C1 AND B4: THE PENN DIXIE SITE: A CLASSIC AND UNIQUE PALEONTOLOGICAL & OUTDOOR EDUCATION CENTER

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INTRODUCTION

The Hamburg Natural History Society, Inc. (HNHS) is a nonprofit educational corporation that owns and operates Penn Dixie Fossil Park & Nature Reserve in Hamburg, New York (Fig. 1). The HNHS was founded in 1993 to promote the study of the natural sciences, with a particular emphasis on field activities associated with the geological and biological sciences. The HNHS offers a wide variety of hands-on educational programming to students of all ages, both at the Penn Dixie Site and off-site at local schools, libraries, and civic group meetings. Since its inception, the HNHS has expanded its educational curriculum to include public educational programming in astronomy and ornithology to complement its core study in geology and fossil collecting and identification. Unlike conventional museums or research facilities, the Penn Dixie Site is a hands-on outdoor educational facility-one at which visitors of all ages are encouraged to actually collect and keep 380-million-year-old fossils-"*Where Science Comes Alive*".

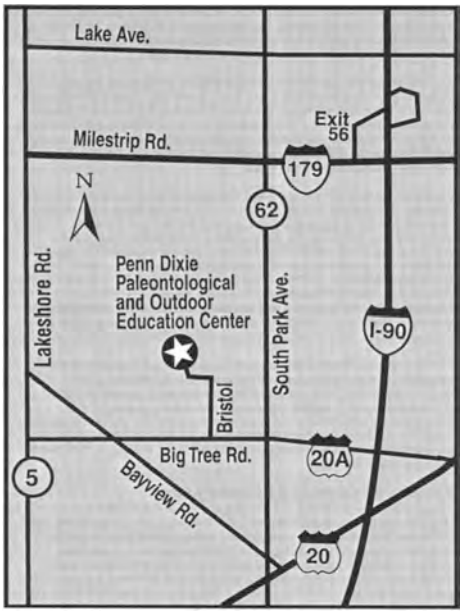


Figure 1. Location of Penn Dixie in Hamburg, New York.

The site of a former quarry operation that was the source of calcareous shale excavated and used for cement aggregate by the Penn Dixie Cement Company. A majority of the 57-acre site was quarried until the late 1960s, during which time 9 to 10 feet of shale was removed from the surface. A gray, somewhat flat "desert-like" or "lunar landscape-appearing" surface now occupies a majority of the site. After quarry operations ceased, weathering forces began to expose 380 million-year-old Devonian fossils preserved within the Windom Shale. This highly fossiliferous unit underlies the entire site and provides an inexhaustible supply of fossils. In addition to the Windom Shale, several limestone units (the Genundewa, North Evans, and Tichenor) outcrop on the

surface. The Wanakah Shale is also exposed, underlying the Tichenor Limestone, in a tributary that flows into Rush Creek and in cliffs along Rush Creek on the northern section of the site. All of these units contain a variety of fossils.

Preservation Of Penn Dixie

The HNHS administers and maintains the Penn Dixie, a 32.5-acre former shale quarry that was purchased by the Town of Hamburg in 1995 and deeded to the HNHS in 1996. The HNHS then took immediate steps to clean up the site and establish plans for its transformation into a truly world-class outdoor educational resource center. In 2004, the HNHS purchased 16.75 acres of adjacent land from the Town of Hamburg, increasing the site to 49.25 acres. The HNHS' efforts to preserve the former quarry and its associated wetlands saved one of the richest sites of 380-million-year-old Devonian Era fossils in the eastern United States.

In 1989 and 1990, the site was under the threat of light industrial development, but citizens from the community had other ideas for preserving it for future generations. A group of local residents and geologists collaborated on acquiring and preserving this area for future outdoor educational use. This group worked with members of the Hamburg Town Board to purchase the property. In December 1995 the Town of Hamburg completed the purchase of the property and in January 1996 deeded 32.5 acres to the HNHS.

Fossil collecting and the study of the local geology were the initial intent for the preservation of this former quarry. After acquisition of the property in early 1996, the HNHS reexamined the other resources available for outdoor education programs in the other natural sciences. With over 143 nesting and migratory birds at the site; the deer, turkey, coyote and other animals; the spacious area for viewing the Penn Dixie Skies with telescopes; and the potential for expanding the wetlands, this is a unique location to provide a diversity of programs in the natural sciences. The HNHS also has installed over 2,100 feet of barrier-free paved trails with grants from the East Hill Foundation and the New York State Senate. Eventually, the plan is to install paved and boardwalk trails throughout the entire site. With all these wonderful features and opportunities, the goal continues to be to make Penn Dixie into an outdoor education center and not a museum.

The HNHS hired a full-time Executive Director in 2003 and a full-time educator in September 2004 to manage and develop programs in the natural sciences. As a private non-profit organization, a volunteer board of directors, elected by its membership, governs the HNHS. IINHS staff, volunteer educators and field trip leaders are actively involved in bringing educational programming to the Western New York community.

Geology, Stratigraphy, And Paleontology

Penn Dixie contains an extensive exposure of 380-million-year-old fossiliferous Middle Devonian shales and limestones, serving as an excellent outdoor classroom for introducing students to the local geology and paleontology. The Genudewa Limestone, North Evans Limestone, Windom Shale, Tichenor Limestone, and Wanakah Shale at this site are readily accessible and have the most extensive exposure available for study in Western and central New York. Figure 2 (Brett and Baird, 1982) illustrates the stratigraphic units present at the Penn Dixie Site. Prime exposures of these units are present (except for the West River Shale, which is mostly covered by overburden at the south end of the site). Brett (1974) and Baird and Brett (1982), along with Beuhler and Tesmer (L 963), provide a detailed discussion of the stratigraphy and paleontology of these units. The warm tropical seas that covered this region of Western New York 380 million-years ago, when the region was 20 to 30 degrees south of the equator, provided an environment conducive to a variety of

invertebrate and vertebrate animals. The shales and limestones that formed during this time period preserved the remains of the diverse and abundant fauna that occupied these seas. The following brief discussion of the units present on the site begins with the lower Wanakah Shale at the north end through the West River Shale to the south.

Wanakah Shale

The Wanakah Shale is a medium-gray to light-blue gray calcareous shale that weathers to a sticky clay. The Wanakah is exposed in the northeast section of the site in a tributary to Rush Creek and in the high banks on the south side of Rush Creek. The tributary is a popular area for fossil collecting, viewing the large calcareous concretions, and some pyritized burrows, rather than the steeper cliffs along Rush Creek. Brachiopods, bryozoans, trilobites, gastropods, pelecypods, echinoderms, corals, sponges, ostracodes, and some pyritized fossils may be found. Limited area in the tributary does not provide access for large groups.

Tichenor Limestone

The Tichenor Limestone overlies the Wanakah Shale and outcrops at the northern end of the site. Pyrite coating the surface of the Tichenor has weathered, exhibiting a reddish-rusty color that stands out from the surrounding overlying gray Windom Shale. At the northeast section of the site, an unexplained domal feature of the Tichenor, with several feet of relief, is present. This feature is not believed to be a result of the quarrying operation, but possibly from glacial rebound. A large exposure of the eroded limestone surface is adjacent to this feature and extends north to one of the on-site ponds. This area is often referred to as "crinoid heaven" due to the countless number of pelmatozoan columnals that are found lying on the surface. The Tichenor Limestone contains corals, brachiopods, pelecypods, trilobites, bryozoans, and echinoderms, all of which are difficult to remove from the hard limestone. The Tichenor Limestone is approximately 1.5 to 2 feet thick and underlies most of the site, dipping to the south-southwest along with the other units on site.

Windom Shale

The Windom Shale is a medium to dark gray, variably calcareous mudstone with several thin argillaceous limestones, concretionary beds, and pyretic horizons (Beuhler and Tesmer, 1963). In addition, at the southwest portion of the site there is an excellent exposure of phosphate nodules covering the surface. The Windom also weathers to a sticky clay. The Penn Dixie site has the most complete and best exposure of Windom Shale in New York State, approximately 42 feet thick. Brett and Baird (1982) described 14 subdivisions within the Windom that could be recognized at this location (Fig. 2). Fossil assemblage zones were described in Brett (1974) and Brett and Baird (1982). A disconformable basal contact with the Tichenor Limestone is exposed in the domal outcrop in the northeast section of the site. The upper Windom beds have been scoured, and shale clasts can be observed in the overlying North Evans Limestone. The Windom contains a variety of corals, brachiopods, pelmatozoan columnals, bryozoans, trilobites, gastropods, pelecypods, cephalopods, and more rarely fish remains, plant material, and blastoid and crinoid calices. The upper Windom has a variety of pyritized fossils, burrows, and most likely fecal remains weathering out on the surface. Some of the pyritized fossils include brachiopods, pelecypods, cephalopods, trilobites, and blastoids (Fig. 3). The weathering shale exposes thousands of specimens lying on the surface, waiting to be found after 380 million years.

Enrolled trilobites can be commonly found washed out of the shale after a good rainstorm, along with horn corals, brachiopods, and pelmatozoan columnals. Multiple complete trilobites on a slab have been collected from the Lower Windom and complete specimens of *Phacops rana*, like the specimen in Figure 4, keep collectors returning for their perfect specimen. Sections of the Windom

are not as fossiliferous as others (Figure 5), but careful study of the stratigraphic subdivisions identified by Brett and Baird (1982) will yield some interesting discoveries. In addition, Penn Dixie staff and volunteer guides will direct visitors to the better collecting areas on the site.

North Evans Limestone

The North Evans Limestone is a buff-colored, weathered dark-gray crinoidal limestone that is 1.5 to 4 inches thick and contains angular clasts derived form the underlying Windom Shale. Erosional lag concentrations of hiatus concretions, pelmatozoan fragments, conodonts, fish plates, teeth, and mandibles, along with some brachiopod valves, are present (Brett and Baird, 1982). Carbonized plant remains are also found in this unit. Although a variety of fish remains have been found at the Penn Dixie Site (Fig. 4), they are difficult to find even with the good exposure of North Evans present. The buff-colored weathered surface of the North Evans and bone material make this unit easily recognizable.

Genundewa Limestone

The Genundewa Limestone is a nodular, medium dark-gray, poorly bedded limestone that weathers to a light gray, which has been referred to as the "Styliolina Limestone" directly overlying the North Evans Limestone (Buehler and Tesmer, 1963). Carbonized wood can be frequently found, but other examples of the fauna are more difficult to obtain.

West River Shale

The West River Shale is dark gray to black in color and overlies the Genundewa Limestone. Most of this unit is covered by overburden at Penn Dixie and Eighteen Mile Creek provides a better opportunity to view this unit. Conodonts, cephalopods, pelecypods, and fish remains have been reported from the West River Shale at other localities in Western New York (Buehler and Tesmer, 1963).

The preservation, diversity, abundance of fossils, and the extensive bedrock exposures at the Penn Dixie Site makes this an excellent outdoor classroom for students as well as amateur and professional paleontologists to be introduced to Western New York geology and paleontology. In addition, students and possible future scientists from pre-school through college are being introduced to the rich geologic history of Western New York by the thousands each year. Plates 1 through 4 illustrate some of the more common fossils that can be found at the Penn Dixie Site. Weathering of the Windom Shale results in many corals, brachiopods, pelmatozoan columnals, and trilobites being continually exposed on the surface. Those who extend the effort to dig into shale are rewarded with an extensive introduction to the variety of fossils preserved within the Windom. The northern section of the site provides an excellent outdoor classroom for students and visitors to be introduced to fossils and the local geology. Many specimens found at Penn Dixie can be viewed on the web site at www.penndixie.org.

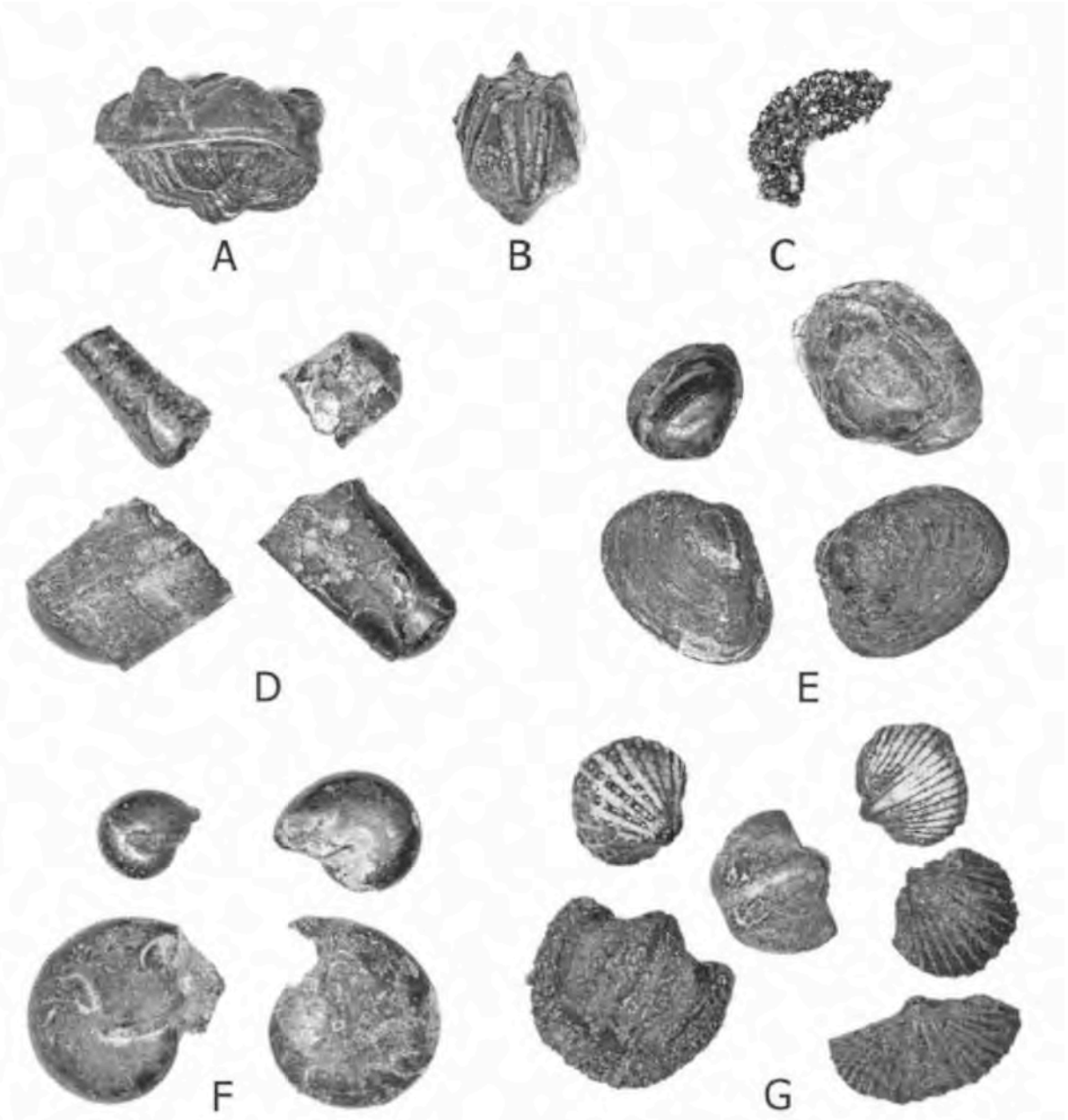
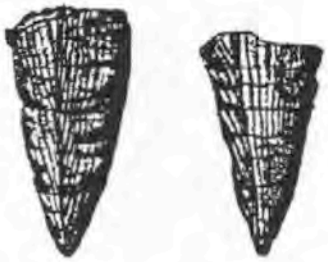


Figure 3. Pyritized fossils that weathered out of the Penn Dixie pyrite beds at the southern end of the site from the Upper Windom Shale. A-*Greenops* sp., enrolled, 0.7 cm wide; B- Blastoid calyx, 0.5 cm wide; C-pyrite, 1 cm long – burrows, nodules, or other shapes may weather out; D-Cephalopods, *Michlinoceras* sp. , largest 1 cm across; E-Pelecypods, largest 1 cm; F-Cephalopods, *Tornoceras* sp. , smallest is 0.4 cm across; G-Brachiopods, largest is 1 cm across; Blastoid was collected by Amanda Czechowski, pyrite specimens collected by Richard Spencer, and all other specimens collected by the author.

Plate 1
Fossils of the Penn Dixie Site

CORALS



Sterolasma rectum

Cystophyllum americanum

Amplexiphylum hamiltoniae

Trachypora sp.

Favosites hamiltomiae

Pleurodictyum americanum

BRYOZOANS

Fenestella sp.

Hederella sp.

Reptaria stolonifera

Drawings from "Geology and Paleontology of Eighteen Mile Creek" by Amadeus Grabau
Plates compiled by Scott Clark

Plate 2
Fossils of the Penn Dixie Site

BRACHIOPODS

Orbiculiodea sp.

Rhipidomella sp.

Stropheodonta demissa

Mucrospirifer mucronatus

Spinocyrtia granulosa

Mediospirider auduculus

Athyris spiriferoides

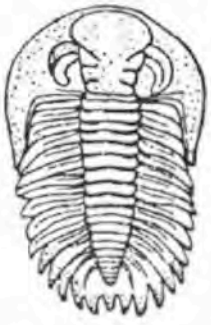
Spinatrypa spinosa

Pseudoatrypa devonica

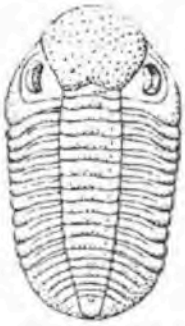
Drawings from "Geology and Palaeontology of Eighteen Mile Creek" by Amadeus Grabau
Plates compiled by Scott Clark

Plate 3
Fossils of the Penn Dixie Site

TRILOBITES

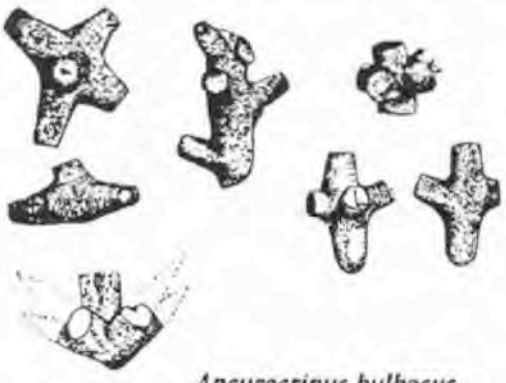


Greenops boothi



Phacops rana

CRINOIDS



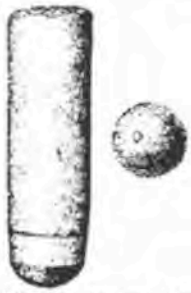
Ancyrocrinus bulbosus

Various Crinoid segments

Drawings from "Geology and Palaeontology of Eighteen Mile Creek" by Amadeus Grabau
Plates compiled by Scott Clark

Plate 4
Fossils of the Penn Dixie Site

CEPHALOPODS



Michlenoceras sp.

Tornoceras uniangulare

Spyroceras sp.

GASTROPODS

Naticonema lineata

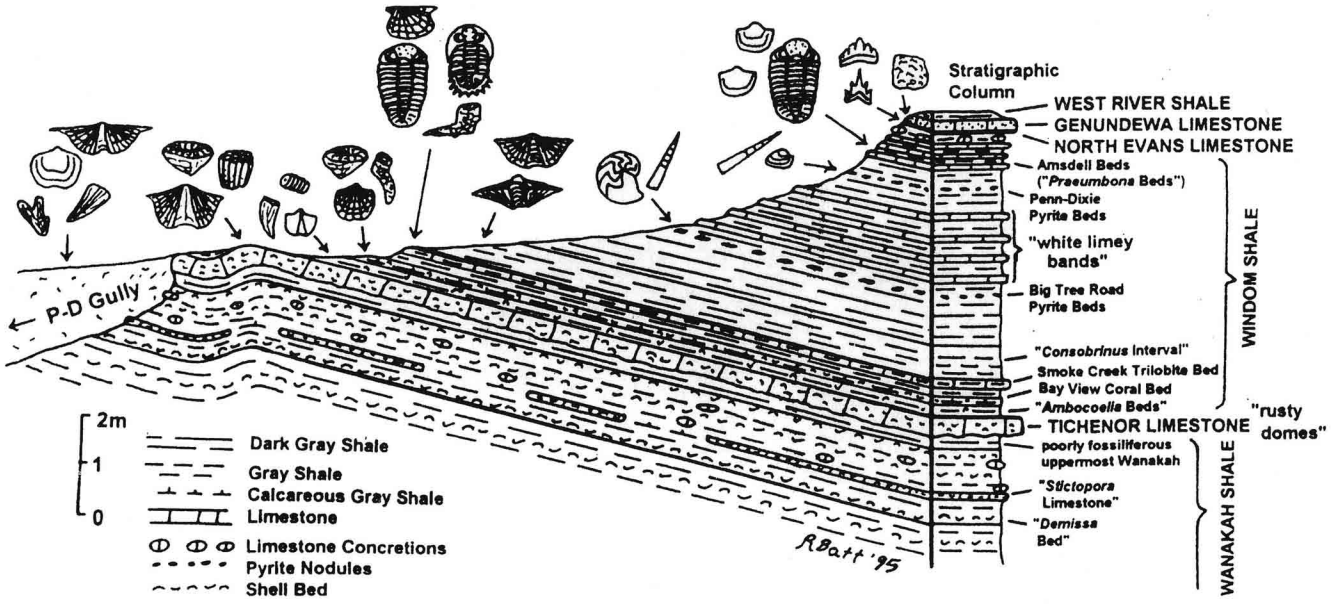
PELECYPODS

Pterinopecten sp.

Palaeoneilo sp.

Plethomytilus sp.

Drawings from "Geology and Palaeontology of Eighteen Mile Creek" by Amadeus Grabau
Plates compiled by Scott Clark



Cross section of Penn Dixie geology by Rick Batt. Regional dip is two degrees south (to the right).

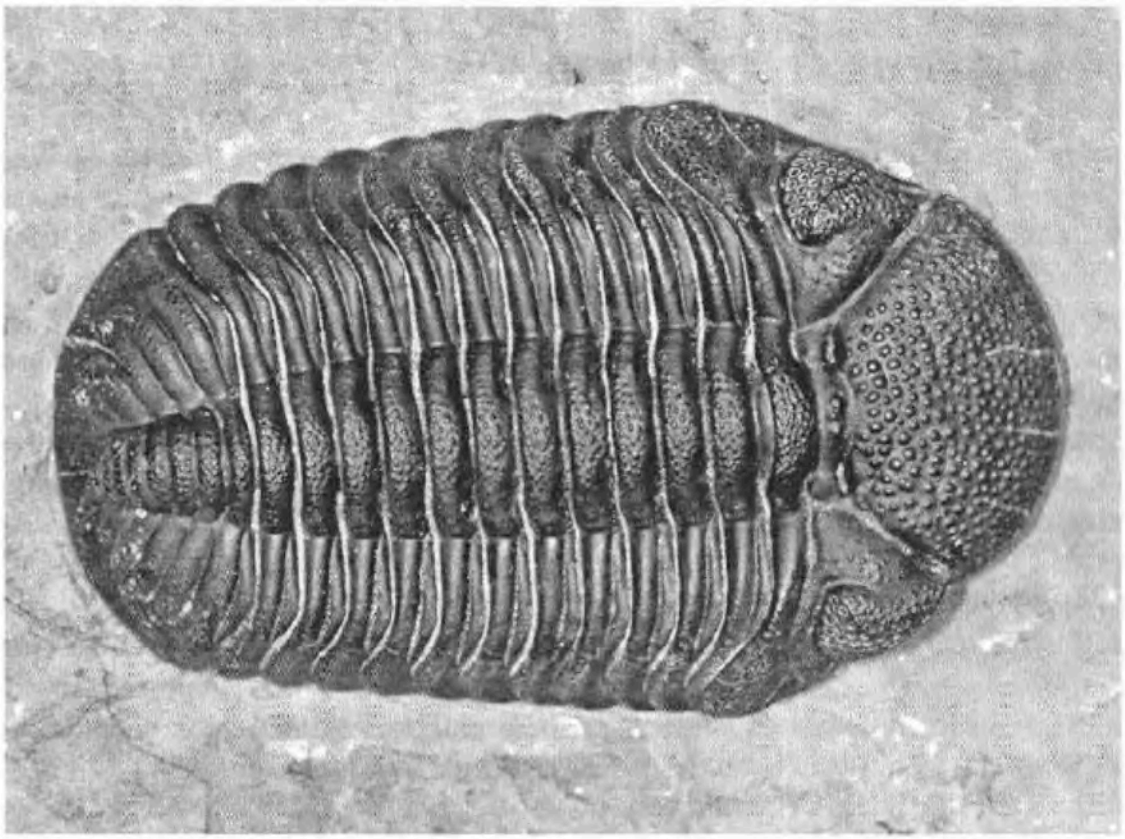


Figure 4. *Phacops rana* collected by Jon Luellen and prepared by Gerry Kloc. Collected during the Dig with the Experts in May 2005 from the Lower Windom Shale at Penn Dixie. Trilobite is 2 inches long.