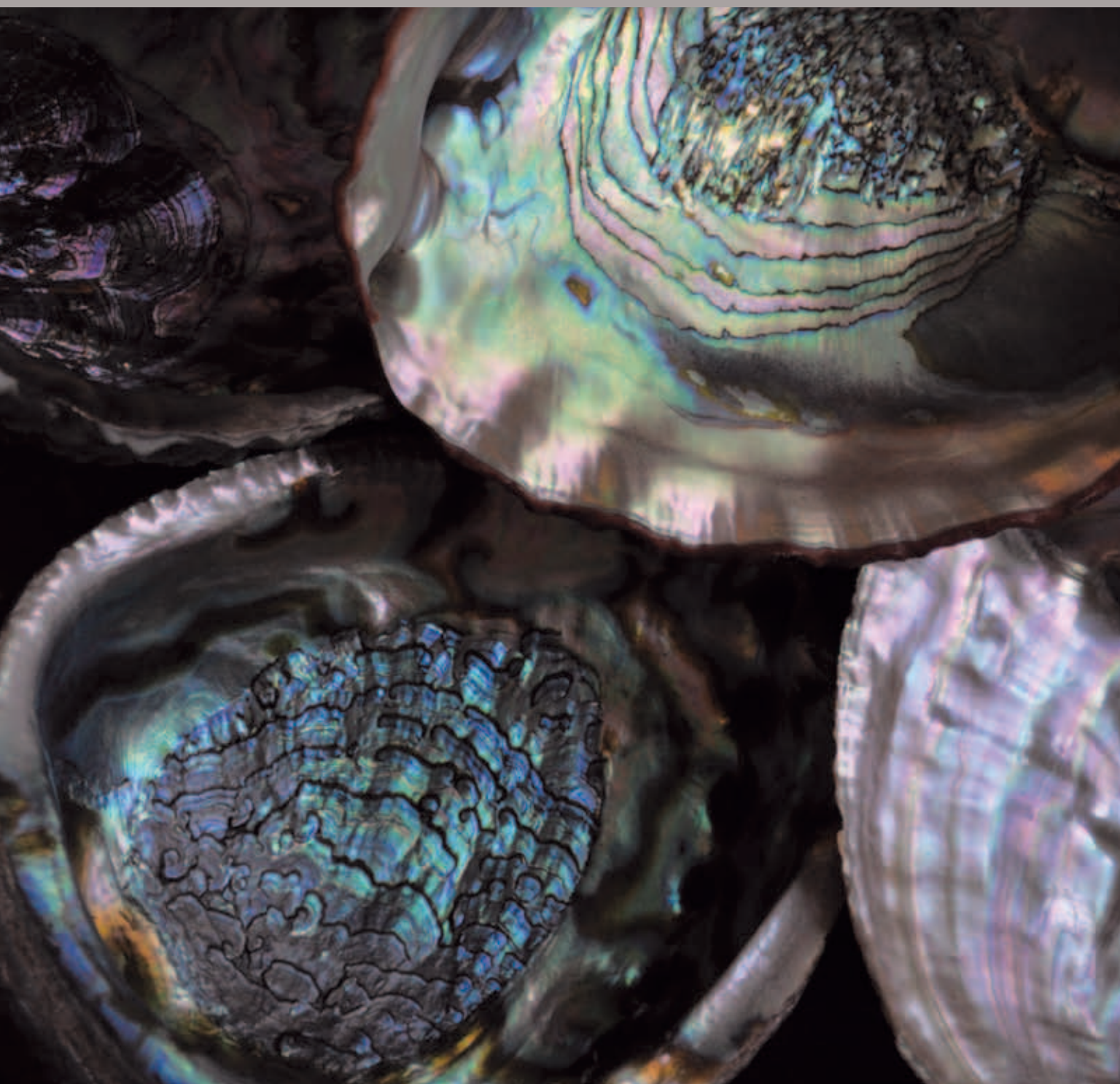
ACADEMY

FRONTIERS

The member magazine of the Academy of Natural Sciences of Drexel University

March 2012

Special Bicentennial Supplement



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Academy Frontiers is a quarterly publication of the Academy of Natural Sciences of Drexel University, 1900 Benjamin Franklin Parkway, Philadelphia, PA 19103.

Academy membership includes a subscription to *Academy Frontiers*, free admission to the museum, discounts in the Academy Shop and Academy Café, invitations to special events and exhibit openings, and much more.

For information about Academy membership, call 215-299-1022 or visit ansp.org/membership.

On the cover: *Iridescent Abalone shells (genus* Haliotis*) from the Academy's Malacology Collection. Photo by Brandon Zimmerman.*

Academy Frontiers

Bicentennial Supplement

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On March 21, 1812, seven amateur naturalists gathered to form a society in which they could engage in "modest and friendly converse" on the subject of science. They wished to share their collections, books, ideas, and discoveries with each other and with like-minded individuals around the world. These Academy founders had formed what was to become one of the most important natural history research institutions in the world. Growing from its humble beginning in rented rooms above a Philadelphia apothecary shop, the Academy is recognized today as a leader in biodiversity and environmental science.

At the Academy of Natural Sciences of Drexel University, our mission is to bring our scientific discoveries to you. With support from our colleagues at Drexel University, we have launched a new version of ansp.org that connects internet users everywhere with news about our research, programs, and more. During our Bicentennial, Town Squares, Urban Sustainability Forums, and a scientific symposium will present up-to-the-minute environmental and biodiversity information. Outreaches and workshops will bring foundational natural science knowledge to learners young and old. Our bicentennial exhibit, *The Academy at 200: The Nature of Discovery*, will immerse you in our scientists' discoveries and current research throughout the world.

In this special bicentennial supplement, we provide a glimpse into why the Academy has gained its reputation as a center for world-class scientific research. On page 4, we reflect on our founding and examine the ways Academy scientists have shaped the institution. On pages 16-19, we introduce you to three Academy staff members featured in *The Academy at 200: The Nature of Discovery*. In the center of this issue, we offer you a very special look at our behind-the-scenes collections.

The next 365 days will be some of the most exciting ever to take place at the Academy, and I look forward to spending many of them with you. Thank you for your ongoing support of the Academy of Natural Sciences of Drexel University on this, the 200th anniversary of our founding.

All the best,

George W. Gephart, Jr.
President and CEO

SCIENCE AT THE ACADEMY:

By Gary Rosenberg, Curator and Pilsbry Chair of Malacology,

When the Academy of Natural Sciences was founded in 1812, Philadelphia was an epicenter for scientific inquiry. Decades of developments in science and medicine had brought influential scientific leaders to Philadelphia. The city was home to John and William Bartram's botanical garden, the multi-disciplinary American Philosophical Society founded by Benjamin Franklin, and a commercial natural history museum under the guidance of Charles Willson Peale. Lewis and Clark's transcontinental expedition, concluding just six years before, prompted questions about the diversity of life in the American wilderness. The timing was ideal for the birth of an institution dedicated to the encouragement and cultivation of the natural sciences.

Founded in rooms above an apothecary shop at the northeast corner of Market and Second streets, this "glorious enterprise," the Academy of Natural Sciences of Philadelphia, was the first of its kind in the Americas. Academy members rapidly built a foundation for the study of natural sciences by sharing their specimen collections, building a library, and establishing in 1817 the *Journal of the Academy of Natural Sciences*, the first journal in the Western Hemisphere dedicated to natural sciences. The institution quickly established itself as a leader in biological studies in North America, a position it has maintained for 200 years.

ANSP Archives Coll. 49

The site of the Academy's founding at Market and Second streets in Philadelphia

EARLY DEVELOPMENTS AT THE ACADEMY

Among early Academy members were scientists who are now considered the "fathers" of their respective disciplines in the Americas. By integrating and systematically arranging knowledge in their fields, these pioneers provided a foundation for generations of natural science research.

Academy founder Thomas Say gave scientific names to more than 1,000 species of insects and more than 300 species of mollusks. He was the first American to study mollusks formally; before his time, most scientists sent these organisms to Europe for identification and study. William Maclure, an early member and president of the institution from 1817–1840, produced the first geological map of the United States.

ANSP Archives Coll. 286

Portrait of Thomas Say by Charles Willson Peale

Born 11 years after the Academy's founding, Joseph Leidy became an important member during the middle of the 19th century. He was a gifted scientist who broke ground in several scientific fields before he became the institution's president in 1881. He petitioned for Charles Darwin's election to Academy membership in 1860, leading the Academy to become the first American scientific institution to recognize Darwin's contributions.

ANSP Archives Coll. 9

Joseph Leidy with the bones of Hadrosaurus foulkii

Leidy described the first nearly complete dinosaur skeleton discovered in North America, *Hadrosaurus foulkii*, and he uncovered information on extinct species whose fossils he assembled

200 YEARS AND COUNTING

and Roland Wall, Director of the Center for Environmental Policy

at the Academy. He also studied and published papers on invertebrates, fungi, and protozoa. Much of his research had important relevance to humans, including his conclusion that meat should be fully cooked to prevent parasitic infection.

Although amateur scientists and wealthy collectors often set the direction for scientific study during Leidy's early years at the Academy, his diverse interests demonstrate the increasing professionalization of science that developed during his lifetime. In fact, biographer Leonard Warren has described Leidy as "the last man who knew everything," reflecting Leidy's mastery of many of the specialized biological fields that developed by the end of the 19th century.

COLLECTING AND EDUCATING

Bolstered by scientists like Leidy, the Academy was instrumental in establishing in the United States the ethic of assembling and preserving natural history collections for scientific study. Through this work, the institution served as a model for natural history museums across North America.

Partial lower jaw of an American mastodon from the Academy's Thomas Jefferson Fossil Collection, ANSP 13103. Gift of the American Philosophical Society, Philadelphia

In 1812, Academy founders assembled their own specimens from nature to establish the institution's first natural history collections. That same year, the Academy purchased the Adam Seybert Mineral Collection, then the largest and most important mineral collection in America. Midway through the century, the institution acquired bird collections from the Duc de Rivoli and John Gould; became the depository for Thomas Jefferson's fossil collection; and received plant specimens from Lewis and Clark's Corps of Discovery Expedition. Enhancing the diversity of these collections were specimens gathered during Academy-sponsored expeditions. These specimens still help scientists identify species, providing an essential foundation for the scientific process.

Throughout the century, the Academy worked to share its scientific discoveries with the public, a goal that remains central to its mission today. Just 16 years after the institution's founding, it began to display its collections for the public by opening a museum at 12th and Sansom streets. Building on a tradition of public lectures dating back to 1814, the Academy renewed its focus on public education in 1896 with assistance from the Ludwick Institute, a foundation supporting education in Philadelphia. The Education Department was formally established in 1936.

Expeditions, beginning in 1817 and expanding internationally in 1890, brought specimens from around the world into the museum and its collections. In 1929, dioramas began to give visitors a window into the natural landscapes of other parts of the world by displaying specimens gathered during expeditions. A combination of science and artistry, these dioramas helped museum visitors understand the amazing biological diversity of our planet.

ANSP Archives Coll. 64

Brooke Dolan (left) with members of the 1943 Dolan Expedition to Tibet

Erik Almas Photography

The animals in the Academy's Takin diorama were gathered during Brooke Dolan's 1931-32 expedition to China and Tibet. When the diorama was completed, it was the only exhibition of takin in the world.

ENVIRONMENTAL SCIENCE AT THE ACADEMY

As scientists of the early 20th century explored their ever-changing world, they began to understand the ways human actions affect natural systems. Early conservationists in America recognized that the earth's resources were limited as they saw the impact of the Industrial Revolution on a country that, just a century before, had been one of the largest wilderness areas on Earth.

As Academy scientists continued to collect specimens that would one day make the institution an important source of information about changing natural systems, they increasingly discovered that integrating information from a wide range of scientific disciplines opened new possibilities for research. The Academy's Dr. Ruth Patrick led the way in developing an interdisciplinary approach to environmental research. The driving force linking the institution's continuing studies in the traditional sciences to the study of ecology, Patrick enriched the Academy's relevance and established the institution as a major player in the field of environmental research.

ANSP Archives Coll. 2010-020

Dr. Ruth Patrick at work in the Diatom Herbarium

Starting with a groundbreaking 1947 study of the Conestoga River near Lancaster, Pennsylvania, Patrick's work helped develop practices and principles that would set standards for scientists and regulators across the country. Patrick pioneered the formation of interdisciplinary teams focused on ecosystem-level analysis of streams and rivers, conducted comparative studies of disturbed and pristine waterways, and connected water quality to ecosystem function.

Her most important discovery was that scientists can assess human disturbance of waterways by examining the biodiversity of organisms within them. Today the United States Environmental Protection Agency and other regulatory agencies use sophisticated versions of this fundamental principle to assess water quality in aquatic and terrestrial ecosystems. The Academy's Patrick Center for Environmental Research, which bears Patrick's name, also uses updated versions of this approach to monitor and assess water quality throughout the United States.

ANSP Archives Coll. 2010-020

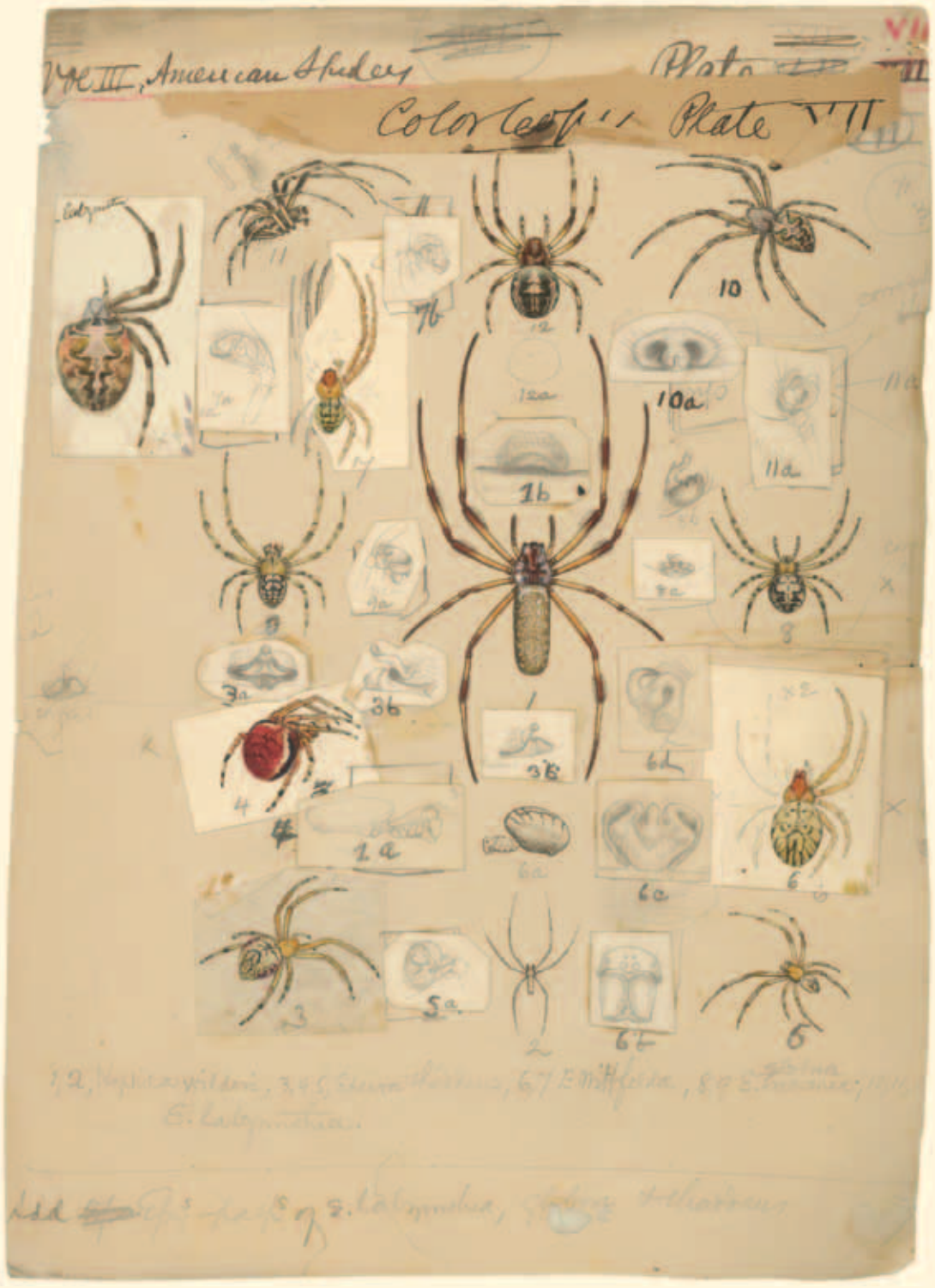
Patrick (fourth from left) with members of the 1948 Conestoga Survey

By conducting rigorous scientific analyses while providing accessible information to decision makers and the public, the Academy became a respected voice on critical environmental issues. In the 1970s, the institution's scientists assisted in drafting the Clean Water Act, a law that regulates water pollution. In the 1980s, they monitored the effects of the Three Mile Island nuclear accident. Recent Academy research has helped identify invasive fish species, recognize contaminants in the Delaware River, monitor stream conditions before and after dam removal, investigate the impacts of sea level rise, and determine whether gas drilling in the Marcellus Shale Formation is affecting local streams.

(continued on page 15)

Roger Thomas/ANSP

David J. Velinsky (right), vice president of the Patrick Center for Environmental Research, and Philippe Hensel of the National Oceanic and Atmospheric Administration drill a stainless steel rod into a Barnegat Bay marsh until it meets resistance. This process leaves a stable benchmark on which our scientists can measure the elevation change of wetlands over time to help them understand wetland health and whether wetlands are going to be sustainable in the future.



LIBRARY AND ARCHIVES

Since the 1990s, the Academy Library and Archives has created about 20,000 digital images from rare books and archival materials. Staff digitize paper materials using cameras and scanners in the Greenfield Imaging Center and outsource archival films to a professional laboratory. Items scanned from Library and Archives collections are captured "as is"; wear and tear and occasional smudges are part of a book's social history. Staff record information about the items, such as bibliographic citations, and digitally attach these records to the images. The Library fulfills imaging requests through its Interlibrary Loan program, giving staff scientists and researchers around the world access to hard-to-find publications. For more information, contact library@ansp.org.

Image: Original pencil and watercolor drawing for Henry McCook's *American Spiders and their Spinningwork* (1889–93). ANSP Archives Coll. 478

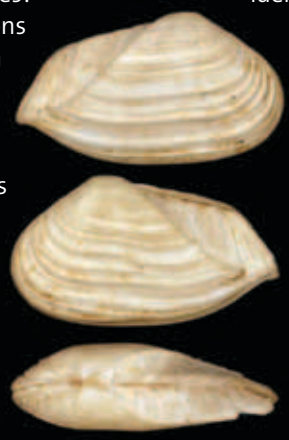
DIGITIZATION

ENRICHING THE FUTURE OF NATURAL HISTORY COLLECTIONS

By Mary Alice Hartsock, Editor

Is that flower in your yard actually an invasive weed? Is the insect climbing on your roses a garden pest or a helpful visitor pollinating your plants? Does this unfamiliar mollusk possess enough unique characteristics to be considered a new species?

These and many other questions increasingly are being answered with the help of electronic databases, which contain the digital records of specimens in our natural history collections. According to the Academy's many collection managers and curators, digitization enriches the future of natural history collections.



Corbula lyonsi
ANSP Malacology 70538

More than 30 years ago, Academy scientists began building computerized digital records of specimens by inputting scientific names; dates and locations of collection; collector names; and other relevant data. Having all of this information in one place allows scientists to search our catalogs quickly and analyze data on specimens collected decades or even hundreds of years ago. This analysis supports studies of present-day issues such as the effects of climate change on living things.

"A database can allow you to track the distribution and the abundance of a species over time," says Ichthyology Curator John Lundberg. "When you know the locations of a species, the characteristics of its habitats, and its tolerances to certain kinds of weather, you could take models of climate change and predict what will happen in 100 years."

In the past two decades, scientists have added digital images to this data, making digital specimen records even more valuable to scientists throughout the world and the general public. Digital images of many Academy specimens are online, and several departments are working to make images publicly accessible. Collection managers often help individuals gain access to images that are not available online.

"The public is better informed by the images," says Lundberg. "Good photographs of specimens can be easier to understand than written work, which often can be too technical."

ADDING SCIENTIFIC VALUE

For scientists inside and outside the Academy, digital images of specimens increase the usefulness of our collections. Researchers across the world can now see the images on their computers, eliminating the risk of Academy specimens being damaged when they are loaned to other institutions. Images help researchers identify what they need for additional study and prompt follow-up visits to the Academy.

"Many researchers around the world need to consult valuable type specimens, which were designated as the name-bearing specimens when a new species was described," explains Botany Assistant Curator Tatyana Livshultz.

"Not many years ago, a researcher would write to ask if we had the specimen, and the collection manager would find it and physically mail it to the researcher," Livshultz says. "Now you can log in to an online database, look up a specimen, and see a high-resolution digital image."

Having digital images of type specimens puts researchers on the same page, explains Malacology Collection Manager Paul Callomon. If everyone looks at the same image of a type specimen, the chance for misidentification decreases.

Online digital data and images also are time-saving resources.

"Next only to insects, mollusks are the largest group of animal species, and new mollusks are being discovered at the same rate as they were during the 19th century," Callomon says. "It can be hard even for experts to keep track. One thing that makes our work more efficient is not having to leave your desk to confirm the identification of a specimen."

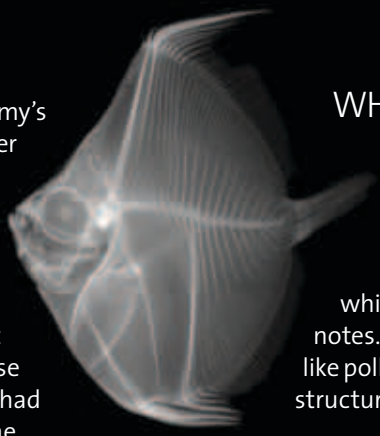
DIGITAL IMAGING BASICS

The process for generating a digital image varies from department to department. For Callomon and his colleagues in the Departments of Malacology, Entomology, Ornithology, Ichthyology, and the Diatom Herbarium, the process involves taking high-resolution photographs of specimens using a digital camera.

In other departments the process requires different equipment. Botany, for example, uses a large, upside-down flatbed scanner to record images of extremely delicate dried plant specimens. The Academy Library and Archives uses a similar process along with other methods to digitize fragile archival materials. Visual Resources

for Ornithology (VIREO), the Academy's image bank of live birds, uses a scanner to digitize 35 mm slides, some dating back to the 1950s.

Ichthyology staff photograph fish specimens and use a digital X-ray imaging system to create high-quality radiographs that reveal fishes' skeletons. Before these methods were available, scientists had to destroy soft tissues to view the bones, which can indicate differences and similarities between species.



Antigonia browni
ANSP Ichthyology 60173

Academy ichthyologists also are using high-resolution micro CT (computerized tomography) scans to create 3-D images. These images are useful for examining small specimens, and they can be rotated and sliced into sections digitally.

Given the diversity of specimens within the collections and the many different methods scientists use to learn more about them, organizing the Academy's digital data can be a challenge.

"We're steeped in data," says Database Programmer Steve Dilliplane, regarding the cards, discs, CDs, hard drives, and other devices that store specimen information. "Managing the digital collection enables us to share the information widely."

Dilliplane enables internet searches of Academy databases by standardizing data fields and building "data bridges" between collections. His work increasingly involves migrating images into the databases. He finds ways to overcome technological and organizational hurdles, freeing up time for collection managers and curators to focus on specimens.

WHY SPECIMENS ARE IMPORTANT

While images enhance specimens' value and make them accessible to more people, the originals must be preserved in the collections.

"Specimens preserve genetic material, which you can't get from an image," Livshultz notes. "In plant specimens, microscopic structures like pollen provide valuable information about plant structure and evolutionary relationships. Botanical specimens often preserve information on the ecological interactions of the plant while it was still alive."

The rapid developments in science suggest that specimens might provide information decades from now that we can't even anticipate needing today. Specimens are and always will be the ultimate sources of reliable information.

LOOKING TOWARD THE FUTURE

For now, most digitization efforts at the Academy focus on the type specimens, which help researchers determine whether two specimens belong to the same or different species. Government and private foundations recognize the scientific value of digitization, advancing this new frontier by providing financial resources to museums and universities.

The Academy currently has more than 18 million specimens in its collections, which are growing every day. As the Academy moves into its next 100 years, digitization will be of the utmost importance.

Diatoma mesodon
ANSP Diatom Herbarium GC111350

The Academy thanks the following contributors for their generous support of our digital imaging projects.

The Albert M. Greenfield Foundation
The Andrew W. Mellon Foundation
Cornell Multiscale CT Facility
Delaware Valley Ornithological Club
ERC Endowment for Chesapeake Watershed Research
Friends of Mollusks
Hattersley Collection Care Fund
Institute of Museum and Library Services
Mr. Shewell D. Keim
National Film Preservation Foundation
National Science Foundation
United States Geological Survey National Water Quality Assessment Program
University of Texas High-Resolution X-ray Computed Tomography Facility

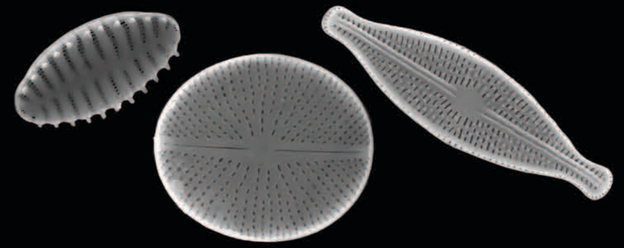
Thank you to the Academy scientists and staff who contributed their time and expertise to the digitization feature: Jennifer Beals (Diatom Herbarium); Cathy Buckwalter (Library and Archives); Paul Callomon (Malacology); Ted Daeschler (CSBE); Steve Dilliplane (CSBE); Linda Ellsworth (Institutional Advancement); Clare Flemming (Library and Archives); Tanya Livshultz (Botany); Kyle Luckenbill (Ichthyology); John Lundberg (Ichthyology); Marina Potapova (Diatom Herbarium); Nate Rice (Ornithology); Dan Thomas (VIREO); Doug Wechsler (VIREO); and Jason Weintraub (Entomology).

1 cm

ORNITHOLOGY

In the early 2000s, the Ornithology Department photographed most of the bird skin type collection using a handheld digital camera. Digital photographs of our complete spreadwing collection, which may be the most diverse collection of its kind in the world, are available online at vireo.ansp.org. Ornithology collections do not traditionally loan type specimens, so digital images are essential for expediting research. The Ornithology Department's next priorities are to enhance and expand its type image collection, generate digital images of extinct and endangered species, and photograph specimens from the Audubon Collection.

Image: *Brotogeris chrysopterus* (Golden-winged Parakeet), ANSP Ornithology 188404



1 µm

DIATOM HERBARIUM

The Academy's Diatom Herbarium began generating digital images of slides in March 2009 as part of a major collection renovation project. Herbarium staff imaged type specimens stored on glass slides using a digital camera connected to a light microscope and a computer. The process is complicated because many slides contain a whole community of diatoms consisting of many individuals and species, and only one diatom in that community is a type. If this diatom is not clearly marked, staff must study the slide through the microscope to determine which species is the type. Visit clade.ansp.org/diatoms/interim/imggallery.php to view type specimen images.

Images, left to right: *Staurosira construens* var. *venter*, GCM4750; *Cavinula pseudoscutiformis*, GCM4443; *Brachysira microcephala*, GCM4443

1 cm

ICHTHYOLOGY

Ichthyology staff photograph fish specimens and use the state-of-the-art Inspex 20i Digital X-ray Imaging System to create high-quality radiographs that reveal fishes' skeletons. Features of the skeletons can suggest evolutionary relationships and help distinguish differences between species. Academy ichthyologists also send specimens offsite for imaging via high-resolution micro CT (computerized tomography) scans. These scans generate 3-D models that can be manipulated and sliced into sections, almost like a loaf of bread, enabling scientists to focus on one section of the specimen at a time. The department has digitized type specimens and other historically important specimens. Visit clade.ansp.org/ichthyology/FTIP/zsearch.php to search.

Image: *Dactyloscopus moorei* (Speckled Stargazer), ANSP Ichthyology 30621

5 mm

MALACOLOGY

The Academy's Malacology Department was the first in the institution to begin inputting digital data in 1976. Digital imaging began in 2001, with the first camera room built in 2002. Malacologists place a shell on a stand above a black or white background and take a photograph using a digital SLR camera also on a stand. Currently the Malacology Department performs imaging upon request, though the department hopes to develop a new system that will enable digital imaging of all its type specimens. Visit clade.ansp.org/malacology/collections/gallery.php to see online images.

Image: *Abra aequalis*, ANSP Malacology 58227

60 mm

133 mm

ENTOMOLOGY

Scientists in the Academy's Entomology Department take digital photographs of specimens using macrophotography. They utilize a digital single-lens-reflex (SLR) camera, equipped with various interchangeable macro-focusing lenses. For extremely small insect specimens or slide-mounted samples, scientists often use a digital camera attached to a binocular microscope. Though most imaging of insect specimens occurs upon request, entomologists have digitized historically and scientifically important portions of the collection, including the Titian R. Peale Collection of butterflies and moths as well as some portions of the Entomology Type Collection. Visit clade.ansp.org/entomology/collections/peale/index.html to view digital images of the Peale Collection online.

Images, left to right: *Scamandra thetis* (Stål), *Angamiana floridula*, *Chrysiridia ripheus* (Drury)

95 mm

BOTANY

Academy botanists use two Herbscans, large, upside-down flatbed scanners held in heavy metal frames, to create digital scans of dried and pressed plant specimens. The Herbscan was constructed by a team of imaging specialists at the Royal Botanic Gardens Kew specifically for the Global Plants Initiative, an international collaboration to build a digital archive of type specimens. Since 2006, the Botany Department has imaged more than 22,000 type specimens and other historically important specimens from the Philadelphia Herbarium. Upcoming digitization efforts will focus on North American bryophytes (mosses) and lichens. Images are available at ph.ansp.org and will be part of a global database housed in JSTOR.

Image: *Solidago ludoviciana* (A. Gray) Small (Louisiana goldenrod), phoo027133

VIREO

Visual Resources for Ornithology (VIREO) is the most comprehensive bird image bank in the world. It was started in 1979 to provide a centralized and taxonomically curated slide collection of avian photos for scientific and public use. Since the 1990s, VIREO has scanned about 40,000 35 mm transparencies dating from the 1950s to the 2000s. Some older Kodachrome slides must be scanned twice and the two images composited to produce clean, sharp images. VIREO also has 45,000 images taken on digital cameras in its growing collection. The images provide a record of bird species and behaviors and depict colors of "soft parts" such as bills, legs, and eyes, which do not preserve well in the bird skin collection. Visit vireo.ansp.org to access the entire VIREO Collection online.

Image: *Coeligena iris* (Rainbow Starfrontlet), wo2/38/054

Doug Wechsler/VIREO

(continued from page 6)

LOOKING TOWARD THE FUTURE

Over the last 200 years, the Academy has gathered important information about our planet and its organisms and studied and interpreted the complicated ways those organisms interact with their environment. As scientific and technological advances have developed, so too has the Academy's ability to perform cutting-edge research in biodiversity and environmental science.

Until the 1950s and 1960s, Academy research about the diversity of the world's plants and animals was still largely based on their size, shape, and coloration. In the 1970s, Academy researchers began using electronic microscopes, acoustical recordings, and enzyme studies to determine more precisely the differences among species.

Today, DNA sequencing and mass spectrometry provide information about specimens collected long before the double helix was discovered. Academy scientists use computers to analyze vast collections of data to reconstruct evolutionary relationships and to visualize the distribution of species in geographic information systems.

Academy expeditions continue in the 21st century. Specimens gathered during recent expeditions to Vietnam, Mongolia, the Philippines, Jamaica, Brazil, Peru, Canada, and many other areas strengthen the collections and enhance the institution's ability to identify species and uncover evolutionary relationships. Today's expeditions are driven not only by the urge to discover, but also by the urgent need to protect habitats and demonstrate the importance of biodiversity.

As biodiversity studies have evolved, so too have public attitudes and policy priorities regarding the environment. Though we still seek ways to regulate pollution, concerns about development and consumption of natural resources require critical thinking about sustainable ways to balance natural and human systems.

As the Academy enters its third century, continued exploration of the natural world will help our scientists, together with our partners at Drexel University, learn more about maintaining this delicate balance. Despite enormous growth in our knowledge of biological diversity over the past 200 years, scientists think that at least half and perhaps as much as 90 percent of the world's species remain undiscovered and unnamed. Discovering and describing this diversity and promoting a more sustainable planet to preserve it will be among the Academy's glorious enterprises for the next century.

Natalia Tkach

In 2011, the Academy of Natural Sciences and Drexel University announced a unique academic affiliation that unites two of Philadelphia's most respected research institutions and promotes learning, discovery, and civic engagement in the natural and environmental sciences. The new partnership creates many opportunities for collaboration between Academy and Drexel scientists. Botany Collection Manager Alina Freire-Fierro (above, surrounded by Gunnera *plants in Panama), is studying the origin and diversification of the plant genus* Monnina, *which grows from the southern United States to Chile and Uruguay. Her Ph.D. advisor, Dr. Walter F. Bien, is a Drexel ecologist who has been associated with the Academy for more than 35 years.*

INTRODUCING TRACY QUIRK AND DAVID KELLER

From as far away as Mongolia and as close to home as Pennsylvania, New Jersey, and Delaware, scientists from the Academy's Patrick Center for Environmental Research (PCER) work to enhance environmental quality and improve environmental stewardship. This multidisciplinary group of environmental scientists and engineers studies ecosystem health, analyzing the ways natural processes and human activities affect aquatic systems.

The Patrick Center was named for Dr. Ruth Patrick, whose pioneering environmental research at the Academy set the stage for future work aimed at protecting and promoting the health of freshwater and coastal marine ecosystems. Following in her footsteps, PCER scientists Dr. Tracy Quirk and David Keller seek solutions to environmental problems that affect organisms and their surrounding aquatic environments.

Quirk, a wetland ecologist, came to the Academy in 2010 after she completed her Ph.D. at the University of Delaware's School of Marine Science and Policy. Having grown up in New York City, she was first exposed to nature and environmental issues while majoring in wildlife and fisheries biology in college.

Field experiences in dune, wetland, and stream ecosystems across the world prompted her to pursue graduate degrees and a postdoctoral research position at the Academy. Recently promoted to section leader of PCER's Wetland Ecology Lab, Quirk has been coordinating regional, long-term wetland monitoring projects.

"A large part of my research examines the ecological value of wetlands to society and the impacts of human activities on wetlands," Quirk says. "Wetland monitoring initiatives will document how wetlands are affected by climate change. I want to help people understand why it's important to maintain the wetlands in the face of sea level rise and various human impacts such as urbanization."

Quirk wants people to know that, in addition to providing habitats for wildlife, wetlands protect coastal communities from storm surges and flooding. Wetlands also help to reduce watershed nutrient inputs to estuaries, improving water quality and habitat for shellfish and fish.

Quirk studies changes in wetland elevations to predict whether wetlands will be sustainable given projected rates of sea level rise. She looks at changes in plant communities, plant biomass, and soil and water chemistry, which help her understand wetland health and how human activities like mosquito control and urbanization may be contributing to wetland changes. Quirk performs this research with the help of various PCER scientists.

Roger Thomas/ANSP

Tracy Quirk monitors wetland surface elevation changes at Island Beach State Park in Barnegat Bay, New Jersey. The Patrick Center team jackhammers stainless steel rods down into the marsh until they meet resistance (page 6, center photograph), leaving a stable benchmark against which Quirk can measure the elevation change of the wetlands over time.

"Having a multidisciplinary team allows the Academy to have expertise in many areas, which makes us a great resource for people and agencies that want to monitor water quality," she says.

Fisheries Scientist David Keller agrees. He uses different methods to assess animal populations than Quirk does to study plant, microbial, and physical processes in wetlands, but both scientists help people and agencies lessen their environmental impacts.

Keller came to the Academy in 2004 after working for the New Jersey Division of Fish and Wildlife in the state's Department of Environmental Protection. He works with Senior Fisheries Scientist Dr. Richard Horwitz to survey endangered and invasive fishes and to assess how manmade environmental disturbances impact aquatic communities of fishes and other organisms. Results of this work help guide conservation, industry, and water management decisions.

"Government agencies have limited resources to study endangered and invasive species," Keller says. "We help them by providing assistance in those areas."

Keller also coordinates the fieldwork for the Academy's research on the potential impacts of drilling in northeastern Pennsylvania's Marcellus Shale Formation. This multidisciplinary study led by Dr. Jerry Mead and Frank Anderson is dedicated to understanding the cumulative effects of mining natural gas on small streams by examining the aquatic insects, fish, amphibians, algae, and water chemistry in areas with varying densities of mining activity.

As field manager, Keller makes sure all aspects of the field research are completed safely and according to industry standards. As a fisheries scientist, he also is sampling fish, salamanders, and crayfish and recording information about their habitats. He and other Academy scientists will use this information to compare sites with different densities of drilling and to determine if drilling is impacting these streams.

Though Keller and Quirk focus on different projects, they help to guide important decisions about water quality monitoring and environmental conservation through their research. You can wade through a Barnegat Bay marsh with Quirk or investigate the effects of gas drilling alongside Keller when you visit our bicentennial exhibit, *The Academy at 200: The Nature of Discovery*.

"When people come to visit the Academy in 2012, they will learn more about how the Academy is actively involved in current research," Quirk says. "I love the fact that we're in the field, observing the world around us and trying to make sense of it all. Now visitors will get to experience that, too."
~Mary Alice Hartsock

Linda Zaoudeh/ANSP

David Keller (right) nets Flathead Catfish as Paul Overbeck steers an electrofishing boat on the Schuylkill River below Philadelphia's Fairmount Dam. An invasive species first documented in the Schuylkill in 1997, Flathead Catfish have spread throughout the Delaware River drainage. Academy scientists plan to implant these fish with tracking devices and release them back into the river to find out how they impact the ecosystem.

MEET JASON POOLE

Doug Wechsler/ANSP

Jason Poole holds a cast of a Tyrannosaurus rex *jaw discovered by paleontologist Stan Sacrison and excavated in South Dakota by the Black Hills Institute of Geological Research (BHI). The Academy purchased this jaw from BHI along with a cast of the dinosaur's skull, which is on display in Dinosaur Hall and represents the best preserved and most complete* T-rex *skull ever discovered.*

Fossil Prep Lab Coordinator Jason Poole wants to set the record straight. The fossil record, that is. While unearthing and repairing fossils, he answers countless questions and clarifies misconceptions about animals that roamed the earth millions of years ago.

"Many people watch movies and TV shows about dinosaurs, and they come away without realizing the content can be sensationalized," Poole says. "We can fill in the blanks by helping people understand what is really known, how it's known, and what the limitations of science are right now. Someday our visitors may push those limitations in their own research."

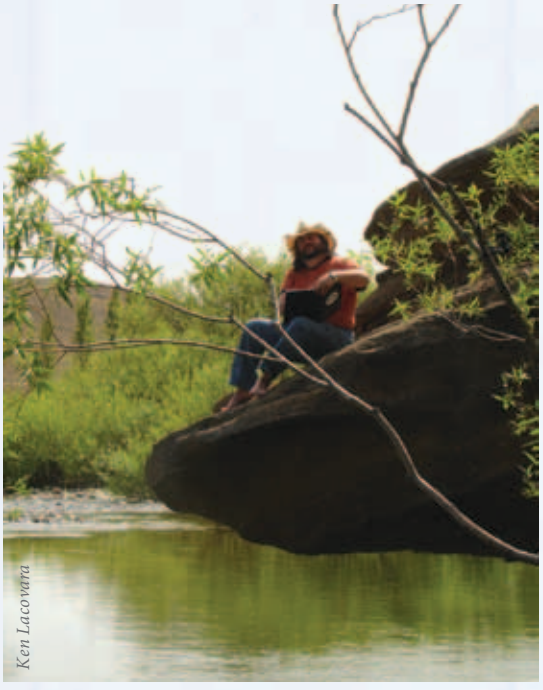
Answering questions from observers is Poole's favorite part of his work. Confident the Academy has "done its job" when the museum experience continues at home, he invites curious visitors to email him with inquiries.

Poole has been an Academy educator for almost 18 years, but he has been interested in paleontology all his life. As a child growing up in Philadelphia, he collected trilobite and fern fossils, and as a young teenager, he made comic book art featuring dinosaurs.

Poole's undergraduate training in classical art prepared him to work as a fossil preparator. He acquired the ability to work with chemicals and putties, which he now uses to repair fossils. Visualization techniques he picked up in school help him mentally assemble shattered fossils and disjointed skeletons. After he began working at the Academy, he complemented his art education with graduate-level

courses on dinosaur taxonomy, osteology, and historical geology.

Poole got his start at the Academy by volunteering in the temporary *Jurassic Park* exhibit, soon returning to the institution to learn cutting-edge techniques of fossil preparation. He later educated visitors about everything from water quality to baby animals while serving as a teacher naturalist. Now that he's in charge of the Fossil Prep Lab, he oversees Dinosaur Hall, trains volunteers to repair fossils, teaches adult classes, co-stars in live animal stage shows, performs at Mega-Bad Movie Night, and more.



Poole sketches an archaeological dig site during the 2005 expedition to Patagonia, Argentina.

"I often work with Academy scientists who spend most of their time behind the scenes," Poole says. "It's amazing to see how they explain their work to visitors during special programs. I have a lot of respect for folks who, with such passion, are able to inspire visitors to learn more and get involved. It makes my job way too fun."

With the Academy's new affiliation with Drexel, Poole now counts even more experts among his colleagues. In fact, he's been working with Drexel paleontologist and Associate Professor of Biology Dr. Ken Lacovara for more than 10 years. During an expedition to Egypt in 2000, their team unearthed *Paralititan*, a new type of titanic dinosaur. Those fossils were later prepared in the Fossil Prep Lab.

In 2004 Lacovara and a Drexel crew traveled to Patagonia, Argentina, where they found a 66-million-year-old, super-massive dinosaur fossil. The following year, Poole did the mapping for the expedition and went into the field with the team. He made sure the fossils were collected properly so that they would arrive in good condition in the Fossil Prep Lab.

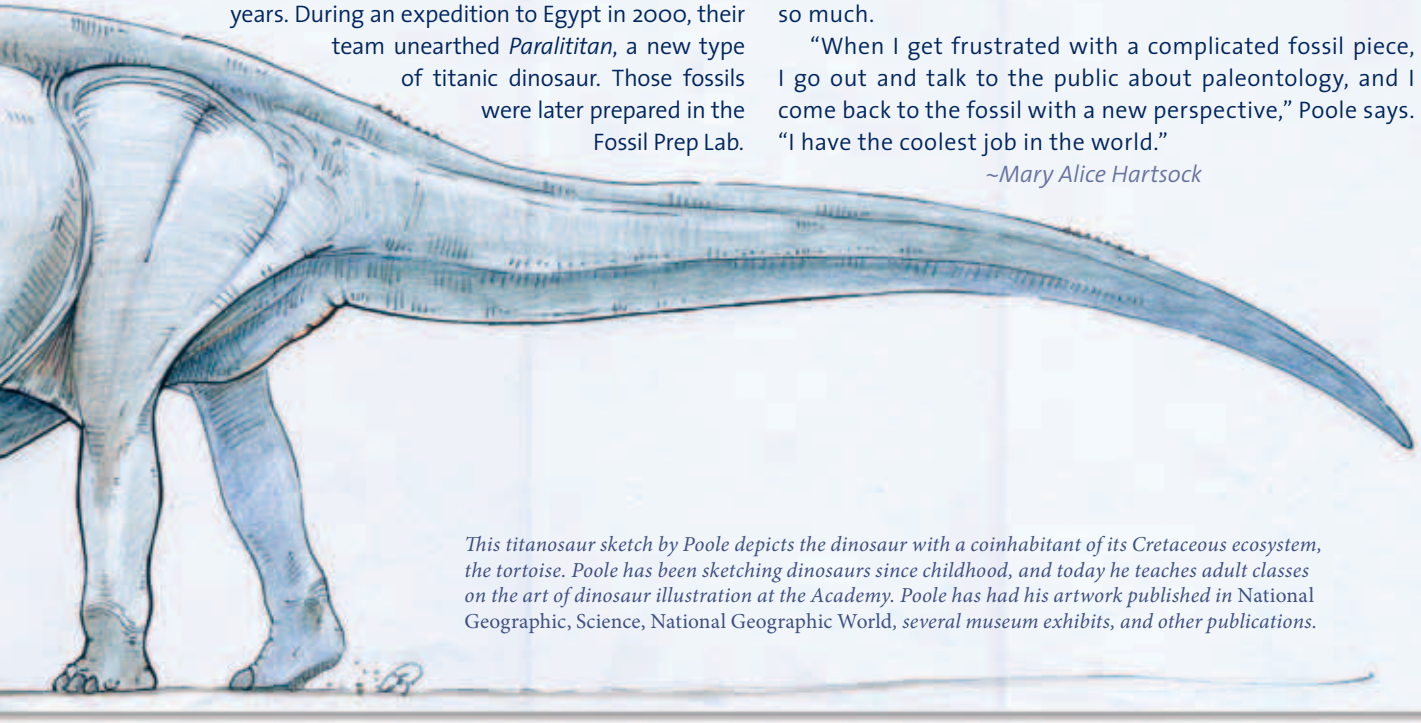
Lacovara and Poole work well together, Poole notes, because they share a passion for communicating their research to the public.

"My philosophy is, 'Why bother doing the science if you can't get it out there and get people interested?'" Poole says. "When visitors' first lab experience is seeing world-class research in action, they learn that the behind-the-scenes research is even more important."

The bone lab in the Academy's bicentennial exhibit, *The Academy at 200: The Nature of Discovery*, features Poole and Lacovara plus some early Academy paleontologists who were the first to discover and study dinosaurs. After you see the exhibit, you can stop by the Fossil Prep Lab in Dinosaur Hall to ask Poole one of those questions he loves so much.

"When I get frustrated with a complicated fossil piece, I go out and talk to the public about paleontology, and I come back to the fossil with a new perspective," Poole says. "I have the coolest job in the world."

~Mary Alice Hartsock



This titanosaur sketch by Poole depicts the dinosaur with a coinhabitant of its Cretaceous ecosystem, the tortoise. Poole has been sketching dinosaurs since childhood, and today he teaches adult classes on the art of dinosaur illustration at the Academy. Poole has had his artwork published in National Geographic, Science, National Geographic World, *several museum exhibits, and other publications.*

THE ACADEMY
OF NATURAL SCIENCES
of DREXEL UNIVERSITY

1900 Benjamin Franklin Parkway | Philadelphia, Pennsylvania 19103

TWO HUNDRED
YEARS *of* DISCOVERY

BICENTENNIAL CALENDAR: MARCH 2012–MARCH 2013

The Academy turns 200 on March 21, 2012! We invite you to celebrate with us during a full year of bicentennial festivities.

MARCH 2012

Bicentennial Weekend
March 24–25, 2012, 10 a.m.–9 p.m.

Multimedia light show on the Parkway, on the hour and half hour from 7:30–10:30 p.m.

On Exhibit: *The Academy at 200: The Nature of Discovery*
March 24, 2012–March 2013

APRIL 2012

2-for-1 Visit Days
April 2012–March 2013

Discounted admission on the 21st of each month

Sustainability Rocks!: Earth Month
Every day during April

Bicentennial Town Square Series: New Questions for an Old Planet
April 2012–June 2013 $

Academy Earth Day at the Philadelphia Science Festival
April 21, 2012, 11 a.m.–4 p.m.

A Glorious Enterprise
Book Talk and Signing
April 25, 2012, 6:30 p.m.

MAY 2012

The Academy by the Book: Library Month Featuring Women In Natural Sciences
Every day during May

Women In Natural Sciences Discovery Weekend
May 12–13, 2012, 10 a.m.–5 p.m.

Philadelphia Airport Exhibit, *The Academy Takes Flight*
May–November 2012
(ticketed passengers)

JUNE 2012

Birds of a Feather: Ornithology Month
Every day during June

Bird Discovery Weekend
June 9–10, 2012, 10 a.m.–5 p.m.

30th Anniversary of the Women In Natural Sciences Program
June 2012, Celebration date TBA $ 📞

JULY 2012

Furry, Scaly, Slimy: Mammal, Reptile, and Amphibian Month
Every day during July

Mammal, Reptile, and Amphibian Discovery Weekend
July 14–15, 2012, 10 a.m.–5 p.m.

AUGUST 2012

Bug Bonanza: Insect Month
Every day during August

Bug Fest
August 11–12, 2012, 10 a.m.–5 p.m.

SEPTEMBER 2012

All About Algae: Diatom Month
Every day during September

Bicentennial Scavenger Hunt
September 8, 2012

Diatom Discovery Weekend
September 22–23, 2012, 10 a.m.–5 p.m.

Behind-the-Scenes Tours

April 15, 2012–February 2013
Thursdays–Mondays at 11 a.m.
Ages 8 and up $

OCTOBER 2012

Shells!: Malacology Month
Every day during October

Bicentennial Scientific Symposium, Biodiversity: From Evolutionary Origins to Ecosystems Function
October 11–12, 2012 $ 📞

Philadelphia Shell Show and Festival
October 20–21, 2012, 10 a.m.–5 p.m.

Cuisine From the Collections Party
October 27, 2012 $ 📞

NOVEMBER 2012

A Living Exhibit: Live Animal Month
Every day during November

Live Animal Discovery Weekend
November 23–25, 2012, 10 a.m.–5 p.m.

DECEMBER 2012

Focus on Fish: Ichthyology Month
Every day during December

Fish Discovery Weekend
December 8–9, 2012, 10 a.m.–5 p.m.

JANUARY 2013

The Science of Plants: Botany Month
Every day during January

Botany Discovery Weekend
January 19–21, 2013, 10 a.m.–5 p.m.

FEBRUARY 2013

Can You Dig It? Fossil Month
Every day during February

Paleopalooza
February 16–17, 2013, 10 a.m.– 5 p.m.

MARCH 2013

Third Century Celebration
March 20, 2013 $ 📞

$ Fee 📞 Registration required

Unless otherwise noted, all events held at the Academy are free with museum admission.

Visit ansp.org for more information and to register.
Check *Academy Frontiers* and ansp.org for more upcoming events.