Ohio Geology

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FOSSILS OF OHIO—THE BOOK

by Michael C. Hansen

Fossil collectors in Ohio can enjoy a new book that is perhaps the finest and most comprehensive modern work on fossils from an individual state. This book, *Fossils of Ohio*, Division of Geological Survey Bulletin 70, is now available (see ordering information at the end of this article). This much-anticipated new book replaces Bulletin 54, *Ohio fossils*, the Survey's all-time bestseller, which has been out of print for several years. Bulletin 54, by Aurèle La Rocque and Mildred F. Marple, was first published in 1955 and sold more than 50,000 copies through 13 reprintings during its nearly 40-year availability. These facts alone attest to the interest in fossils and fossil collecting in Ohio.

Fossils of Ohio has nearly 600 pages and more than 200 figures, the majority of which are full-page photographic plates illustrating the more common species of fossils. The frontispiece is a page-size color photograph of a 10-inch-long specimen of a trilobite, *Isotelus*, which is Ohio's state fossil. Of interest to many collectors, especially those just starting their journey into the diversity of past life, are full-color reconstructions that depict fossils as they appeared in life during each geologic period represented by deposits in Ohio. The reconstructions of the Paleozoic periods are from professionally prepared transparencies of dioramas at the Carnegie Museum of Natural History in Pittsburgh. The Pleistocene Epoch is represented by an excellent color illustration of the Burning Tree mastodon from a transparency provided by Discovery magazine. The cover of the book is sure to attract attention—it features a skull and thoracic shield of *Dunkleosteus terrelli*, the ferocious arthrodire fish that is so well known from the Upper Devonian Cleveland Shale Member of the Ohio Shale in northern Ohio.

In the 1980's it became apparent to many geologists and amateur fossil collectors that Bulletin 54 had become outdated because of new fossil discoveries, changes in names of fossils, and graphic presentation. In 1988, Dr. Rodney M. Feldmann, noted paleontologist, Professor of Geology at Kent State University, and former editor of the Journal of Paleontology, undertook the monumental task of coordinating the preparation of a new fossil book for the state. It was apparent to Dr. Feldmann that no single person could prepare a comprehensive, authoritative volume on the remarkable diversity of fossils known from Ohio. It was his plan to recruit experts to prepare each chapter on a particular group of fossil organisms known from Ohio.

This approach, to have each chapter summarize a particular group of fossils, was different from Bulletin 54, which treated the fossils stratigraphically, that is, each chapter dealt with all of the common fossils from each geologic system. Twenty-three experts were enlisted to prepare the 25 chapters. All of these authors are noted authorities, many of international reputation, on a particular group of fossils. Seventeen of the authors are affiliated with Ohio institutions and all but a few of the remainder have long-standing research ties to Ohio paleontology. As Dr. Feldmann notes in the preface to Bulletin 70, having so many authorities on fossils affiliated with Ohio is testimony to the popularity and importance of Ohio fossils. None of the authors received compensation other than the pride of being a contributor to what is destined to become a benchmark publication on fossils from a state. Dr. Feldmann outlined the plan of the book, furnished each author with guidelines for preparation of their chapter, encouraged authors to meet deadlines, reviewed each manuscript, and made sure all the computer files for the manuscripts were in the same word-processing program for delivery to the Survey.

For more than two and a half years, Survey geologist and editor Merrianne Hackathorn has labored over the manuscripts for each chapter, checking and cross-checking keys, descriptions, glossary terms, references, spelling of scientific names, and all of the other tedious editorial tasks that are not apparent in a publication—unless they are not done. She has been aided by the work of Survey cartographer Lisa Van Doren, who has done the layout and design of the book on the Survey's Macintosh desk-top publishing system.

It is appropriate that this book be prepared because Ohio has long been known for abundant and well-preserved fossils. These remains of past life attracted attention soon after European settlement of the state. Early naturalists such as Dr. Samuel P. Hildreth of Marietta began to describe and illustrate fossils from the state in the 1830's, and geologists of the first Geological Survey of Ohio, particularly John Locke and J. W. Foster, described and named fossils that they encountered during their geological explorations of the state in 1837 and 1838.

It was not, however, until the Second Geological Survey of Ohio, begun in 1869, that the state's

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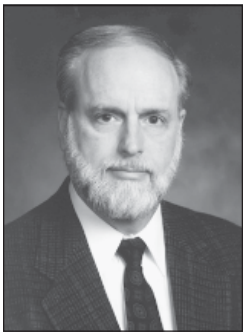

Thomas M. Berg, Division Chief and State Geologist

From The State Geologist...

Thomas M. Berg

THE AWESOME ORDER OF LIFE

Thirty-three years ago, while working on my Masters thesis, I spent part of the summer scrambling around the higher elevations (around 12,000 feet) of the Sangre de Cristo Mountains of south-central Colorado. I was collecting fossils of Pennsylvanian age (about 295 million years old) from a huge bioherm—a limestone formation much like a modern-day reef. As I collected a wide variety of marine invertebrate fossils and data on the limestone, I never ceased to be amazed that that place—high in the rarefied air of the Rocky Mountains—was once part of an inland sea teeming with life. What a wonderful planet we live on! Because of the preservation of ancient life as fossils in the constantly shifting crust of Earth, we are able to study and enjoy the progression of living things through millions upon millions of years.

Fossils teach us a powerful lesson on the awesome order present in the world of living things. When we collect and analyze fossils we learn that forms of life have adapted to all kinds of different environments. Through time, living creatures have marvelously adapted to each other and established intricate interrelationships beneficial to their survival. They have developed shapes, sizes, colors, skeletons, organs, and behaviors that have given them an opportunity to survive and reproduce. For example, look at the Pennsylvanian brachiopod *Dictyoclostus.* This wonderful marine invertebrate developed a concavo-convex shell structure that allowed it to live right at the sediment-water interface on the bottom of the sea, and be virtually invisible! The convex bottom shell was buried in the mud, and the concave upper shell was filled with sediment, so that when both shells were closed, only the muddy bottom would be visible. Consider the amazing trilobite! These extinct marine arthropods are almost as popular among fossil hunters as dinosaurs. The trilobites had a visual system that was truly remarkable. Their multifaceted eyes could see in almost all directions at once! No wonder they survived for almost 325 million years.

The state of Ohio is richly blessed with fossils of all kinds. The Paleozoic strata exposed at the surface in Ohio yield beautifully preserved marine invertebrates of all kinds. Trace fossils (the tracks and trails of organisms moving across or through sediment) are abundant. Fossil plants are abundant in the coal-bearing rocks of eastern and southeastern Ohio. Skeletons of extinct vertebrates such as mastodon and elk can be found in the Pleistocene glacial deposits that cover two-thirds of the state.

The Ohio Geological Survey is most pleased to be releasing a brand-new book that will delight fossil collectors of all ages. Bulletin 70, *Fossils of Ohio*, is nearly 600 pages of descriptions and illustrations of fossils of all kinds that can be found in Ohio. This multi-author publication was assembled by Kent State University's Dr. Rodney M. Feldmann (Editor-in-Chief) and Ohio Survey Geologist/Editor Merrianne Hackathorn (Managing Editor). This book will surely provide great enjoyment for all who are interested in fossils. Most assuredly, it will bring a new appreciation for the awesome order of life.

FOSSIL COLLECTING AT SECOR METROPARK

The Silica Formation of Middle Devonian age has long been known from exposures in limestone quarries in the vicinity of Sylvania, west of Toledo. The gray shale in the unit produces exquisitely preserved fossils, particularly brachiopods, and, most notably, a trilobite, *Phacops rana*. This fauna is the subject of Division of Geological Survey Bulletin 32, *Fauna of the Silica Shale of Lucas County*, by Grace A. Stewart, published in 1927 and now out of print.

For many years, collectors could easily gain access to the quarry at Sylvania and obtain many fine specimens. It was not unusual on a Sunday summer afternoon to see dozens of collectors in the quarry. However, change of ownership and safety concerns closed the quarry to collecting.

Recently, Metroparks of the Toledo Area, in cooperation with Barrett Paving Materials, Inc., of Sylvania, has made Silica shale fossils available to collectors. Denise Gehring, programs manager for the parks, made arrangements with Mike Smith of Barrett to bring truckloads of Silica shale from the Barrett quarry to Secor Metropark. The shale is dumped behind the Nature Discovery Center where children and adults can look for fossils. This program, known as "Dig into the Past," is free of charge and available daily from 7 a.m. to dark. The shale is replenished periodically. A few rock hammers and other tools are available at the Nature Discovery Center but it is suggested that collectors supply their own equipment. Each individual is to remove only three fossils from the site.

Secor Metropark is located just south of U.S. Route 20 (Central Avenue) about 4 miles west of U.S. Route 23, on the west side of Toledo. For more information, please contact Metroparks of the Toledo Area, 5100 West Central Avenue, Toledo, OH 43615-2100, telephone 419-535-3050.

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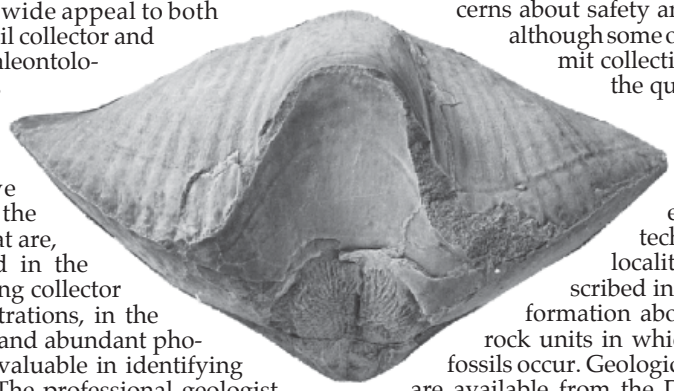
remarkable fossils were first described in detail and fully illustrated. Dr. John Strong Newberry, Director of the Second Survey, was an accomplished geologist and paleontologist of international reputation who realized that the abundant fossils in Ohio's rocks were not only of great interest and curiosity to the state's citizens, but that these fossils were the key to determining the sequence and lateral relationships of rock strata in Ohio. Newberry's plan was to publish three volumes on paleontology as companions to volumes on geology. Two of the three paleontology volumes (1873, 1875) were published under Newberry's direction. Portions of the intended third volume were published under the direction of third State Geologist Edward Orton in 1893 as part of Ohio Geological Survey Volume 7.

These volumes illustrated the paleontological abundance and diversity found in Ohio rocks and have long served as important references on many groups of fossils. Bulletin 70 is dedicated to Dr. John Strong Newberry in recognition of his foresight and persistence in revealing the paleontological wealth of Ohio to the world.

Bulletin 70 is more than just a catalog of common or important fossils found in Ohio and is designed to have a wide appeal to both the beginning fossil collector and the professional paleontologist. The text is written in a clear, relatively non-technical manner, and an extensive glossary defines the technical terms that are, of necessity, used in the book. The beginning collector will find the illustrations, in the form of drawings and abundant photographs, to be invaluable in identifying fossil specimens. The professional geologist will be able to use the book in a similar way for identification of fossil specimens and have the satisfaction of knowing that the names of the fossils are accurate and up to date. The introductory chapters serve as a general introduction to paleontology and include sections on preservation, preparation, occurrence, collecting, classification, and identification as well as an overview of the major fossil groups. A chapter on surface rocks and sediments gives a summary of the state's geology and explains many basic geologic principles that are important in understanding the accumulation and distribution of fossils.



Separate chapters describe sponges, stromatoporoids, conulariids, corals, trilobites, ostracodes, other arthropods, rostroconchs, pelecypods, gastropods, cephalopods, bryozoans, brachiopods, echinoderms, conodonts, graptolites, tentaculitoids, vertebrates, plants, and ichnofossils (trace fossils). Each chapter gives information on major morphological features of the group, common species, and extensive photographs of specimens. Many chapters include a key to help identify common genera. The book has separate indexes to genera and species. Of particular value to users at all levels will be the extensive reference list. Much information that could not be included in the book because of space limitations can be found in the references.

An effort was made to list publicly accessible collecting localities, and a number of them are noted in various chapters in the book. In many chapters, mention is made of rock units and general areas of the state where collecting is productive. Many readers would prefer to see an extensive list of localities with detailed locational information. Omission of such a list is not an oversight and has been the topic of lengthy discussion and deep thought among many people involved in the production of the book. There is no purposeful scientific intent to keep localities secret; however, all but a very small percentage of known Ohio fossil localities are on private land and accessible only with the landowner's permission. From a practical and legal standpoint it is difficult to advertise the availability of an outcrop on private land. If a few people visit a private-property site it is not likely to cause any problems, but a widely distributed book such as *Fossils of Ohio* could potentially initiate hundreds of visits to a site. Furthermore, site ownership may change, or modifications, natural or human, may radically alter the suitability of a site for collecting. Many fossils in some parts of the state have been collected from rocks exposed in quarry or strip-mine excavations; in some areas of the state these artificial exposures are the only outcrops. The availability of these sites for collecting has changed radically in the last few decades because of concerns about safety and potential litigation, although some operations will still permit collecting in inactive areas of the quarry.

The good news is that the dedicated collector can still find good collecting sites, either by referring to the technical literature, where localities commonly are described in detail, or by using information about the distribution of rock units in which particular kinds of fossils occur. Geologic maps, many of which are available from the Division of Geological Survey, can be used to locate outcrops of these units. These approaches entail extra effort, but it appears to be the only prudent way to deal with the problem in the context of modern societal complexities.

Fossils of Ohio will serve admirably as a guide to collecting and identifying fossil remains in the state. The book will have a much larger audience as well because it will be useful to collectors in any other area of the country who wish to identify a variety of Paleozoic and Pleistocene fossils. It was no small undertaking but the effort will prove to be worthwhile. The citizens of Ohio can be proud of a volume that publicly displays the paleontological riches of the state.

Silurian cephalopod, Graftonoceras ortoni. *Below left: Mississippian brachiopod,* Syringothyris typus.

FURTHER READING

All of these volumes are out of print, but may be consulted in many libraries across Ohio.

La Rocque, Aurèle and Marple, M. F., 1955, Ohio fossils: Ohio Division of Geological Survey Bulletin 54, 152 p.

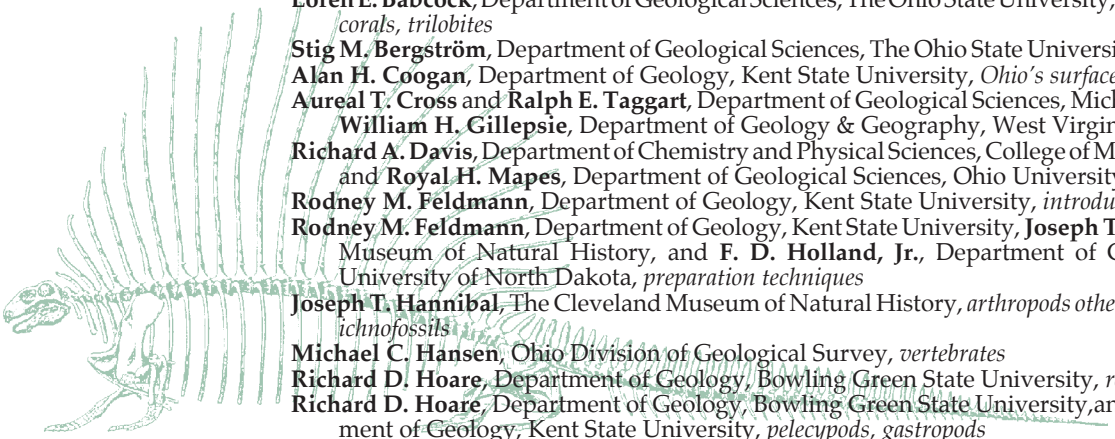
Newberry, J. S., 1873, Palaeontology: Ohio Division of Geological Survey, Volume 1, Part 2, 399 p.

_____ 1875, Palaeontology: Ohio Division of Geological Survey, Volume 2, Part 2, 435 p.

Orton, Edward, 1893, Economic geology, archaeology, botany, paleontology: Ohio Division of Geological Survey Volume 7, 700 p.

Pennsylvanian gastropod, Worthenia tabulata.

THE FOLLOWING AUTHORS CONTRIBUTED TO *FOSSILS OF OHIO*:



Robert L. Anstey, Department of Geological Sciences, Michigan State University, and **Mark A. Wilson**, Department of Geology, College of Wooster, *bryozoans*
William I. Ausich, Department of Geological Sciences, The Ohio State University, *echinoderms*
Loren E. Babcock, Department of Geological Sciences, The Ohio State University, *stromatoporoids, conulariids, corals, trilobites*
Stig M. Bergström, Department of Geological Sciences, The Ohio State University, *graptolites, tentaculitoids*
Alan H. Coogan, Department of Geology, Kent State University, *Ohio's surface rocks and sediments*
Aureal T. Cross and **Ralph E. Taggart**, Department of Geological Sciences, Michigan State University, and **William H. Gillepsie**, Department of Geology & Geography, West Virginia University, *plants*
Richard A. Davis, Department of Chemistry and Physical Sciences, College of Mount St. Joseph, Cincinnati, and **Royal H. Mapes**, Department of Geological Sciences, Ohio University, *cephalopods*
Rodney M. Feldmann, Department of Geology, Kent State University, *introduction*
Rodney M. Feldmann, Department of Geology, Kent State University, **Joseph T. Hannibal**, The Cleveland Museum of Natural History, and **F. D. Holland, Jr.**, Department of Geology and Engineering, University of North Dakota, *preparation techniques*
Joseph T. Hannibal, The Cleveland Museum of Natural History, *arthropods other than trilobites or ostracodes, ichnofossils*
Michael C. Hansen, Ohio Division of Geological Survey, *vertebrates*
Richard D. Hoare, Department of Geology, Bowling Green State University, *rostroconchs*
Richard D. Hoare, Department of Geology, Bowling Green State University, and **Barry B. Miller**, Department of Geology, Kent State University, *pelecypods, gastropods*
J. Keith Rigby, Department of Geology, Brigham Young University, *sponges*
Michael R. Sandy, Department of Geology, University of Dayton, and **Barbara A. Schwimmer**, The Cleveland Museum of Natural History, *brachiopods*
Alison J. Smith, Department of Geology, Kent State University, and **John R. Tillman**, Department of Geology & Geography, Ohio Wesleyan University, *ostracodes*
Walter C. Sweet, Department of Geological Sciences, The Ohio State University, *conodonts*

Ordering Fossils of Ohio

Bulletin 70, *Fossils of Ohio*, can be ordered from the Division of Geological Survey, 4383 Fountain Square Drive, Columbus, OH 43224-1362 for $18.00 plus $3.00 mailing and $1.04 sales tax for orders mailed to an Ohio address. Credit-card orders can be placed by calling 614-265-6576. Please contact the Geologic Records Center at the above address or telephone number for information on multiple-copy discounts to bookstores and organizations. Bulletin 70 also can be ordered using the list of General Interest Publications included as an insert in this issue of *Ohio Geology*.

New fossil commemorative pin

In commemoration of publication of *Fossils of Ohio*, the Survey is offering a 1 x 3/4 inch cloisonné lapel pin that depicts *Isotelus*, an Ordovician trilobite that is Ohio's official state fossil. The brown trilobite is outlined in gold on a bluish-gray background. The trilobite is bordered by the words "Ohio Fossils" in gold lettering. The Ohio Fossils lapel pins are available from the Division of Geological Survey for $2.00 each plus $0.12 tax and $2.00 mailing. Quantity discounts are available.

Fossils of Ohio poster

The Survey has produced an 18 x 24 inch poster to accompany the new *Fossils of Ohio* book. The colorful poster features a photograph of a trilobite, *Isotelus*, in the center. This photo is also the frontispiece in the book. Seven additional photographs of fossils illustrated in the book are positioned around the perimeter of the poster. These include a brachiopod, a cephalopod, a crinoid, an arthrodire fish, another trilobite, a seed fern, and a coral. The posters are available for $1.00 each plus $0.06 tax and $3.00 mailing (rolled in a tube).

RUSSELL A. BRANT RECEIVES MATHER MEDAL

Former Survey geologist Russell A. Brant received the Mather Medal of the Ohio Geological Survey in ceremonies held on September 27, 1996, at the Fawcett Center at The Ohio State University. He is the tenth recipient of the medal named for Wiilliam W. Mather, Ohio's first state geologist (1837-1838). The award recognizes outstanding, career-long contributions to the knowledge of the geology of Ohio.

Russell A. Brant was born in 1919 in Brooklyn, New York, and came to Mogadore, Ohio, with his family at the age of four. After graduating from high school in 1937, Russ took a job as a lab technician with Monarch Rubber Co. in Hartville, Ohio. From 1939 through 1943 he was enrolled at the University of Akron Evening College while advancing to the position of assistant chemist at Monarch. In 1943 Russ began service with the U.S.

Army Air Force in England as a tail gunner on a B-17 bomber. He flew 35 missions over Europe.

After the war, Russ married Elizabeth (Rae) Dewey, a union that resulted in four children. He took a job as a lab technician with the B. F. Goodrich Rubber Co., but it wasn't long until he enrolled in the forestry program at the University of Michigan, where he became captivated by the geology and mineralogy courses he took. After a year of forestry studies, Russ changed his major to geology, receiving the B.S. degree in 1948 and the M.S. degree in 1949 from the University of Michigan.

Russ Brant's first geology job was with the Fuels Branch of the U.S. Geological Survey, where he worked for Paul Averitt on coal resources of Michigan and North Dakota. He then became interested in pursuing further graduate studies in geology at The Ohio State University on a part-time basis and was lured to Columbus in 1952 by then Ohio Geological Survey Chief John H. Melvin to become part of the Survey's new initiative to assess the coal resources of the state. This initiative had begun soon after the Survey, in 1949, became one of the seven originally chartered divisions of the newly created Ohio Department of Natural Resources. State Geologist Melvin had begun to expand the staff and activities of the Survey during the postwar economic boom.

Throughout the 1950's Russ published several reports on coal resources, culminating in 1960 in publication of Bulletin 60, *Coal resources of Ohio*, coauthored by 1992 Mather Medalist Richard M. DeLong. This 245-page volume stood for many years as the definitive report on coal in Ohio and pulled together a huge amount of coal information that previously was not readily available to the public in a single document.

Russ was possessed with considerable foresight in dealing with massive amounts of coal and stratigraphic data. In 1956, long before the computer age, Russ, Bill Smith, and Marian Klein published a Survey Information Circular (No. 18) titled, *An application of business machine technique to stratigraphic and coal resources studies*. Their system utilized punch cards to sort and analyze data.

In 1957 Russ assumed responsibilities as Head of the Coal Section and, in 1960, he was appointed Assistant State Geologist by then State Geologist Ralph J. Bernhagen. He served in this latter position until 1968 when he became Senior Geologist with the Division.

During the late 1950's and 1960's, Russ became interested in the significant problem of acid-mine drainage from Ohio's abandoned coal mines. In 1960, he and Edward Q. Moulton of the Ohio State University Engineering Experiment Station published a 40-page manual on acid-mine drainage. As a result of his expertise on acid-mine drainage, Russ was offered and accepted a position with the Cincinnati-based Ohio River Sanitation Commission (ORSANCO) in 1969. During his tenure with this organization, until 1976, his knowledge about coal geology and acid-mine drainage resulted in significant progress in mitigating the acid problem in the Ohio River drainage basin.

The Kentucky Geological Survey hired Russ in 1976 to work in their coal geology program and, for five years, he served as head of the KGS Coal Section, overseeing the mapping of eastern Kentucky coal resources and conclusion of mapping of these resources in western Kentucky. In 1986, Russ retired after 37 years of studying the geology of coal. He was the first geologist to be awarded emeritus status with the Kentucky Geological Survey.

Russell A. Brant (left) receives Mather Medal from Division Chief and State Geologist Thomas M. Berg.

Russ was the first chairman of the Coal Division of the Geological Society of America and is a fellow of that organization. He is also a member of the American Institute of Professional Geologists, Geological Society of Washington, D.C., Geological Society of Kentucky, Northern Ohio Geological Society, and the Ohio Academy of Science.

Ohio and the Survey are fortunate to have had his services for 17 years. His tenure with the Division was during one of the most ambitious periods of study of Ohio's coal resources, and Russ was a major contributor to and leader of these efforts. The Survey still relies heavily on the data, maps, and reports gathered and generated by Russ and others during this period.

Since his retirement in 1986, Russ and Rae have lived in Lexington, Kentucky, enjoying their lifelong hobbies of gardening and sailing. Russ also does volunteer work in preventive medicine and industrial hygiene and a bit of coal consulting.

Russ's former colleagues at the Ohio Geological Survey all have high praise and respect for his intelligence, diligence, leadership, and gentlemanliness and many expressed these feelings at the Mather Medal banquet. Praise for such characteristics has been repeated by colleagues from other organizations that were fortunate to have Russ as an employee. There is little doubt that Russ's departure from the Ohio Geological Survey in 1969 was a loss to his colleagues at the Survey and to the citizens of Ohio. The Division of Geological Survey is honored to award the Mather Medal to Russell A. Brant for his contributions to Ohio geology.

—Michael C. Hansen

Geology of the Cincinnati/northern Kentucky region

Paul Edwin Potter, Professor Emeritus of the Department of Geology at the University of Cincinnati, has prepared an excellent guide to the geology of the greater Cincinnati area of Ohio, Indiana, and Kentucky. This 114-page book, *Exploring the geology of the Cincinnati/northern Kentucky region*, was recently published by the Kentucky Geological Survey.

Geologically, the Cincinnati region is perhaps best known for the abundant and well-preserved Ordovician fossils that have been collected locally for nearly two centuries. There is a voluminous literature on these fossils, oriented to both the amateur and the professional. Dr. Potter has chosen to focus his book on the geologic setting and framework of the area and to relate these factors to the historical and modern development of the tri-state region. He describes the bedrock units and glacial deposits of the area, along with a synopsis of their depositional histories, giving the reader an excellent, broad understanding of the relationships of geologic history to the landscape, mineral resources, geologic hazards, and environmental and construction concerns.

Although the book is oriented toward the nongeologist, an extensive glossary explains the technical terminology that, of necessity, is used where needed. The volume includes 87 maps and photographs and 14 tables. Each chapter has a list of cited references and a separate, annotated list titled "Digging deeper." A useful feature to many readers will be the section titled "Sources of information," which provides names, phone numbers, addresses, and missions of local, state, and federal governmental agencies, museums and universities, and other public and private agencies.

Exploring the geology of the Cincinnati/northern Kentucky region will be a great resource for civil engineers, teachers, planners, architects, and local officials, as well as professional geologists. This volume, known as Special Publication 22, is available from the Kentucky Geological Survey, University of Kentucky, 228 Mining & Mineral Resources Building, Lexington, KY 40506-0107 (telephone: 606-257-5500) for $10.00 plus $3.25 postage ($13.25 total). Please add $0.60 sales tax if shipped to a Kentucky address.

Note: This publication is NOT available from the Ohio Geological Survey.

HANDS-ON EARTH SCIENCE No. 9

by Sherry L. Weisgarber

UNDERSTANDING GEOLOGIC TIME

Time. A simple concept we take for granted every day. "I have a karate class in two hours." "One more day until the weekend." "My birthday is in eight months." "I have worked here for 12 years." "The Ohio Geological Survey originated nearly 160 years ago." "The Age of the Dinosaurs began 245 million years ago." "The Earth is 4.6 billion years old." Well, wait a minute. Maybe the concept of time, especially geologic time, is not so simple. It's easy to comprehend the time span of "one more day until the weekend." However, it is not so easy to comprehend the time span of "the Earth formed 4.6 billion years ago."

How much is a billion? One billion seconds from the beginning of 1996 would be the year 2029. How much is a million? If a person lived for 1 million days, they would be 2,740 years old. These analogies may help put into perspective the immensity of geologic time. We hope the following activity of making a human time line will help even more.

This activity is easier to do outside. You will need an area approximately 260 yards in length, 260 yards of twine, and some masking tape. Mark off the twine in yards using the masking tape and a yard stick. The last yard measured should be marked off in feet. The last foot measured should be marked off in inches. Assign each student an event from the list below. The outdoor scale used here is 2 inches = 1 million years.

The student representing the formation of the Earth should pace off 254 yards from the present. The rest of the students should then pace off their respective distances from the present for their assigned events. For example, the student representing the beginning of life on Earth would pace off 194 yards from the present, and the student representing the first reptiles would pace off 18 yards from the present.

When the human time line is complete, start with the formation of the Earth and have the students shout out what event they represent and how long ago they happened. For example, "I am the first reptile. I appeared 330 million years ago." Remember, the student representing the beginning of the Earth will have to shout very loudly, as they will be more than two football fields away from "the present"!

The students representing "recent" events, those events closer to the present, will be crammed together at the end of the time line. If the students cannot fit closely enough together, use longer pieces of tape to mark the event on the twine and have the students stand to the side.

This activity can be done inside using a smaller scale, such as $^{1}/_{10}$ inch = 1 million years. The time line can be made on adding-machine paper and then taped to the wall. The students could also draw pictures of their events and tape them under the time line on the wall. For "recent" events, a larger scale could be used. This larger scale time line could be taped under the longer time line, indicating that much has happened in a relatively short period of time.

Source: *Ranger Rick's Nature Scope: Digging Into Dinosaurs* (National Wildlife Federation), *Historical geology of North America* (Morris Peterson, J. Keith Rigby, and Lehi Hintze, Wm. C. Brown Company Publishers), *Understanding and collecting rocks & fossils* (Martyn Bramwell, Usborne Publishing), *Fossils, rocks, and time* (Lucy Edwards and John Pojeta, Jr., U.S. Geological Survey).

Note: Maps showing the geology and glacial deposits of Ohio are available from the Division of Geological Survey.

Distance from present, indoor scale (1/10 inch = 1 million years)	Distance from present, outdoor scale (2 inches = 1 million years)	Years ago	Events
38 feet	254 yards	4.57 billion	Formation of Earth • Precambrian
31.5 feet	210 yards	3.78 billion	Oldest known rocks
29 feet	194 yards	3.5 billion	Life on Earth begins • oldest known fossil (anaerobic bacteria)
12.5 feet	83 yards	1.5 billion	Oxygen accumulates in atmosphere • granite-rhyolite emplaced in western Ohio • one-celled algae appear
10 feet	67 yards	1.2 billion	Oldest animal fossil (jellyfishlike organism)
8 feet	56 yards	1 billion	Formation of iron, copper, and nickel ores • rifting in western Ohio, Grenville Mountains form in eastern Ohio
6 feet	37 yards	670 million	Abundant soft-bodied, wormlike animals in the sea • Precambrian rocks deeply eroded in Ohio
5 feet	32 yards	570 million	Cambrian Period • numerous hard-shelled animals (trilobites) appear in the sea
4 feet	28 yards	500 million	Ordovician Period • oldest rocks exposed in Ohio—limestone and shale in southwestern Ohio • North America situated close to Equator • diverse sea life (trilobites, brachiopods, clams, snails, corals, fish without jaws)
3 feet 7 inches	24 yards	435 million	Silurian Period • salt and gypsum deposits in northern and northeastern Ohio • first life on land (ferns and mosses) • first fish with jaws • giant sea scorpions abundant
3 feet 5 inches	23 yards	410 million	Devonian Period • black shale deposits in northern and central Ohio • Age of Fishes • first sharks • first land animals (amphibians and wingless insects) • first forests
3 feet	20 yards	360 million	Mississippian Period • sandstone and shale deposits in eastern, central, and northwestern Ohio • Age of Crinoids • supercontinent Pangea is forming
2 feet 10 inches	18 yards	330 million	Pennsylvanian Period • coal deposits in eastern Ohio • coastal swamps and tropical forests common • formation of Appalachian Mountains • supercontinent Pangea is complete • large winged insects, spiders, and scorpions abundant on land • first reptiles • first evergreen trees • large trees and plants
2 feet 5 inches	16 yards	290 million	Permian Period • youngest rocks exposed in Ohio—sandstones and shales in southeastern Ohio • widespread extinctions occur among land and sea life (trilobites, brachiopods, ancient corals, many amphibians, trees, and ferns) • great fin-backed reptiles (*Dimetrodon*) dominant
2 feet	13 yards	240 million	Triassic Period • no deposits in Ohio • Pangea begins to split apart into Laurasia and Gondwana • Age of Reptiles begins • first dinosaurs • pine forests • abundant clams, snails, modern corals, ammonoids, marine reptiles (ichthyosaurs and plesiosaurs), and land reptiles (phytosaurs) • first small mammals
1 foot 8 inches	11 yards	205 million	Jurassic Period • no deposits in Ohio • North American Plate moves westward at a rate of 6 miles per million years • dinosaurs (*Stegosaurus, Allosaurus, Brachiosaurus, Diplodocus*) rule the Earth • flying reptiles (pterosaurs) appear • marine reptiles common • first known bird
1 foot 2 inches	8 yards	138 million	Cretaceous Period • no deposits in Ohio • formation of Rocky Mountains • North America continues to move west • ammonoids, clams, snails, corals, bryozoans, ichthyosaurs, and plesiosaurs abundant in seas • *Tyrannosaurus* and *Triceratops* abundant on land • large pterosaurs abundant in the air • first snakes • first grasses and flowering plants
6 inches	4 yards	65 million	Tertiary Period • Teays-age stream deposits in southwestern Ohio • North American Plate and Pacific Plate collide • huge extinction (dinosaurs and many other species) • Age of Mammals begins • beginning of modern shell life in seas • North America begins to cool
5 inches	3 yards	45 million	Pangea splits into modern continental masses
4 inches	2 yards	37 million	First elephants, horses, deer, bears, and ancestors of cats and dogs
2 inches	1 yard	24 million	Apes abundant • huge sharks in seas • plant life similar to today
0.04 inch (1 mm)	10 inches	5 million	Early forms of humans • first tool-using primitive humans
0.01 inch (0.3 mm)	3 inches	1.6 million	Quaternary Period • beginning of the Ice Age • abundant horses, mastodons, beavers, porcupines, and large ground sloths
0.008 inch (0.2 mm)	2 inches	1 million	Abundant sabertooth cats, wooly mammoths, bison, and rodents
0.001 inch (0.03 mm)	0.02 inch	10,000 years	End of recent Ice Age • two-thirds of Ohio covered by unconsolidated glacial deposits • many large land mammals become extinct
0	0	the present	Humans dominate the Earth • North America continues to move west

Changes in Survey e-mail addresses

Survey e-mail addresses have changed since listed in the Summer 1995 issue of *Ohio Geology*. The general e-mail address for the Survey is *geo.survey@dnr.state.oh.us*.

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