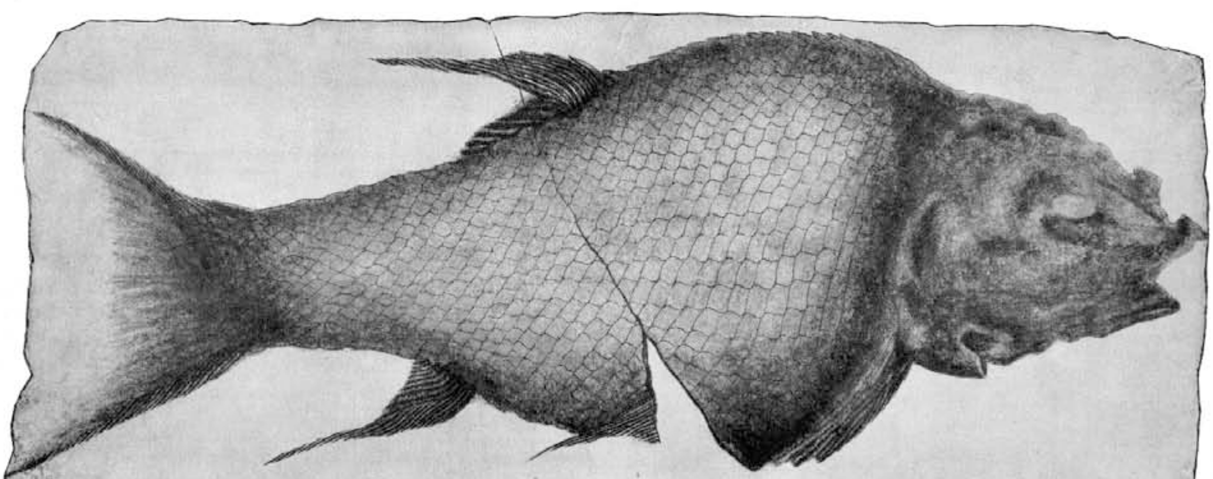
Contributions to the Paleontology of New Jersey (II)

Field Guide and Proceedings

Edited by
Emma C. Rainforth
Ramapo College of New Jersey



Geological Association of New Jersey

XXIV Annual Conference and Field Trip
October 12-13, 2007
East Stroudsburg University,
East Stroudsburg, Pennsylvania

STOP 1: MARCELLUS FORMATION AT OLD BROWN STREET QUARRY, STROUDSBURG, MONROE CO., PA

Paul S. Boyer
Department of Chemistry and Geology, Fairleigh Dickinson University, 285 Madison Ave., Madison, New Jersey 07940-1099

Collecting is permitted at this outcrop.

LOCATION

Stroudsburg 7.5-minute Quadrangle.
This former quarry is located about 400 m north from the Courthouse, just southwest of the intersection of Brown Street and Wallace Street (Figure 1).

Figure 1. Exposure of the Marcellus Formation at the old Brown Street Quarry

SITE DESCRIPTION

The Marcellus Formation (formerly called the Marcellus Slate, and later the Marcellus Shale) is a dark gray to black carbonaceous shale with well poorly developed cleavage. It spreads widely over New York and Pennsylvania, and is more uniform in its lithology than any other of the Devonian formations. It overlies conformably a sequence of calcareous units, from which it initiates a distinct transition to more terrigenous, and also carbonaceous sedimentation. This change marks the start of the Hamilton Group, widely known for its rich fossil content, particularly father to the west.

At this site, the Marcellus Formation is find-grain and arenaceous. Although the quarry reveals only at most 9 m, the formation reaches its greatest total thickness here in Monroe County (about 270 m. according to Willard, 1939, p. 169). Where covered by subsequent formations, as in the Appalachian Basin, the Marcellus Formation is a producer of natural gas, and a prospect for petroleum.

The portion of the Marcellus Formation exposed at this site has been named by Willard (1939, p. 171) the Brodhead Member.

PALEONTOLOGY

Most of the fossils to be found at this exposure are small. A hand-lens would help in spotting some of them. Although over the years a good variety of marine organisms has been found here, one generally finds only a few species during a short visit. The most abundant are the small brachiopods, particularly *Liorhynchus limitare* (Vanuxem), the most characteristic species of the Marcellus Shale (Prosser, 1905). Vanuxem noted that in New York State the species is restricted to the lower, shaley part of the Hamilton Group, and was most abundant near the upper boundary of the Marcellus Shales, "from whence its name" (Vanuxem, 1842, p. 147).

Also locally abundant at this quarry is a very small, discoidal bryozoan, only a few mm across, which somehow (as far as I know) has escaped further study, and does not appear to have been identified, other than being noted as "Bryozoan indet." (Willard, 1939, p. 171). Occasional pieces of the trilobite *Homalonotus* turn up: one must be alert for fragments, because no complete specimens have yet been found here. Figure 2 shows examples of species represented at this location.

ENVIRONMENT

It is assumed that the sea floor was stagnant (anoxic) during most of the deposition of the Marcellus Formation. A number of writers have cited this formation as a typical result of such environments, and state that they are characterized by small fossils of limited variety. There have even been comparisons with the conditions on the floor of the Black Sea, where seasonal or otherwise episodic times of overturn (perhaps brought on by storms) brings in enough oxygen to allow colonization by young shellfish larvae, only to have the hopeful colonists die off when the reigning euxinic conditions return.

As you look at the fossils here (or, at least, as you look *for* them!), perhaps you might consider another possibility: that most of the preserved animals here were not benthic (bottom-dwelling) at all. It is notable that there are very few creatures represented which could tolerate living in deoxygenated waters. Some bivalves might have tolerated such an environment, for some are very tolerant of low oxygen levels even today. There are, however, only rare pieces of one species of trilobite. Trilobites were predominantly deposit-feeders, crawling over and within muds, subsisting on the organic debris adsorbed on clay particles, much as earthworms do in a garden (Seilacher, 1959). Yet trilobites are very rare here. The commonest fossils here are members of the lophophorate phyla, which do not thrive in stagnant water. What are they doing here?

Observe that here the common fossils are small. I would suggest that most of what we see are *epiplanktic* organisms: those which lived attached to floating objects such as algae. They are for the most part small by necessity; for only small creatures can live by adhering to seaweed. Of course, maybe they were bottom-dwellers which simply washed in with storms, and were subsequently smothered. But look at that small bryozoan, and try to imagine such delicate colonies surviving so perfectly the mill of sedimentary transport. Much more likely would seem the possibility that those "Bryozoa indet." were attached to seaweed, and after death (perhaps when their algal substrate foundered) gently drifted to the bottom.

The possible causes for the environment which gave us the dark shales such as the Marcellus Formation has been thoroughly studied, as one might expect in view of it hydrocarbon content. Werne *et al*. (2002) envision tectonic and eustatic events which altered the sediment supply and changed circulation patterns to bring about the anoxic bottom waters of the Hamilton Group.

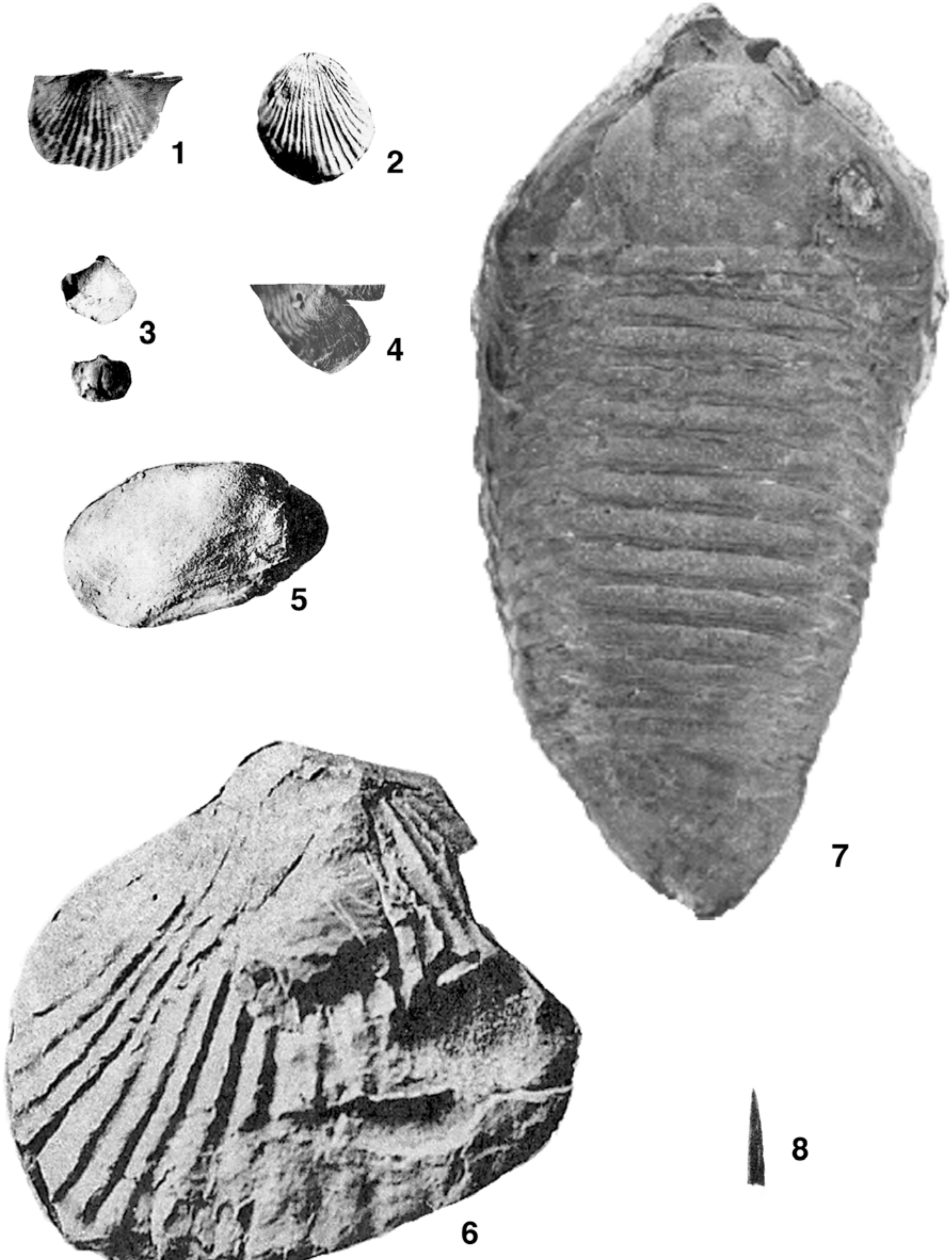

1
2
3
4
5
6
7
8

Figure 2 (facing page). Fauna of the Marcellus Formation at the Brown Street Quarry. All x2 except as otherwise noted. BRACHIOPODA: 1. *Chonetes mucronatus* Hall. 2. *Liorhynchus limitare* (Vanuxem). 3. *Ambocoelia nana* Grabau. BIVALVIA: 4. *Aviculopecten invalidus* Hall. 5. *Nyassa arguta* Hall. 6. *Paneka costata* Hall. TRILOBITA: 7. *Trimerus dekayi* (Green), x 0.5. At the Brown Street Quarry, only fragments of this trilobite species have been found. *INSERTAE SEDIS*. 8. *Styliolina fissurella* (Hall), x 4
These figures are from Willard, 1939, and represent specimens from the Brown Street Quarry, with the exception of 7, which is from Hamilton Group in Madison Co., New York, and is in the New York State Museum (NYSM E958).

REFERENCES

Prosser, C. S., 1905. The Delaware Limestone, *Journal of Geology*, vol. 13, no. 5, pp. 413-442.

Seilacher, A., 1959. Vom Leben der Trilobiten. *Naturwissenschaften*, vol. 46, no. 12, 389-393.

Vanuxem, L., 1842. Geology of New-York. Part III, comprising the survey of the Third Geological District. *Natural History of New York: Geology.* Albany. 306 pp.

Werne, J., B.B. Sageman, T.W. Lyons, and D.J. Hollander, 2002. An integrated assessment of a "type euxinic" deposit: evidence for multiple controls on black shale deposition in the Middle Devonian Oatka Creek Formation. *American Journal of Science*, vol. 302, pp. 110-143.

Willard, B., 1939. Middle and Upper Devonian, *in* The Devonian of Pennsylvania. Pennsylvania Geological Survey, 4th Series, *Bulletin G 19*, Harrisburg, PA. xii + 481 pp., 30 pl.

STOP 2: CENTERFIELD BIOSTROME, STROUD TOWNSHIP, MONROE CO., PA

Paul S. Boyer
Department of Chemistry and Geology, Fairleigh Dickinson University, 285 Madison Ave., Madison, New Jersey 07940-1099

Collecting is limited to specimens in float only.
Leave hammers in the buses.

LOCATION

East Stroudsburg 7.5-minute Quadrangle.
This site is located on the west side of North 5th Street (Rt. 191), about 900 m south of the crossing of that road over Brodhead Creek (Figure 3).
This roadside outcrop is on private land; permission to visit must be obtained from Pinebrook Bible Conference and Retreat Center.

Visitors are warned to stay by the side of the road, for traffic coming around the curve at the north end of the exposure has very poor visibility.

Figure 3. Exposure of the Mahantango Formation and the included Centerfield Biostrome

Figure 4. The coral-rich layer of the Centerfield Biostrome as exposed in the south side of the eastbound lane of Interstate 80, near mile-marker 135. (The coin for scale is a quarter, 24 mm in diameter.)

SITE DESCRIPTION

This locality is one of the most renowned fossil sites in Pennsylvania. It was described and pictured by Willard (1939, pp. 177-178). Hoskins (1964, p. 87) used it to represent Monroe County in his guide.

Willard called the coral-rich exposure the "Centerfield coral zone" because he correlated it with the Centerfield Limestone of New York State. It has been called informally the Centerfield Reef, and the Centerfield Coral Reef, but Hoskins noted that it is not a true reef, because it is not a mound. It also does not appear to have been elevated above the surrounding sea floor, nor does it show evidence of resistance to waves, as required by the modern definition of a reef (Bates and Jackson, eds., 1987, page 555.) The deposit does conform to the definition of a **biostrome**, "a distinctively bedded and widely extensive or broadly lenticular, or blanketlike mass of rock built by and composed mainly of the remains of sedentary organisms, and not swelling into a moundlike or lenslike form; an 'organic layer', such as a bed of shells, crinoids, or corals, or a modern reef in the course of formation, or even a coal seam." That definition is not without some difficulties: for example, lenticular means lenslike; and it is hard to understand why a modern reef in the course of formation can be called a biostrome, but not the finished product. Nonetheless, "biostrome" is probably preferable to "reef" in this case.

Unlike its correlatives in western New York, the rock here is not by any means a limestone. It is mostly terrigenous ("clastic"): a dark shale "replete with corals and other organisms, many of them reef-builders" (Willard, 1939, 178). The bedding is indistinct, but is made obvious by the crude layering of the skeletal debris. Where the exposure is near the land surface, downward percolation of acid waters has dissolved the carbonate (mostly calcite) from the fossils, so that molds are all that is left. In fresh road-cuts or other construction sites, it is possible to find shelly material intact.

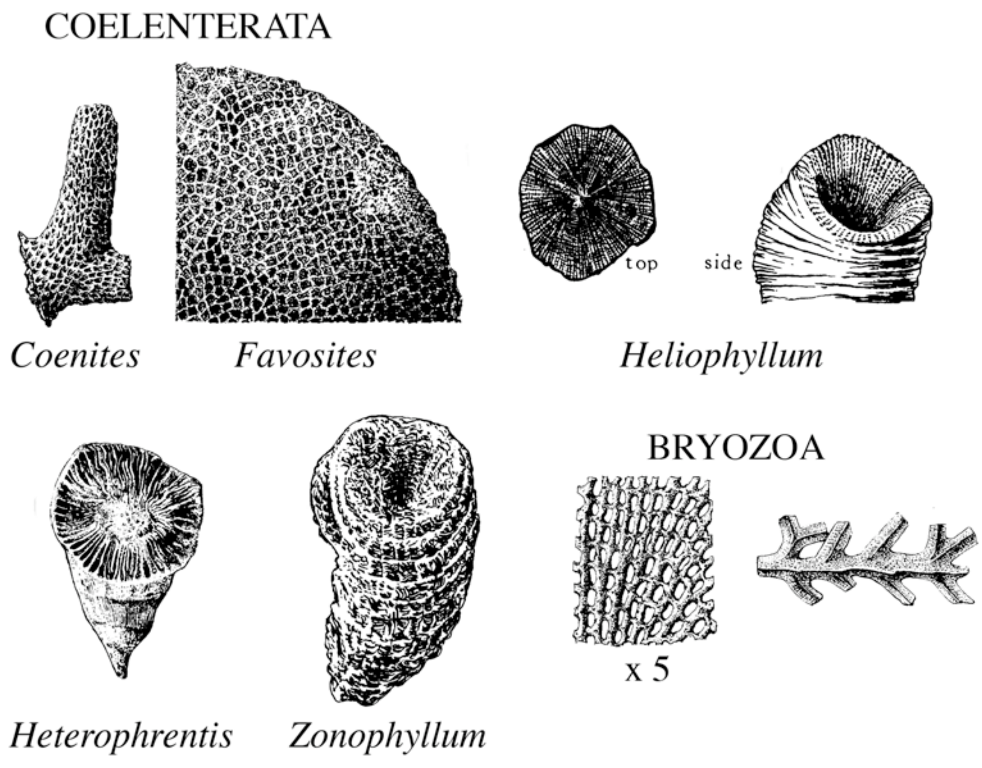


Figure 5. Coelenterata and Bryozoa of the Centerfield Biostrome. All x 1 except as noted. Drawings after Hoskins (1964).

PALEONTOLOGY

Willard (1939) gives a partial faunal list for this locality, but it is incomplete, and many of the names are not updated. Hoskins (1964) also gives a list, but only to genera. It is, nonetheless, a useful aid to identification. (His guide is out-of-print, and I recently have seen copies offered for sale on the Internet for from $79 to $450.) Reproduced here (Figures 5-7) are Hoskins' illustrations for the Centerfield fauna.

Ellison (1965) covers the Mahantango Formation in south-central Pennsylvania, far from our site. Nonetheless, his book (also unfortunately out-of-print) has numerous illustrations of fossils, some of which occur in Monroe County.

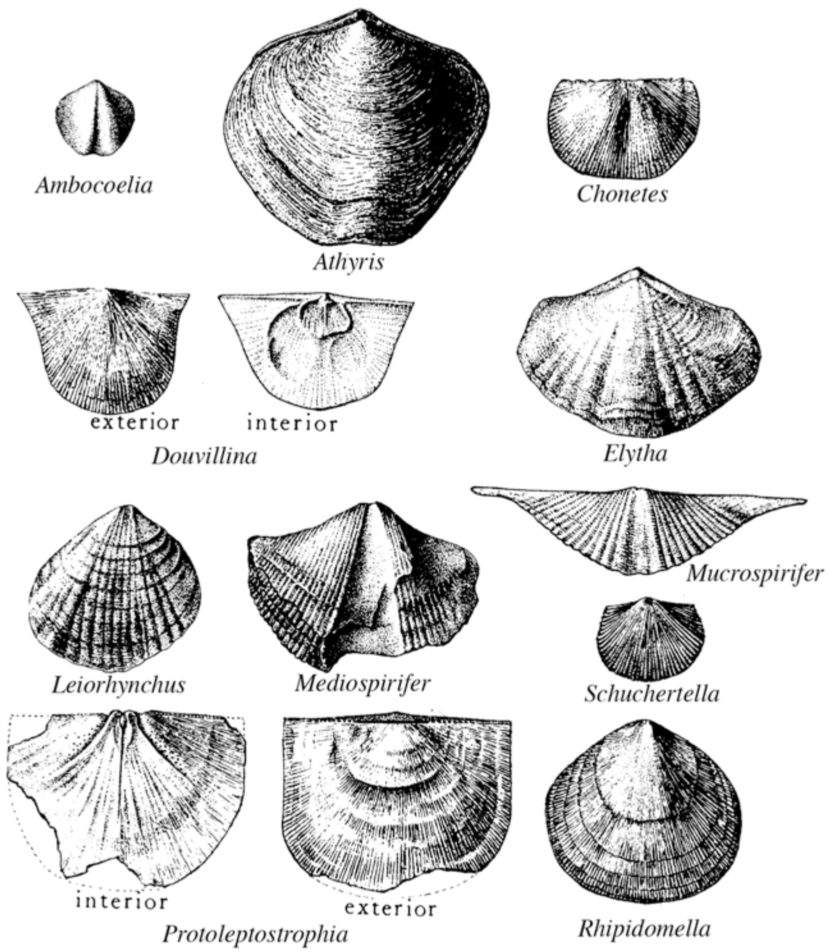


Figure 6. Brachiopoda of the Centerfield Biostrome. All x 1. Drawings after Hoskins (1964).

ENVIRONMENT

"The Centerfield Biostrome" represents a period of extreme abundance of coral growth. Apparently, though mud was being deposited here, the 'horn' corals could grow fast enough to keep from being totally buried in the mud. They grew with the small end downward. The water must have been relatively clear, however, for the brachiopods and other animals to live." Thus Hoskins (1964) summarizes what we might see as the main question about this deposit. How did so many sessile-benthic

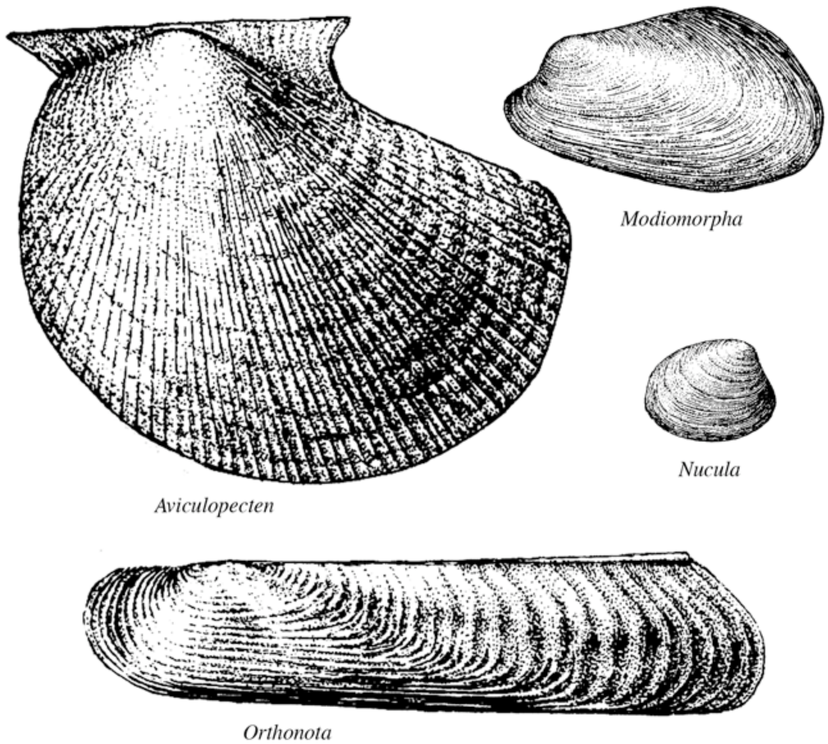


Figure 7. Bivalvia of the Centerfield Biostrome. All x 1. Drawings after Hoskins (1964).

Figure 8. The two phacopid trilobite species found in the Centerfield Biostrome: *Phacops rana* (left) and *Greenops boothi* (right). These particular specimens are not from Monroe County, but are shown here as aids for identification. (Pictures courtesy of Valdosta State University Virtual Fossil Museum)

organisms survive on a terrigenous, muddy sea floor, under conditions which were preserving so much carbonaceous material? There is little sign of winnowing which would give evidences of current activity.

It also appears that the skeletal debris show little or no evidence that they were actually growing and flourishing in the sedimentary environment in which we find them today. There is no sign of any hard grounds which would favor coral growth. There are no trilobite trails. The crinoid columnals are common, but never articulated. There is little order to the array of mixed debris. The corals themselves are virtually never found in growth position, and the branching forms are broken, and lying on their sides (as shown most clearly in the cuts on Interstate 80, which unfortunately we cannot visit).

It would seem that this deposit does not represent a flourishing area for benthic life, but is more like a graveyard of transported debris. If so, it is an extensive cemetery, for the Centerfield bed can be traced across several counties east of the Susquehanna River (Willard, 1939, p. 178). Correlative fauna continue westward in even richer abundance, as the carbonate content of the rock increases.

If the shelly debris was transported, where did it originate? How did it end up in sediments which imply an inhospitable environment for most of the represented organisms? Were storms or tsunamis involved, or some slumping mechanism?

REFERENCES

Bates, R. L., and J. A. Jackson, eds., 1987. *Glossary of Geology*. America Geological Institute, Alexandria, Virginia. [xi] + 788 pp.

Ellison, R. L., 1965. Stratigraphy and paleontology of the Mahantango Formation in south central Pennsylvania. 298 p., 19 pls.

Hoskins, D. M., 1964. Fossil collecting in Pennsylvania. Pennsylvania Bureau of Topographic and Geologic Survey, *General Geology Report G 40* (Rev. 1969). Harrisburg. 126 pp., 10 pl.

Willard, B., 1939. Middle and Upper Devonian, *in* The Devonian of Pennsylvania. Pennsylvania Geological Survey, 4th Series, *Bulletin G 19*, Harrisburg, PA. xii + 481 pp., 30 pl.