Inside *Virginia Museum of* NATURAL HISTORY RESEARCH

Virginia Museum of
NATURAL HISTORY
IN ASSOCIATION WITH THE
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TWO DOLLARS

From the Director of Research and Collections

The three main articles in this issue of *Inside VMNH Research* illustrate three fundamental facets of research: Firstly, it can be of immense significance to our way of life. Secondly, ignoring the writings of the earliest researchers could prove perilous. Thirdly, it is often truly surprising and produces spectacular results.

Take the humble caddisfly. As Dr. Richard Hoffman points out, these insects are an important food source for trout, and as a result, the ability to make a good imitation lure can reap great rewards for fishermen. However, they are also significant indicators of water quality, and it is therefore vitally important to have a clear understanding of their diversity in our streams, and to have the ability to monitor changes in their distribution. Such monitoring can't be successful until a comprehensive inventory of caddisflies is completed. Fortunately, Richard and his colleagues, Drs. Oliver Flint and Charles Parker, have already made great strides in this endeavor for the Commonwealth of Virginia. Their work will undoubtedly be a great help to future generations of biologists and conservationists as we strive to maintain the quality of our waterways.

Dr. Lauck Ward has spent a lifetime scouring the waterways and cliff faces of the Coastal Plain, recording the distribution of various fossil invertebrates and vertebrates. Where rivers such as the Mattaponi, the James, the Potomac and the Pamunkey snake across the Coastal Plain, Lauck knows each turn like the back of his hand. He is also equally conversant with the work of the earliest explorers and scientists. Workers such as Thomas Say, Martin Lister and Charles Lyell were keen observers and astute thinkers, and in the world of field geology, we always do well to turn to the masters before jumping to our own conclusions. Admittedly, some branches of science, such as molecular biology and genetics, seem to change with such alarming speed that publications just a decade old are now completely obsolete. Yet, it is comforting to know that this is certainly not true for many basic scientific disciplines; we still continue to build on the foundation of earlier knowledge.

Science is always capable of the unbelievable. In 1963 the State Geologist pronounced the Solite Quarry to be interesting but largely devoid of fossils. Today we know it as one of the world's most significant Triassic localities! The preservation of fossil insects from this site is truly remarkable, and they are matched only by some quite bizarre gliding and swimming reptiles. Equally surprising is a new Triassic locality halfway around the world that is yielding stunningly preserved plant fossils. I anticipate that this new site in China will help us build an even clearer picture of life in the Triassic, and at the same time, provide a link to Virginia.

I hope that these three quite different peeks into research at the Virginia Museum of Natural History will inspire you to go out into the countryside around your own home and see what surprises there are in store for you when you take a closer look. Then perhaps, go a bit further afield – the world is your oyster.

Dr. Nicholas Fraser

From the Executive Director

Conducting meaningful scientific research and then sharing that knowledge is what the scientists and educators at the Virginia Museum of Natural History do best. This issue of *Inside VMNH Research* is no exception. We proudly present our second issue after publishing our first issue last year to excellent reviews including being honored by the Southeastern Museums Conference (SEMC).

In our first issue, we shared with readers research being conducted by three of our scientists. Included were the stories of Dr. Jim Beard's quest to solve some of the mysteries of the deep ocean crust; Dr. Judith Winston's discovery of a new fauna of minute species of bryozoans and other encrusting animals; and, the search by Dr. Alton Dooley to find fossil whales in the Peruvian desert.

With this issue, we learn from Dr. Lauck "Buck" Ward about his research in the Coastal Plain and the fossil beds in cliffs that have been studied since the British settled this region. Dr. Richard Hoffman tells us about caddisflies and their unique ability to construct abodes with precision and elegance. And then there is Dr. Nick Fraser, who is studying sites in China and Virginia with hopes of discovering whether the flora and fauna of the two had more in common during the Triassic than they do today.

As executive director of the Virginia Museum of Natural History, it is a real privilege to work with our scientists and educators as we conduct research around the world and then share that knowledge through publications, lectures, exhibits and our Web site, www.vmnh.net.

Timothy J. Gette

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About the cover: The Harvest Foundation of the Piedmont Great Hall at the new Virginia Museum of Natural History, 21 Starling Avenue in Martinsville. *(Photo by Melody Cartwright)*

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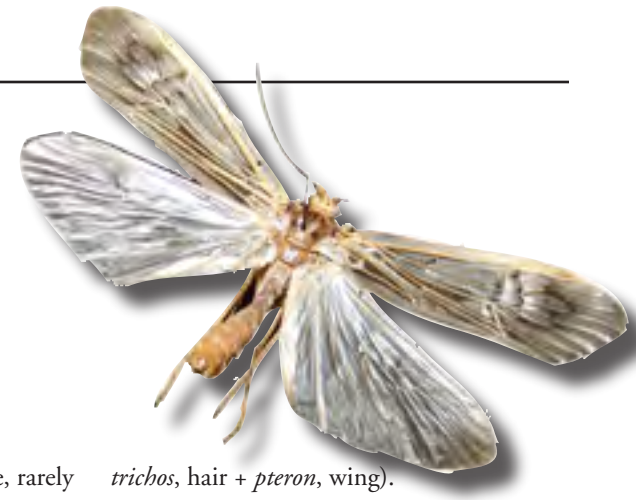
More than just trout food!



By Dr. Richard Hoffman,
VMNH Curator of Recent Invertebrates
and Assistant Director of Biological Sciences

Out of sight, under the water, live the caddisfly larvae. All over the world, these small aquatic insects conduct their daily activities. In icy springs, woodland pools, rivers, lakes, and even warm stagnant swamps, they thrive in astonishing numbers of both individuals and species. Like animals elsewhere, some are vegetarians that grind up and recycle both living and dead plant material; others are carnivorous predators; still others extract microscopic food particles from flowing water by using exceptionally fine sack-like nets of their own weaving. All fall prey to larger animals, among them aquatic biologists and entomologists like me who choose them as objects of study. These larvae, rarely over an inch in length, closely resemble the caterpillar stage of their relatives, the butterflies and moths. They differ in their use of gills to extract oxygen from the water. Like caterpillars, the caddis larvae are basically the feeding and growth stage, and like their relatives, they undergo a period of structural metamorphosis that produces a winged, reproductive stage. Adult caddisflies are not always easy to distinguish from small moths, but a basic difference is that their wings are covered with fine short hairs instead of colorful scales. The scientific group name applied to caddisflies collectively, Trichoptera, reflects that character (from the Greek *trichos*, hair + *pteron*, wing).

Many kinds of animals are renowned for constructing abodes for individuals or colonies: ants, termites, wasps, beavers, weaver birds, and humans. But in terms of structural complexity and elegance of design, none can compare with the case-making caddis larvae. These creatures, despite their somewhat worm-like appearance, have evolved a wide variety of shelters which they construct with precision and adherence to patterns characteristic of their species. They build these shelters by using whatever materials may be available. Species that live in ponds or slow streams often use plant material: a hollowed-out grass-stem, for instance, or a

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Above: With a wingspan of 2.5 inches (60 mm), *Hydatophylax argus* is Virginia's largest caddisfly. The species is widespread in Virginia, but not frequently collected. **Right:** Pinned specimens of three large Virginia caddisfly adults.

Top: Dr. Hoffman demonstrates collection of night-flying adults using an ultra-violet light trap. Insects attracted to the light tube are deflected by the four clear plastic panels and fall into a jar of preservative centered in the bucket below.

Right: An adult caddisfly of the genus *Pycnopsyche*, represented in Virginia by 14 large, light brown species. *(Photos by Dr. David Jones)*

long tube composed of bits of plant stems and leaves cut to size and glued together. The larva is thus camouflaged and difficult to notice except when it moves about. Some stream-dwellers use small pebbles stuck together; others specialize on sand grains glued into a long hollow tube. The individual sand grains are carefully fitted together at the larger end to extend the tube as its occupant grows. The grains may be variable in appearance, or in some cases, almost exactly similar in size, shape, and color. Each grain is obviously selected with great deliberation.

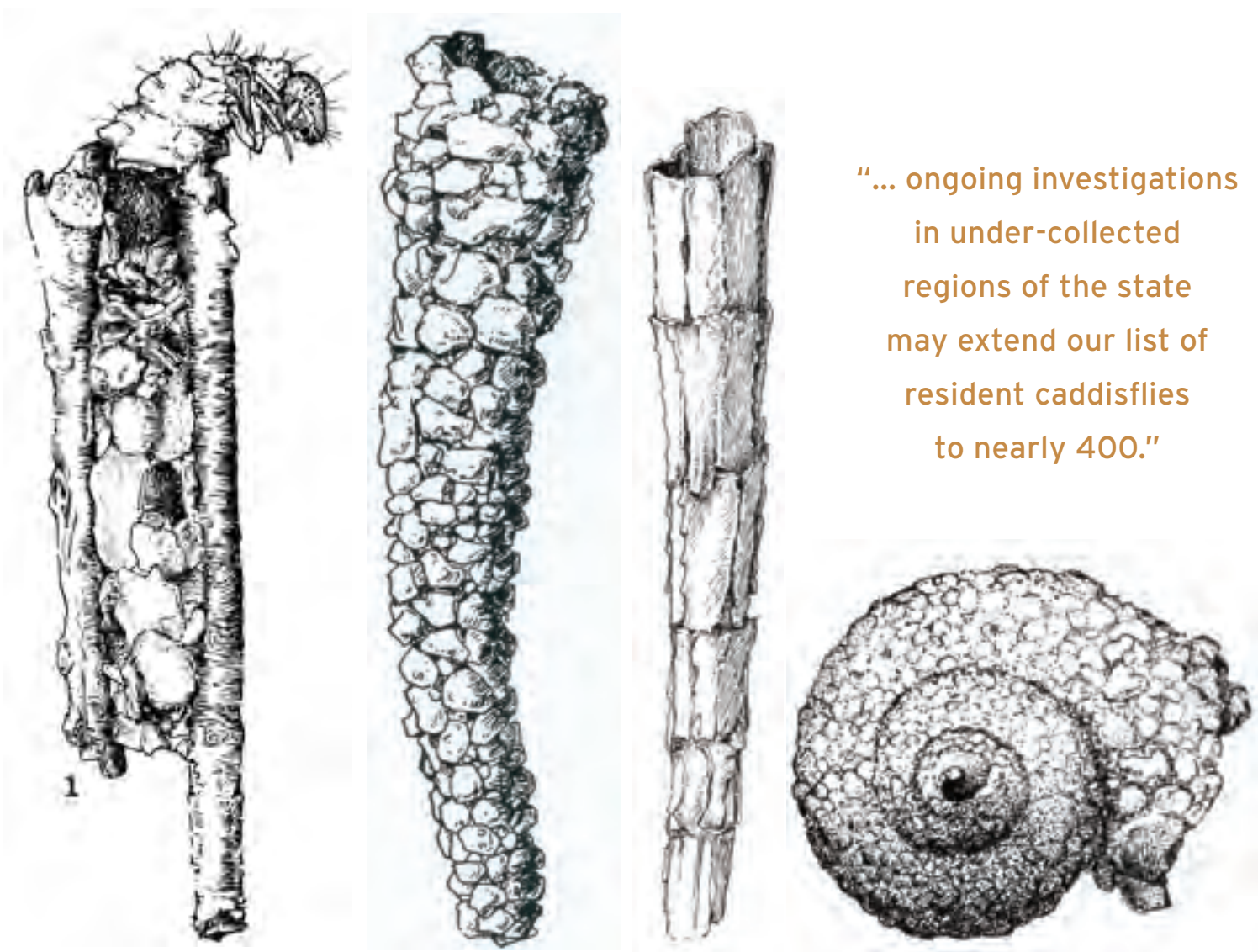
The underwater phase of life ends when the metamorphosizing insects acquire wings and reproductive organs and float to the surface. This emergence is almost instantaneous; the adult must be ready to fly as soon as it breaks the surface film (there can be no long period of wing growth and hardening such as enjoyed by moths). Such emergences often consist of untold thousands of insects, a large number of which fall prey to trout, birds, dragonflies, and other predators. Enough survive to reproduce and recommence the life cycle. It is by random migration of fertilized females (lucky enough to find another suitable habitat to drop their eggs) that caddisflies maintain and extend the ranges of the various species.

Over 9,000 species of caddisflies are known globally, with about 1,400 for North America, and at present, 343 in Virginia. Since these insects act as important indicators of water quality and serve an important role in aquatic food chains, they are of much interest to environmentalists and trout fishermen, some of whom tie their dry-fly lures to resemble the adults. Serious research on our in-state fauna extends back over 30 years, but it was greatly accelerated when the founding of VMNH provided the opportunity for statewide inventory projects. Adults, active mostly at night, are strongly attracted to ultra-violet light, and may be collected by placing a lighted sheet or bucket trap beside a stream or pond after dark. Sometimes thousands of individuals will congregate at the light within a matter of minutes, especially in a Tidewater swamp on a hot humid night. The collector must

endure becoming covered with small excited caddisflies, entirely harmless but a real nuisance when in one's eyes, ears, throat, and nasal sinuses!

The larvae are collected from their various aquatic habitats by hand-picking or with the use of nets. Both larvae and adults are preserved in alcohol, but some adults are usually pinned as well. Identification is normally made in the laboratory, although a number of species are distinctive enough to be recognizable in the field. Although many museum collections contain Virginia caddisflies, by far the three most important are at VMNH, the National Museum of Natural History, and the Entomology Department at Virginia Tech. These collections together hold well over 100,000 specimens from the Commonwealth. Currently an annotated list of Virginia's species is being compiled as the first step toward an eventual illustrated manual that will be used to identify species and help form the basis for more applied studies. As VMNH Curator of Recent Invertebrates, I am working with Dr. Oliver S. Flint, emeritus curator at the National Museum and a VMNH senior scientist, and Dr. Charles Parker, a VMNH research associate stationed at the Great Smoky Mountains National Park as co-investigators for this project. Extensive donations of material from zoologists of the Natural Heritage division of the Department of Conservation and Recreation aid our research. The first half of the list was published in "Banisteria" in 2006; the second half is now being prepared for publication. It is expected that ongoing investigations in under-collected regions of the state may extend our list of resident caddisflies to nearly 400. Virginia now joins the few other states (New York, Illinois, Tennessee, and Alabama) that have achieved a significant stage in the knowledge of these interesting insects. We hope to take the lead in making them better known.

Below: A selection of cases produced by various caddisfly larvae. The structure at left shows a larva partly exposed at top. Despite the great variety in the shape of the cases, the adult stages of the various larvae are basically very similar in overall appearance.



"... ongoing investigations in under-collected regions of the state may extend our list of resident caddisflies to nearly 400."

A Chinese Connection?

By Dr. Nicholas Fraser,
VMNH Curator of Vertebrate Paleontology
and Director of Research and Collections

Thanks to modern airline travel, the distance between China and Virginia doesn't seem quite as far as it once did. Yet, it is still an arduous 13-hour plus flight, and the sights, sounds and smells of the crowded Beijing airport forewarn Virginian visitors that a great cultural difference waits beyond the airport – particularly if they step outside Beijing. The distance between eastern North America and eastern Asia was just as daunting 220 million years ago as it is today. But was the Orient so distinct from the Occident when the continents were joined together as the supercontinent Pangaea and the journey between the two regions could be made entirely by land?

To partly answer that question, my colleagues and I have been undertaking detailed excavations at the Solite Quarry. This unique site, which straddles the Virginia–North Carolina state line, is providing us with one of the clearest windows into terrestrial life 220 million years ago. No other Triassic site in the world has yielded such an abundance of complete insects. Indeed, the rocks at this locality hold such a wealth and diversity of new material and data that it would be impractical for one person to take on the research single-handedly. In 1994, I began to put together a team to investigate every aspect of the sediments and their fossils. Dr. Paul Olsen of Columbia University, who originally discovered the site in 1974, joined me to study the vertebrates. Dr. Dave Grimaldi, Curator of Entomology at the American Museum of Natural History and a world authority on insects in amber, was delighted to lead the insect research. For plants, I approached Dr. Brian Axsmith, a paleobotanist at the University of South Alabama. Along the way, our team has sought the help of a number of

Left: Dr. Zan Shuqin stands in a village in Liaoning Province built on Triassic sediments.

Left: Dr. Nicholas Fraser stands contemplating dinosaur-bearing sediments in a village in northern China.

Above: Triassic scorpionfly from the Solite Quarry.
Right: Triassic thrips from the Solite Quarry.

Above: Countryside around Yixian, Liaoning Province.

(Photos courtesy of Dr. Nicholas Fraser)

Many of the Triassic forms are remarkably similar to their living counterparts.

other experts. For example, we immediately contacted a recognized authority of fossil arachnids, Dr. Paul Selden (at the time at the University of Manchester in England) when we found our first spider. When we were unable to find a method to clean the sediment away from two unique specimens of a new gliding reptile, Dr. Tim Ryan at Penn State kindly agreed to CT scan the blocks, and the incredible skeletons of these remarkable beasts were quickly revealed.

Thanks to the team's discoveries, we now know that the origins of many of today's insect orders and families are linked to the Triassic. Furthermore, many of the Triassic forms are remarkably similar to their living counterparts. For example, a thysanopteran (thrips) that is little more than 1mm long shows exactly the same narrow body and characteristic fringed wing margins as individuals found today wreaking havoc on rose gardens. Abundant plant remains tell a story of richly vegetated hillsides that surrounded a lake in which small aquatic reptiles and fish once feasted on hosts of water bugs. This couldn't have been an isolated verdant oasis of abundant insect life in the Triassic.

What was life like in other parts of the world? Was life so different in the Orient 220 million years ago?

Tanytrachelos, the little aquatic reptile at the Solite Quarry, has a very close cousin called *Tanystropheus* that lived in Switzerland and northern Italy. *Tanystropheus* must rank among the strangest-looking creatures that ever lived. With a neck longer than its body and tail combined, it has been compared to some sort of living drain cleaner. *Tanystropheus* and *Tanytrachelos* both belong to a little-known group of extinct reptiles called protorosaurs. Recently, a new long-necked reptile was discovered in China and described by Dr. Li Chun, a paleontologist at the Institute of Vertebrate Paleontology and Paleoanthropology in Beijing. He named it *Dinocephalosaurus* ("terrible headed reptile") and invited me and my good friend Dr. Olivier Rieppel of the Field Museum to investigate this beast. The nature of its long neck, complete with extraordinarily elongate, overlapping ribs, immediately hinted at very close affinities to the protorosaurs. But, *Dinocephalosaurus*, like *Tanystropheus*, was a marine animal. While the fossil helped us better understand the relationships of *Tanytrachelos*, the

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Above: *Cladophlebis*, **a fossil fern from the Triassic of China.**
Below: Drs. Zan Shuqin and Xing Dehe collect Triassic fossils from Liaoning.

marine sediments did not provide any clues about life on land or life around rivers and lakes during that time.

This is where a stroke of good fortune intervened. Two years ago, as part of an AAM sponsored partnership program, I spent five weeks in Northern China with my host, Dr. Zan Shuqin of Jilin University Museum. While there, I persuaded her to take me to the countryside around the town of Yixian, Liaoning Province, which is home to the famed feathered dinosaurs. While it would be disingenuous for me to claim that the feathered dinosaurs were not a significant draw for me, I was desperate to visit the little-known Triassic outcrops that occur in exactly the same area. So one humid afternoon we set off in a small black sedan. When we could go no farther off the dirt road, we abandoned the car in favor of first, our feet, and later, a donkey-drawn cart. We finally reached a remote village that apparently lacked any running water but was well equipped with satellite dishes! This village is built on Triassic sediments – sediments that we soon found to be extremely rich in fossil plants. This fact had not escaped the local farmers who showed us some of the most complete examples of ferns, cycads and horsetails known from the entire Mesozoic era, let alone the Triassic. Suffice to say, with the support of a National Geographic Society grant, I shall be returning to Liaoning Province this year with Drs. Brian Axsmith and Zan Shuqin to undertake a careful paleontological excavation. The possibility for new insect remains is, perhaps, just as exciting as the plant fossils. We have high hopes that this site will tell us whether the flora and fauna of China and Virginia had more in common in the Triassic than they do today.

Virginia's Coastal Plain

Where the New World Originated

By Dr. Lauck Ward,
VMNH Curator of Invertebrate Paleontology

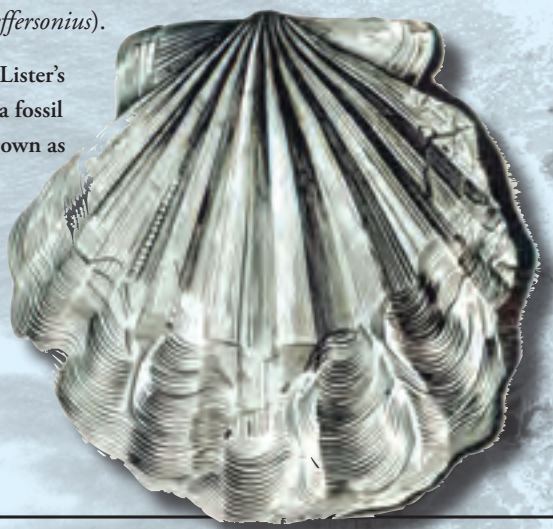
Above: Whales are common in some Coastal Plain beds. This one dates back to about 14 mya (million years ago).

Background photo: These vertical cliffs make collecting a scary experience. *(Photos by Dr. Lauck Ward)*

William Strachey, an explorer who accompanied Captain John Smith, wrote in his notes in 1609 "All the low land of South and North Virginia is conjectured to have been gained naturally out of the sea . . . And we find within the shores of our rivers whole banks of oysters and scallops which lie unopened and thick together as if there had been their natural bed before the sea left them."

The area Strachey was describing is Virginia's Coastal Plain, the cradle of the British colonies in the New World. Though not a geologist, Strachey correctly observed that these mollusks were fossils, still in their living positions, and that this area must have been covered by the sea at one time. The Coastal Plain still exhibits these fossil beds in cliffs great and small on every tidal river in Eastern Virginia. Paleontologists have been collecting and studying these fossils since the British settled. The oldest known illustration of a fossil from North America was of a specimen from the Jamestown area. The specimen was published by Martin Lister in 1687 and the species was later named *Pecten jeffersonius* by Thomas Say in 1824 (now known as *Chesapecten jeffersonius*).

"... the serious research worker must embark on more strenuous activities including scaling 150 foot cliffs to collect fossils systematically from each horizon."



Right: Martin Lister's 1687 figure of a fossil scallop now known as *Cheseapecten jeffersonius*. It is Virginia's state fossil.

The Coastal Plain is that part of Virginia which has been intermittently covered by the ocean during the last 180 million years. The result of these marine transgressions is a series of sedimentary beds that contain the fossils of that era. The tidal rivers and northeast wind have helped to erode these beds into spectacular cliffs full of fossils. Exposures directly across the river from the Jamestown area exhibit slightly lower cliffs, but they are still completely filled with marine fossils, principally mollusks. Other finds in these beds are macro-fossils (easily visible to the naked eye) such as whales, and micro-fossils (only visible under microscope) such as diatoms.

While most amateur collectors prefer the ease of collecting in streams and beaches, the serious research worker must embark on more strenuous activities including scaling 150 foot cliffs to collect fossils systematically from each horizon. Over the years, through such efforts, I have been able to identify and name 21 new and unique geological strata from Maryland, Virginia, North Carolina, and South Carolina. These units have been formally accepted by the U. S. Geological Survey as well as the geological surveys of those states. Moreover, I have also named 10 new genera and 64 new fossil species from Maryland, Virginia, and North Carolina. This is more a testament to how much remains to be discovered about this area and my persistence to learn than any genius on my part.

My interest in fossils was sparked during a visit to the Shenandoah Valley at eight years old.

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Top left: Lieutenant Run in Petersburg contains abundant fossil shells that have been studied since the 1840's.

Right: Pictured is a cliff exposure of fossils around 7 mya at Cobham Wharf in Surry County.

Above: Typical cliff in the Coastal Plain. The geologists pictured are sampling beds that contain the richest assortment of fossils.

Right inset: Mollusks from the Yorktown Formation (3.5 mya).

There, at Bryces, I collected brachiopods and trilobites from the Devonian period (around 375 million years ago). At the time, I lived in Richmond and thought fossils only came from the mountainous regions; I didn't realize I was growing up on the edge of the Coastal Plain where fossils abound. My first taste of the Coastal Plain was in Surry County, right across from Jamestown. Marine scallops littered the beach, and I was told they were brought there by the Indians. Finally a knowledgeable amateur took me to the beaches at Claremont and properly introduced me to the Coastal Plain. The bulk of VMNH's Invertebrate Paleontology Collection is effectively the result of that fortuitous meeting so many years ago. Today these collections consist of 68 cases containing 3,400 drawers of Coastal Plain fossils spanning the last 100 million years of earth's history. Our collection houses mostly mollusk fossils, but also consists of coral, bryozoans, echinoids, crustaceans, etc. that have been collected from some of the most important fossil localities ranging from Massachusetts to Mississippi.

The contents represent a mixture of specimens collected during my college years, two years working for the Maryland Academy of Sciences, followed by 19 years working for the U. S. Geological Survey, and finally my last 18 years working for VMNH.

VMNH Books and Publications

Special Publications:

Proceedings of the Second Symposium on Southeastern Fox Squirrels, *Sciurus niger*. N. Moncrief, J. W. Edwards, and P. A. Tappe. Pp. 1-84. 1993.

Amphibians and Reptiles of Assateague and Chincoteague Islands. J. C. Mitchell and J. M. Anderson. Pp. 1-120. 1994.

Scale Insects of Northeastern North America: Identification, Biology, and Distribution. Michael Kosztarab. Pp. 1-650. 1996.

Developing Staff Resources for Managing Collections. P. S. Cato. Pp. 1-71. 1996.

The Biology of Tiger Beetles and a Guide to the Species of the South Atlantic States. C. B. Knisley and T. D. Schultz. Pp. 1-210. 1997.

Ecology and Evolutionary Biology of Tree Squirrels. M. A. Steele, J. F. Merritt, D. A. Zegers. Pp 1-310. 1998

Proceedings of the Appalachian Biogeography Symposium. R. P. Eckerlin. Pp. 1-258. 1999.

Checklist of the Millipeds of North and Middle America. R. L. Hoffman. Pp. 1-564. 1999.

Identification of Waterfowl Breastbones and Avian Osteology (Sterna) of North American Anseriformes. D. W. Oates, E. D. Boyd, and J. S. Ramaekers. Pp. 1-51. 2003.

A Classification and Checklist of the Genus *Pseudanophthalmus* Jeannel (Coleoptera: Carabidae: Trechinae). T. C. Barr, Jr. Pp. 1-52. 2004.

A Field Guide to Moths of Eastern North America. C. V. Covell, Jr. Pp. 1-496. 2005.

The Hispine Beetles of America North of Mexico (Chrysomelidae: Cassidinae). Charles L. Staines. Pp. 1-178. 2006

Memoirs:

Evolution of Environments and Hominidae in the African Western Rift Valley. N. T. Boaz, ed. Pp. 1-356. 1990.

Molluscan Biostratigraphy of the Miocene, Middle Atlantic Coastal Plain of North America. L. W. Ward. Pp. 1-159. 2001.

Molluscan Assemblages of the Chowan River Formation, Part A. L. W. Ward and N. L. Gilinsky. Pp. 1-40. 1993.

The Megaflora from the Quantico Locality (Upper Albian), Lower Cretaceous Potomac Group of Virginia. G. R. Upchurch, P. R. Crone, and A. N. Drinnan. Pp. 1-57. 1994.

A Synopsis of the North American Centipedes of the Order Scolopendromorpha (Chilopoda). R. M. Shelley. Pp. 1-108. 2002.

Systematics of the freshwater amphipod genus *Crangonyx* (Crangonyctidae) in North America. J. Zhang and J. R. Holsinger. Pp. 1-274. 2003.

Re-description and revision of Smitt's "Floridan Bryozoa" in the Collection of the Museum of Comparative Zoology, Harvard University. J. E. Winston. Pp.1-160. 2005.

A New Species of *Squalodon* (Mammalia, Cetacea) from the Middle Miocene of Virginia. A. C. Dooley, Jr. Pp. 1-17. 2005.

Guidebooks:

Early to Middle Carnian (Triassic) Flora and Fauna of the Richmond and Taylorsville Basins, Virginia and Maryland, U.S.A. B. Cornet and P. E. Olsen. Pp. 1-83. 1990.

Geologic Evolution of the Eastern United States. A. Schultz and E. Compton-Gooding. Pp. 1-304. 1991.

Stratford Hall Plantation and Westmoreland State Park: Physical and Cultural Geology, and Paleontology. L. B. Rohr, M. E. Lewis, and L. W. Ward. Pp. 1-93. 2002.

Eocene and Oligocene Stratigraphy of Southeastern North Carolina. L. W. Ward. Pp. 1-25. 2003

Geology and Paleontology of the Stratford Hall Plantation and Westmoreland State Park. L.W. Ward and A.C. Dooley Jr., Pp. 1-87. 2005.

Geology in the Southside Virginia Piedmont. W. S. Henika, J. Hibbard, J. S. Beard. Pp. 1-30. 2006.

Insects of Virginia:

Seed bugs of Virginia Heteroptera: Lygaeoidea: Lygaeidae). R. L. Hoffman Pp. i-vi, 1-111. 1996.

Assassin bugs of Virginia (Heteroptera: Reduviidae). R. L. Hoffman. Pp. 1-73. 2006.

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The George Ferguson Mineral Collection

Mr. George Ferguson of Bracey, Virginia has been an enthusiastic collector of minerals for many years. When his collection reached the point where it had started to overtake the basement of his lakeside home, Ferguson decided he wanted to share it with others instead of leaving it in his basement where only he, his family, and his friends could enjoy it. So, Mr. Ferguson approached VMNH Curator of Earth Sciences Dr. Jim Beard. On arriving at the Ferguson home, Dr. Beard was thrilled to see a wonderful array of minerals from Virginia and around the world.

Through Mr. Ferguson's generosity, VMNH now has an additional 200 mineral specimens that will be accessible to the students of Virginia. We hope that the same minerals that inspired George Ferguson to begin collecting years ago will excite future generations of Virginian students, and we are grateful to Mr. Ferguson for his willingness to share his passion with the people of the Commonwealth.

*Sulfur, Mexico.

Blue Kyanite from Willis Mountain, Buckingham County, Virginia

*Amazonite, Amelia County, Virginia

Angelwing Calcite, Mexico

*Turgite, Buckingham County, Virginia

Flame Agate, Texas

Picture Agate, Nevada

Specimens were donated by George Ferguson. *denotes those donated on behalf of John Smith. *Photos by VMNH Registrar, Jill K. Harris.*

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