



AMERICAN MUSEUM OF NATURAL HISTORY

# ROTUNDA

Member Magazine  
Summer 2015 Vol. 40 No. 3

# DARWIN GOES DIGITAL

EXPEDITIONS REPORT

# From the President

Ellen V. Futter



On May 5, the National Science Board awarded the American Museum of Natural History its prestigious 2015 Public Service Award. The citation commended the Museum for “fostering public understanding of science through scientific research, improving the teaching and learning of science, and training and encouraging the next generation of scientists.”

In accepting the award on behalf of the Museum, I had the opportunity to highlight its extraordinary work, and to point to specific ways in which the Museum is now marshaling its exceptional resources—its scientific research, collections, laboratories, equipment, galleries, and educational expertise, along with a deep well of public trust built up over nearly 150 years—and applying them in new ways in the formal education system and through groundbreaking partnerships

to train the next generation of scientists, science teachers, and a scientifically literate populace.

I’m alluding, of course, to such model programs as our Richard Gilder Graduate School’s Ph.D. program in comparative biology, our Master of Arts in Teaching science program, and the Urban Advantage middle-school science collaborative, to name just a few. Through these and many other pioneering initiatives, the Museum is forging a new role for natural history museums in the 21st century and reinforcing the centrality of science to our nation, society, and people’s everyday lives.

I hope you, as a Member, share in the pride of this important recognition of the Museum’s leadership and work, at a time when it is more important and essential to our nation and world than perhaps ever before.

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## ROTUNDA

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# New York City Coyotes, Explained



This image of a mother coyote and her pups in the Bronx was captured by the Gotham Coyote Project.

The city’s normally shy coyotes have made some unexpected appearances this year, most notably in Manhattan’s Riverside Park. Mark Weckel, who manages the Museum’s Science Research and Mentorship Program and also works with the Gotham Coyote Project (GCP), says coyotes are fixtures of New York City wildlife now—just not very visible ones.

“Urban coyotes have smaller home ranges, and they find the areas we frequent the least,” says Dr. Weckel.

Weckel and his GCP colleagues say that animals like the one spotted in Riverside Park are likely tourists from the Bronx, where a breeding population has been established for years. The GCP has been following these populations with video cameras for several years, capturing images like the one above of a mother coyote and her pups. While the animals are unlikely to find a foothold in Manhattan, Long Island is another story.

In April, GCP staff, including Weckel, published an article in the journal *Cities and the Environment* that described the establishment of a coyote population on Long Island as “inevitable and imminent.” The GCP is trying to anticipate how the coyotes will make inroads to these new habitats so they can better understand the ecosystem change that will accompany them.

“We’re developing computer models that tell us where we want to monitor for colonization,” says Weckel. “We’ll need to collect baseline data on fox and rodent populations in these areas before and after coyotes arrive.”

So what does the expansion of coyotes into more of the city mean for New Yorkers? Not much, Weckel says. Despite the spate of appearances this spring, coyotes are retiring animals that are most successful when they avoid humans.

“There is very little risk to living next to coyotes, because they don’t want to see you or be seen by you,” Weckel says.

## Explorer Updated for Android

The Museum has a lot to offer, and we want to make sure that visitors can always find what they’re looking for—whether that’s the *Stegosaurus* or a sandwich after a long day browsing the galleries. That’s why we recently updated our first-of-its-kind Explorer app. The latest version, which features a new look and enhanced wayfinding features, was developed with the support of Bloomberg Philanthropies through the Bloomberg Connects initiative. Explorer is now available for Android on Google Play, as well as for iPhones on Apple App Store.

With this update, the Museum began using Bluetooth wireless technology, which uses short-range, low-power wireless devices called beacons for navigation. Explorer now uses a new location-awareness and mapping system powered by more than 700 Bluetooth beacons located all around the building.

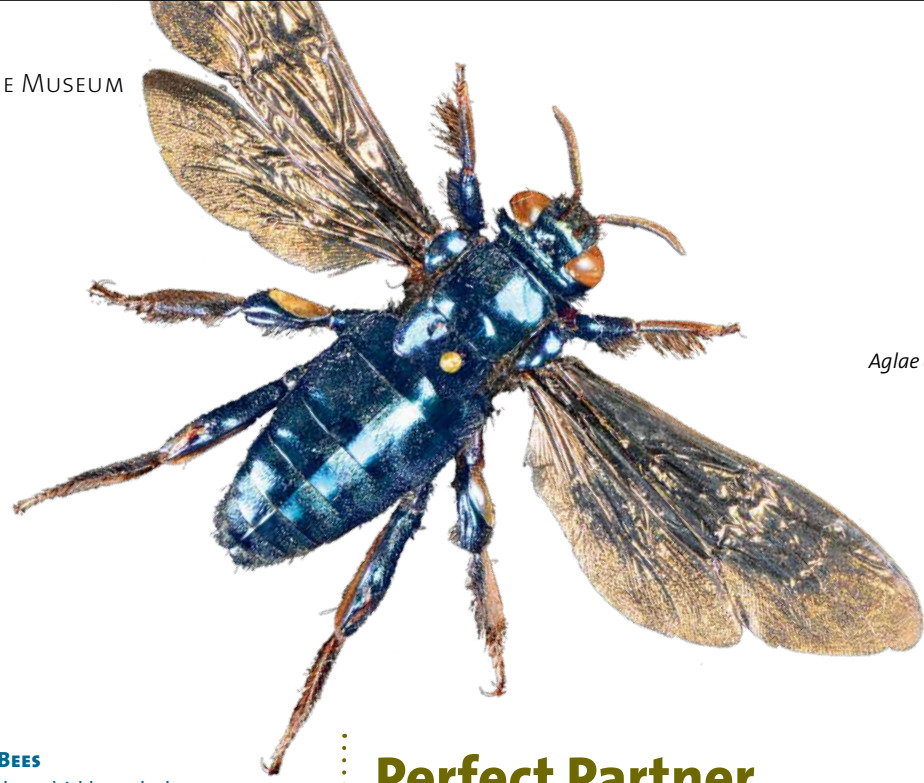
Smaller than a pad of Post-it notes, these devices contain fairly simple electronics: a circuit board that identifies each beacon with an individual identification number, a Bluetooth antenna that broadcasts that number, and a pair of batteries.

The beacons broadcast their IDs on the same frequency and at the same “volume,” and a phone that’s running the Explorer app will be able to pinpoint its user’s location in relation to nearby signals. The app can then calculate the best route from its current position to an exhibit, the nearest cafe, or restroom.

Supported by Bloomberg Philanthropies.



The new Explorer app is available for Android and iPhone.



Aglae caerulea

**“WELL-TONGUED” BEES**

The tribe to which orchid bees belong, Euglossini, means “well-tongued” in Latin, referring to the prodigious mouthparts of most orchid bee species, which are used for sipping nectar from the deep wells of orchid flowers. The tongues of some orchid bee species are longer than their bodies and tend to curl around behind them when not in use. In preserved specimens, these tongues are sometimes mistaken for stingers.

**LOOK, DON'T TOUCH**

Contrary to appearances, male orchid bees don't actually have stingers. The more rarely seen females do, and are quite capable of defending themselves from predators and entomologists alike. “Females can produce a painful sting if you try to catch one with a bare hand,” says Scientific Assistant Ely Wyman, speaking from experience in the field.

**BURGLAR BEES**

Not all orchid bees are industrious gatherers of nectars and scents. Some orchid bee species have become parasites, stealing food and shelter from other species. To make sure their young are brought up right, these insects operate as cuckoo-like “kleptoparasites” that lay their eggs in the nests of neighboring orchid bees and let them handle the child-rearing duties.

**NO NECTAR FOR YOU**

Usually, a bee's visit to a flower results in a bite to eat for the animal in return for pollinating the plant. Some of the flowers that orchid bees visit don't produce nectar, though, meaning the insects don't get a meal in exchange for helping to pollinate the plant. The fragrant oils these flowers produce are the bees' only reward.

## Perfect Partner

Orchid bees are famous for their long tongues, which are ideally suited to sipping pollen from the narrow necks of orchids in the neotropical regions of South America, where both are common. The massive mouthparts are just one of many adaptations born out of the partnership between the orchid family and this group of bees, many of which are distinguished by their bright, metallic colorations that make them look like flying green, gold, or blue gemstones.

As orchids and bees have evolved close relationships, certain species of bee have come to prefer certain species of orchid, and vice versa. The flowers even have a specialized way of transferring their pollen via bee.

“Orchids transfer pollen in sticky clumps called pollinia,” explains Jerome Rozen, curator in the Museum's Department of Invertebrate Zoology. Different orchids have evolved shapes that place these pollinia at specific sites on an orchid bee's body. “Some pollinia will stick to a bee's head,” Rozen says. “Others will cling farther back on its body.”

These precise placements of pollen increase the chances that the bee will successfully fertilize another flower of the same species. A pollinia that attaches to a bee's abdomen, for instance, is unlikely to be knocked off until that bee visits another orchid of the same kind that placed it.

Orchid bees also collect scents from flowers. Scraping up aromatic chemicals using brush-like fibers found on their legs, a male orchid bee will transfer the chemical to a pouch in its abdomen. By visiting a variety of blossoms, males create unique bouquets, which scientists think are used to impress females during mating. “It's thought that creating a combination of smells demonstrates fitness,” says Scientific Assistant Ely Wyman.

The importance of combining scents is also suggested by the absence of females at traps—males show up in force when a single, strong scent is present, but just one aroma is not enough to draw out females of the species. Researchers use this behavior to their advantage when collecting specimens: Wyman says potent essential oils like eucalyptus and wintergreen tend to be the most effective at attracting male orchid bees, though he has also had success with less savory aromas. “I have a jar of artificial feces smell that I've used in the past,” says Wyman. “I don't travel with that anymore, though. I'm too afraid it will break in my luggage.”

See a larger-than-life model of an orchid bee in *Life at the Limits*, now on view and free for Members.

## Exquisite Threads

One of the most recent additions to the Museum's anthropology collections, accessioned about six months ago, is this intricately embroidered jacket from Kashmir with a historic link to the Indian craft movement.

The jacket came to the Museum, along with 10 other pieces, from the collection of Enakshi Bhavnani, author of *Decorative Designs and Craftsmanship of India*. The late Mrs. Bhavnani traveled widely through India with her husband, film producer and director Mohan Bhavnani, including trekking into the inner Himalayas. She was an active member of the Crafts Council of India, which was founded in 1964 to support artisans and keep their crafts relevant and marketable amid rapidly changing economies at home and abroad.

This jacket is notable for “the embroidery, the stitching, the array of colors, and the variety of patterns,” says Laurel Kendall, chair and curator in the Division of Anthropology. “It's just exquisite.”

Embroidery is an ancient art. As Bhavnani notes in her book, bronze needles found at the archaeological site of Mohenjo-daro in Pakistan's Sindh province suggest that some form of needlecraft has been practiced for thousands of years.

Also striking is continuity over time and place. “Each region naturally has worked out its own modes, influenced by particular environmental conditions, customs, and history,” wrote Bhavnani. “But all through there is a similarity in the use of the basic stitches like the satin, stem, chain, darning, running, and herringbone, which have been used in a multitude of ways with varying inspiration to give each embroidered object a characteristic beauty all its own.”

Kashmir, long associated with the high-quality fabric woven from the wool of cashmere goats, also has its own recognized tradition of embroidery, characterized by delicate designs with motifs following nature—a tradition well represented in this jacket's exuberant interweaving of birds and flowers.

See more artifacts from the Museum's anthropology collections at [amnh.org/our-research/anthropology](http://amnh.org/our-research/anthropology).



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**TREASURE TROVE**

The Museum has a total collection of more than 55,000 Asian ethnological objects, from religious paintings to tools. Some 6,700 items, including more than 750 textiles, are from South Asia, making it the fourth-largest collection by geographic location after China, the Philippines, and Russia.

**FINE EXAMPLE**

In the Islamic section of the Gardner D. Stout Hall of Asian Peoples, visitors will find a traditional woman's costume from the Upper Sindh province purchased in 1962: embroidered dupatta (scarf), embroidered kameez (dress) embellished with tiny mirror insets, striped shalwar (pants), and tufted khussa (slippers). Such outfits are still worn in Sindh today, made using the same ancient process of cotton weaving, dying, and hand embroidery.

**LOCAL SOURCE**

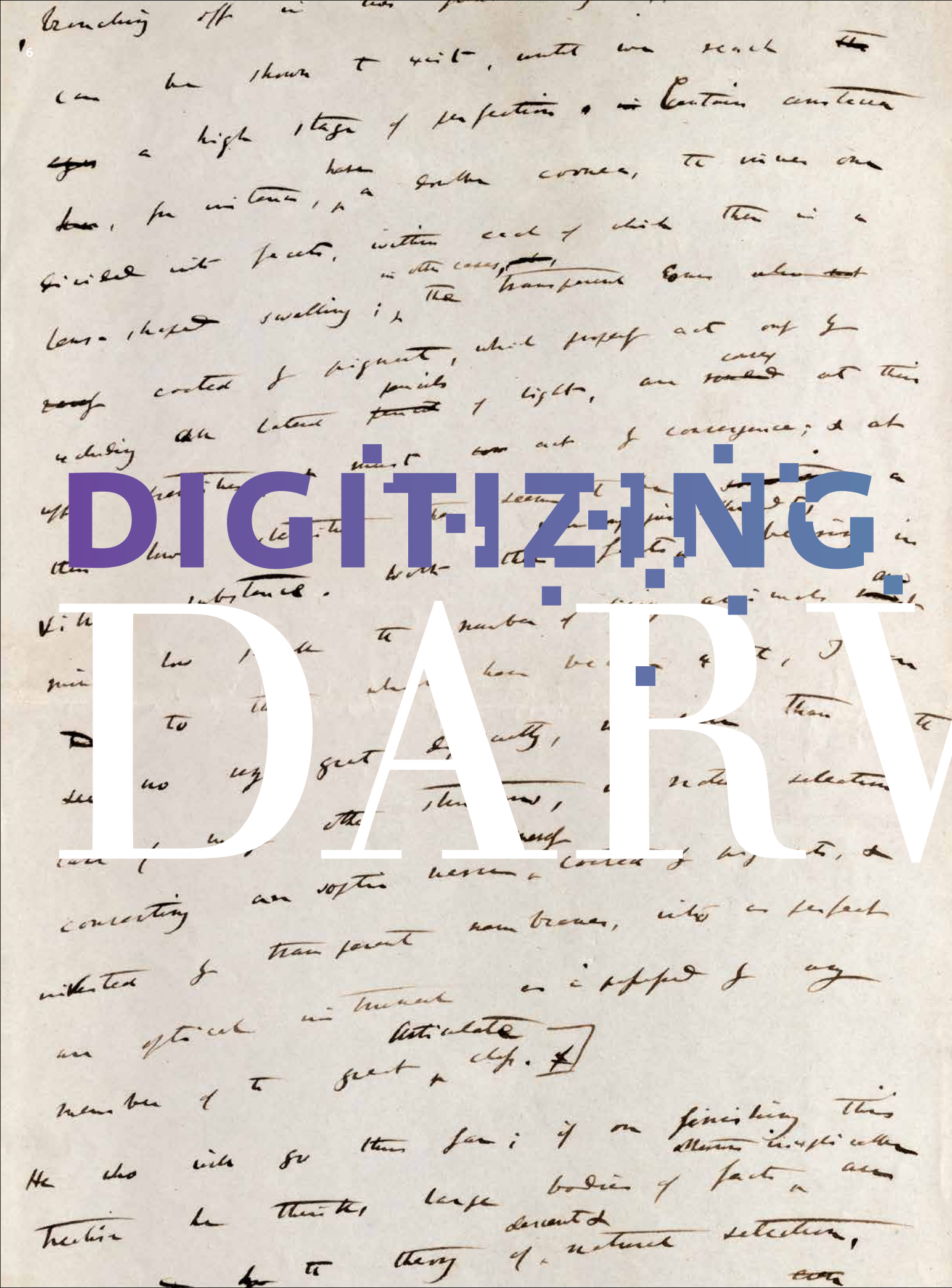
Many of the Museum's South Asian textiles were collected by Irene Mott Bose (1899–1974), the American-born wife of Vivian Bose, a judge on the Supreme Court of India. Mott Bose had moved to India in 1926 after earning a Master's degree in health and social welfare at Columbia University, and her letters and diaries, reprinted in *An American Memsahib in India*, offer her unique perspective on life in India during the country's struggle for independence.

**IMPORTANT SYMBOL**

The spinning wheel became a powerful emblem of independence from British colonial rule in the 20th century when Mohandas K. Gandhi (1869–1948) urged Indian men and women to wear only homespun cloth and boycott foreign-made goods—himself making a daily practice of spinning domestic cotton into thread. A photo of him with his spinning wheel taken by *LIFE* magazine photographer Margaret Bourke-White in 1946 became an iconic image of the Mahatma.

**OBJECT LESSON**

Asked last year what artifact set him on his career path, Richard Kurin, the Smithsonian's Undersecretary for Arts, History, and Culture, named a Punjabi spinning wheel he had collected for the American Museum of Natural History as a college student in 1970. “There was an inherent dignity which the maker had imparted to it,” he wrote, “And the woman [spinning] honored that with an air of respect for the tool as she worked.”



# DIGITIZING

# DARWIN'S

# WINNINGS

# WORK

*The ambitious project  
to bring the 19th-century  
genius online*

There was a time when people who wanted to read Charles Darwin's scientific papers—the portfolios of notes, observations, essays, and more that would help the great naturalist articulate his radical idea of natural selection in *On the Origin of Species*—had to travel to England and visit a reading room at Cambridge University.



Since 2006, a wealth of primary materials has been digitized and brought online, available to anyone with an interest and an internet connection. By the end of this summer, the Museum's Darwin Manuscripts Project, working closely with Cambridge University Library, will have made available some 30,000 pages written between 1835 and 1882 at [darwin.amnh.org](http://darwin.amnh.org). The documents, posted as high-resolution, full-color images, form an intimate record of a scientist at work.

"You can watch him in his father's garden making great discoveries, sailing the voyage of the *Beagle* and reacting to an earthquake in the Andes, formulating his most important theories," says David Kohn, director of the Darwin Manuscripts Project, which is hosted at the Museum's Research Library. "It's possible to follow his revisions, every crossed-out line, every deletion, how he underlines for emphasis. He underlines all the time, and when you see three or four underlinings, you know he's excited."

In addition to instant access to thousands of pages, the Darwin Manuscripts Project also provides casual readers with a way to decipher Darwin's famously confounding handwriting. Under Kohn's direction, trained volunteers have transcribed much of the material. Kohn, who consulted on the Museum's 2005 exhibition *Darwin*, came to the subject early: Before embarking on a 25-year career teaching the history of science at Drew University, he was tapped by a mentor while a doctoral candidate in botany to help edit Darwin's letters. He and the late Frederick Burkhardt worked on the first three volumes of *The Correspondence of Charles Darwin*, covering letters written by the naturalist from age 12 to his return in 1836 from his five-year voyage on the *Beagle*.

The voyage, of course, was instrumental in providing Darwin with insights that ultimately led him to develop his theory. For decades, Darwin grappled with the implications of revealing his groundbreaking theory, discussing it only with a few trusted friends. At the time, most geologists had abandoned a Bible-based calculation that Earth was only 6,000 years old, but they still believed that its flora and fauna were divinely created and immutable. Also, while evolutionary ideas had been explored

by natural philosophers for generations—including by Darwin's grandfather Erasmus Darwin, a physician—the conventional thinkers of the day held that humans were ordained by their Creator to be above and apart from the rest of the natural world and couldn't possibly have descended from other animals. The idea of evolution was heresy—and Darwin knew it. On January 11, 1844, he wrote to botanist Joseph Hooker that to be convinced that species are not immutable was "like confessing a murder."

The Hooker letter, and some 15,000 others, are part of a sister digitization project, The Darwin Correspondence Project. Taken together with the Darwin Manuscripts Project, these digital collections put at our fingertips all the drama and dogged pursuit of scientific proof that ensured Darwin's legacy as the founder of evolutionary biology.

"These are highly unusual collaborations, and they are only possible because of the power of the internet," says Tom Baione, the Museum's Harold Boeschstein Director of Library Services. "Not only does technology now allow scientists to work together across oceans, it allows anyone anywhere with a computer or a phone to read Darwin's thoughts in his own hand."

Take Darwin's pocket diary from 1838 to 1881, which includes the telling, clipped entry "interrupted" on June 14, 1858. The note was prompted by receipt of a manuscript from a young naturalist, Alfred Russel Wallace, proposing his own theory of evolution. At the urging of his friends, Hooker and the geologist Charles Lyell, Darwin realized he must accelerate publication of his theory. After a break in his diary, on July 20, he writes, "begin abstract, book on species."

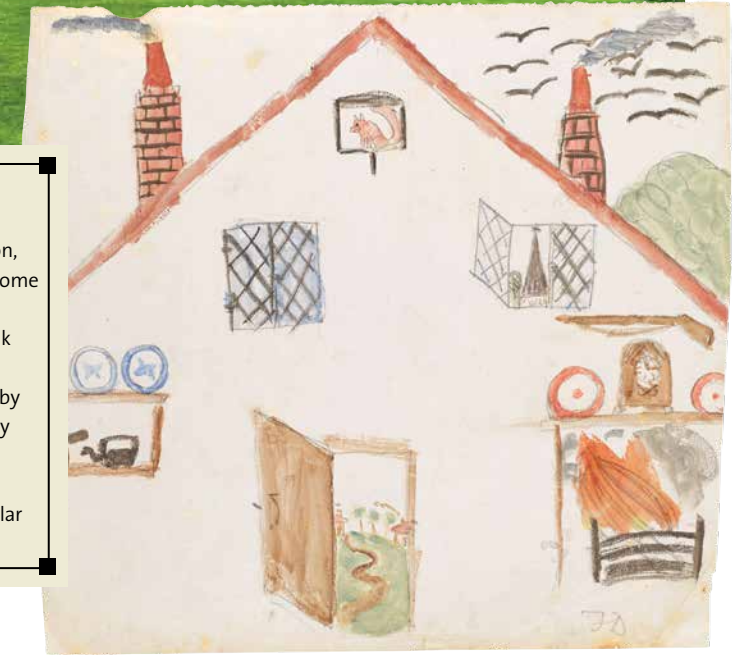
And then there are the more intimate items, which offer a glimpse into Darwin's daily life: for example, the Darwin Manuscripts Project includes dozens of colorful drawings made by Darwin's children on the backs of loose leaf pages, some with their father's writing on the other side. The sketches, which range from fanciful battles between vegetables to an imagined family crest, likely helped preserve manuscript pages for posterity, says Kohn.

"You also see in these drawings how thin the line of separation was between Darwin at work and home and family," says Kohn.

In addition to Cambridge University Library, which houses the bulk of Darwin's papers, the Darwin Manuscripts Project has made available, online, books from Charles Darwin's scientific library, many of which bear his notes in the margins.

*The Darwin Manuscripts Project has been supported by grants from the National Endowment for the Humanities, the National Science Foundation, and the Higher Education Funding Council for England.*

Pages 6-9: Darwin manuscript page reproduced with the permission of the American Museum of Natural History and William Huxley Darwin; Darwin photograph © Bettmann/CORBIS. Photo of Down House © S. Woodmore; Francis Darwin's drawing reproduced with the permission of the Syndics of Cambridge University Library and William Huxley Darwin



**Place Apart**

Down House, drawn here by Darwin's third son, Francis, was the family home in Kent, England, where the naturalist did the bulk of his writing—stowing manuscript pages in cubby holes in the now carefully preserved study. Today, the home is an English Heritage site and a popular tourist destination.

# Darwin at Home

**Scrap Paper**

Darwin's study was part of a busy, active family home. The children often drew pictures or wrote stories using their father's writing paper or the backs of discarded manuscript pages, including his original handwritten draft of *On the Origin of Species*. Only 45 pages of that draft are known to exist, one batch salvaged by his daughter Henrietta as an adult and four pages with children's drawings.

**Family Legacy**

Darwin's wife—who was also his first cousin—and his mother were both descendants of Josiah Wedgwood, who founded the pottery company in 1759. Combined with finances from his father, a wealthy physician, the Darwin-Wedgwood family connection provided Darwin an inheritance that allowed him to pursue his studies unhindered by worries about money. Can you find the Wedgwood china plates in Francis' drawing?

**Field Work**

The garden at Down House, seen through the open door in this drawing, and the surrounding fields, walks, and woods were Darwin's laboratory. Here, with the help of his family, friends, and even household staff, he tested his theory through countless experiments.

**Love and Loss**

Emma and Charles Darwin had 10 children. Two died in infancy, and one, Annie, passed away at age 10, possibly of tuberculosis. Devastated by her death, Darwin, who was ill for much of his adult life, worried that he had passed constitutional weaknesses on to his children.

See this and other children's drawings and story pages online in "Featured Collections" at [darwin.amnh.org](http://darwin.amnh.org).

Documents Available at [darwin.amnh.org](http://darwin.amnh.org):

**10,000**

on Development of *On the Origin of Species* (11%)

**15,300**

on Botanical Research (17%)

**4,700**

on Human Evolution (5%)

Future Projects:

**10,000**

on HMS *Beagle* Manuscripts (11%)

**33,000**

Books, Serials, Pamphlets, and Abstracts (37%)

**17,000**

Materials on Diverse Topics (19%)

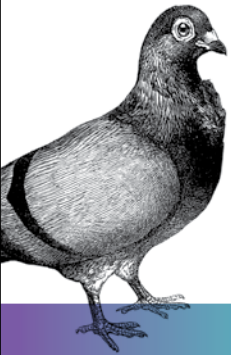
## By the Numbers

The Darwin Manuscripts Project has digitized about 30 percent of the naturalist's scientific papers so far.

# Experimental Notebooks

### Weed Garden (No. 25, right)

To study competition for survival among plants, Darwin fenced off a garden plot measuring 3 feet by 2 feet and cleared it, allowing weed seedlings to emerge. He marked each seedling with a wire, removing it if a seedling died. He made his regular counts from January to August and discovered that the vast majority of seedlings were destroyed, "chiefly by slugs and insects."



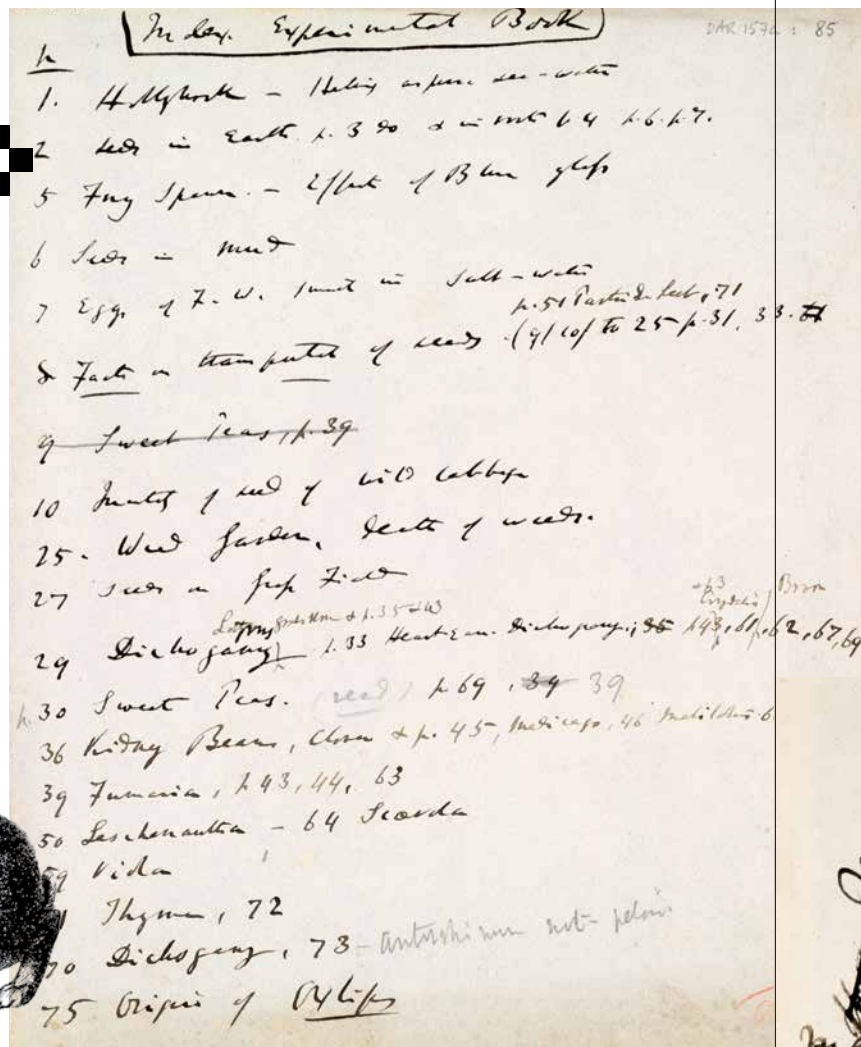
It wasn't just religious scruples that kept Darwin from publishing the details of his ideas about natural selection for nearly 20 years. He needed time to establish his reputation as a scientist and to do the necessary work on his selection theory, developing evidence and preparing for predictable objections.

Darwin bred pigeons, dissected orchids, and skeletonized rabbits. He spent so much time studying barnacles that his children thought that was just what fathers did; one of the boys reportedly asked a friend, "Where does your father do his barnacles?"

Then, after publication of *On the Origin of Species*, Darwin's days at Down were filled with experiments, often using no more sophisticated equipment than a microscope or a magnifying glass. His notebooks are a wonderful record of the scientific method in practice—raising questions based on his theory and testing them. The index page shown here, from Darwin's "Experimental Book" begun in 1855, hints at the breadth of his explorations, dealing with everything from snails to sweet peas, wild cabbages to frog spawn.

Notable for their simplicity, some of his experiments are ideal for children—for example, his weed plot experiment or soaking seeds in salt water. Detailed instructions for carrying out these two, as well as another on insectivorous plants, can be found in the Schools section of The Darwin Correspondence Project at Cambridge at [darwinproject.ac.uk](http://darwinproject.ac.uk).

Find this index on [darwin.amnh.org](http://darwin.amnh.org) by searching for "death of weeds."



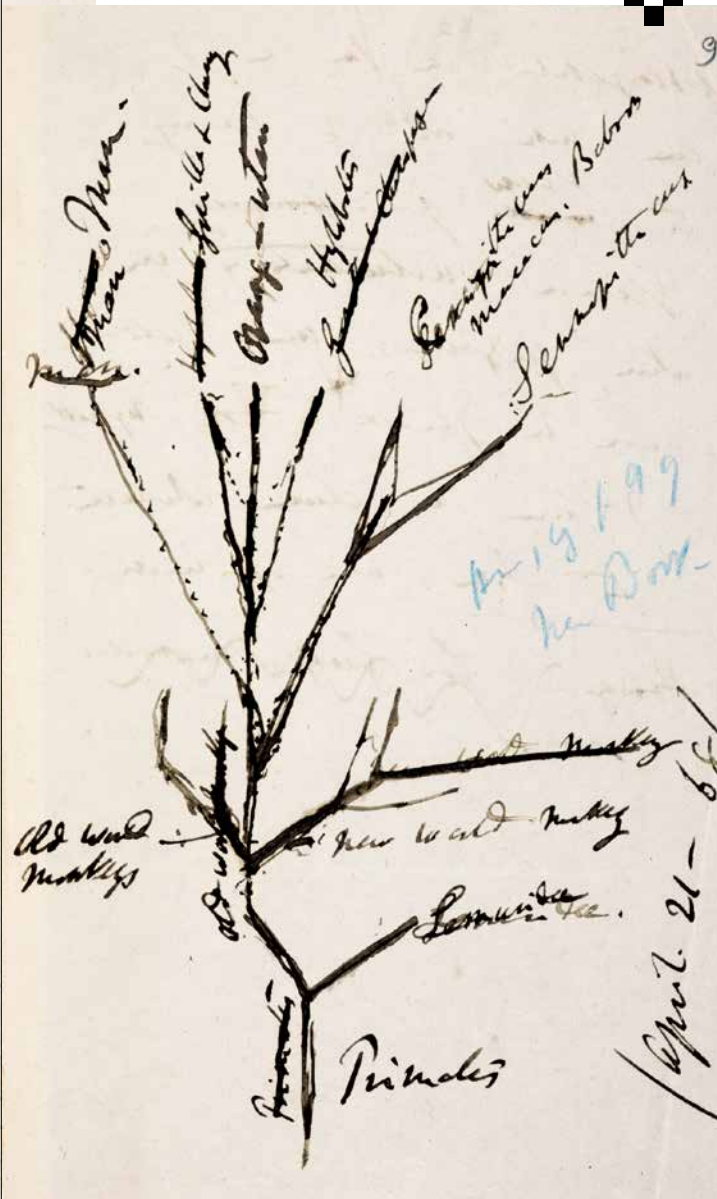
### Soaking Seeds (No. 10 and 36, above)

Hoping to unlock the secret behind similarities between mainland and island plant species, Darwin tested whether seeds would germinate after long immersion in salt water. He soaked a variety of seeds in salt water for varying lengths of time and found that many did in fact germinate. But he was disappointed to observe that most of them sank, making wave-borne transmission highly unlikely. His eight-year-old son Francis suggested a strikingly simple alternative—what if the seeds were carried in the crop of a dead bird? Darwin floated a seed-sated dead pigeon in salt water for 30 days and, sure enough, seeds recovered from the carcass germinated. This, of course, is not an experiment recommended for replication at home!



"Experimental Book" index and Primate tree reproduced with the permission of the Syndics of Cambridge University Library and William Huxley Darwin; archival illustrations via Dover

# Tree of Life



Charles Darwin published only one tree of life in his lifetime, a foldout that appears in the *Origin*. But Darwin drew many trees over his career, including this one for primates, the last one he was known to produce, dated April 21, 1868.

Scholars suspect that Darwin, not a skilled draftsman, was likely using his trees as a tool for working out relationships in his own mind—a form of thinking out loud.

"I think it was one step beyond doodling," says J. David Archibald, author of *Aristotle's Ladder, Darwin's Tree: The Evolution of Visual Metaphors for Biological Order*. "Darwin was a terrible artist, but a wonderful writer. His work led to an explosion of evolutionary trees. Evolution took over the iconography of trees and the non-evolutionists stopped using them."

Scientists and philosophers have long striven to organize life—and where humans rank within it—into some coherent pattern, from the *scala naturae* of ancient Greece and Rome to the great chains of being in the Middle Ages to intricate cladograms of today.

So what was Darwin getting at with this tree full of scratched-over labels and apparent second thoughts? Dr. Archibald, a paleomammalogist, speculates that Darwin was sure of the relationships, basing them, as he acknowledges, on the work of other naturalists. He was just not sure how best to illustrate them. In the end, his tree is close to the modern understanding, correctly branching the relative positions of lemurs and New World monkeys, linking humans and apes with Old World monkeys, and identifying humans as a branch of apes. Also, although Darwin did not know, as we do now, that chimps and bonobos are our closest relatives, he did argue that humans' closest living relatives were gorillas and chimpanzee, and posited that humans probably originated in Africa. Abundant fossil evidence has proven his prediction right.

**The key to building trees of life still lies in the foundation Darwin laid for evolution itself.**

Much has changed in evolutionary biology since Darwin sketched out this tree three years before publishing *The Descent of Man* in 1871. Debates have waxed and waned on how best to group organisms, and on what basis. The most commonly used system today is cladistics, which uses shared derived traits to discover how close—or distant—the relationship is between groups of organisms. And the relatively recent revolutions of genome sequencing and supercomputing have both further refined and complicated the process.

And yet, the key to building trees of life still lies in the foundation Darwin laid for the fact of evolution itself: "descent with modification by means of natural selection."

As Archibald concludes in his book, "Before Darwin's *On the Origin of Species* was published in 1859, evolutionary trees of life were a novelty; after Darwin, they were a necessity."

Find this tree on [darwin.amnh.org](http://darwin.amnh.org) by searching for "branching tree diagram of primate descent."

The Grand Prismatic Spring  
in Yellowstone Park

# EXTREME LIVING

MEET THE CREATURES  
THAT PROSPER IN SOME  
OF THE TOUGHEST  
PLACES ON EARTH

**Boiling hot springs. Lightless caves. Frozen glaciers. These environments may feel uninviting to us, but they are often teeming with forms of life specialized to tolerate the tough conditions—and to thrive in them.**

## CAULDRON CREATURES

The geysers and hot springs of Yellowstone National Park host an array of thermophilic, or heat-loving, microorganisms that can tolerate temperatures as high as 175 degrees Fahrenheit. These bacteria, along with other microorganisms like archaea, create the vivid color palettes of some of Yellowstone's famed springs and geysers, like the Grand Prismatic Spring pictured here.

The blue center is the heart of the spring, where nearly boiling water makes it impossible for anything to survive, resulting in a startlingly blue hue. As the temperature dips farther out from the hot spring's superheated center, though, more and more kinds of bacteria, fungi, and other microorganisms are able to endure. The different rings of color emanating from the steaming epicenter represent different microbial communities that call the spring home. The most heat-tolerant cyanobacteria dominate the still-extreme temperatures in the yellow-colored ring, while the outer, orange layer hosts an array of organisms that can't stand the heat quite as well as their neighbors.

The colors of these rings also change in response to the time of year and other environmental factors. The cooler outer rings, meanwhile, form ecosystems of their own, hosting flies, mites, spiders, and other animals. Ephydrid flies feast on the bacterial communities and lay their eggs there, while predators like wolf spiders and parasites such as mites are drawn here to the flies.



This aquatic amphibian thrives in lightless caves.

## Tougher than Tough

Extreme temperatures? No sunlight for nourishment? No problem. Here are three organisms that have found incredible ways to thrive.

### HOT SPRINGS: EPHYDRID FLIES

These tiny flies lay their eggs on the bacterial mats near the edges of hot springs. When the eggs hatch, these mats go from nest to meal as the larvae chow down on bacteria.

### CAVES: SNOTTITES

Instead of photosynthesizing their meals, these colonies of single-celled organisms convert chemicals into energy, becoming a vital food source in some lightless caves. Their diet of sulfur compounds makes snottites emit a rotten-egg smell.

### GLACIERS: ICE WORMS

Worms in the genus *Mesenchytraeus* spend their whole lives in the ice of North American glaciers. They're so at home in the snow pack that when the sun warms the surface, these worms burrow away from the heat.

## CAVE CREATURES

Described by Charles Darwin as 'wrecks of ancient life,' caves were once thought to be evolutionary dead-ends, cut off from the outside world and even from basic elements of life like sunlight. As it turns out, nothing could be further from the truth. Rather than halt evolution, the trying conditions of cave habitats, like total darkness and an unreliable food supply, force living things to develop incredible ways of coping with their extreme environments.

Since they're facing the same set of general problems, cave-dwelling animals with no relation to one another tend to develop similar solutions. Species in caves often lack pigmentation and navigate and hunt with senses other than sight. One great example is the European cave salamander known as the olm.

These pinkish-white aquatic amphibians thrive in lightless, watery caves throughout Eastern Europe. They eat, mate, and sleep underwater, breathing through external gills. Olms are also nearly blind, as developing eyes in a dark cave isn't an efficient way to spend the body's resources. The same principle accounts for the olm's pallid coloration—pigmentation is an unnecessary luxury when you spend your life in darkness.

To compensate for their poor sight, olms employ a suite of highly developed senses terrifically suited to life in the waterlogged caves they call home. Special cells running the length of their bodies can detect tiny pressure changes caused by fish and creatures moving in the water nearby. Olms also boast organs that can detect the weak electric fields of animals around them, and specialized tissues in the salamanders' inner ears grant them acute underwater hearing.

These heightened senses come in handy when an olm hunts its prey of cave-dwelling fish, crabs, and insects, which the salamander swallows whole instead of biting or chewing. Cave food sources can be fickle, though, and olms are as well prepared for famine as for feast. By lowering their metabolic rate and living on nutrients stored in their livers, they can survive for months at a time without a meal.

The lack of sunlight means that the food web in caves is an unusual one, not founded on Sun-driven photosynthesis as it is in most other environments. In some caves, the base of the food chain is instead made up of slimy colonies of single-celled organisms called "snottites." (See sidebar for more on these curious organisms.)

## PENGUINS ARE THE MOST DENSELY FEATHERED BIRDS ON THE PLANET, BOASTING UP TO 100 FEATHERS PER SQUARE INCH.



Emperor Penguins tolerate temperatures as low as 40 degrees below zero.

## CRYONIC CREATURES

While hot environments pose challenges to life, cold climates can be equally unforgiving. As in hot springs and caves though, some animal species are impeccably prepared to cope with freezing conditions. There are even a few you might not expect to find in extremely cold climates.

For instance, Antarctica is home to one species of insect hardy enough to survive some of the coldest climates on Earth. Wingless midges (*Belgica antarctica*) are well-equipped for this extreme environment. Their dark purple coloration helps them absorb and hold what little heat is available, and they spend much of their time burrowed just beneath the surface of the snow, where temperatures are more stable than on the wind-blown surface.

Wingless midges spend most of their lives in the larval stage, during which they're able to survive for weeks at a time without oxygen and live through the loss of more than two-thirds of their body water. When they emerge as adults, though, the midges mate and die in a span of just a few days. While they're out and about these tiny insects do get one bragging right—even though the largest specimens measure just a few millimeters long, scientists consider these modest midges the largest Antarctic species that lives entirely on land.

Of course, it's not just the small stuff that prospers in frigid temperatures. Antarctica's iconic Emperor Penguins can tolerate temperatures as low as 40 degrees below zero thanks to an inch-thick layer of fatty insulation and short, spear-shaped feathers—up to 100 of them per square inch of skin, enough to make these the mostly densely feathered birds on the planet.

These famously flightless birds are also accomplished divers, hunting fish, squid, and other marine fare more than 1,700 feet below the surface of the ocean. These hunting trips necessitate another set of adaptations for the penguin, which boasts solid bones that are resistant to trauma brought on by changing pressures during deep dives. Emperor Penguins can also shut down some of their organs during a dive, redirecting energy and oxygen to support only the most essential functions. Combine these traits, and you've got an amazing animal that can swim for nearly 20 minutes at a time in freezing water—and bring back a meal for its chick to boot. 🐧

Find out about more amazing species in *Life at the Limits*, which is free for Members.

*The American Museum of Natural History gratefully acknowledges the Richard and Karen LeFrak Exhibition and Education Fund.*

*Generous support for Life at the Limits has been provided by the Eileen P. Bernard Exhibition Fund.*

*Life at the Limits is proudly supported by Chase Private Client.*



## Programs and Exhibits

For more programs and to purchase tickets, visit [amnh.org/calendar](http://amnh.org/calendar).

For updates and reminders, sign up for monthly Calendar Highlights for Members by sending your membership number and request to subscribe to [members@amnh.org](mailto:members@amnh.org). The Museum does not trade, rent, or sell this information.

## Tickets

Tickets are available by phone at 212-769-5200, Monday–Friday, 9 am–5 pm, or by visiting [amnh.org](http://amnh.org). Please have your membership number ready.

Availability may be limited. Please purchase tickets in advance.

Please be aware that ticket sales are final for all Member programs. All programs go ahead rain or shine. There are no refunds unless the program is cancelled by the Museum.

Information about programs is current as of June 1. Please check [amnh.org/calendar](http://amnh.org/calendar) for updates.



Climb the Hercules beetle in Life at the Limits.

### ON EXHIBIT

**Life at the Limits: Stories of Amazing Species**  
LeFrak Family Gallery, fourth floor  
**Free for Members**

Discover the diverse and jaw-dropping strategies animals and plants employ to find food, fend off predators, reproduce, and thrive in habitats we would find inhospitable, even lethal.

**Countdown to Zero: Defeating Disease**  
**Free for Members**

This exhibition highlights scientific and social innovations that are ridding the world of ancient afflictions.

Please check [amnh.org](http://amnh.org) for Member ticket prices for live-animal exhibits and giant-screen 2D and 3D films.

**Spiders Alive!**  
Opens Saturday, July 4  
Gallery 77, first floor  
*Spiders Alive!* immerses visitors in the fascinating and complex world of spiders, among the most versatile animals on the planet.

**Jean-Michel Cousteau's Secret Ocean**  
Opens Monday, July 6  
*Jean-Michel Cousteau's Secret Ocean* introduces audiences to more than 30 marine species and behaviors captured for the first time thanks to groundbreaking advances in underwater filming. Narrated by renowned oceanographer Sylvia Earle, this 40-minute giant-screen film is showing in 2D and 3D.

**The Butterfly Conservatory**  
Opens Saturday, September 5  
Housed in a vivarium that approximates their natural habitat with live flowering plants, butterfly species in this ever-popular exhibition include iridescent blue morpho butterflies, striking scarlet swallowtails, and large owl butterflies.

**Credits**  
*The American Museum of Natural History gratefully acknowledges the Richard and Karen LeFrak Exhibition and Education Fund.*

*Generous support for Life at the Limits has been provided by the Eileen P. Bernard Exhibition Fund.*

*Life at the Limits is proudly supported by Chase Private Client.*

*Countdown to Zero is presented by the American Museum of Natural History in collaboration with The Carter Center.*

*Countdown to Zero is proudly supported by Conrad N. Hilton Foundation, Lions Clubs International Foundation, Mectizan Donation Program, and Vestergaard.*

*This exhibition is made possible by the generosity of the Arthur Ross Foundation.*

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## JULY

**Milstein Science Series Water World Immersive Dome Experience**  
Through Saturday, July 11  
Museum Hours  
**Free**

Take a ride through the solar system and gain a new perspective on our home planet, a unique world colored ocean blue. After passing through Earth's orbit, we'll splash down into the deep oceans to examine life underwater. This 10 minute Geodome experience mixes science visualization and high-resolution video to reveal the many scales at which scientists explore our oceans and marine life.

**Stars and Stripes Hall Tour**  
Saturday, July 4  
3–5 pm  
**Free**

Stars and stripes are everywhere in nature, from the stars in our galaxy, to the stripes on a centipede. Explore the Museum's halls and learn about all kinds of stars and stripes on this unique and fascinating tour.

**Evening Bat Walks in Central Park**  
Fridays, July 10, 24, or 31  
Rain Date: Saturday, August 1, 8 pm  
\$40 adults; \$25 children  
At dusk, bats leave the warm spaces under city roofs to feed on flying insects. Join **Bradley Klein, Danielle Gustafson**, and other members of the New York City Bat Group for a walk through Central Park. Aided by detectors that amplify the bats' otherwise inaudible high-frequency chirps, bat-watchers monitor and catalogue the species that call the city home.

**Manhattanenge**  
Monday, July 13  
7 pm  
\$12

As the Sun sets on July 13, it will be perfectly aligned with Manhattan's east-west numbered streets, creating cinema-worthy photo opportunities of Manhattan's brick-and-steel canyons. Astrophysicist **Jackie Faherty** will be your guide to the history and astronomy behind this fascinating phenomenon in a special presentation at the Hayden Planetarium.

**Summer Star Sail**  
Friday, July 17  
8–10 pm  
\$95

Set sail in New York Harbor with astrophysicist **Charles Liu** and watch the Sun set while learning the science and star lore that surrounds the summer sky.

**Astronomy Live: Deep Sky Scavenger Hunt**  
Tuesday, July 21  
6:30 pm  
\$12

Grab your binoculars and join your guides **Emily Rice** and **Irene Pease** to explore celestial treasures from the comfort of the Hayden Planetarium. Learn how astronomers measure distances to faraway stars, clusters, and galaxies, and where to find them in the night sky.

**Walk to Little Red Light House**  
Wednesday, July 22  
6–7:30 pm  
\$25

Featured in the 1942 children's classic *The Little Red Lighthouse and the Great Gray Bridge* by Hildegard H. Swift, the Little Red Lighthouse is the last beacon of its kind left in Manhattan. Join geologist **Sidney Horenstein** for this stroll through Fort Washington Park and learn about the geology and history of the area while enjoying the sunset views of the Hudson River from the highest natural elevation in Manhattan.

**Journey to a Lost World**  
Saturday, July 25  
9 am–4 pm  
\$95

Put on some old sneakers, pack a lunch, and travel back in time with **Paul Nascimbene** from the Museum's Division of Invertebrate Zoology, for an expedition to Big Brook in Monmouth County, New Jersey. The area offers a variety of invertebrate and vertebrate fossils from the Late Cretaceous period. Plentiful fossils and diverse fauna make it an ideal spot for collecting. Includes bus transportation to and from the Museum. Feel free to bring your own collecting equipment.

**Astronomy Live: Grand Tour of the Universe**  
Tuesday, July 28  
6:30 pm  
\$12  
Join **Brian Abbott** to experience the entire observable universe and come to a cosmic understanding of where we are and how we came to be.

## AUGUST

**Astronomy Live: Superstitions in the Stars**  
Tuesday, August 4  
6:30 pm  
\$12

Numerous celestial events make the news, but what is the science behind them? **Emily Rice** and **Jackie Faherty** will explore phenomena such as the Super Moon and more, using both the Zeiss star projector and the 3D Digital Universe Atlas.

**Member Field Trip to the Moon**  
Thursday, August 6  
6 pm

\$12 adults; \$8 children  
Take a virtual trip to the Moon from the Hayden Planetarium. Feel the ground shake beneath you as you experience a thrilling NASA rocket launch. Guided by a live presenter, orbit the Earth and get an astronaut's view of a sunrise in space. Recommended for ages 4 and older.

**Inwood Park with Sidney Horenstein**  
Tuesday, August 11  
6–7:30 pm  
\$25

Inwood Hill Park contains the last substantial forest on the island of Manhattan, and its underlying rocks make it one of the best places to learn about New York City's geology. Join geologist **Sidney Horenstein** to learn more about the city's distant geologic past, and phenomena like plate tectonics, volcanism, landslides, and glacial features. For ages 10 and up.

**SEPTEMBER**

**Astronomy Live: Visiting Pluto and Friends in the 21st Century**  
Tuesday, August 11  
6:30 pm  
\$12

This July, NASA's New Horizons space probe will fly by Pluto, collecting data about this dwarf planet and its relatives in the Kuiper belt. During this presentation, we will use the 3D Digital Universe Atlas to take you through the probe's historic journey to the edge of the solar system and highlight the groundbreaking science that has emerged along the way.

**Summer Stars Zeiss Show**  
Thursday, August 13  
6 pm

Escape the summer heat and join us in the Hayden Planetarium for a stellar presentation. The glow of stars not normally seen in the city can be found if one knows where to look. Discover the Milky Way as a live presenter, aided by the Museum's Zeiss star projector, guides you on a celestial journey of the summer sky.

**Member Trip to Stone Barns and Blue Hill Café**  
Friday, August 28  
10 am–2:30 pm  
\$125

Enjoy a tour of the bucolic Stone Barns Center in Westchester County and learn about its efforts to create a healthy and sustainable food system. Then, enjoy a buffet lunch at the popular Blue Hill Café, made with seasonal ingredients and items harvested from the Center's four-season farm. Recommended for ages 10 and up. Includes bus transportation from the Museum, one-hour tour, and lunch.

**Early-Morning Bird Walks in Central Park**  
Eight-week series starting Tuesday, September 8  
Wednesday, September 9  
Thursday, September 10  
Friday, September 11  
7 am (Fridays start at 9 am)  
\$85

Observe the exciting fall migration of birds in Central Park with ornithologists **Paul Sweet** (Tuesdays, 7 am and Fridays, 9 am) and **Joseph DiCostanzo** (Wednesdays and Thursdays, 7 am). Learn how to use field marks, habitat, and behavior as aids to identify warblers, thrushes, sparrows, and raptors.

**Lunchtime Bird Walks in Central Park**  
Four Tuesdays, September 8–29  
Noon–1:30 pm  
\$50

Glimpse owls, hawks, and woodpeckers in the woods, finches and sparrows in the fields, and ducks and gulls in the lakes as ornithologist **Paul Sweet** guides you through three Central Park habitats to observe varied bird species.

**Animal Drawing**  
Eight Wednesdays,  
September 9–October 28  
7–9 pm  
\$160 (Materials not included)  
Enter at 77th Street

The celebrated dioramas, dinosaur exhibits, and halls of the Museum serve as the settings for an intensive after-hours drawing course with illustrator and naturalist **Patricia Wynne**. Learn about the gifted artists who created the world-class dioramas as you sketch subjects in their "natural" environments. All experience levels welcome.

**"What Darwin Saw" Hall Tour**  
Saturday, September 12  
3–4:30 pm  
Free

Tour the Museum halls and learn how Charles Darwin became convinced that both evolution and natural selection occurred.

**Behind the Scenes: Preservation and Conservation in the Research Library**  
Thursday, September 17  
6:30–7:30 pm, 7–8 pm,  
7:30–8:30 pm  
\$30

The Research Library is home to some of the Museum's best-kept secrets, including the Library Conservation Lab, repairs and preserves manuscript and printed materials. Join Library Director **Tom Baione**, conservator **Barbara Rhodes**, and Darwin Manuscripts Project Director **David Kohn** to learn about how some of the Museum's most delicate collections are preserved and conserved and how technology is being used to make these unique materials accessible online.

**Member Highlights Tour**  
Sunday, September 20  
10:30 am–noon  
Free

Families are invited to take part in this tour for adults and children alike. Experts will guide you through the Museum's halls to explore some family favorites.

**Family Bird Walks**  
Saturday, September 26  
9 am, 11:30 am, 2 pm  
\$15

Families, join Museum naturalist **Noah Burg** for a bird walk in Central Park. Young explorers and their parents will learn how to find and identify the many bird species and habitats found in our own backyard. (Binoculars and bird guides included; recommended for families with children ages 4–10.) *Note:* This program includes approximately 45 minutes of walking outside. Please wear comfortable shoes and appropriate clothing.

**Credits**

*The Milstein Science Series is proudly sponsored by the Irma and Paul Milstein Family.*

*Support for Hayden Planetarium Programs is provided by the Horace W. Goldsmith Endowment Fund.*

**JULY**

Through Saturday, July 11  
Water World  
Immersive Dome Experience  
*Milstein Science Series*

**4 SATURDAY**  
Stars and Stripes Hall Tour  
*Member Program*

*Spiders Alive!* opens

**5 SUNDAY**  
Tiny Giants closes

**6 MONDAY**  
Jean-Michel Cousteau's Secret Oceans opens

**10 FRIDAY**  
Evening Bat Walk in Central Park  
*Nature Walk*

**13 MONDAY**  
Manhattanenge  
*Hayden Planetarium Program*

**17 FRIDAY**  
Summer Star Sail  
*Member Excursion*

**21 TUESDAY**  
Deep Sky Scavenger Hunt  
*Hayden Planetarium Program*

**22 WEDNESDAY**  
Walk to Little Red Light House  
*Member Excursion*

**24 FRIDAY**  
Evening Bat Walk in Central Park  
*Nature Walk*

**25 SATURDAY**  
Journey to a Lost World  
*Member Excursion*

**28 TUESDAY**  
Grand Tour of the Universe  
*Hayden Planetarium Program*

**31 FRIDAY**  
Evening Bat Walk in Central Park  
*Nature Walk*

**AUGUST**

**1 SATURDAY**  
Evening Bat Walk in Central Park (rain date)  
*Nature Walk*

**4 TUESDAY**  
Superstitions in the Stars  
*Hayden Planetarium Program*

**6 THURSDAY**  
Member Field Trip to the Moon  
*Member Program*

**9**  
*Nature's Fury* closes

**11 TUESDAY**  
Inwood Park with Sidney Horenstein  
*Member Excursion*

Visiting Pluto and Friends in the 21st Century  
*Hayden Planetarium Program*

**13 THURSDAY**  
Summer Stars Zeiss Show  
*Hayden Planetarium Program*

**28 FRIDAY**  
Member Trip to Stone Barns and Blue Hill Café  
*Member Excursion*

**SEPTEMBER**

**5 SATURDAY**  
*The Butterfly Conservatory* opens

**8 TUESDAYS**  
Early-Morning Bird Walks in Central Park  
Tuesday, Wednesdays, Thursdays and Fridays through October 30  
*Nature Walk*

Lunchtime Bird Walks in Central Park  
Through September 29  
*Nature Walk*

**9 WEDNESDAY**  
Animal Drawing  
Eight Wednesdays through October 28  
*Adult Course*

**12 SATURDAY**  
"What Darwin Saw" Hall Tour  
*Member Tour*

**13 SUNDAY**  
*Natural Histories* closes

**17 THURSDAY**  
Behind the Scenes: Preservation and Conservation in the Research Library

**20 SUNDAY**  
Member Highlights Tour  
*Member Tour*

**26 SATURDAY**  
Family Bird Walks  
*Family Program*

# 25 Years in the Gobi

The dream dig site that keeps yielding treasures



The joint American Museum of Natural History–Mongolian Academy of Sciences expeditions have uncovered hundreds of significant fossils over the past quarter century.

*The AMNH–Mongolian Academy of Sciences expeditions are generously supported by the Margaret and Will Hearst Paleontological Research Fund.*

Paleontologists will tell you that Mongolia's Gobi Desert is a fantastic place to find fossils. The Mesozoic and Cenozoic fossils that have been buried there are widely varied and exquisitely preserved. Animals large and small—dinosaur, crocodile, turtle, lizard, and mammal—have been discovered here, their skeletons preserved so well they often retain small telltale details and fragile bones that offer researchers invaluable clues about their evolution.

The Museum's connection to the Gobi stretches back to the 1920s, when the legendary explorer—and later Museum director—Roy Chapman Andrews led five large-scale expeditions that resulted in amazing discoveries, including new species of dinosaurs and ancient mammals and the first-ever dinosaur eggs. Recalling his last glimpse of the Mongolian desert, Andrews predicted great things to come. "We have but scratched the surface," he wrote. "And every season of blasting gales will expose more riches hidden in its rocks. Who can tell what will come from a place that has already given so much?"

But after the 1920s, Mongolia became increasingly inaccessible to Western scientists as it fell under the influence of the Soviet Union. Prospecting for fossils continued, but only by researchers from Russia and its satellite states for nearly six decades.

Only when the Soviet Union finally began to teeter in the late 1980s did the chance to return present itself. In June 1990, a team of Museum scientists—paleontologists Malcolm McKenna, Michael Novacek, who today is the provost of science, and Mark Norell, who today is the Macaulay Curator of Paleontology

© Chang W. Lee/The New York Times/Redux



and chairs the Division of Paleontology—made the first trip to the Gobi, a scouting expedition of sorts to figure out how to restart an expeditionary program in a place that still had so much to give.

"Mark, Malcolm, and I would be hard pressed to remember a more important day," Dr. Novacek would write in his book *Dinosaurs of the Flaming Cliffs*. "We were living what for our colleagues and their predecessors was only a dream."

That trip, 25 years ago this year, marked the beginning of the joint American Museum of Natural History–Mongolian Academy of Sciences expeditions that have returned to the great desert every year. In 1995, Museum and Mongolian Academy paleontologists discovered Ukhaa Tolgod, a fossil locality that has yielded one of the richest concentrations of dinosaur, lizard, and ancient mammal skeletons to date. Researchers have been working there every summer since.

"We've collected hundreds of skeletons of dinosaurs, fossil lizards, birds, and mammals there," says Dr. Norell. "Probably the most significant of what we've found there have been the first embryo of a theropod dinosaur, and dinosaur nests with the adults sitting on top, brooding them just like modern birds. And then the exquisite mammals that we've found, which give us an unprecedented look at what mammal diversity and what mammal anatomy was like during the age of the dinosaurs."

The adventure continues this summer, with the team departing in the next few weeks.

Rotunda / Summer 2015 / AMNH.org

## Glimpse the Gobi

The Museum's 2013 expedition team to the Gobi included Aki Watanabe, a graduate student in the Museum's Richard Gilder Graduate School who was beta-testing Google Glass and filmed while in the field. Watch the best moments from the trip on [amnh.tv](http://amnh.tv) or the Museum's YouTube channel, [YouTube.com/amnhorg](http://YouTube.com/amnhorg):

### Google Glass in the Gobi: Prospecting

Follow Watanabe as he scours the desert for exposed fossils, showcases his field kit, and discusses why paleontologists' best tools are always their eyes and feet.



### Google Glass in the Gobi: Dinosaur Nest

Watanabe's first fossil find in Mongolia is a clutch of five dinosaur eggs, an oviraptor nest. He extracts the fossils and shows how they're prepared for the trip back to the Museum.



### Google Glass in the Gobi: Something Big

Watanabe uncovers a big bone, which he quickly realizes is a rib. As the team keeps working, they discover the rock holds more bones and bone fragments of a large animal.



# THE YEAR IN THE FIELD

The Museum is base camp for hundreds of scientific expeditions that help fuel research and add to the collections. Here are just a few that took place in the last 12 months.

**CANADA**

**Ross MacPhee**  
Division of Vertebrate Zoology  
With colleagues from the Yukon Paleontology Program, Dr. MacPhee searched for Pleistocene megafauna in the Klondike and excavated a mammoth tusk.

**CUBA**

**George Amato**  
Sackler Institute for Comparative Genomics  
Dr. Amato conducted research at the wildlife refuge in Monte Cabaniguán for a project on the genetics of the American crocodile.

**ARGENTINA**

**Felicity Arengo**  
Center for Biodiversity and Conservation  
This winter, Dr. Arengo and colleagues visited 20 lakes in six days to count flamingos as part of a large regional census. Read her dispatches from the field at [www.bit.ly/1Q1giQt](http://www.bit.ly/1Q1giQt).

**CUBA**

**Paul Sweet**  
Department of Ornithology  
Collections Manager Paul Sweet traveled to Cuba last summer to collect specimens and tissue samples from the islands' native birds.

**PERU**

**James Carpenter**  
Division of Invertebrate Zoology  
After a conference in Cuzco, Dr. Carpenter and Dr. Adrien Perrard collected wasps near Aguas Calientes, near the famous Incan site of Machu Picchu.

**KENYA**

**Brian Richmond**  
Division of Anthropology  
Dr. Richmond and colleagues discovered 1.5-million-year-old footprints of early human ancestors and a variety of other animals on an expedition to Lake Turkana in northwestern Kenya.

**NEW YORK**

**Melanie Hopkins**  
Division of Paleontology  
Dr. Hopkins collected trilobite specimens from two historic quarries in upstate New York.

**CANADA**

**Robert Rockwell**  
Division of Vertebrate Zoology  
Dr. Rockwell was in the field as part of the Hudson Bay Project, a decades-long effort to monitor the rapidly rising population of snow geese and their interactions with polar bears.

**INDIA**

**David Grimaldi**  
Division of Invertebrate Zoology  
**Ross MacPhee**  
Division of Vertebrate Zoology  
Under the banner of the Constantine S. Niarchos Expedition, Dr. Grimaldi and Dr. MacPhee traveled to India to collect fossils from 52-million-year-old outcrops. Dr. Grimaldi collected ancient amber in the western state of Gujarat, and Dr. MacPhee searched for fossils of ancient hoofed mammals known as odd-toed ungulates.

**CHINA**

**Jin Meng**  
Division of Paleontology  
Dr. Meng led fieldwork at Jurassic fossil localities in northeastern China.

**ROMANIA**

**Mark Norell**  
Division of Paleontology  
Dr. Norell and colleagues looked for fossils in Romania.

**PAPUA NEW GUINEA**

**Brett Benz, Neil Duncan, Christopher Raxworthy, Paul Sweet**  
Division of Vertebrate Zoology  
The Explore21 Expedition to Papua New Guinea included surveys of amphibians, reptiles, birds, and mammals plus associated parasites in a remote region. Read dispatches from the field at [www.bit.ly/1uydrZ9](http://www.bit.ly/1uydrZ9).

**VANUATU**

**Brian Smith**  
Division of Vertebrate Zoology  
In November, Dr. Smith and colleagues flew to Vanuatu to survey the birds of this archipelago in southern Melanesia as part of a Constantine S. Niarchos Expedition. Watch a video about the trip at [amnh.tv](http://amnh.tv).

**VIETNAM**

**Mary Blair**  
Center for Biodiversity and Conservation  
Dr. Blair, who studies slow lorises, is back in Vietnam this summer to conduct surveys and collect tissue samples of these nocturnal primates. Read about her 2014 expedition at [www.bit.ly/1PANIQq](http://www.bit.ly/1PANIQq).

**SOUTH AFRICA**

**Ed Mathez**  
Division of Physical Sciences  
Dr. Mathez and colleagues collected rocks for a study on the evolution of the mantle beneath the ancient continental craton that makes up much of southern Africa on a Constantine S. Niarchos Expedition.

**SOUTH AFRICA**

**Lorenzo Prendini**  
Division of Invertebrate Zoology  
Last summer, Dr. Prendini spent several months visiting natural history collections and gathering about 1,500 arachnid specimens from more than 100 locations in the field.



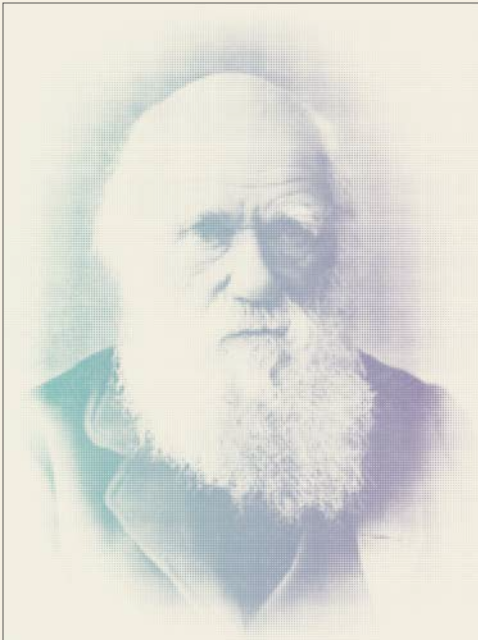
*The Constantine S. Niarchos Expeditions were generously supported by the Stavros Niarchos Foundation. The Museum's Explore21 Initiative is supported by the leadership contributions of Kathryn P. and Thomas L. Kempner, Jr., and Linda R. and William E. Macaulay.*

Central Park West at 79th Street  
New York, New York 10024-5192  
[amnh.org](http://amnh.org)



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The Museum is home to an ambitious project which, working closely with Cambridge University Library, is making available some 30,000 pages written by Charles Darwin between 1835 and 1882, at [darwin.amnh.org](http://darwin.amnh.org).

## General Information

### HOURS

Museum: Open daily, 10 am–5:45 pm;  
closed on Thanksgiving and Christmas.

### ENTRANCES

During Museum hours, Members may  
enter at Central Park West at 79th Street  
(second floor), the Rose Center/81st Street,  
and through the subway (lower level).

### RESTAURANTS

Museum Food Court, Café on One,  
Starlight Café, and Café on 4 offer  
Members a 15-percent discount.  
Hours are subject to change.

### MUSEUM SHOPS

The Museum Shop, Dino Store,  
Shop for Earth and Space,  
Cosmic Shop, Life at the Limits Shop,  
Nature's Fury Shop,  
and Online Shop ([amnhshop.com](http://amnhshop.com))  
offer Members a 10-percent discount.

### PHONE NUMBERS

Central Reservations 212-769-5200  
Membership Office 212-769-5606  
Museum Information 212-769-5100  
Development 212-769-5151

### TRANSPORTATION AND PARKING

Subway: **B** (weekdays) or **C** to 81st Street;  
**1** to 79th Street, walk east to Museum  
Bus: M7, M10, M11, or M104 to 79th Street;  
M79 to Central Park West  
Parking Garage: Open daily, 8 am–11 pm;  
enter from West 81st Street. Members can park  
for a flat fee of \$10 if entering after 4 pm.  
To receive this rate, show your membership card  
or event ticket when exiting the garage.