THE PENN DIXIE PALEONTOLOGICAL AND OUTDOOR EDUCATION CENTER: AN INTERNATIONALLY RENOWN MULTIDISCIPLINE EDUCATIONAL, CULTURAL, RECREATIONAL AND TOURIST ATTRACTION

Jerold C. Bastedo
Executive Director
Penn Dixie Paleontological and Outdoor Education Center
P.O. Box 772
Hamburg, New York 14075
jbpendix@gmail.com
www.penndixie.org

The Hamburg Natural History Society, Inc. (HNHS) is a nonprofit educational corporation that owns and operates The Penn Dixie Paleontological and Outdoor Education Center 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".***

Penn Dixie is he 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 are exposed
on the surface. The Wanakah Shale also outcrops, 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.

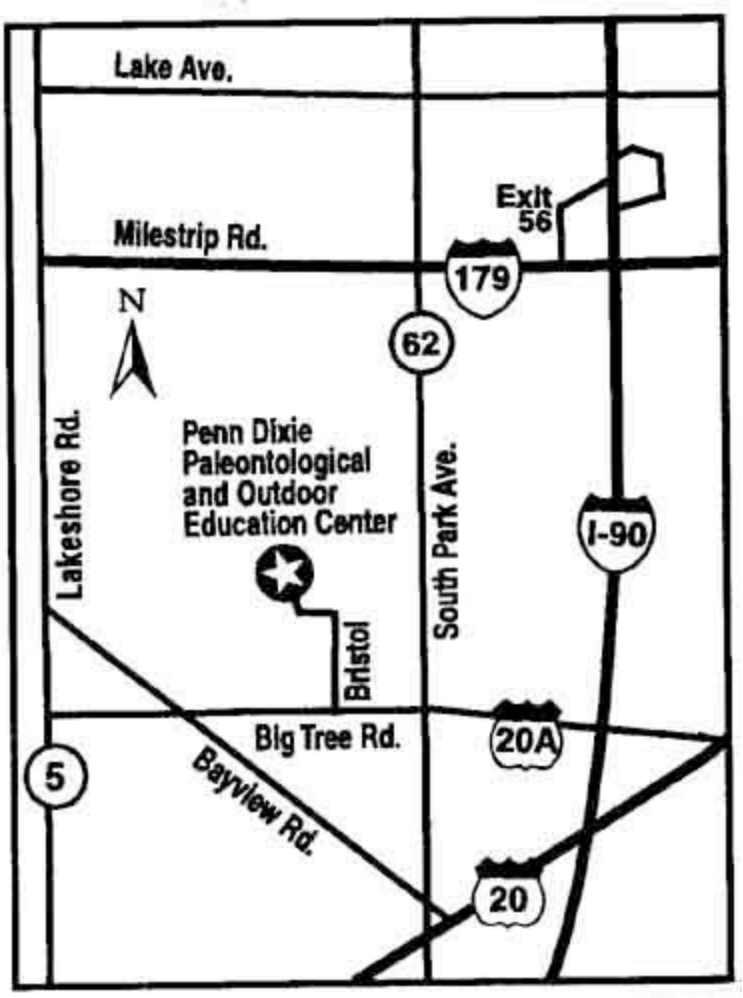

Figure 1. Penn Dixie location in Hamburg, NY.

PRESERVATION OF THE PENN DIXIE SITE

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. The preservation and development of the Penn Dixie Paleontological and Outdoor Education Center had begun.

The HNHS administers and maintains the Penn Dixie Site, the former shale quarry that was purchased by the Town of Hamburg in 1995. The first 32.5-acre tract of land was 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. In 2008, the HNHS completed the purchase of an additional 5 acres of property that will provide a new entrance to Penn Dixie off Jeffrey Boulevard on the western perimeter of the site. This five acres will serve as the location for the proposed and much needed outdoor education center building. The two additional tracts of land were acquired with support from local foundations and the HNHS/Penn Dixie membership. The HNHS/Penn Dixie has installed 5 shelters and over 4,100 feet of paved trails for handicap accessibility at the site. In 2008, Penn Dixie was the recipient of a 2.24-acre wetland mitigation project, which has enhanced the former ponds on the site, increased the wildlife habitat, and provided an added educational feature. 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.

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. Penn Dixie began evening and daytime astronomy programs, with volunteer astronomers, and have grown these programs into an important segment of the educational programming. 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, the New York State Senate, and Erie County. 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 the Penn Dixie Site 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. HNHS staff, volunteer educators and field trip leaders are actively involved in bringing educational programming to the Western New York community. For example, in 2012 alone, the HNHS sponsored or participated in more than 408 programs that were attended by more than 103, 901 children and adults. In 2013, to date, visitors from 38 different states, Washington, D.C., and 9 countries visited the Penn Dixie Site. Penn Dixie has over 1,100 memberships in over 30 states, Canada, England and Germany.

GEOLOGY, STRATIGRAPHY, AND PALEONTOLOGY

The Penn Dixie Site 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 illustrates the stratigraphic units present at the Penn Dixie Site and prepared by Dr. Rick Batt and is provided to visitors to the 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 (1963), 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 pyrite 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. 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. 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 (Fig. 3 & 4) have been collected from the Lower Windom and complete specimens of *Phacops rana* keep collectors returning for their perfect specimen. Sections of the Windom are not as fossiliferous as others, 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, 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

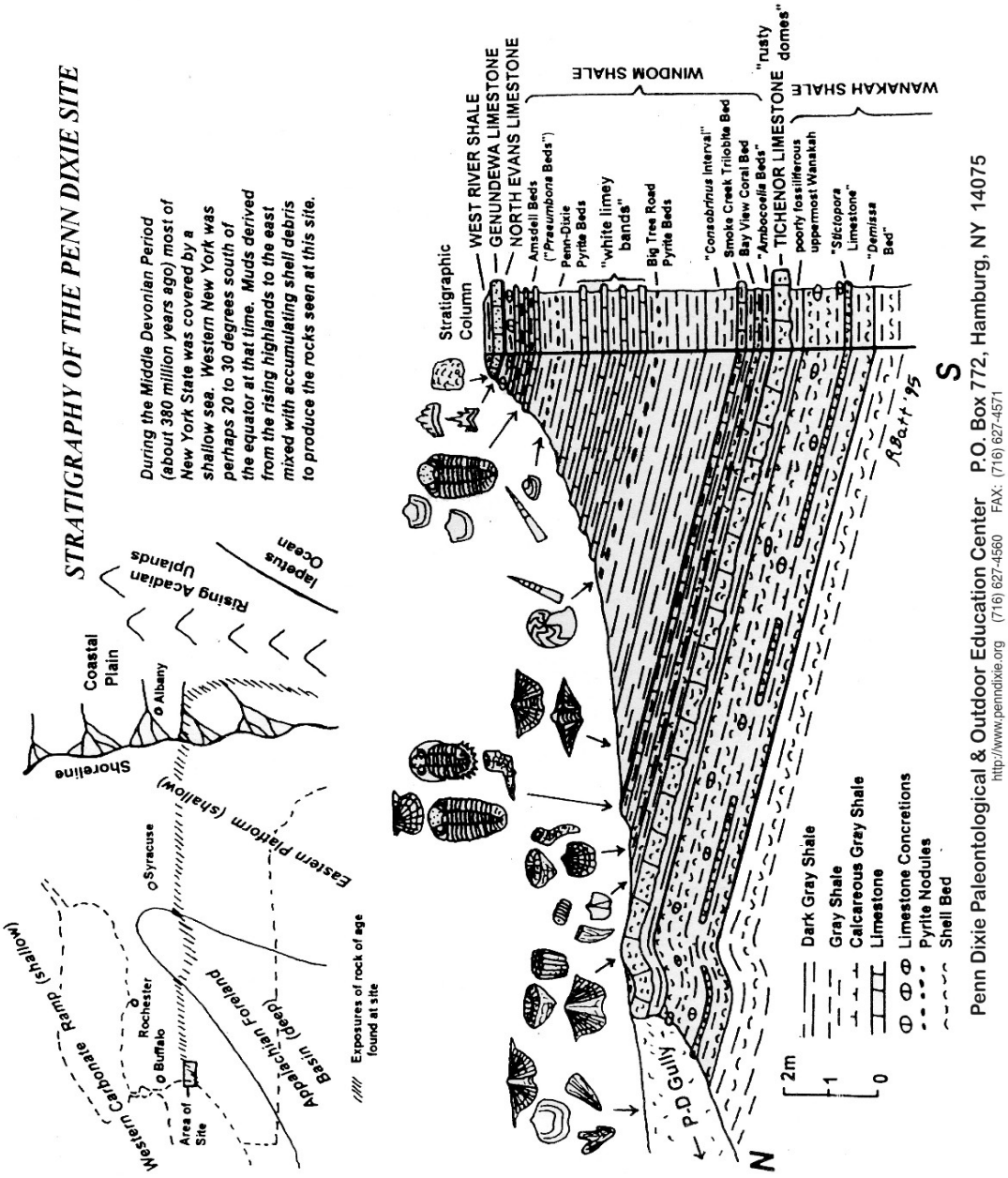

Figure 2. Stratigraphy of Penn Dixie. Prepared by Dr. Rick Batt in 1995.

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. 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 make 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. 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 the shale are rewarded with an extensive introduction to the variety of fossils preserved within the Windom. The northern section of the site provides an

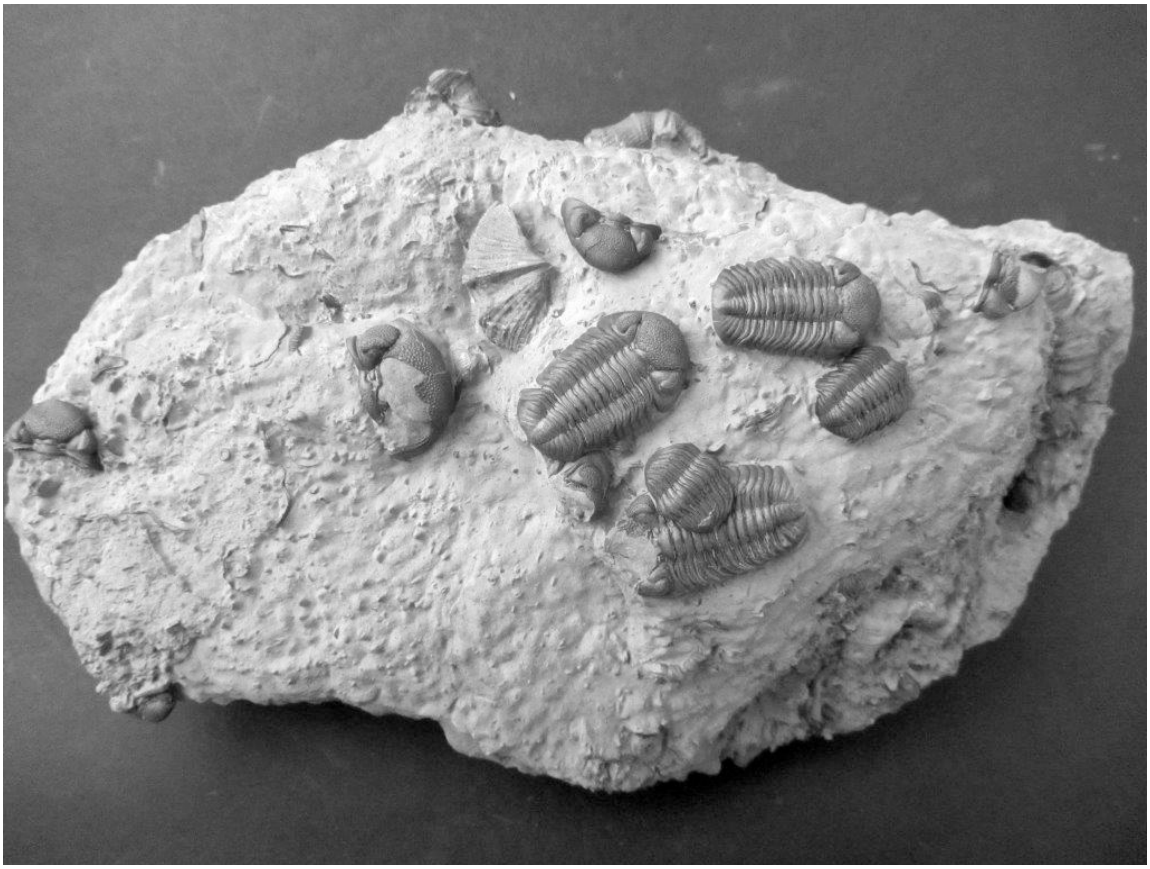

Figure 3. *Phacops rana* group collected by Roger Furze, of Germany, in August 2013, one of many multiple slabs that have been found in the Lower Windom Shale Smokes Creek Bed in 2013 and recent years.

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 under Fossil Photos.

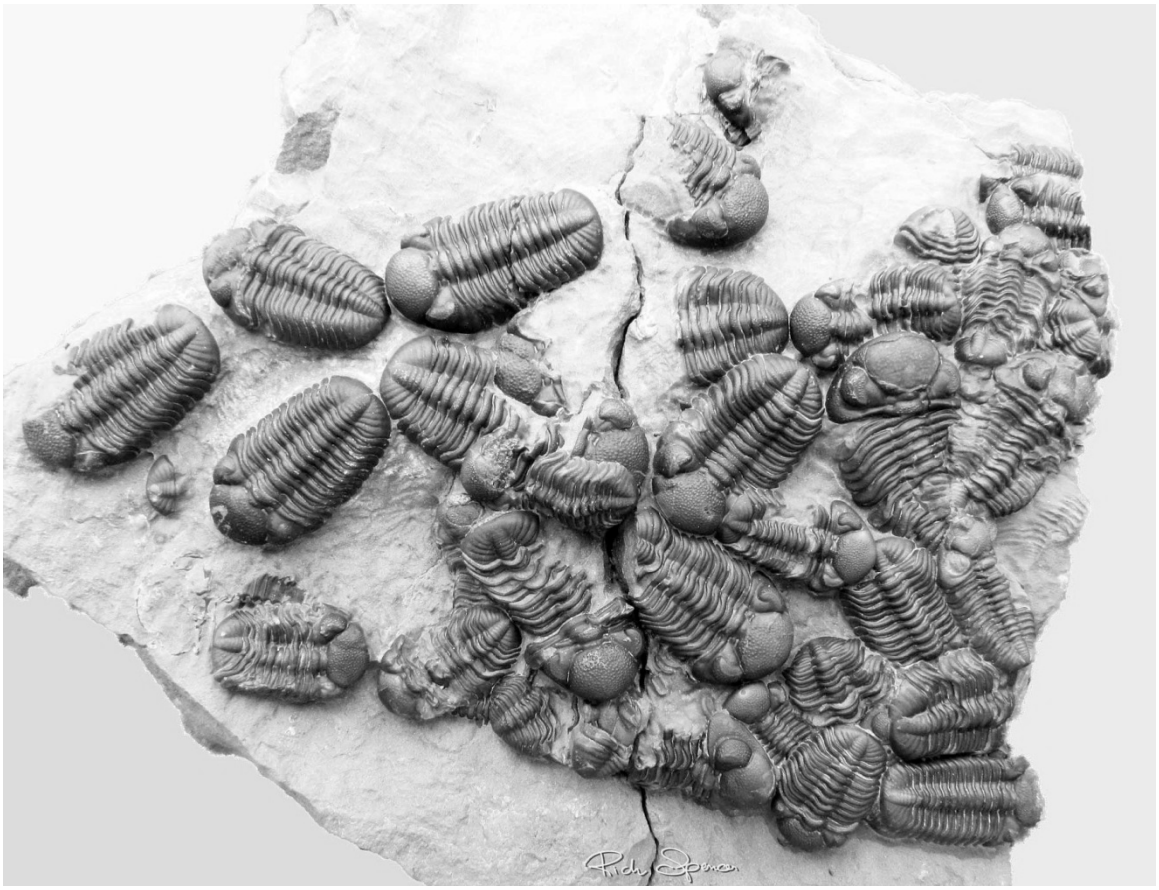

Figure 4. Mortality group of *Phacops rana* trilobites collected by Matt Phillips, Martinsville, VA, from the Lower Windom Smokes Creek Bed in May 2011.

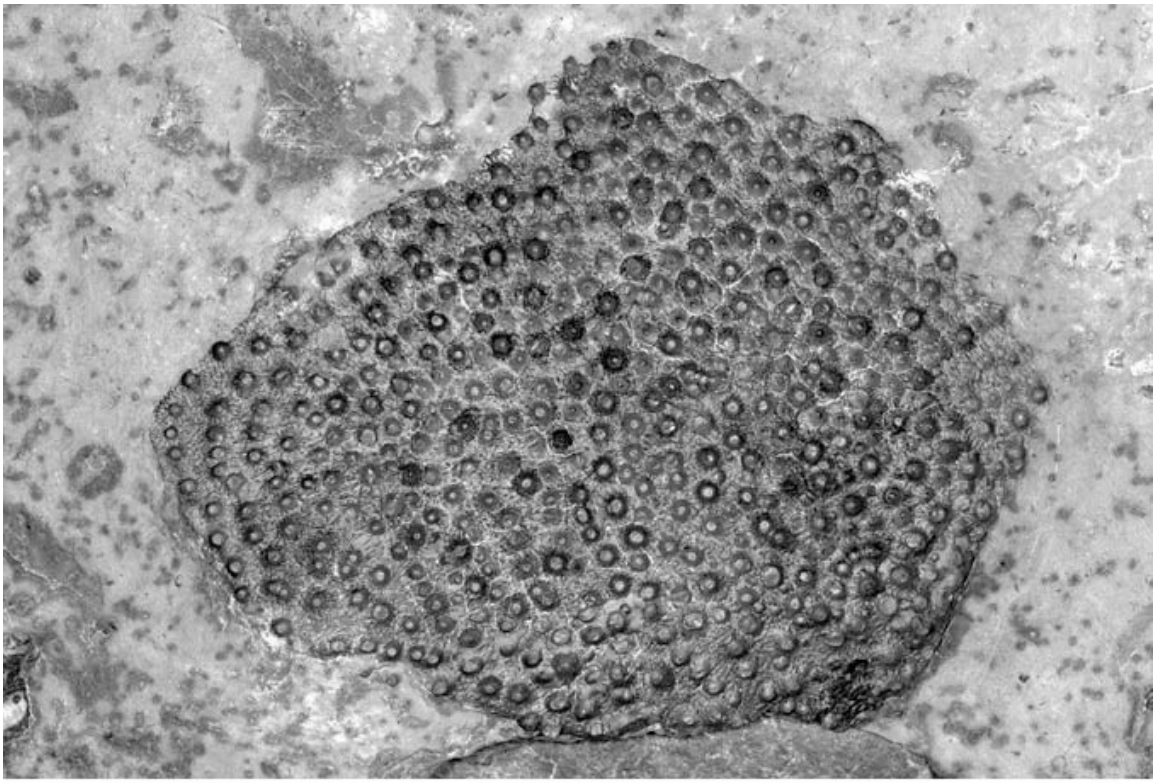

Figure 5. One of the rare fossils that can be found at Penn Dixie.

PENN DIXIE RANKED THE NO. 1 FOSSIL PARK IN THE U.S.

The Geological Society of America Special Paper 474, June 2011, **"Geobiological opportunities to learn at U.S. Fossil Parks,"** by Renee Clary, of Mississippi State University, and James Wandersee, of Louisiana State University, evaluated seven fossil parks and the **Penn Dixie Paleontological and Outdoor Education Center in Hamburg, NY is ranked No. 1.**

The authors analyzed the seven fossil parks on key variables that influenced visitors opportunities to learn geobiology concepts at fossil parks which included (1) authenticity of the experience, (2) age of the fossils, (3) fossil-collection training facilities, (4) availability of on-site paleontological mentors, (5) fossil identification via signage and brochures, (6) site organization and way-finding signs, (7) accessibility of site, including safety. The authors visited and ranked the seven U.S. Fossil Parks against these variables evaluating these variable criteria to the effectiveness as science education sites.

The HNHS/Penn Dixie is pleased to have been included in this study and it reinforces the importance of our goals and objectives in providing an outdoor educational facility where children and adults can have a 'hands-on' experience in geology, fossil collecting and the natural

sciences. Penn Dixie's preservation for future generations is critical for the study of the sciences providing a safe, easily accessible, and rich resource for all.

HNHS/PENN DIXIE HAS REPRINTED THE *GEOLOGY AND PALAEONTOLOGY OF EIGHTEEN MILE CREEK*

The HNHS/Penn Dixie has reprinted Amadeus W. Grabau 1898-1899 ***Geology and Palaeontology of Eighteen Mile Creek*** publication which is available for purchase. The book is selling for $34.95, plus 3.06 in sales tax and $5.00 shipping and handling. The book will sell, with sales tax included, for $38 plus $5 shipping in the U.S. An order form is available on the website at www.penndixie.org and it also may be purchased at Penn Dixie. This is the second reprinting of this publication and the revenues will go to help support the operations and programs at Penn Dixie.

CURRENT PROGRAMS AT PENN DIXIE

The opportunity to actually find and collect ancient creatures that roamed the seas of Western New York 380 million-years ago fascinates children and adults alike. Children are amazed that these fossils are older than the dinosaurs and their parents and that they can keep what they find! Penn Dixie has an inexhaustible supply of fossils and the opportunity to find new and rare specimens. The Penn Dixie Site provides an opportunity to open a whole new world of geology and paleontology, along with the other natural sciences, to students, scouts, senior citizens, and the general public. It has provided an outdoor educational experience for many hearing impaired, visually impaired, blind, and physically challenged individuals. The preservation and continued development of this site is extremely important. Commercial and residential development, along with landowners restricting property access, have made many fossil- collecting sites extinct or no longer accessible. For example, earlier this year a new landowner posted the property along the north side (Hamburg side) of Eighteen Mile Creek restricting access to the mouth of Eighteen Mile Creek along the frequently used
trails. In addition, Penn Dixie can accommodate large groups, whereas many streambeds, road and railroad cuts, and shoreline exposures cannot or are impractical. Attempts to preserve collecting sites, such as Penn Dixie, must be made, or many classic collecting and geologic locations will be lost for future generations to visit and study.

Students, scouts, families, summer day camps, amateur and professional geologists find this classic geologic site an ideal place to study geology, collect fossils, observe over 143 nesting and migratory birds, view the WNY skies and explore nature. Guided tours, astronomy programs, birthday parties, Boy and Girl Scout activities, corporate and civic picnics, and family outings are available by reservation. The 4,100 ft. of paved trails provide wheel chair, walker, stroller and wagon access for handicap individuals, elderly, and young families with strollers.

The HNHS has scheduled a variety of programs throughout the year. Currently, the Penn Dixie Site is open to the public every May through October, Saturdays 9 AM-4

PM and Sundays 11 AM-4 PM; during Spring Break Monday-Saturday 9 AM-4 PM and Sunday 11 AM-4 PM, and 7 days a week mid-June through Labor Day, Monday through Saturday, 9 AM to 4 PM, and Sundays 11 AM-4 PM to collect fossils. Visits may be scheduled at other times for schools, scouts, pre-schools, universities, birthday party, corporate groups or other events by calling (716) 627-4560. Events are held rain or shine. Special Events, evening astronomy programs, bird walks, summer day camps, group and family tours are held throughout the year. Some of the Special Events and activities held annually include:

- Lecture programs in the natural sciences in the Gateway Executive Office, 3556 Lake Shore Road, Blasdell, NY.
- "Dig with the Experts" the third weekend in May
- Annual Children's Day the first Sunday in June
- Annual Miss Buffalo Nature Cruise and Buffalo Lighthouse Tour in June and September
- "Big Toys, Trucks & Bikes Event" in early July
- Mid-Summer's Night Adventure in August
- Special Event in September
- Annual WNY Earth Science Day Celebration in October
- Members Only field trip to various collecting localities and museums

Evening astronomy programs are held at Penn Dixie one Saturday night once a month March through October. Visits may be scheduled at other times by calling Penn Dixie at (716) 627-4560. Additional on-site and off-site events are open to the public, which are listed on the Penn Dixie website www.penndixie.org.

A GROWING MEMBERSHIP ORGANIZATION

The HNHS has experienced phenomenal growth since its inception in 1993. While many of the HNHS members come from Western New York, the society counts among its membership residents from over 30 states, and Canada, England, and Germany. Over 1,100 memberships, at a variety of levels, contribute to the daily operations of the HNHS and the Penn Dixie Site, along with increasing the HNHS endowment fund. Visitors from all over the U.S. and from Algeria, Australia, Brazil, Canada, China, England, France, Germany, Israel, Italy, Japan, Lebanon, Mexico, Mongolia, New Zealand, Pakistan, Scotland, Spain, Sweden, Switzerland, and United Arab Emerates have found the Penn Dixie Site a tremendous educational resource. **Penn Dixie was ranked No. 19 by attendance of the Top 25 Tourist Attractions in WNY in 2005** by Business First of Buffalo, NY.

OUR PLANS FOR GROWTH

The first priority is to obtain funding to hire two-full time staff - a Director of Education and a Director of Development to work closely with the Executive Director to generate revenues to help make the Penn Dixie Site fully sustainable. The HNHS/Penn

Dixie is submitting requests to foundations to help fund these two positions.
The second priority is to secure funding to construct an outdoor education center building to provide facilities, utilities, and shelter from inclement weather conditions that affect programs, attendance, and revenues. The Penn Dixie Site revenues are affected by weather and the building will provide an opportunity for year-round programming. A building on-site will increase programs, attendance, a larger gift shop, and opportunities for new and expanded programs. The proposed building will consolidate all the Society's resources and property at one location. It will provide an opportunity for the site to be open year-round and for programs like astronomy even during inclement weather. The HNHS Board is searching for sources of funding from a variety of opportunities in the government, foundation, corporate, private sector, and membership support. Information on the building plans are available on the Penn Dixie website www.penndixie.org. The HNHS/Penn Dixie welcomes any suggestions, leads or contacts that could possibly result in funding.

The HNHS/Penn Dixie has preserved a classic, unique resource for the region in which schools, amateur and professional geologists, fossil collectors, families, pre-schools through university level students, and visitors rely on it for the educational, cultural, recreational and tourism aspects of the site.

HOW YOU CAN HELP

The HNHS has some ambitious plans to further develop this site into a world class outdoor educational, recreational, and tourist attraction for the Niagara Region. In completing the first phase, the HNHS has effectively preserved a unique educational and green space resource for future generations. With the completion of the next phases of development, the HNHS will maximize the educational opportunities afforded by the Penn Dixie Site for all of Western New York and the region. The Penn Dixie Site is already proving a powerful draw for visitors from all across North America and, indeed, the world. Completion of the site's educational facilities will only enhance this draw and bring increased numbers of visitors to the site.

The difficult economic conditions in Western New York continue to impact the HNHS and the Penn Dixie Site. The HNHS (a non-profit organization) needs to secure additional funding to keep our current level of public programs at Penn Dixie**.** The HNHS is attempting to raise funds by increasing memberships, admissions, programs, donations, grants, and seeking corporate support. The HNHS' goal is to become self-sustaining. Many members and donors, who have not even been to Penn Dixie, are willing to support our cause to preserve and develop this classic site for future generations.

You can help continue the tremendous advances and accomplishments that have been made to date by:

- Sending a donation.
- Taking out a membership.

- Recruiting a new HNHS member.
- Bringing visitors to Penn Dixie.
- Recruiting a Corporate member.
- Enrolling your family in a program or summer day camp.

The HNHS is actively seeking financial support from a variety of sources to attain its goal of transforming the Penn Dixie Site into an educational resource that fully utilizes and shares the unique resources contained within the site. If you are interested in learning more about how you can help support the HNHS and the Penn Dixie Site, please call the HNHS at 716/627-4560. Visit our web site www.penndixie.org for program and membership information. We look forward to having you visit Penn Dixie.

ACKNOWLEDGEMENTS

I thank my wife, Linda, for her review of this manuscript, Stan Martin for proof reading the article, Dr. Rick Batt for use of the Penn Dixie Stratigraphic Column, Roger Furze for his photo of multiple trilobites, and Matt Phillips for his multiple mortality slab. I also thank the HNHS/Penn Dixie Board, Penn Dixie members, and volunteers who have unselfishly provided their time and talents to the preservation and development of the Penn Dixie Paleontological and Outdoor Education Center.

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ROAD LOG FOR PENN DIXIE SITE VISIT

Total Miles	Miles from last point	Route Description
		Take NYS Thruway to Exit 56 Blasdell, after the tollbooth, turn right onto Rt. 179 north.
0.0	0.1	Proceed to first traffic light and turn left onto Rt. 62 South Park Avenue.
0.1	1.2	Proceed 1.2 miles to the traffic circle at Big Tree Road
1.3	0.2	Turn right and proceed west on Big Tree Road to Bristol and turn right.
1.5	0.3	Proceed to the end of Bristol and turn left on North Street.
1.8	0.1	The Penn Dixie entrance is directly ahead. Enter the gate and meet at the Penn Dixie shelter on the north side of the parking area.