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Middle Silurian paleoecology; The Raber Fossil Beds, Chippewa County, Michigan

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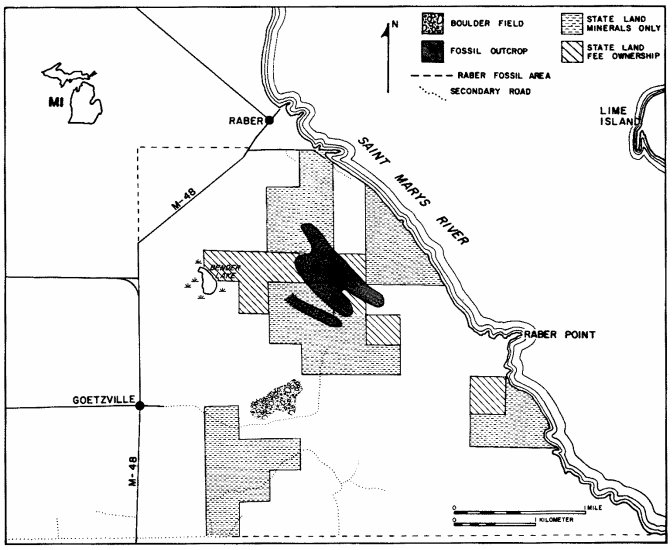

Figure 1. Location of the Raber Fossil Beds, Chippewa County, Michigan.

LOCATION AND SIGNIFICANCE

The Raber Fossil Beds are in Sec. 32, 33, 34, T.43N.,R.3E., and Sec. 3-5, 8-11, T.42N.,R.3E., Chippewa County, Michigan; Goetzville, Michigan, 7½-minute Quadrangle. T he Raber Fossil Beds are located roughly 1 mi (2 km) south and southeast of the village of Raber, on the St. Marys River (Fig. 1).

The area is accessible from two points. A trail from near the Bernard Farm leads in a southeasterly direction 0.5 mi (0.8 km) to the base of a low rock escarpment and follows this escarpment for an additional 0.5 mi (0.8 km) where the trail branches and continues to the top of the ridge. A second point of access is by means of a road extending directly east of Goetzville which is passable for approximately 0.5 (0.8 km) into the area. Other bush trails into the area are not readily passable by automobiles.

The majority of land in which the Raber Fossil Beds exist is owned by the State of Michigan. The Raber Fossil Beds represent a unique natural formation of imposing size. They are significant to geologists and students because of their natural historical value and to the general public for their unusual scenic appeal. Collecting of fossil specimens on state-owned land is discouraged. Presently, the Raber area is under review as a potential protected Natural Area. Within such a Natural Area the collecting of specimens will be forbidden by law.

Privately-owned land surrounding the state property offers many fine collecting areas. Permission must be gained from land owners prior to entry on their property.

Visitors to the Raber site should prepare themselves adequately for hiking through rough, often uneven wooded terrain. From early spring to late autumn, biting insects can be bothersome.

In addition to the fossil beds, boulder field and bog lake, the Raber area contains the ruins of a structure built of limestone, brick, and lime mortar similar to old fortified buildings on Drummond Island. No historical record of this structure has been uncovered, but its style and location commanding the St. Marys River channel and St. Joseph Island, and a masonry platform that could well support a cannon, strongly suggest the site was used by the British in connection with their early colonial Fort St. Joseph.

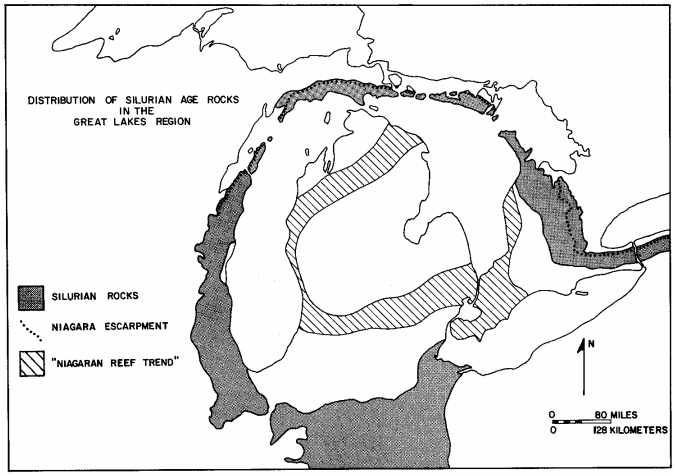

Figure 2. Map shows the distribution of Silurian age rocks in the Great Lakes region, location of the Niagara escarpment and the subsurface "Niagaran Reef Trend."

GEOLOGIC SETTING

The topography of the Raber Fossil Area is dominated by an escarpment that runs in a northwest-southeast direction. This escarpment is part of the outer scarp of the Niagara cuesta. The cuesta is a belt of Middle Silurian (Niagaran) limestone and dolomite, which stretches west from the State of New York and makes a great arc around Lakes Huron and Michigan (Fig. 2). In regions west of Lake Ontario, this band of upland slopes gently inward toward the southern peninsula of Michigan and presents a strong scarp on its outer edge. This escarpment is well known where it is crossed by the Niagara River at Lewiston, New York, and forms the northern front of the plateau in which the Niagara gorge has been cut some 250 ft (76 m).

The escarpment forms the peninsula and islands that lie between the Lake Huron Basin and Georgian Bay. This same upland belt continues west to the Garden

Peninsula of Michigan where it skirts the east side of Big Bay de Noc and forms the massive Niagara Escarpment at Fayette. From here, the cuesta stretches southward to form a series of islands, the Green Bay Peninsula, and the dominating ridge of eastern Wisconsin. The cuesta forms the high rocky cliffs overlooking Green Bay, as well as the local cliffs near Lake Winnebago.

In the area of the Raber Fossil Beds, Silurian rocks of the Burnt Bluff and Manistique groups of the Niagaran Series are exposed and form an abrupt north-facing limestone ridge over 90 ft (27 m) high. This ridge slopes gently downward to the south. Along the ridge top on the south slope are extensive exposures of well-preserved fossil colonial corals of unusual size, variety, and quantity. A short distance to the southwest of the main escarpment is a smaller ridge, apparently of glacial origin. This smaller ridge is covered with glacial erratics whose lithology is dominated by fossil remains.

To the west of the smaller ridge is Bender Lake (Fig. 1), a small bog lake of considerable interest because of the variety of vegetation around it. Directly east of Goetzville is a large field of gigantic limestone boulders of unusual scenic and geologic interest (Fig. 1).

During the depositional period of the Silurian rocks exposed at the Raber site, the platform margin of the Michigan Basin was situated in a subtropical environment at about 20° to 25° south of the equator (Ziegler and others, 1977). Accumulating sediments were predominately composed of biogenic carbonate.

Johnson and Campbell (1980) identify three distinct paleo-communities found within Silurian rocks in the Michigan Basin. Each community was adapted to a particular water depth, in which salinity, wave turbulence, and light intensity were controlling factors. The three communities identified were (1) fucoid-ostracode, living in quiet waters close to shore; (2) coral-algal, developing near shore, in shallow active water; and (3) a pentamerid community established in deep off-shore waters.

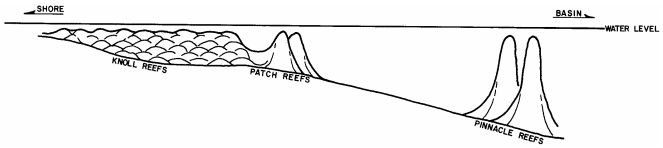

Figure 3. The distribution of Silurian reefs types in the Michigan Basin with relation to ancient shorelines (after Johnson and others, 1979).

While all three community types can be identified in outcrop at the Raber site, the dominant paleocommunity is the coral-algal, and this is best exhibited in the Cordell Dolomite. In the Cordell, reef-forming stromatoporoids, tabulate corals, stromatolites, and other invertebrates established and maintained for a considerable time organic buildups, which formed massive reef colonies.

Johnson and others (1979), find that three types of fossil reefs can be distinguished in the Silurian rocks of the Michigan Basin: pinnacle reefs, patch reefs, and knoll reefs.

Silurian pinnacle reefs in the Michigan Basin are noted for their large size, often covering hundreds of acres and rising vertically over 800 ft (245 m). These pinnacle reefs dominate the heavily drilled “Niagaran Reef Trend” (Fig. 2) and have proven to be the major hydrocarbon producers of the Michigan Basin over the past decade. While having formed in deep water and being of great areal size, the faunal assortment of these pinnacle reefs parallels that of smaller shallow water reefs. Johnson and others (1979) conclude this provides a firm basis for assuming that the pinnacle reefs reached their size as a mark of successful buildup of the colony from generation to generation. Each successive colony would build atop an older colony, keeping pace with basin subsidence and remaining in shallow sunlit and food-rich water (Fig. 3).

Patch reefs developed nearer to the shore than pinnacle reefs (Fig. 3). Because subsidence was less nearer to shore, the patch reefs did not attain the height of pinnacle reefs. A maximum height for a patch reef in the Michigan Basin would be roughly 100 ft (30 m). Patch reefs do not display the large areal size seen in pinnacle reefs. The taller pinnacle reefs were more susceptible to storm erosion and slumping, making them less stable. Lost debris from the pinnacle reef would fall to its base, forming large, ever-expanding rubble piles. The smaller areal size of the patch reef is attributed to the sturdiness and stability of its shorter height, making it less a victim of erosion during its lifetime than the taller pinnacle reef.

Closest to the shoreline of the Silurian Sea, and in very shallow water, were the knoll reefs (Fig. 3). The constant shallowness of the water, due to minimal subsidence, retarded the upward development of the knoll reef and forced growth to expand laterally. Coral colonies were numerous and closely spaced, with many of the colonies becoming intergrown or overgrown. The extensive exposures of fossils noted in the Cordell Dolomite at the Raber site are from knoll reef colonies.

DESCRIPTION

The lowest stratigraphic unit identifiable at the Raber escarpment is the Hendricks Dolomite of the Burnt Bluff Group. The Hendricks consists of even-bedded dolomites and limestones of a gray to buff color and are slightly argillaceous. The Hendricks Dolomite is very similar to the underlying Byron Formation in color and lithology but is easily distinguished by its abundant fossils. Ehlers (1973) states the most characteristic fossils of the Hendricks are *Clathrodicyon vesiculosum*, *Favosites*, *Camarotoechia winiskenses*, *Rhynchospira lowi*, *Stokesoceras romingeri*, *Leperdita fabulina*, and *Isochilina latimagrinata*.

The Schoolcraft Dolomite of the Manistique Group overlies the Hendricks Formation. The Schoolcraft is a massive, coarsely crystalline, buff to brownish gray

dolomite. Ranging throughout the brownish dolomite beds are thin, even beds of finely crystalline, blue-gray dolomite. Fossil remains are scarce in the thin, blue-gray beds, while replaced shells and molds of one or more species of the brachiopod *Pentamerus* appear in great abundance in the massive brownish dolomites. Ehlers (1973) finds the *Pentamerus* beds of the Schoolcraft to be a helpful marker horizon of exceptional continuity throughout the region. The top of the Schoolcraft Dolomite contains numerous layers of chert nodules, and these can be used to indicate a proximity to the contact with the overlaying Cordell Dolomite.

The Cordell Dolomite of the Manistique Group consists almost entirely of thin, uneven-bedded, brownish gray to buff colored, siliceous dolomites, interbedded with layers of chert nodules, isolated chert nodules, and silicified fossils. Ehlers (1973) finds the silicified corals of the Cordell to be extremely useful in the recognition of the interval. The most abundant of these silicified corals identified by Ehlers include several species of such genera as *Alveolites*, *Amplexus*, *Arachnophyllum* (Fig. 4), *Favosites*, (Fig. 5), *Halysites* (Fig. 6), *Heliolites*, *Lyellia*, *Omphysma*, *Prychophyllum*, *Streptelasma*, *Syringopora*, and Zaphrentis. In total, Ehlers (1973) identifies and lists the following numbers of invertebrate species from the Cordell Dolomite at the Raber site: hydrozoans, 2; bryozoans, 8; brachiopods, 11; trilobites, 5; cephalopods, 19; gastropods, 2; pelecypods, 1; and corals, 52.

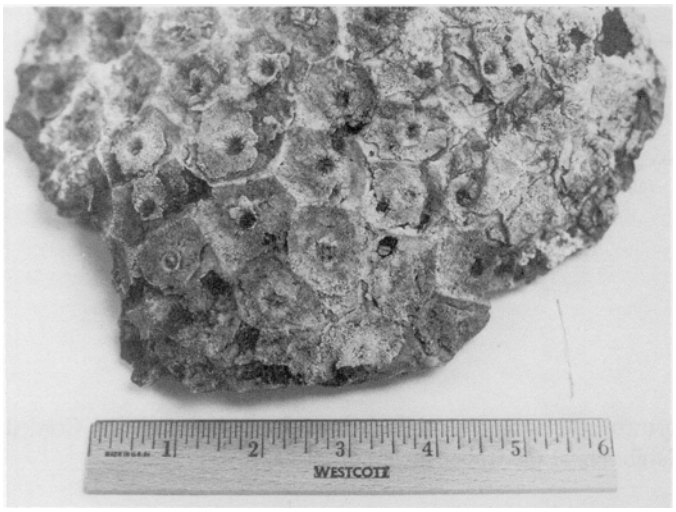

Figure 4. *Arachnophyllum striatum* (d'Orbigny), scale in inches (sample courtesy R. T. Segall, Michigan Geological Survey).

The fossil invertebrates of the Cordell developed in a warm, shallow near-shore marine environment some 410 m.y. ago during the Middle Silurian. Most of the calcareous material of which the fossils were originally composed has been replaced by silica due to ground water activity. The silica is extremely resistant to weathering and erosion, and the structure of the fossils, especially the corals, is well preserved. As a result of the silica replacement, the corals tend to stand up in bold relief, often 2 in or more (5+ cm) above the carbonate matrix to which they are attached. While the silica replacement makes for striking specimens, from an anatomical standpoint most are too well crystallized for effective microscopic study.

Figure 5. *Favosites favosus* (Goldfuss), scale in inches (sample courtesy R. T. Segall, Michigan Geological Survey).

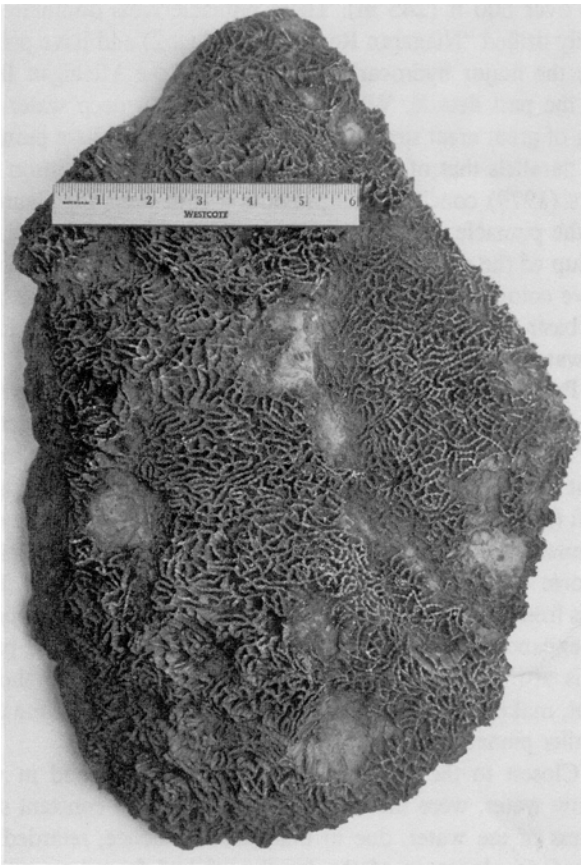

Figure 6. *Halysites labyrinthicus* (Goldfuss), scale in inches (sample courtesy D. M. Bricker, Michigan Geological Survey).

The best exposed outcrops of fossiliferous Cordell Dolomite at Raber are shown on Figure 1. Records of the Michigan Geological Survey indicate large exposures of colonial coral are best viewed in the vicinity of the north quarter-corner of Sec.4,T.-42N.,R3E. This site is marked on Figure 1 by an X.

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