Inside

Smithsonian Research

3
GLOBAL WARMING
55 MILLION YEARS AGO

6
ARTFUL BOXES OF
JOSEPH CORNELL

8
BRADLEY & HUBBARD
LAMP MAKERS

10
ALIEN ID CHART

Smithsonian Institution

SCIENCE, HISTORY AND THE ARTS
NUMBER 15 · WINTER 2007

Global radio. From the ringing of the Appalachian banjo to Haitian meringue piano, Scottish ballads, Comanche flute, protest songs and the Uruguayan accordion, with a few clicks of a computer mouse, Smithsonian Global Sound will send to your computer a continuous stream of music from every corner of the world—at no charge. All audio tracks are selections from the eclectic and respected library of Smithsonian Folkways Recordings. As a selection plays, listeners can click the "Recording Info" button on their computer screen to learn more about the track and the CD—available for purchase online—on which it is featured. Listeners can choose from an index of genres, such as Silk Road Radio, Songs of Protest, Music of Appalachia, Fiddle Radio, Radio Latino, Radio Haiti and even a channel featuring the favorite Folkways tracks of Greatful Dead drummer Mickey Hart. Online video performances and interviews round out this cyber-age wellspring of the music that the world is listening to.**—www.smithsonianglobalsound.org**

Los Gaiteros de San Jacinto, a Colombian group that plays folk dance music on Folkways Recordings

'Women of Our Time.' Aviator Amelia Earhart, Actress Mae West and First Lady Eleanor Roosevelt are among the 36 memorable faces gracing the online exhibition "Women of Our Time: 20th-Century Photographs From the National Portrait Gallery." Each portrait selected for this exhibition captures a significant moment in its sitter's life. Taken together, the stylistic diversity of these images is a testament to the depth and breadth of creativity in photographic portraiture in the 20th century. From the soft-focus pictorialism used in the early 1900s, such as Arnold Genthe's 1916 silver print of dancer Isadora Duncan, to contrived portraits of Hollywood stars—Nickolas Muray's colorful photograph of actress Anna May Wong, for instance—these images chart the evolution of photographic portraiture in the 1900s. Short biographies accompany each portrait, as does a brief summary of the circumstances surrounding how each image came to be taken. **—www.npg.si.edu/cexh/woot**

Anna May Wong, by Nickolas Muray, 1937, from "Women of Our Time"

Inside
Smithsonian Research

NUMBER 15 • WINTER 2007

Published quarterly by the Smithsonian Office of Public Affairs, Smithsonian Institution Building, Room 354, MRC 033, P.O. Box 37012, Washington, D.C. 20013-7012, for Smithsonian Contributing Members, scholars, educators, museum personnel, libraries, journalists and others. To be added to the mailing list or to request this publication in an accessible format, call (202) 633-5181 (voice) or (202) 633-5285 (TTY).

John Barrat, *Editor*

Evelyn S. Lieberman, *Director of Communications and Public Affairs*

Kathy Lindeman, *Publications Director*

Telephone: (202) 633-2400
E-mail: insideresearch@si.edu
Internet: www.si.edu/insideresearch

Contributing Members who seek information about the Smithsonian or about their memberships may write to The Contributing Membership, Smithsonian Institution, MRC 712, P.O. Box 37102, Washington, D.C. 20013-7012, or call 1 (800) 931-32CM or (202) 633-6300.

On the cover: A fossil leaf of Populus wyomingiana, *possibly a relative of living poplar trees.* P. wyomingiana *expanded its range north into Wyoming some 55 million years ago, after the Earth became warmer, during the period known as the Paleocene-Eocene Thermal Maximum. After the climate cooled again,* P. wyomingiana *disappeared from this region. Excavated in Wyoming's Big Horn Basin by Scott Wing, a paleobotanist at the Smithsonian's National Museum of Natural History, fossils such as this are helping scientists predict how modern-day plants will respond to global warming. See story, Page 3. (Photo by Scott Wing)*

Smithsonian Institution

Fossils hold clues to predicting how plants will respond to global warming

By Michael Lipske
Special to Inside Smithsonian Research

When Scott Wing is hunting for plant fossils in the badlands of Wyoming's Bighorn Basin—a vast, lightly peopled zone of sagebrush and weathered hills that the Smithsonian National Museum of Natural History paleobotanist has visited off and on for more than 30 years—sometimes his attention strays.

"You can hardly help it," he explains. "If you're collecting fossils, you're sitting in a hole in the ground. In between using the pick and the shovel to make the hole bigger, and pulling out the biggest pieces of rock and splitting them open with a hammer, it's not uncommon to think about what the landscape would have been like" back when the Bighorn Basin was still being formed and the fossil leaves Wing seeks were alive and green.

If Wing's hole in the ground could transport him to that time—55 million years ago, when the late Paleocene era was giving way to the early Eocene era—the scientist would find himself surrounded not by desert sagebrush and rattlesnakes but by palm trees and ferns, alligators and cat-sized horses. "The climate was very different," he says, and the landscape "would have looked something like a forest in Florida."

The Rocky Mountains that surround the Bighorn Basin would still be rising, rivers crossing the basin would be depositing massive quantities of mud and sand shrugged off by the mountains, and those sediments would be capturing the plant parts that Wing digs for every summer.

In Wyoming's Bighorn Basin, Scott Wing searches for fossil leaves in sediments laid down during the Paleocene-Eocene Thermal Maximum. (Photo by Francesca Smith)

What Wing is learning about this long-ago world is helping scientists understand how plants will respond to the global warming being caused today by the burning of massive amounts of fossil fuel and the resulting build-up of greenhouse gases, such as carbon dioxide, in the atmosphere.

Thermal maximum

Wing is studying fossils from a sliver of time known as the Paleocene-Eocene Thermal Maximum, or PETM, a geologic eyeblink when that warm, moist world of 55 million years ago grew even warmer. In just about 10,000 years, the basin's climate went from Floridian to something more like southern Mexico.

"It was a global warming on top of an already globally warm situation," Wing says. Earth's average surface temperature rose 4 to 8 degrees Celsius and stayed that way for the next 80,000 to 100,000 years.

The Bighorn Basin's eroded hills expose rock from the Paleocene-Eocene boundary. That rock contains evidence of changes brought on by the PETM: fossils

(continued)

Wing calls this work "one of the most important things that we do with this fossil record."

of primates and other mammals that migrated to North America when the warming exposed Arctic land bridges to Asia and Europe. But only recently have paleobotanists like Wing had proof of how the PETM affected plant life.

"Things started to click in the summer of 2003," says Wing, who that season found the first fossil leaves and pollen known to be from the PETM. Since then, six PETM plant sites have been identified, all in the Bighorn Basin, and in November 2005, Wing and his team reported their findings in the journal Science.

Pushing north

What they have learned is that during the PETM, global warming pushed several kinds of plants northward into the basin. These include ancestors of warmth-loving plants like the paw-paw and poinsettia. Fossils reveal these same plants had long thrived in Mississippi, Louisiana and Texas. But during the 10,000 years that worldwide temperatures climbed to PETM levels, several species of Southern plants surged north some 1,000 miles. Then, at the end of the period of global warming, those plants disappeared from the Bighorn Basin.

The last time plants anywhere on Earth changed their ranges so widely and rapidly was when glaciers retreated from the Northern Hemisphere some 20,000 years ago. "So it is known that plant populations have the capacity to adjust their ranges relatively quickly," Wing says. But when the glaciers withdrew, they left behind a landscape scraped clean of vegetation, exposing territory ripe for colonization by plants.

That wasn't the case during the PETM. Even before that global warming event, North America was carpeted with forests to the shores of the Arctic Ocean. "There were already plants living all over the place," Wing says. Thus the climate change caused by the PETM favored some plants—invading Southern species that replaced earlier basin plants—over others. That makes the fossil plants from the Bighorn Basin the first "real examples" of how rapidly plants can respond to warming in an already warm world, Wing says.

Hot topic

Knowing how plants have responded to global warming in the past may help in predicting the effects of future climate change. In fact, the PETM is a hot topic among scientists, and not just those with their eyes on the past. "We had a conference last summer, and there were close to

200 people there who were all working on various aspects of this event. It's a very lively topic right now," says Wing, adding that there is a good reason for all the interest in the PETM. "It's seen as being relevant to the future."

Not only was the PETM a rapid change in climate, like the accelerated warming we are witnessing today, but the massive quantity of carbon (about 5,000 gigatons) that was released into the atmosphere during the past event "is roughly the same amount of carbon that we estimate humans are going to produce during the next 500 years by burning fossil-fuel reserves," Wing says.

That makes the PETM the best geologic analog to climate change now being caused by human production of carbon dioxide and other greenhouse gases.

What caused the PETM? No one knows for sure, but one theory suggests that rising ocean temperatures, or perhaps an undersea earthquake, led to the melting of ice containing methane, which was trapped in sediments on the ocean floor. Methane is a powerful greenhouse gas. Released into the ocean and atmosphere, it would have reacted with oxygen, producing still more greenhouse gases in the form of carbon dioxide and water vapor. Those gases may have set in motion the abrupt, worldwide warming, the effects of which Wing reads in the fossils he excavates in the Bighorn Basin.

Field guide

Good finds from his summers of fieldwork are carefully wrapped and brought back to the National Museum of Natural History in Washington, D.C. There, Wing and museum volunteers "prepare out" the specimens. "Almost always, part of the thing that you're interested in is still covered up," Wing explains, so he and his helpers must painstakingly chip away the fine-grained, pale mudstone that contains each fossil leaf.

Photos and descriptions of the leaves end up in fat binders that Wing calls a "field guide to the flora" of the Bighorn Basin of 55 million years ago. The shapes and sizes of leaves, whether of plant species still living today or those from the distant past, are highly correlated with climate. By analyzing each fossil leaf—its overall size, as well as the features of the leaf margin—Wing can draw conclusions about changing levels of precipitation and temperature during an event like the PETM.

'Postdictions'

For several years, Wing has shared his findings with climatologists who create the general-circulation computer models used to predict the rate of future climate change, including global warming. Wing calls this work "one of the most important things that we do with this fossil record.

"The projections of how much warming there will be as the result of anthropogenic carbon dioxide emissions are based on computer models," Wing adds, "and the truth is that we don't really know how well those models work at doing their job. They all show warming, but they show different amounts of warming."

Wing and other paleontologists are helping climate scientists test the accuracy of the models' 'postdictions' of temperature and rainfall patterns in the past against what is actually known about those past conditions from the fossil record. That work can help reveal the strengths, as well as the weaknesses of models that government policy makers are relying on to predict the severity of future warming.

"It's the time-machine aspect of things that I enjoy," Wing says of his work in the Bighorn Basin, where pick-and-shovel labor among the sagebrush can set his mind roaming backward across the ages. But Wing's time machine clearly travels forward, too, with the fossil leaves he unearths and studies revealing as much about our world's warm future as about its past. ❖

Above: *Rhus nigricans*, a fossil relative of the sumac tree, was found in Wyoming's Bighorn Basin in sediments laid down during the Paleocene-Eocene Thermal Maximum. During the PETM, many species of Southern plants, including this one, spread north from the Gulf of Mexico into Wyoming, a distance of some 1,000 miles, in 10,000 years or less.

Opposite, top: Fossils of an unidentified species of plant found in rock laid down during the Paleocene-Eocene Thermal Maximum in the Bighorn Basin of Wyoming.

Opposite, bottom: Fossil bean leaves (*Machaerium*) from 55 million-year-old sediments deposited during the PETM. These leaves are not found in sediments laid down before or immediately after the PETM, indicating that the plants moved into the area during the PETM and disappeared when temperatures cooled. (Scott Wing photos)

Thoughtful juxtapositions fill Cornell retrospective

By Donald Smith
Special to Inside Smithsonian Research

He was a package of paradoxes. He admired women, yet never married. A filmmaker, he never owned a camera. He loved music, but never took up an instrument. During his career as an artist, however, Joseph Cornell focused his relentless energy on collecting bits of paper, dime-store toys and natural objects, such as stones and seashells. He arranged these objects in glass-fronted boxes reminiscent of the "shadow boxes" favored in Victorian-era homes for showing off accumulations of precious minutia.

A prolific artist, Cornell, who died in 1972 at age 69, all but invented boxes as art, a form much admired and occasionally borrowed by surrealists and pop artists.

The challenge faced by Joseph Cornell authority Lynda Roscoe Hartigan in putting together the second major Cornell retrospective since his death—the exhibition "Joseph Cornell: Navigating the Imagination," on view through Feb. 19 at the Smithsonian American Art Museum in Washington, D.C.—was figuring out how to present the 177 widely varied Cornell artworks. Many were borrowed from Cornell aficionados from around the world.

"It was a great puzzle," says Hartigan, chief curator at the Peabody Essex Museum in Salem, Mass., and co-organizer of the Cornell exhibition. "Putting together an exhibition is a very creative act. One must come up with a concept, decide how best to visualize it and organize the material around ideas. I spent a lot of time arranging and rearranging images of Cornell's works on my dining room table, deciding whether something worked better over here or over there.

During the two months leading up to the exhibition opening, Hartigan worried "that people wouldn't get the 'conversa-

Above: Joseph Cornell with his box "Garbo: The Crystal Mask," about 1939-1940, Joseph Cornell Study Center, Smithsonian American Art Museum

Left: "Untitled (Cockatoo With Watch Faces)," about 1949, box construction with inoperative music box, The Lindy and Edwin Bergman Collection, © The Joseph and Robert Cornell Memorial Foundation/ Licensed by VAGA, New York, N.Y. (Photo by Michael Tropea)

Opposite: "Untitled (Soap Bubble Set)," 1936, box construction, Wadsworth Atheneum Museum of Art, Hartford, Conn. Purchased through the gift of Henry and Walter Keney, © The Joseph and Robert Cornell Memorial Foundation/Licensed by VAGA, New York, N.Y. (Photo by Allen Phillips)

tions,'" she says, referring to the cross-references she sought to suggest by thoughtful juxtapositions of disparate pieces.

But her worries were unsubstantiated. When the exhibition opened, "it was gratifying that people would look at the works for a long time and then say things like, 'I never thought of it in that way' and 'It's great to see such different combinations, related ideas and visual elements, to look at such great conversations.' These comments were music to my ears," Hartigan says.

Joseph Cornell was a late bloomer as an artist. Born into an old, distinguished and sometimes rich American family, he struggled, from age 18, to provide for his family after his father died. He cared for both his mother and younger brother, Robert, who suffered from cerebral palsy.

A self-taught artist, Cornell drew on themes suggested by his restless, wide-ranging curiosity about the natural world and the world of art. He read incessantly. His interests ranged from 17th-century English metaphysical poet John Donne to contemporary French novelist and filmmaker Alain Robbe-Grillet. He had a special affection for the American transcendentalist poet Emily Dickinson.

Rarely venturing beyond the borders of his native New York, Cornell took long meandering walks from his wooden frame house in a modest area of Queens. He haunted Manhattan bookstores and art galleries and the theater district, where he formed worshipful relationships with actresses, ballerinas (ballet was another of Cornell's great passions) and movie stars, including Lauren Bacall, Hedy Lamar and Greta Garbo. Cornell used images of these women in his artful boxes.

Hartigan has been a Cornell scholar for more than 20 years, while working as chief curator at the Smithsonian American Art Museum, where she was founding curator of the museum's Joseph Cornell Study Center. The center was established in 1978 when Cornell's sister and brother-in-law donated a collection of his works and related documentary material to the Smithsonian.

The first major posthumous Cornell retrospective, mounted in 1980 by New York's Museum of Modern Art, was organized chronologically, exploring Cornell's development as an artist from beginning to end.

For this exhibition, Hartigan took a thematic approach, dividing Cornell's work into 10 sections. The introductory "Navigating a Career" provides an overview of Cornell's evolution as an artist.

"Cabinets of Curiosity," "Dream Machines," "Nature's Theater," "Geographies of the Heavens," "Bouquets of Homage," "Crystal Cages" and "Chambers of Time" each explore recurring themes of his work.

The section "Wonderland" is composed of a selection of source material drawn from the Joseph Cornell Study Center.

Finally, "Movie Palace" displays a selection of Cornell's experimental films. Like much of his other art, none of the film images were originally created by Cornell. Instead, he took bits and pieces of film shot by others and spliced them together in new ways.

"I'd already done a tremendous amount of research on Cornell and his work," Hartigan says. "This show was a chance to read his art more broadly in terms of concepts like memory and vision, the relationships between art and science, what Cornell did with those subjects and how he interpreted them. I was able to really reflect on what I'd learned and been thinking about over the years." ❖

After its Smithsonian debut, "Joseph Cornell: Navigating the Imagination" will be on view at the Peabody Essex Museum in Salem, Mass., from April 28 to Aug. 19 and at the San Francisco Museum of Modern Art from Oct. 6 to Jan. 6, 2008.

Smithsonian Castle holds a well-documented collection of Bradley & Hubbard lamps

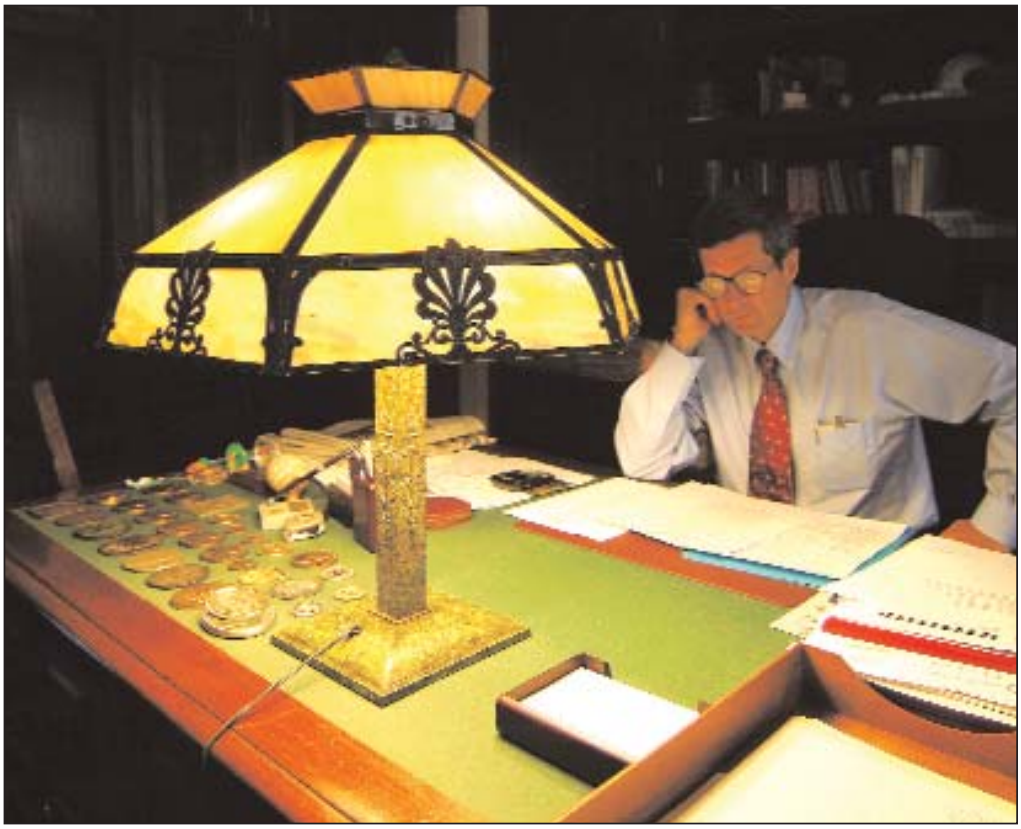
By Donald Smith
Special to Inside Smithsonian Research

He was instantly smitten. The curvaceous kerosene lamp for sale in the antique shop in Hyattsville, Md., had a regal look. It stood 2 feet tall with a center pedestal of green alabaster resting on lions-paw feet. Its heavily filigreed font-holder, decorated with human faces, was right out of Victorian New England.

"It's a Bradley & Hubbard, you know," the shop owner said encouragingly. Rick Stamm had no idea what the man meant, but it sounded impressive. He bought the lamp on the spot.

Since that day 23 years ago, Stamm—keeper of the collection of furnishings used inside the Smithsonian's circa-1850 Castle, the Institution's administrative headquarters, in Washington, D.C.—has learned a great deal about the Bradley & Hubbard Manufacturing Co., one of the premier lamp makers of 19th-century America. Somewhere on his scholarly journey retracing the history of antique lighting, paging through a labyrinth of U.S. Patent Office records and traveling to antique shops throughout most of the mid-Atlantic states, Stamm's interest turned, he says, into an obsession.

"As I got into my research, I began to understand and appreciate how different Bradley & Hubbard Co. objects are. Their makers were truly masters of metalwork," Stamm says, picking up an 1880s match-safe and turning it over. "These objects were made by pouring molten metal into sand molds. They are made of cast iron yet are smooth and finished on the bottom."



One of America's largest producers of kerosene lamps and other metal household items, including andirons, clocks, match-safes and desktop stationery sets, Bradley & Hubbard was founded in 1852 and continued through 1940, when the company was bought by the Charles Parker Co.—one of Bradley & Hubbard's rivals in the town of Meriden, Conn. The last Bradley & Hubbard lamp was manufactured in the early 1950s, and the demolition of the old factory buildings after a catastrophic fire in 1973 destroyed any factory records that may have still existed

Above: James Hobbins, executive assistant to the Secretary of the Smithsonian, works by the light of an electrified table lamp made by the Bradley & Hubbard Manufacturing Co., circa 1910.

Opposite, from top: A Bradley & Hubbard brass desk set, circa 1934; a Bradley & Hubbard table lamp, circa 1910; a page from an 1892 Bradley & Hubbard patent; and a Bradley & Hubbard kerosene lantern, circa 1905 (Photos by John Barrat)

in the long-abandoned buildings.

As keeper of the Castle collection, Stamm is responsible for the care of more than 3,000 pieces of 19th-century furniture, lighting fixtures, porcelain, glass and other decorative objects that give the offices, halls and reception rooms of the Smithsonian Castle a historical ambience. He thoroughly documented every item in this collection based on its identity, provenance and other pertinent information.

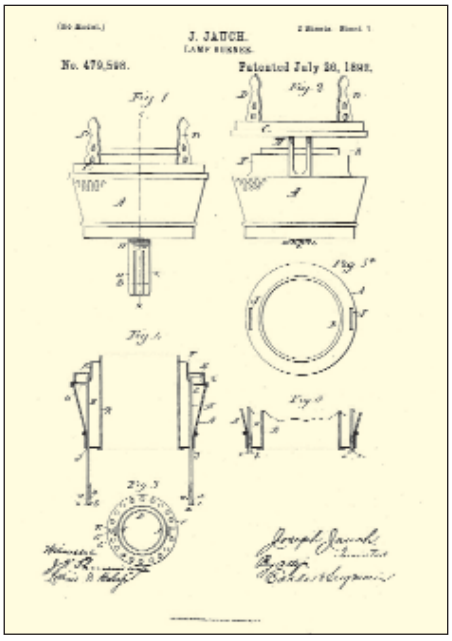
Partly to compile information on his new acquisitions and partly to satisfy his own curiosity, Stamm has been researching the Bradley & Hubbard Co. for decades. Early on, he ran into a major roadblock because of the destruction of the firm's records in the 1973 fire.

"I went a couple of times to Meriden, Conn., where the company was headquartered, but there wasn't much to find," he recalls. "The historical society had some pamphlets and old catalogs and some photographs. But there wasn't much more."

Lacking the company's archives, Stamm turned to the next best thing—the official records of the U.S. Patent Office. The Smithsonian's National Museum of American History, Kenneth E. Behring Center also has a complete set of indexes to patents, as well as the patents themselves, on microfilm, which Stamm used.

From 1856 to 1934, Bradley & Hubbard took out more than 200 different patents. About 140 were for mechanical improvements in basic lamp designs: for example, better ways to raise a wick; gauges for measuring how much oil was left in a lamp's reservoir; a ridge stamped in the metal to keep oil from spilling over; even the arrangements of holes in flame spreaders.

"The research was a two-step process," Stamm says. "First, I would scan through the indexes searching for Bradley & Hubbard patents. Inventors were frequently Bradley & Hubbard employees, and they would assign the patent rights to the company. I often had to do cross-referencing. Then, once I had the number, I could find the patent record." Patent records not only helped Stamm piece together the manufacturing history of the Bradley & Hubbard Co., but also to put a date to many objects in the Castle collection. On one occasion, they even helped him solve a puzzle.



"I found a pair of kerosene lamps whose parts had been mixed up," Stamm says. "One was made by Bradley & Hubbard, and the other, by a different company. In electrifying them, someone had taken them apart, then put them back together with the font from one, the column from the other and so on. By having the actual patent drawing of the Bradley & Hubbard lamp, I was able to put each lamp back together the right way."

Stamm's work on the Bradley & Hubbard story has been outside his official duties. He has purchased and donated all but six of the Castle's 133 Bradley & Hubbard artifacts, which include 14 kerosene lamps—about half of which have been electrified—two chandeliers, three sconces and 28 candlesticks.

Along the way, he has carefully preserved his research, complete with convenient digests he has written to make the often lengthy and abstruse language of patent applications more accessible.

Five years ago, it occurred to Stamm that he might have the makings of a book. Working on it now, he intends to one day publish his work as a comprehensive guide to the many stylish kerosene lamps that once illuminated homes and offices across America. ❖

Astronomers create chart to ID life-bearing planets in distant star systems

By Christine Pulliam
Smithsonian Astrophysical Observatory

From outer space, no other planet in our solar system resembles Earth, the blue planet. Our atmosphere, oceans and green, plant-covered continents reflect the light of the sun in a unique spectrum of colors. Earth also emits invisible infrared radiation. Should astronomers on Earth one day spy a planet in some distant star system with a similar profile, they might say the existence of life on this new world is the best explanation.

Building upon this simple concept, astronomers Lisa Kaltenegger, Wesley Traub and Kenneth Jucks of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass., have created a new guide by which astronomers can identify planets in other solar systems that may contain life. The guide is based on computer models that calculate how the reflected light and emitted radiation of the Earth appears from trillions of miles away and just how that spectrum has changed during the Earth's geologic past.

Spectral signatures

Different atmospheric gases leave specific spectral signatures or fingerprints, both visible and infrared, on the light reflected and emitted from a planet. By collecting this light and splitting it into a rainbow spectrum of colors (as a prism does), astronomers can determine which gases are present in a planet's atmosphere.

"By looking at a planet's atmosphere, we can search for signs that the air has been altered by living organisms," Kaltenegger explains. "Since Earth is the only known planet with life, we studied the history of Earth's atmosphere to learn what signs to seek on other worlds," she adds.

Although current space telescopes are unable to examine the faint light from planets in distant solar systems, future instruments will have that capability. The work of Kaltenegger, Traub and Jucks is in anticipation of that day. Many astronomers believe the search for extraterrestrial life will meet with success in the next 10 to 20 years.

To find other life-bearing worlds, astronomers plan to first look

Left: Earth's early atmosphere of nitrogen, methane and carbon dioxide was hostile to life as we know it, but friendly to the first methane-loving bacteria. This artist's rendering shows Earth 4 billion years ago, before continents formed and while our planet still suffered bombardment from asteroids and comets left over from the solar system's formation. (David Aguilar image)

Opposite: Lisa Kaltenegger peers through the eyepiece of a telescope at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass. (Photo by Christine Pulliam)

"The first extraterrestrial life we discover may be just slimes, molds and bacteria," Kaltenegger says.

in distant solar systems for planets in Earthlike orbits around their stars. These orbits are in what astronomers call "habitable zones"—areas around a star where the temperature allows for the presence of water in a liquid state.

To get its start, life on Earth required both land and liquid water. So researchers will be on the lookout for small, rocky planets orbiting in a "habitable zone" around a star.

Methane

In creating their models, the scientists also took into consideration that Earth's spectral profile has changed dramatically in the past 4.5 billion years. Today, the air we breathe consists of about three-fourths nitrogen and one-fourth oxygen. Four billion years ago, no oxygen was present. Instead, Earth's atmosphere was a blend of carbon dioxide, nitrogen and hydrogen sulfide that would be toxic to humans. Yet life arose and flourished in this early atmosphere.

Earth's first inhabitants were anaerobic bacteria—organisms that can live without oxygen. Those bacteria pumped large amounts of methane into the planet's atmosphere, changing it significantly. If anaerobic bacteria exist on another planet, future space missions might detect a methane fingerprint in the planet's atmosphere.

But natural processes like volcanism also can inject methane into the air, Kaltenegger cautions. "Methane itself is not an unambiguous sign of life. But detecting both methane and oxygen at the same time is an excellent biosignature."

Oxygen

About 2.5 billion years ago, drastic changes permanently shifted Earth's atmospheric balance. Blue-green algae appeared in the oceans and began emitting large amounts of oxygen into the air. The oxygen reacted with methane, clearing away most of that gas. It also suffocated many of the anaerobic bacteria that had ruled the world until that time. Soon, blue-green algae became the new dominant life form and Earth's atmosphere gained its first free oxygen. Two billion years ago, Earth's oxygen revolution was fully under way.

"When aerobic bacteria displaced anaerobic bacteria as the dominant life form, they introduced oxygen to Earth's atmosphere," says Traub, who also works at NASA's Jet Propulsion Laboratory in Pasadena, Calif. "That oxygen made multicellular life, including human life, possible.

Complex, diverse

"If an extrasolar planet is found with a spectrum similar to one of our models, we potentially could characterize that planet's geological state, its habitability and the degree to which life has evolved on it," Traub continues.

On Earth, life continued to evolve from blue-green algae to more complex organisms, yielding the great diversity of species now present on this planet. Some scientists are skeptical that life forms as complex as those found on Earth exist elsewhere in the galaxy.

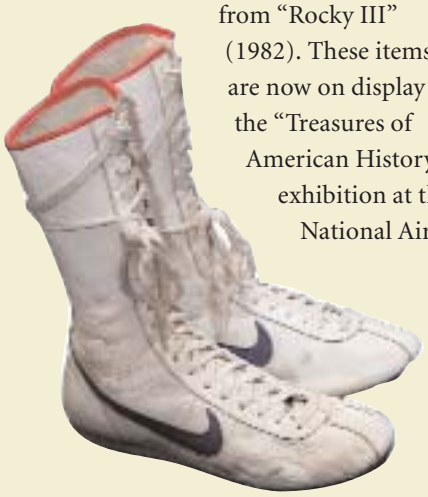
"The first extraterrestrial life we discover may be just slimes, molds and bacteria," Kaltenegger says.

Nevertheless, discovering life elsewhere in the universe surely would count as one of the greatest and most profound moments in human history.

"Looking up at the night sky and knowing that planets like ours, complete with life, exist out there somewhere would forever change our view of the universe," Kaltenegger says. "The sky would be even richer because we could start to investigate what

Asia Trail. The Fujifilm Giant Panda Habitat and Asia Trail, a 6-acre, $52 million exhibition area, opened in October at the Smithsonian's National Zoological Park. Providing a newly expanded home for seven of the Zoo's Asian animal species—giant pandas, sloth bears, fishing cats, clouded leopards, red pandas, Asian small-clawed otters and Japanese giant salamanders—the Fujifilm Giant Panda Habitat and Asia Trail incorporate enrichment activities that stimulate each animal's natural behavior. The new exhibition highlights Zoo research and conservation activities through interactive kiosks, interpretive hands-on learning stations, videos and other state-of-the-art methods.

Rocky at Smithsonian. In a December ceremony in Washington, D.C., filmmaker Sylvester Stallone donated objects from his Academy Award-winning "Rocky" films to the Smithsonian's National Museum of American History, Kenneth E. Behring Center. Stallone donated the boxing robe Rocky Balboa wore to the climactic fight with Apollo Creed in 1976's "Rocky"; a black hat and a pair of boxing gloves from "Rocky II" (1979); and a pair of boxing shorts and shoes from "Rocky III" (1982). These items are now on display in the "Treasures of American History" exhibition at the National Air and Space Museum, which features 150 well-known objects from the American History Museum collection. The American History Museum, currently closed for a renovation, will reopen in mid-2008.



Boxing shoes worn by Rocky Balboa in "Rocky III" (Photo by Hugh Talman)

Red panda in its habitat at the National Zoo's Asia Trail (Photo by Jessie Cohen)

Crozet remains. At the request of officials from Virginia Military Institute, the remains of Claudius Crozet (1790-1864), noted French engineer and scientist buried on the VMI campus in Lexington, were recently examined by Douglas Owsley, a physical anthropologist at the Smithsonian's National Museum of Natural History. Crozet's remains, contained in a cast-iron coffin, were exhumed so they could be moved to a new location on VMI's campus. They revealed Crozet was about 5 feet, 10 inches tall and had mild arthritis, herniated discs and abscesses in three teeth. Hair, brain and bone tissue samples were taken for further analysis.

Airplane directory. An expanded online version of the "Smithsonian National Air and Space Museum Directory of Airplanes, Their Designers and Manufacturers" is newly available on the Internet at the address: siris-thesauri.si.edu. This free guide serves as a single authoritative listing of aircraft names organized by designer and manufacturer. Included in the list are airplanes, gliders, hang-gliders, helicopters, autogiros and ornithopters. Not included are lighter-than-air craft and remotely piloted aircraft.

New Guinea expedition. Scholarly essays addressing a 1926 Dutch and American expedition to New Guinea have been placed online by Smithsonian Institution Libraries as part of its new series Smithsonian Libraries Digital Editions: Sources and Critical Interpretations. "By Aeroplane to Pygmyland: Revisiting the 1926 Dutch and American Expedition to New Guinea" features interpretive essays by Smithsonian National Museum of Natural History Anthropologist Paul Taylor about this expedition. The essays are accompanied by diaries from the American participants, expedition records, more than 700 photographs and two hours of film footage, accessible at the Internet address: www.sil.si.edu/expeditions/1926/.

A Dayak man with a shield, from the "By Aeroplane to Pygmyland" Web site

Biting bugs no match for poison frog's toxic skin

Scientists have long realized that the toxic chemicals produced by the skin glands of poison frogs serve to protect these amphibians from predators that try to eat them. Recent research by Paul Weldon, a biologist at the Smithsonian National Zoological Park's Conservation and Research Center in Front Royal, Va., and colleagues has revealed these toxins also protect the frogs from mosquitoes, biting flies and other disease-carrying insects.

In the study, Weldon collaborated with John Daly and Thomas Spande of the Laboratory of Bio-organic Chemistry at the National Institutes of Health, both of whom have devoted decades to identifying chemical toxins from poison-dart and other frogs. Experiments using these compounds have been limited because of the small amounts of material available.

Weldon tested the effects of one of these compounds, pumiliotoxin 251D, or PTX 251D, on yellow fever mosquitoes (*Aedes aegypti*) raised in laboratory colonies.

He first coated an ultra-thin silicone membrane with PTX 251D and placed it over a mosquito food source— sugar water. Most mosquitoes that landed on the membrane to feed turned over onto their backs and slowly flailed their legs, or their legs fell off entirely, an effect known as leg autonomy, and they died.

In a second experiment, Weldon confined the mosquitoes inside a narrow pipette into which he inserted a wire coated with PTX 251D, forcing the mosquitoes to stay in contact with the wire for three minutes. Weldon used different concentrations of PTX 251D in this experiment to try to estimate at what level of concentration the poison-frog alkaloid induces toxicosis in mosquitoes.

These results demonstrated that PTX 251D deters yellow fever mosquitoes from feeding and induces toxicosis with contact, as evidenced by impaired flight and leg autonomy. The researchers also learned that PTX 251D is an effective insecticide at concentrations well below those that occur naturally in poison frogs.

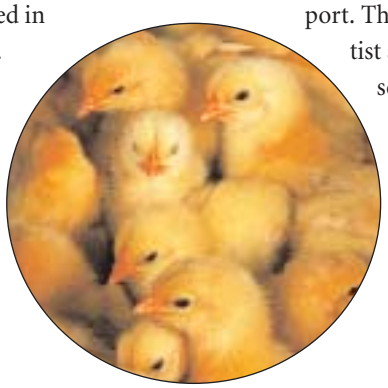
Poison frog *Dendrobates pumilio* from Bocas del Toro, Panama (Ralph Saporito photo)

Weldon credits the wire contact technique—which he developed at the Department of Entomology at the Walter Reed Army Institute of Research—with his ability to test compounds that are only available in small amounts.

"This is the first microscale toxicity test for insects that I am aware of," Weldon says. "It may be useful in demonstrating the insecticidal properties of other compounds." *—John Barrat*

Scientist urge controls on poultry imports to help stop spread of avian flu H5N1

Since the first outbreaks of the strain of avian influenza known as H5N1 appeared in Hong Kong, scientists have debated how to stop the spread of the disease, which has appeared in more than 50 countries in Asia, Europe and Africa. The United States' bird flu surveillance program has focused primarily on migratory birds flying from Asia to Alaska, but new research published in December by scientists from the Smithsonian, the New York-based Consortium for Conservation Medicine and the United Kingdom's Royal Society for the Protection of Birds reports that bird flu is most likely to be introduced to countries in the Western Hemisphere through infected poultry.



Imported chickens may spread avian flu to the Western Hemisphere.

Birds migrating from Siberia are much less likely to introduce bird flu to the United States than infected wild birds flying from countries in Central and South America, which import hundreds of thousands of chickens annually from European and Asian countries where bird flu has been found.

"We need to make sure that we are preparing developing countries in this hemisphere for an outbreak of avian flu," says Peter Marra, an avian ecologist with the Smithsonian National Zoological Park's Migratory Bird Center, who worked on the report. The research team, led by Marm Kilpatrick, a scientist at the CCM and a Smithsonian research associate, set out to identify how the disease has spread through Asia, Europe and Africa. The scientists analyzed the risk of introduction along three pathways: poultry, trade in wild birds and migrating birds.

The findings, published in the Proceedings of the National Academy of Sciences, showed that the combination of poultry trade and migratory bird movements spread H5N1 much further than it would have traveled by either of these pathways alone. The report recommends "strict controls or a ban on the importation of poultry and wild birds into the Americas and stronger enforcement to curb illegal trade." Canada, Mexico and several countries in South America regularly import hundreds of thousands of day-old chicks from other regions where bird flu is circulating, Marra says.

—Alex di Giovanni

In the Beginning: Bibles Before the Year 1000, edited by Michelle Brown (Collins, 2006, $45). A sumptuously illustrated volume featuring a rare assemblage of fragile biblical treasures—the physical evidence for the earliest copies of scriptures. Companion to a major exhibition at the Smithsonian's Arthur M. Sackler Gallery.

Jamestown, Québec, Sante Fe: Three North American Beginnings, edited by James Kelly and Barbara Clark Smith (Collins, 2007, $34.95). The official companion book to the nationally touring exhibition commemorating the 400th anniversary of the founding of Jamestown in 1607, Québec in 1608 and Sante Fe in 1609.

Identity by Design: Tradition and Innovation in Native American Dresses, (Collins, 2007, $24.95). A stunning book of illustrations and essays showcasing the clothing of Native American women and the forces of tradition and change in their lives.

The Invisible Sex: Uncovering the True Role of Women in Prehistory, by J.M. Adovasio, Olga Soffer and Jake Page (Collins, 2007, $26.95). An exciting new look at prehistory, which argues that women played a central role in the development of language and social life and the creation of materials, such as clothing and nets.

Crazy '08: How a Cast of Cranks, Rogues, Boneheads and Magnates Created the Greatest Year in Baseball History, by Cait Murphy (Collins, 2007, $24.95). A rollercoaster ride through the wildest year America's game has ever seen.

Indigenous Motivations: Recent Acquisitions from the National Museum of the American Indian (National Museum of the American Indian, 2006, $19.99). Essays about and images and descriptions of some of the most important and intriguing works made by Native artists and craftsman in recent decades.

U.S. Air Force: A Complete History, by Dik A. Daso (Hugh Lauter Levin Associates Inc., 2006, $75). A definitive and richly illustrated chronology of the U.S. Air Force from Civil War-era Army ballooning to cruise missiles over Afghanistan and Iraq.

Under a Green Sky: Global Warming, the Mass Extinctions of the Past and What They Can Tell Us About Our Future, by Peter D. Ward (Collins, 2007, $26.95). The only book that, by looking backward, finds the key to the potential climate disasters facing humanity.

Classic Canadian Songs from Smithsonian Folkways (Smithsonian Folkways Recordings, 2006, $15). Thirty classic tracks that showcase the rich musical traditions of generations of European settlers.

When the Soul is Settled: Music of Iraq (Smithsonian Folkways Recordings, 2006, $15). Improvisations by Rahim Alhaj on the oud, a Middle Eastern lute—a proud tradition's meeting with modernity.

Friends of Old Time Music (Smithsonian Folkways Recordings, 2006, $29.95). A three-CD set of live recordings taken from a trailblazing series of concerts held in New York City between 1961 and 1965.

Books listed on Pages 14 and 15 can be ordered through online book vendors or purchased in bookstores nationwide.

Recordings can be ordered from Smithsonian Folkways Mail Order, Smithsonian Folkways Recordings Dept. 0607, Washington, D.C. 20073-0607. To order by phone, call (800) 410-9815 or (202) 275-1143.

A Danish Photographer of Idaho Indians: Benedicte Wrensted

By Joanna Cohan Scherer (University of Oklahoma Press, 2006, $29.95)

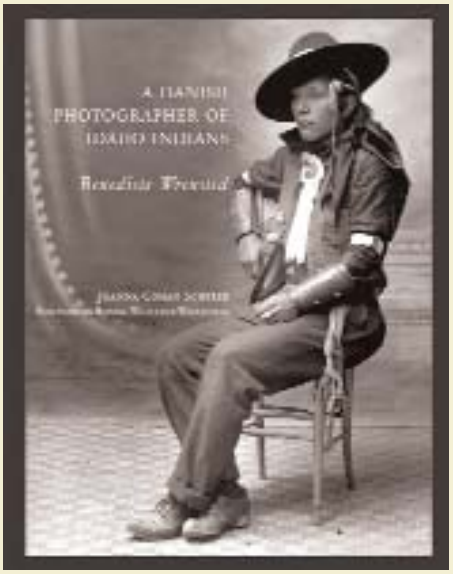
With the publication of *A Danish Photographer of Idaho Indians: Benedicte Wrensted,* author Joanna Cohan Scherer pulls back the cloak of obscurity from the life and achievements of a truly remarkable female photographer. Danish-born Benedicte Wrensted (1859-1949), who, in 1895, at age 35, emigrated from Denmark to southeast Idaho, created an invaluable and fascinating photographic record of the Northern Shoshone, Lemhi and Bannock tribes of American Indians who live at the Fort Hall Indian Reservation near Pocatello, Idaho.

"Putting a woman back into American photographic history is in itself sufficient reason for resurrecting the photography of Benedicte Wrensted," Scherer writes in the book's foreword. "She represents the large number of women photographers of American Indians whom history has not treated kindly with remembrance."

Wrensted enjoyed many years as a commercial photographer in Pocatello, where local residents, both Anglo and Native American, came to her studio to sit for formal portraits. For the American Indians, her photographs document a period of rapid cultural transition.

In this scholarly book, Scherer, an anthropologist and former illustrations researcher with the Smithsonian National Museum of Natural History's *Handbook of North American Indians*, reveals the importance of Wrensted's photographs in a number of areas. "They can be appreciated as visual art—as evocative symbols of American Indian icons. They can be viewed as social documents of the Shoshone-Bannock people at a particular time in history and as records of local, family or individual history," Scherer writes.

This beautifully designed volume reproduces a substantial number of Wrensted's photographs, along with a detailed description of each image, including the names of the subjects, their biographical data and an ethnographic analysis of their Native attire.



The book cover shows Eddie Drink, an Eastern Shoshone, photographed between 1910 and 1912 by Benedicte Wrensted

The book represents years of meticulous detective work that involved library and archival research, interviewing Wrensted's relatives, as well as the descendants of her Native American sitters. "I have pieced together a picture of the photographer and her intentions," Scherer writes, "…and the cultural, historical and ideological contexts in which the photographs were taken and later viewed."

Readers of *A Danish Photographer of Idaho Indians: Benedicte Wrensted* travel back to the railroad town of Pocatello in the late 1800s and into the very studio where many Native Americans sought out the photographer. In addition to Wrensted, Scherer explores the lives of a number of her sitters—both Native American and Anglo American.

One individual Scherer focuses on is Bannock tribal member Pat Tyhee, who Wrensted photographed in either 1898 or 1899, in two photos, one in his Indian clothing and the other in European-style clothing, showing his self-identification in both worlds.

Another of the many poignant photographs in the book is of a group of Northern Shoshone men wearing Native ornaments. One of the men, George Edmo, proudly wears for the photograph the same hairpipe-and-brass-bead necklace that his father, Arimo, owned and had worn when he was photographed years earlier.

"Today, images by Benedicte Wrensted are in many Shoshone-Bannock homes, and the stories they bring to mind are related and passed on to the next generation," former Shoshone-Bannock Tribes Museum Director Bonnie Wuttunee-Wadsworth writes in the book's introduction. "Today, the pictures have a new cultural significance. In them, the Shoshone-Bannock have found the faces of their forebears."

At age 53 in 1912, Wrensted ended her career as a photographer and moved to California where she built a house in the Hollywood Hills. She left no diary and no records, only a collection of photographs widely distributed in private and public hands. Through nearly two decades of research, Joanna Scherer has secured for these treasures their proper place of recognition and importance in the visual history of the United States.

—Daniel Friend

Mitten crab from Chesapeake may indicate an expanding East Coast population

Looks like a big weird spider," Maryland waterman John Delp recalled thinking to himself as he hauled up a strange-looking crab in June 2006 at the mouth of the Patapsco River in the Chesapeake Bay.

He froze the creature and later, at the Smithsonian Environmental Research Center in Edgewater, Md., it was positively identified as a Chinese mitten crab—so called because its claws are covered with tiny setae, or hairs. Scientific name: *Eriocheir sinensis*.

Scientists were alarmed. Was this an isolated individual or one from a previously undetected population of mitten crabs now living and expanding in the bay?

Native to Korea and China, thousands of tons of mitten crabs are harvested in Asia each year for food. Delp's catch, however, was the first of this invasive species to be reported in the Chesapeake. Following local news coverage of the crab, a second specimen was turned in by a local waterman and confirmed to be a mitten crab.

On the West Coast, a single mitten crab was found in San Francisco Bay in 1992. Today, their range has expanded throughout hundreds of miles of the San Francisco Bay and its tributaries.

Digging into stream banks, damaging fishing nets, clogging water pumps and eating native vegetation, mitten crabs have become a serious pest in the San Francisco area. For the Chesapeake and its watershed, the crab may pose the same threat, says SERC Ecologist Greg Ruiz.

"We are now working with the Maryland Department of Natural Resources to conduct further surveys and monitor the upper Chesapeake and its tributaries," says SERC Director Tuck Hines. Yongxu Cheng, a visiting researcher at SERC who happens to be an expert in mitten crab biology and culture from Shanghai Fisheries University in China, also is consulting on the project.

How Delp's mitten crab arrived in the United States is a mystery. Scientists suspect it may have arrived as planktonic larva in the ballast water of a cargo ship. This theory is supported by the fact that the busy Port of Baltimore is on the Patapsco River. It also may have been smuggled into this country from Asia.

For now, Delp's crab is in a jar of alcohol in the invertebrate collections of the Smithsonian's National Museum of Natural History in Washington, D.C. An alert has been issued to Chesapeake Bay watermen for any other catches of mitten crabs. Should more mitten crabs be pulled from the Chesapeake, DNA taken from these first specimens can help determine if the crabs are related and possibly initial members of an expanding East Coast population.

—*John Barrat*

SMITHSONIAN INSTITUTION
MRC 033 PO Box 37012
Washington DC 20013-7012

Official Business
Penalty for Private Use $300

Presorted Standard
U.S. Postage Paid
Smithsonian Institution
G-94

Inside
Smithsonian Research

NUMBER 15 • WINTER 2007