ROBERTS HILL AND ALBRIGHTS REEFS: FAUNAL AND SEDIMENTARY EVIDENCE FOR AN EASTERN ONONDAGA SEA-LEVEL FLUCTUATION

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INTRODUCTION

While Edgecliff reefs have been the subject of numerous studies since the early 1960's (see references below), our understanding of these reefs is still far from complete. They have, for the most part, been perceived as small, simple patch reefs, with the discussion of their developmental history generally limited to two dimensional descriptions of the succession of reef builders and lithofacies. Such studies of surface exposures have mainly concluded that these were shallow water structures whose growth ceased upon entrance into the high energy, near surface turbulence zone (Bamford, 1966; Mecarini, 1964; Poore, 1969; Collins, 1978; and Williams, 1980).

Coughlin (1980), in a study of subsurface pinnacle reefs in southcentral New York, favored the opposing view that despite evidence for much of reef development in shallow water, termination of reef growth was caused by drowning of the reefs due to basinal subsidence. Cassa (1979, 1980), Cassa and Kissling (1982) and Kissling (1981) have on the other hand advocated a deep-water origin for many of the Edgecliff reefs due to the absence of stromatoporoids and algae from these reefs. More recently Wolosz (1984, p.268) has argued that the lack of a well developed stromatoporoid fauna was due to reef growth in a shallow but cool water environment, while Lindemann and Chisick (1984) have reported the presence of algae in these reefs.

STRATIGRAPHY

The stratigraphy of the Onondaga Formation has been extensively described by Oliver (1954, 1956), who divided it into four members. In the type area - "Onondaga County" - the basal Edgecliff member is a massive, coarsely crystalline, biostromal limestone; the Nedrow a thin-bedded, very fine grained and argillaceous shaley limestone; the Moorehouse a fine grained limestone with common chert and shaley partings; while the Seneca (which extends eastwards only as far as Cherry Valley) is differentiated from the Moorehouse on a faunal basis only. For the purposes of this report, the most important aspect of Oliver's stratigraphy is his inability to differentiate the Edgecliff, Nedrow and Moorehouse in the east (where they are mainly crinoidal grainstone and/or packstone) on any but biostratigraphic criteria (Oliver, 1956, p,1457), while these members are quite lithologically distinct only 35 miles to the west in the vicinity of Cobleskill. Further, Lindholm (1967, p.144) found only two microfacies to be present in the Onondaga in the vicinity of Albany as compared to four in the vicinity of Cobleskill. This facies relationship is thought to reflect prevalent shallow water conditions in the east as compared to progressive deepening of the basin to the west.

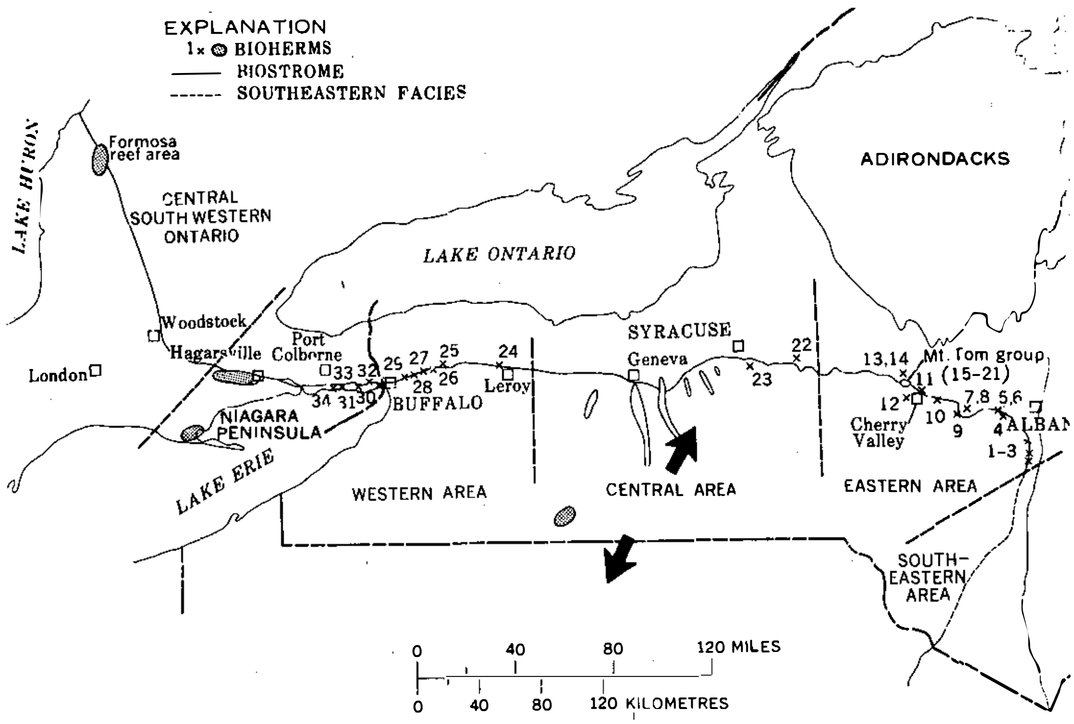

FIGURE 1. Edgecliff outcrop belt in New York and southwestern Ontario with reef locations (numbers). Roberts Hill (#1) and Albrights (#2) Reefs are the southernmost of the eastern reefs. Arrows mark anprox-imate topographic axis of basin. (After Oliver, 1976).

In his eastern Onondaga facies Oliver (1956, p.1446) divides the Edge-cliff into two units, the lower C1 and upper C2 units. The C1 unit is defined as a medium gray, rather fine grained limestone; while the C2 unit is a light to medium gray, coarse grained coral zone similar to the Edgecliff at the type area. While the C1 unit reaches its maximum thickness of 6 to 7 feet at Cherry Valley, it thins to the east and is only 1 foot thick at Sharon Springs. This eastward thinning suggests that the C1 unit would not be expected in the Roberts Hill area; however, at Leeds to the south the lower part of the Edgecliff is similar to the C1 unit and is about 12.5 feet thick. A fine grained, dark limestone at the base of Albrights Reef may represent this C1 unit.

The basal contact of the Onondaga is also of importance to our under-standing of the Edgecliff Reefs. Westward from Richfield Springs this contact marks a major period of erosion with the Onondaga successively overlying the Oriskany Sandstone, the Helderberg limestones, and the Silurian Manlius Limestone. Oliver (1956, p.1447) states that the uncon-formable contact at Richfield Springs is marked by the presence of phos-phate nodules in a glauconitic siltstone, a lithology more indicative of a period of non-deposition than of erosion. In the vicinity of Roberts Hill and Albrights reefs the Onondaga directly overlies the Schoharie Formation, with the contact between the two having been interpreted as gradational by Goldring and Flower (1942). Chadwick (1944, p.153), how-ever, claimed that the unconformity at the base of the Onondaga is present in the east, and represented by a glauconitic bed which marks the contact and indicates a discontinuity of sediment deposition.

TECTONIC SETTING

During the Devonian the Appalachian basin was dominated by two major tectonic elements, the mobile Appalachian geosyncline and the stable cratonic platform. To the east of the geosyncline, a land area contributed sediment into the northwestern geosynclinal trough. The Cincinnati-Algonquin Arch System marked the zone of minimum subsidence to the west, and separated the Appalachian basin from the Illinois and Michigan basins.

Prior to Onondaga time, the topographic axis of the Appalachian basin is believed to have shifted first to the east, and then back west. The Middle Silurian Niagara basin is located in Ohio, but by the early Devonian the basinal axis had shifted approximately 200 miles to the east, forming a northeast trending diagonal across Pennsylvania (Mesolella, 1978). Lindholm (1967) inferred this basinal axis to continue northwards to the vicinity of Albany, New York. After the deposition of the Helderberg, Deerpark, and lower and middle Onesquethaw sediments in the basin, two events occurred. The first was a major regression in the basin, exposing the sediments to erosion, and resulting in the widespread unconformity at the base of the Onondaga. The second was the shifting of the Appalachian basinal axis back towards the west. Lindholm (1967) placed the basinal axis in the center of New York State, where the Onondaga is thin, with thickening occurring to both the east and west. Mesolella (1978) confirmed the position of this topographic basinal axis based upon his interpretation of extensive subsurface data. As a result, the Onondaga basin trended in an approximately northeast-southwest direction (Figure 1).

LOCATION OF ROBERTS HILL AND ALBRIGHTS REEFS

The locations of all Edgecliff reefs known as of 1976 are included on Figure 1. Roberts Hill and Albrights reefs are located in the Ravena 7.5 minute Quadrangle and are the southernmost reefs in the eastern Onondaga outcrop belt (numbers 1 and 2 on Figure 1). Their location is only about 12 miles north of Leeds, where Oliver (1956) placed the boundary between his eastern and southeastern Onondaga facies. This boundary appears to mark a depth related facies change, with depths increasing to the south (see Cassa and Kissling, 1982, p.73).

ALBRIGHTS REEF

Only a small portion of the original reef has been preserved at this locality. Both the hillock on the west side of Roberts Hill Road (Figure 2) and the dipping beds to the east of it are mainly crinoidal packstone/grainstone with large favositids (Emmonsia and Favosites). These exposures represent former low-angle (4 - 8 degree) crinoidal sand flanks, with most of the present dip being tectonically derived.

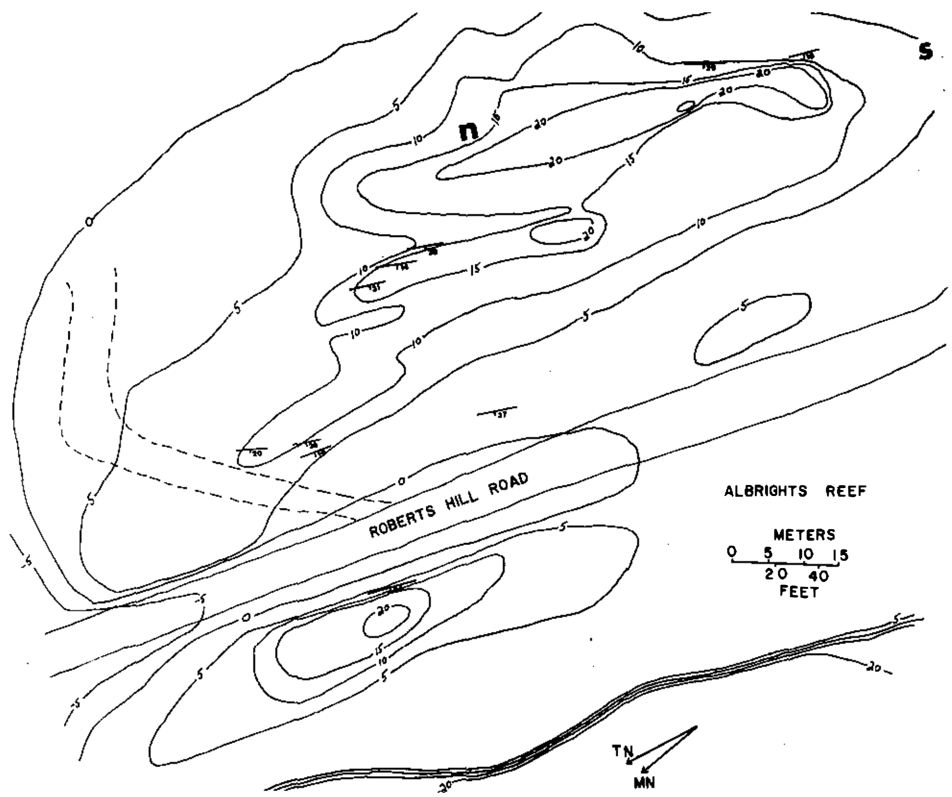

FIGURE 2. Topographic map of Albrights Reef. (n) and (s) on upper part of map mark position of cliff face illustrated in Figure 3. All other exposures are crinoidal flank deposits. Contour values relative to an arbitrarily selected zero point on Roberts Hill Road.

The most notable feature of Albrights Reef is the cliff-face exposure of the rugosan core at the eastern end of the outcrop (Figure 3). Here, a cross-section through the rugosan core displays evidence of the rugosan succession during mound development. As illustrated in Figure 3, initial colonization of the micritic Edgecliff sea-floor was carried out by the phaceloid colonial rugosan Acinophyllum, which was eventually replaced on the southern side of the mound by Cylindrophyllum (a somewhat similar phaceloid colonial rugosan with larger corallites). Cylindrophyllum remained dominant until the core was covered by the flank sands.

The lithology of the rugosan core is mainly a calcisilt bafflestone. Within the basal Acinophyllum portion of the mound there is little evidence of damage to the corals, with most of the present "flattening" of the colonies due to compaction. The first evidence of disturbance of the reef can be seen approximately 3 feet above the base of the mound at approximately the level of the chert nodules on Figure 3. Here the rock at the southern end of the exposure is devoid of rugosans, contains minor biosparites with an erosional base, and marks a temporary shrinkage of the areal extent of the coral thicket, possibly due to storm destruction. This horizon marks the only evidence of interfingering of the core with off-mound sediments. About 10 feet above the base of the mound, within the Cylindrophyllum dominance zone, evidence of storm damage (broken rugosan

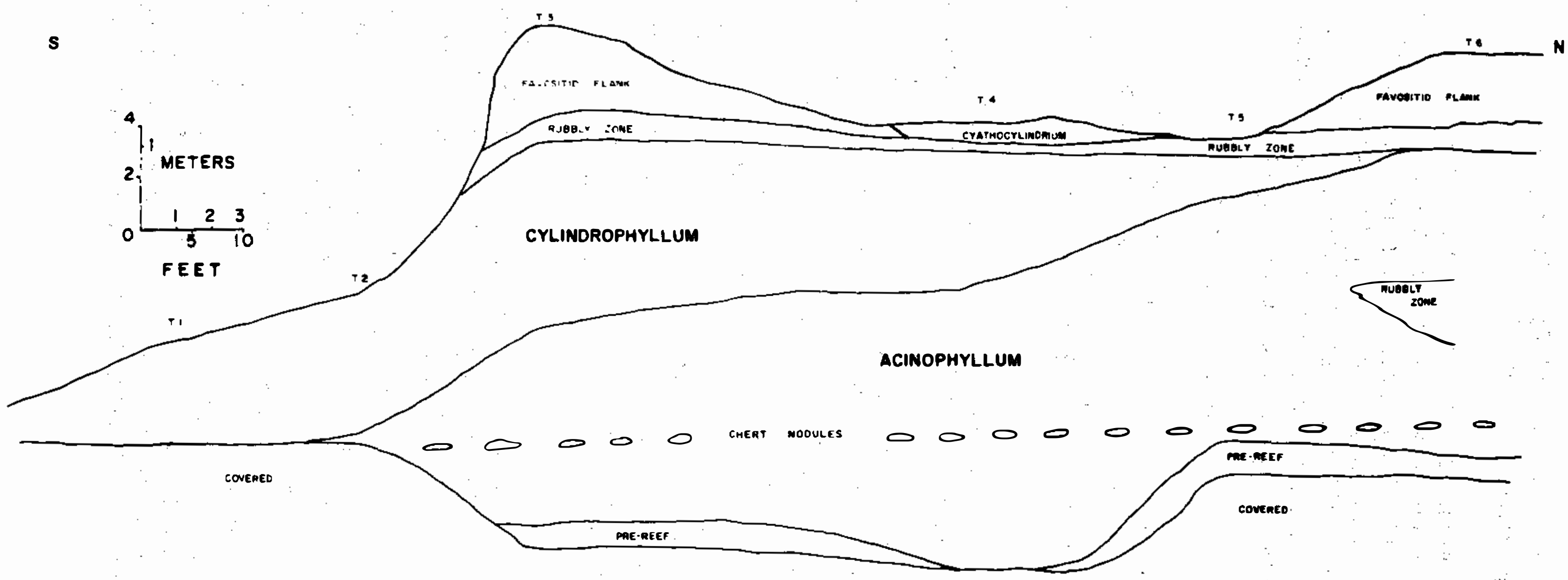

FIGURE 3. Interpretative cross-section of Inner Core exposure at Albrights Reef. Note that the contact between the Acinophyllum and Cylindrophyllum dominance zones suggests replacement over the entire fore-reef, and not a simple vertical successional pattern. Also note that rubbly zone marks the contact between the massive Inner Core facies and the bedded Favositid Flank facies. Use (S) and (N) at upper ends of figure to orient cross-section with Figure 2, the topographic map of Albrights Reef.

corallites and small overturned favositids) becomes common although the primary lithology remains calcisilt.

The bed which marks the contact between the core and flanks is notable for its abundant overturned favositids and broken rugosans, which together give it a more "rubbly" appearance than is characteristic of the flank beds in general. Numerous broken Cylindrophyllum corallites with large clumps of micrite still attached indicate partial erosion of the core. This suggests turbulence conditions of greater intensity than had previously existed during the growth of the rugosan mound.

ROBERTS HILL REEF

In contrast to Albrights Reef, Roberts Hill Reef is almost completely preserved, having lost only its crest and minor portions of its eastern flanks to erosion. Solution along joints has resulted in good exposure of the interior of the reef, allowing examination of almost all reef facies and developmental stages.

As illustrated in Figures 4 (topographic map) and 5 (interpretative cross-section), Roberts Hill Reef may be divided into a number of facies. The Inner Rugosan Core, or initial mound facies, consists of a dense colonial rugosan bafflestone similar to that at Albrights Reef. At Roberts Hill, however, the Inner Core is the result of a succession of three rugosan genera, as opposed to the two stage succession at Albrights Reef. Cyathocylindrium, another phaceloid colonial rugosan (with larger corallites than Cylindrophyllum), dominates the final successional stage of Inner Core growth. While field relations support the Cylindrophyllum - Cyathocylindrium succession, the presence of Acinophyllum as the initial core builder in Figure 5 is an interpretation. This interpretation is based upon analogy with Albrights Reef, and in consideration of the fact that Acinophyllum is documented as the initial successional stage in all eastern Edgecliff reefs studied to date (see references in Introduction).

The rugosan succession is both a vertical and lateral succession on the south side of the mound (Figure 5). There is, however, no evidence for the presence of Cyathocylindrium in the northernmost Inner Core exposures where Cylindrophyllum is the dominant rugosan.

The lithology of the Inner Core is also very similar to that at Albrights Reef. For the most part the inter- and intracorallite lithology is a bioclastic calcisilt, but near the edge of the core on the south side of the mound the initial intracorallite calcisilts are often found to have been partially washed out and replaced by a calcisilt packstone with coarse bioclasts. Finely comminuted rugosan septal fragments are also common in this part of the reef. Dispite this evidence of higher energy conditions, there is again little evidence of interfingering between the Inner Core and the flanks. A "rubbly zone" also marks the core/flank contact at Roberts Hill, but it is nowhere well exposed.

Surrounding the Inner Core are the crinoidal packstone/grainstone flank beds. On the south and west sides of the hill these flanks contain numerous large overturned favositids. Along the northeast edge of the hill these flank beds can be differentiated into a back-reef debris apron and normal flank beds (Figure 5). The normal flank beds consist of crinoidal debris and are similar to those found on the southern and western sides of the Inner Core, but with large favositids only rarely overturned. On the other hand, the debris flanks are characterized by dense accumulations of the solitary rugosan Cystiphylloides, with large overturned favositids and broken phaceloid rugosans. Packing of the Cystiphylloides coralla is tight, and at first glance these deposits can easily be mistaken for masses of colonial rugosans similar to the Inner Core facies. This unit is interpreted as a debris apron and not a simple back-reef facies because it onlaps the reef conformably to the underlying and overlying normal reef flanks.

To the south the flank beds are overlain by a dense rugosan assemblage similar to that which formed the Inner Core, labeled the Rugosan Recolonization Zone in Figure 4. Just below the contact with the Recolonization Zone the flanks contain a number of features not found previously within these former crinoidal sands. Scours become common, as do erosional contacts along bedding plane contacts. Synsedimentary cements and associated framework silt-infills, similar to those noted by James, et al. (1976) on the reef crest off Belize, mark a horizon about 1 foot below the contact. This horizon has been found at both the paleotopographic crest of the reef and at its foot. Finally, wherever the exact contact between the flanks and Recolonization Zone has been found, the upper portion of the flanks (approximately 4 inches of crinoidal grainstone) appears to be barren of corals or other large body fossils.

The overlying Rugosan Recolonization Zone is notable for three reasons: a) it marks a recolonization of the mound by the original core building fauna of colonial rugosans, b) it is characterized by a succession of rugosan genera directly opposite to that noted in the Inner Core (i.e., Cyathocylindrium recolonizes and is succeeded by Cylindrophyllum), and, c) it marks the return of abundant calcisilt in the reef as compared to the well-washed crinoidal sands below the Recolonization Zone.

The units which overly the Recolonization Zone to the south (Figure 5) are mainly the result of deposition following the death of the reef (as are the exposures along the west side of Limekiln Road). The only possible exception may be the fore-reef debris deposits which can be seen along the cliff exposure on the east side of the hill (Debris lenses in Figure 5). Here, rubble derived from the Recolonization Zone consists of both favositids and phaceloid colonial rugosans. The micrite which fills the intercorallite spaces also forms a rim around these colony fragments, suggesting that these are not simply displaced colonies, but are instead large intraclasts, which would indicate erosion of the reef at this time.

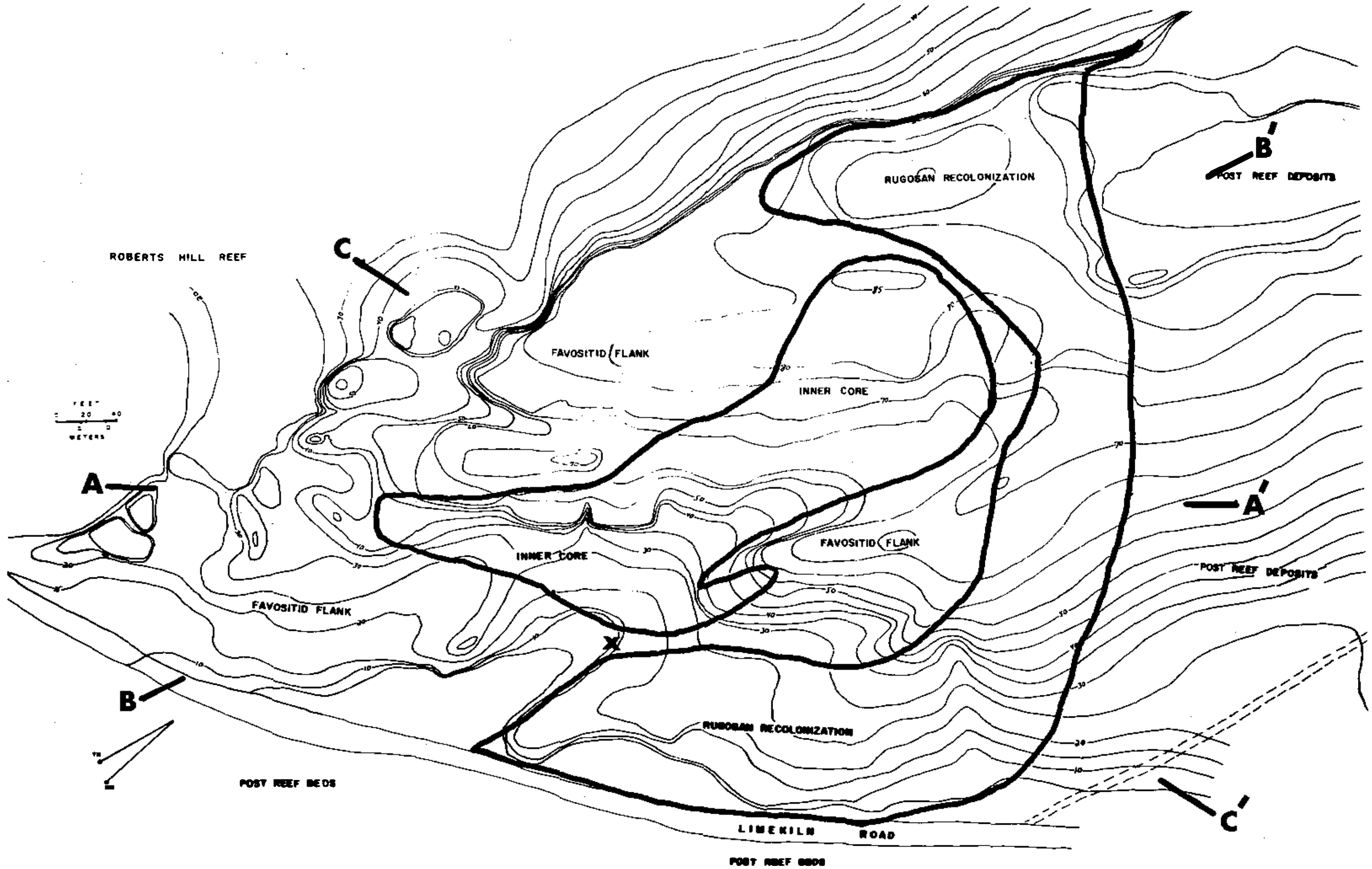

FIGURE 4. Topographic map of Roberts Hill Reef with reef facies boundaries. A - A', B - B' and C - C' marks positions of cross-sections illustrated in Figure 5. Contour values relative to an arbitrarily selected zero point at the intersection of Limekiln and Haas Hill Road.

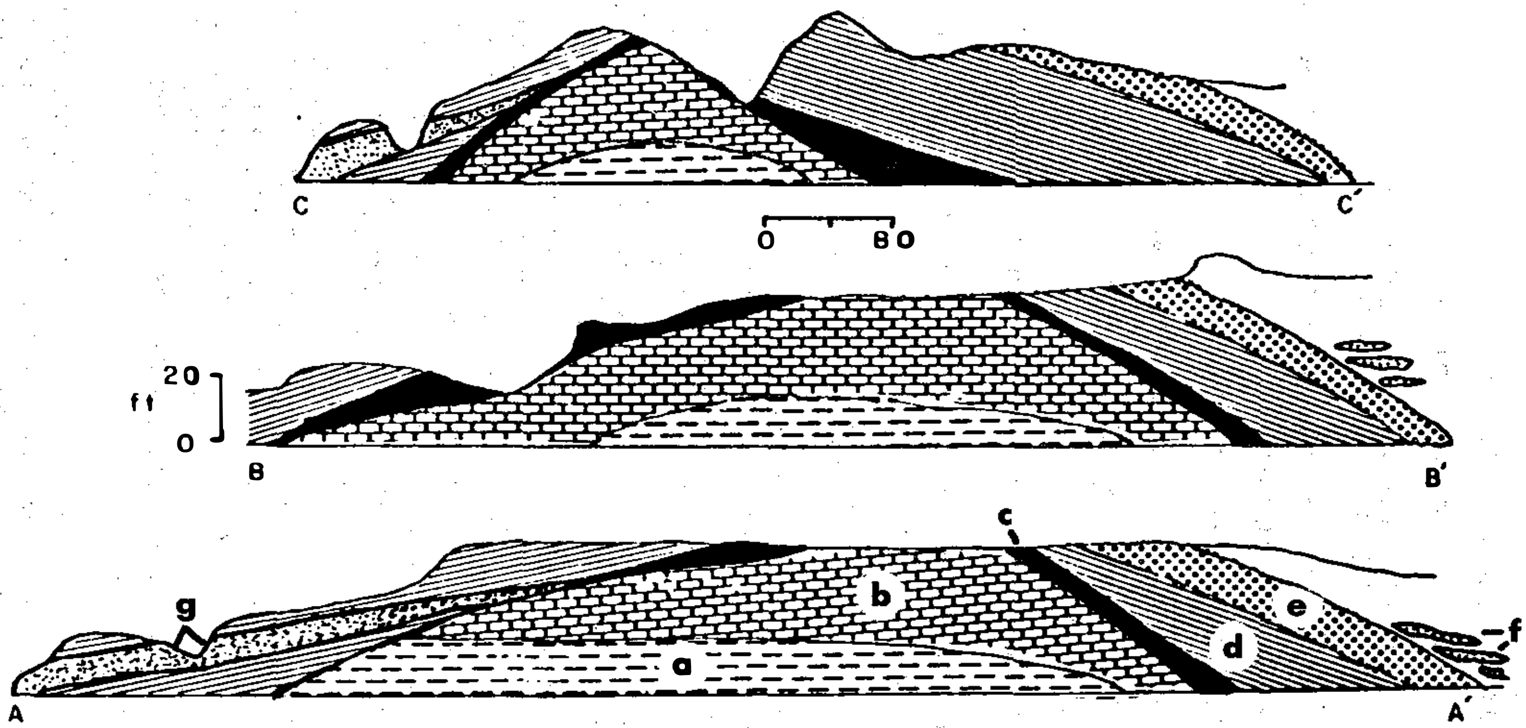

FIGURE 5. Interpretative cross-sections of Roberts Hill Reef. Inner Core consists of three facies: a = *Acinophyllum* dominance zone, b = *Cylindrophyllum* dominance zone, and c = *Cyathocylindrium* dominance zone. Flank facies include d = normal crinoidal sand flank beds and g = back-reef rubble apron. e = Rugosan Recolonization Zone, and f = fore-reef rubble lenses. For positions of cross-sections see Figure 4, topographic map of Roberts Hill Reef.

CRITERIA FOR REEF ZONATION

1) FORE TO BACK-REEF TRENDS

A) RUBBLE APRON TO NORTHEAST

B) PREFERRED RUGOSAN RECOLONIZATION ON SOUTH SIDE OF MOUND

C) BREAKDOWN OF COMMUNITY STRUCTURE TO NORTH

2) TURBULENCE INDICATORS

A) % OVERTURNED COLONIES

B) EVIDENCE OF RUGOSAN BREAKAGE

C) SYNSEDIMENTARY CEMENTATION

D) SCOURING

E) DEGREE OF WASHING OF CRINOIDAL SANDSTONES

FIGURE 6. Criteria used to identify paleocurrent direction and increased levels of environmental turbulence.

EVIDENCE FOR CURRENT DIRECTION DURING REEF GROWTH

Both paleoecological and sedimentary evidence (Figure 6) can be used to support an interpreted current flow from approximately southwest to northeast. The paleoecological evidence consists of the preferential colonization of the south to southwestern sides of both Albrights and Roberts Hill reefs by rugosans. Note (Figure 3) that at Albrights Reef the replacement of _Acinophyllum_ by _Cylindrophyllum_ took place on the south side of the mound with the formerly dominant coral genus being displaced to the north side of the mound. At Roberts Hill Reef (Figure 5) _Cyathocylindrium_ can be found to displace _Cylindrophyllum_ on the south side of the mound while the north side of the Inner Core exposures offer no evidence for the presence of _Cyathocylindrium_. Further, the recolonization of the mound took place preferentially on the southern side of the mound, with no evidence to suggest that the major rugosan recolonization extended to the north side of the reef. Finally, while the south side of the mound displays a well developed community structure in the presence of dominance zones, no such zones exist on the northern sides of either Albrights or Roberts Hill reefs. When rugosan colonies are found on the north sides of the mounds they appear to be haphazard groupings of genera. Preferential placement on the up-current side of reefs or mounds is known to occur in both recent shallow and deep-water reefs (Wallace and Schafersman, 1977; Reed, 1980).

Sedimentologic evidence in support of a northeast flowing current consists of the debris apron which is found on the north side of the reef, scours and intercorallite cross-bed like structures on the south side of the reef, and abundant overturned favositids in the southern flanks as compared to almost no overturning in the normal flanks exposed along the cliff wall on the northeast side of the hill.

OBSERVATIONS	POSSIBLE CAUSES UPWARDS REEF GROWTH	FALLING SEA-LEVEL	RISING SEA-LEVEL
INNER CORE RUGOSAN SUCCESSION		X	
INNER CORE – FLANK FABRIC CHANGES	X	X	
LACK OF CORE – FLANK INTERFINGERING		X	
FORMATION OF BACK-REEF RUBBLE ZONE	X	X	
INCREASED OVERTURNING OF FAVOSITIDS	X	X	
TOPOGRAPHIC POSITION OF SYNSEDIMENTARY CEMENT		X	
RUGOSAN RECOLONIZATION WITH REVERSAL OF INNER CORE SUCCESSION			X
CESSATION OF RUBBLE ZONE DEPOSITION			X
INCREASED CALCISILT DEPOSITION			X

FIGURE 7. Listing of observations made at Roberts Hill and Albrights reefs versus possible causes. Note: "Upwards Reef Growth" assumes static sea-level. See text for details.

EVIDENCE FOR AN ONONDAGA SEA-LEVEL FLUCTUATION

As mentioned in the Introduction, most previous studies of Edgecliff reefs have concluded that evidence of increased turbulence found near the tops of these reefs is due simply to upwards reef growth under static sea-level conditions. While numerous observations made at these reefs do suggest increasing turbulence through initial (Inner Core) growth, an alternative hypothesis - that growth took place during a period of falling sea-level - may better explain these observations. In order to test these two hypotheses, Figure 7 lists observations made at these reefs with possible interpretations of their cause.

Three observations appear to be totally neutral with regard to either falling sea-level or upwards reef growth with static sea-level. Sedimentary fabric changes across the core/flank boundary are suggestive of increased turbulence and occur both at the reef crest and at its foot, but since breakage products from the reef crest may easily be transported down the reef as sand and silt sized sediment, this observation is neutral. The same argument holds for the percentage of overturned favositids in either high or low fore-reef positions; and a back-reef rubble zone would be expected to form behind a high energy reef crest regardless of how the reef had managed to enter the high energy zone.

The rugosan succession in the Inner Core may be considered neutral if it is a purely vertical succession, since reef crest communities in the Carribbean, for instance, are known to be controlled by turbulence level (Geister, 1977). The succession in the Inner Core and Recolonization Zone at Roberts Hill and Albrights reefs are, however, not only vertical but also lateral, and hence, if controlled by the level of

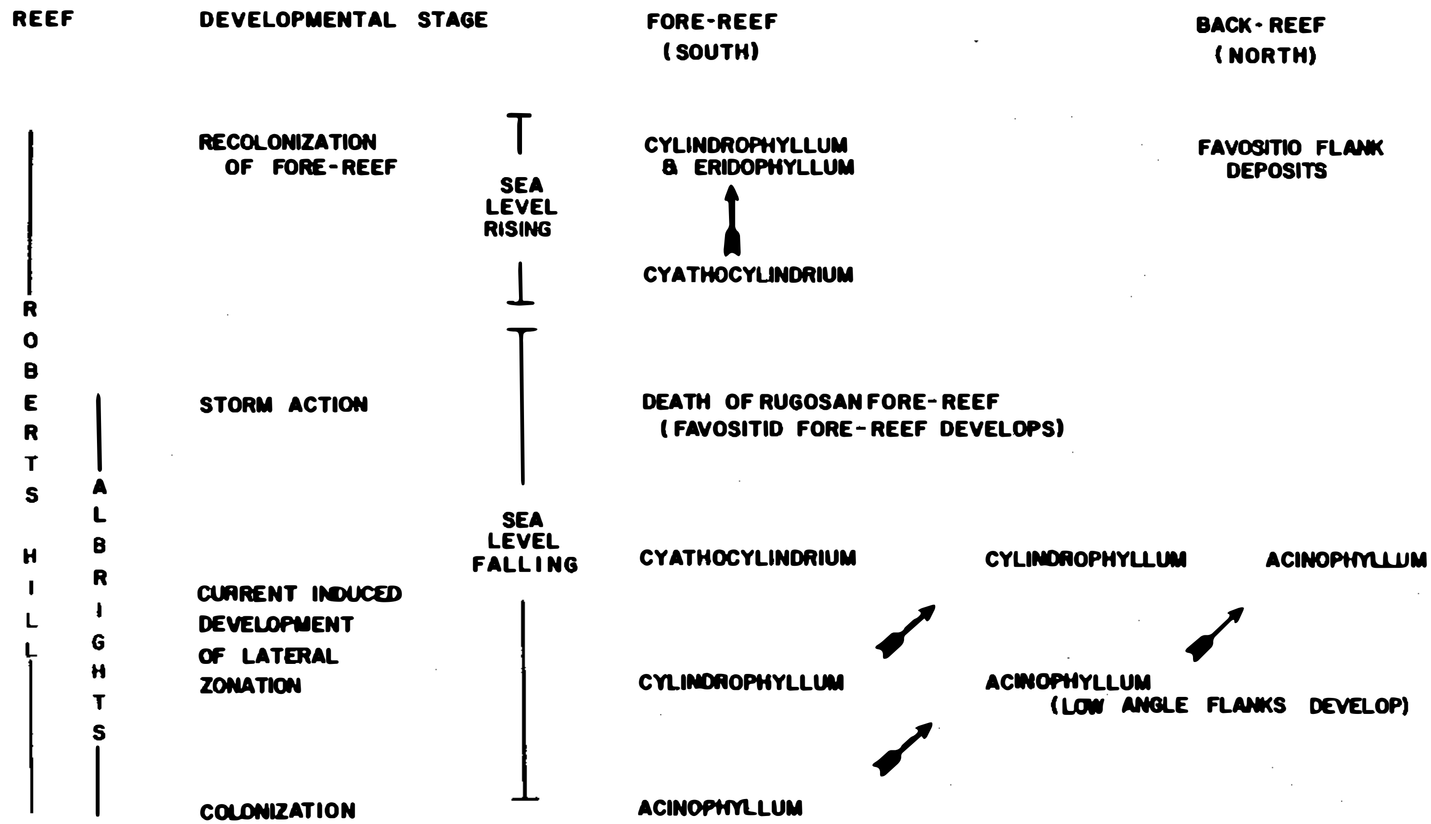

FIGURE 8. Model for the development of Roberts Hill and Albrights reefs. Vertical lines at left mark extent of preserved reef development. Growth of Inner Core is controlled by a succession of three rugosan genera with falling sea-level. Note that early stage genera are displaced to back-reef area (Cyathocylindrium of only minor importance at Albrights Reef). At lowest sea-level Roberts Hill Reef was a crinoidal sand bank with some favositids. Recolonization Zone marks return of rugosans (in reversed successional order) due to rise in sea-level. Final drop in sea-level ends reef growth.

turbulence, must reflect uniformly changing conditions over the entire fore-reef since the rugosan dominance zones extend from the crest to the foot of the mound. Therefore, the lateral rugosan succession can only be explained by falling sea-level, since simple upward reef growth would not cause such a uniform change in turbulence conditions.

The above argument may also be applied for the topographic position of the synsedimentary cements below the Recolonization Zone/flank contact. Synsedimentary cements occur only below this contact, following it from reef crest to foot, over a vertical range of about 35 feet. Since the lower boundary of the Recolonization Zone is assumed to mark a biological event - a time line - the assumed high turbulence conditions required to form these cement fabrics would have had to affect the entire reef at the same time - a requirement which reef growth into a high energy zone could not meet.

The lack of core/flank interfingering also suggests falling sea-level. Roberts Hill may be considered as a preserved sequence of three consecutive communities: a rugosan mound followed by a favositid/crinoid sand bank, and lastly, a new rugosan mound. That the Inner Rugosan Core originally consisted of a large mound without flanks is supported by the complete lateral rugosan succession within the core. If the core and flanks had been developing simultaneously we would expect to find both extensive interfingering of the core with flank sands, and overgrowth of the flanks by later rugosan successional stages. At point X on the Roberts Hill map (Figure 4) the <u>Cyathocylindrium</u> (final) stage of core development may be seen near the <u>topographic base of</u> the reef underlying the flank sands. A second consideration is simply the concept of "flank" beds. Generally, flank beds are considered to have been derived from the actively growing reef, but in the case of Albrights and Roberts Hill reefs the cores could not have acted as the source for the crinoidal flank sands since they consist of calcisilt bafflestone. Hence, the flanks must be considered a separate, in-place buildup of "normal" Edgecliff grainstone/packstone around the already extant rugosan core. Such a relationship would explain the difference in turbulence levels suggested by comparison of the Inner Core fabrics with those of the flank beds with their large overturned favositids. This would also fit a model of falling sea-level, with the rugosan core being a low energy community and the favositid flanks developing under higher energy conditions. Finally, the rubble zone on the north side of Roberts Hill supports this three community concept. If an actively growing colonial rugosan community had, in fact, reached the high turbulence zone, then the rubble apron would be expected to be heavily dominated by fragments of these colonies. Instead, the rubble zone primarily consists of the small solitary rugosan <u>Cystiphylloides</u> and overturned favositids - both characteristic of the <u>flank deposits</u> on the south side of the mound - with only minor contributions from colonial rugosans. This similarity of rubble zone fauna to that of the normal flanks, instead of the rugosan core, suggests that at the time the rubble apron began to form the normal flanks were already well developed and possibly the main reef facies. Since it is doubtful that either the solitary rugosans or the widely spaced favositids could account for active or rapid upwards growth of the mound, falling sea-level appears to be the logical answer.

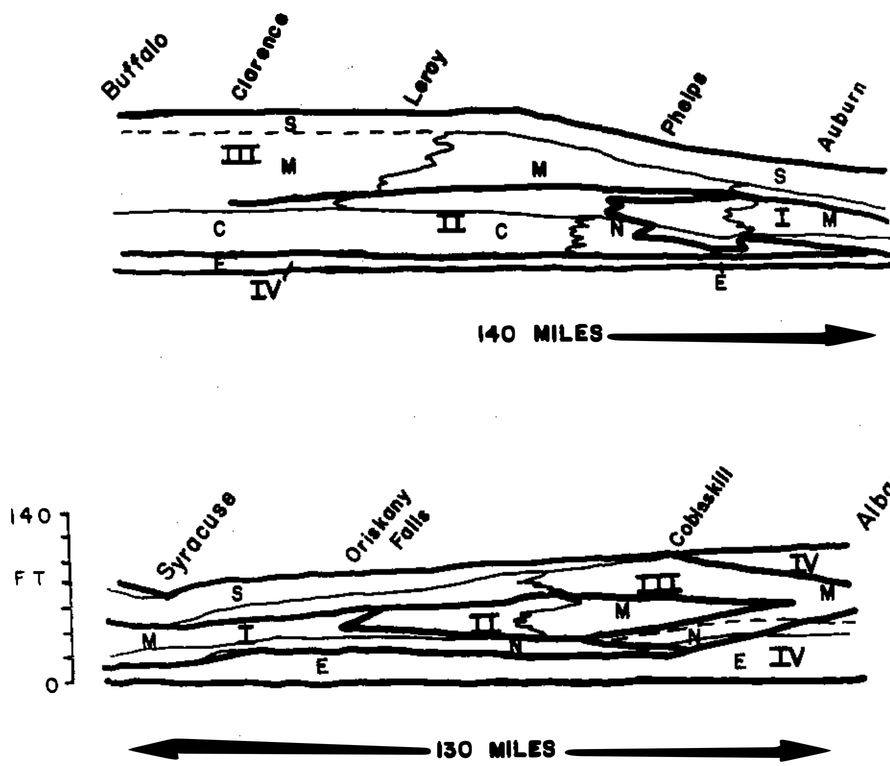

Figure 9. Cross section showing Oliver's (1954, 1956) stratigraphic units (E=Edgecliff, N=Nedrow, M=Moorehouse, and S=Seneca) and Lindholm's (1967) lithofacies (I=fossiliferous calcisiltite with about 25% clay and less than 10% fossils, II=fossiliferous calcisiltite with about 5% clay and less than 10% fossils, III=biocalcisiltite with 10 - 50% fossils, and IV=biosparite and biocalcisiltite with greater than 50% fossils). From Lindholm (1967, p.144).

A reversal of this falling sea-level trend is clearly indicated by the cessation of rubble zone deposition with a return to normal flank conditions, the formation of the Rugosan Recolonization Zone with its reversal of the original Inner Core succession, and the similarity of Recolonization Zone sedimentary fabrics to those of the Inner Core. This reversal in sea-level trend was probably short lived, with return to falling sea-level resulting in the final death of Roberts Hill Reef. Figure 8 summarizes the resultant model for the development of Roberts Hill and Albrights reefs under these fluctuating sea-level conditions.

BASINAL EVIDENCE

The stratigraphy of the Onondaga Formation lends further support to the assumed sea-level fluctuation. As mentioned earlier, the basal contact of the Onondaga in the east indicates at most a discontinuity in sediment deposition as compared to major erosion to the west. Further, the basal C1 unit in the eastern Edgecliff is similar to the assumed deeper water wackestones to the south and passes upwards into the shallow water packstone/grainstone facies of the C2 unit. From that point on the eastern Onondaga lithology undergoes little change, remaining a mainly shallow water facies, while to the west in the center of the basin at least four facies are present (Figure 9). This suggests that Edgecliff deposition began in the east, but water depth gradually decreased there as the basinal axis shifted westward with the major westward transgression. Following the stabilization of the basinal axis in its central New York position, a sea-level fluctuation took place. This fluctuation may be noted in Figure 9, taken from Lindholm's (1967) study of Onondaga microfacies. Note the classic transgressive/regressive shift of the deeper water facies first to the east and then back to the west. This pattern marks the sea-level fluctuation recorded so well in Roberts Hill Reef.

ROBERTS HILL AND ALBRIGHTS REEFS - A MODEL FOR EDGECLIFF REEF GROWTH?

Figure 8, the model for the sequential development of Albrights and Roberts Hill reefs may be used as a general model for Edgecliff reef growth, but only with caution. The initial Inner Core rugosan succession from Acinophyllum to Cyathocylindrium with the late development of crinoidal flanks may be used as a first approximation of an "average" Edgecliff reef; however, we may well ask whether there is in fact any such thing as an "average" Edgecliff reef. Development of Roberts Hill and Albrights reefs was strongly affected by sea-level change, possibly caused by a shift in the position of the basinal axis. Since these are the two most eastern of the Edgecliff reefs what might we expect to find in the reefs to the west?

Paquette (1982) has presented evidence for the presence of a storm disturbance horizon at the base of the Mt. Tom reef near Richfield Springs. Since the entire exposed core of Mt. Tom lies above this horizon and is made up almost exclusively of Acinophyllum, Paquette has suggested that reef growth may have begun in shallow water but continued under conditions of increasing water depth due to subsidence in the basin. The presence of Mt. Tom near the edge of the erosional unconformity that marks the base of the Onondaga and its closeness to the final topographic basinal axis may support this hypothesis.

Coughlin (1980, p.141) describes a repitition of coral dominance zones (Cylindrophyllum/Acinophyllum - Acinophyllum/Cladopora - Cylindrophyllum) in a drill-core from the subsurface Thomas Corners reef in Steuben County. This may be due to episodic sea-level changes during basinal subsidence.

Finally, Poore (1969) in his study of the Leroy bioherm describes an Inner Core dominated by Cystiphylloides and Cladopora - a situation apparently unknown in the eastern Edgecliff reefs.

These studies indicate that there is much diversity in the patterns of development displayed by the Edgecliff reefs, but there is also much in common among them. Since it appears probable that major changes were occurring in the Onondaga basin during reef growth Figure 8 may be used as a model only if differences in basinal conditions based upon geographic location are kept in mind. Whether or not an "average" Edgecliff reef truly exists, Figure 8 may then be a useful first approximation of a model for Edgecliff reef development.

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MILAGE LOG:

0.0	0.0	Toll booth at Exit 21b of N.Y. State Thruway, Coxsackie exit. Make right turn onto Rt. 9W north.
2.2	2.2	Left turn onto County Rt.51.
0.7	2.9	Bear left onto County Rt.54.
0.8	3.7	Right turn onto Roberts Hill Road.
0.15	3.85	STOP I. ALBRIGHTS REEF. Park cars along shoulder of road. Main part of reef lies to the right (east). Exposures along road are crinoidal sand/favositid flank deposits. Cliff face about 130 feet to east exposes rugosan constructed Inner Core. Turn cars around and proceed south on Roberts Hill Road.
1.5	5.35	Right turn onto Reservoir Road.
0.7	6.05	Left turn onto Limekiln Road.
0.3	6.35	STOP II. ROBERTS HILL REEF. Reef lies to the east of the road and makes up the entire northern portion of the hill. Old logging road marks approximate southern end of reef. Exposures to the west of the road and south of the logging road consist of post-reef growth flanks. CAUTION: SOLUTION EXPANDED JOINTS ARE COMMON ON THE TOP OF THE HILL AND ARE COMMONLY FILLED WITH LEAVES. PLEASE WATCH YOUR STEP. Continue south on Limekiln Road.
1.1	7.45	Left turn onto Schiller Park Road.
1.4	8.85	Left turn onto Rt.9W.
0.6	9.45	Right turn for Thruway entrance.