thins to 30 feet at Leroy (fig. 3), 21 feet at the Livonia salt shaft and 19 feet at Syracuse. The eastward thinning is accompanied by lithologic change to a darker and finer grained limestone with a limited fauna. The Seneca Member is lithologically distinct in central New York. The continued usage of the name in western New York is justified by the importance of the Tioga Bentonite Bed at the base of the member.

Only a few exposures of the Seneca are known in the Buffalo area. The Tioga Bed and the lower 5 to 10 feet of the member are exposed at the Bellevue and Stafford quarries. Higher parts of the Seneca beds are exposed in Oatka Creek, north of Route 5, in Leroy. The actual contact with the overlying Hamilton Group is not known to be exposed although it is nearly so at Leroy.

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