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PALEOANTHROPOLOGY

Drastic changes in climate may have forged higher intelligence in humans

By Michael Lipske
Special to Research Reports

In the parched landscape of Olorgesailie, an ancient lake basin in southern Kenya's rift valley, different color soils compose an archives of environmental change.

To a skilled eye, soil sediments at the site disclose the long-vanished lake's expansions and contractions over tens of thousands of years, as well as the spread of plant life, the lake's replacement by a salt flat and the eruption of volcanoes that blanketed the basin with ash. Paleoanthropologist Rick Potts, director of the National Museum of Natural History's Human Origins Program, sees something more at Olorgesailie: a powerful engine of human evolution.

In two recent papers, Potts has advanced a new theory of evolution linking the origins of our species to large-scale environmental shifts of the kind that occurred at Olorgesailie (where Potts and other scientists study humans who lived there between 1 million and 490,000 years ago) and at other places occupied by early humans.

Potts' theory, called the variability selection hypothesis, states that key human traits such as walking on two legs, sophisticated mental behavior and complex social life evolved as a result of living in one of the more volatile eras of Earth's environmental history.

In the November 1998 issue of Evolutionary Anthropology and in the 1998 Yearbook of Physical Anthropology, Potts extends Charles Darwin's idea of natural selection, in which organisms become adapted genetically, over thousands of generations, to consistent features of their environment. In the case of early humans, Potts theorizes that environmental inconsistency tested their ability to survive.

The new theory grew from an attempt to solve a puzzle at Olorgesailie and other fossil research sites in East Africa. Why, Potts wondered, had certain early forms of elephant, zebra and other large mammals died out after dominating the African biota for more than a million years? In investigating the question, he and other researchers found evidence of dramatic environmental changes at Olorgesailie, changes to which the extinct Pleistocene mammals had been unable to adapt.

Potts describes long-term major climate oscillations and their associated landscape changes as a "scythe that goes back and forth" through time, slicing across lineages of animals, letting some species live while sentencing others to oblivion.

Sediments that reveal Olorgesailie's history of environmental instability also contain stone tools crafted as long ago as 1 million years. Early humans at the site contended with the same challenging conditions that mowed down early elephants and zebras. "We began to wonder how in the world were our ancestors getting through it," Potts says.

Investigating such "how and why questions of human origins," Potts says, is the purpose of the program he directs at the museum. The Human Origins Program is the first major research endeavor devoted to creating what he calls "an ecological history of human beings."

Environmental records worldwide show many dramatic fluctuations in climate, and resulting changes in vegetation and other resources, across the span of human evolution. Potts argues that this sporadically changing environment was a more important factor in human evolution than long-popular scenarios such as the rise of the African savanna or of Ice Age conditions in Europe and Asia. According to these earlier theories of our origins, certain uniquely human characteristics evolved to meet the demands of a single environment. But Potts says that a growing database of ancient-climate records shows that humans evolved in a world where "the environment is fluctuating all over the place.

"The last 5 million years," he adds, "is one of the most environmentally dynamic and instable times in Earth's history. Our evolutionary heritage happens to correspond exactly with that. To my mind, that leaves us with a fairly strong indication that our evolutionary history was, at least in part, a response to this fluctuation."

Human traits such as large brains and sophisticated culture enhanced our ancestors' ability to deal with habitats that, over tens of thousands of years, shifted between wooded and open, wet and dry, and warm and cool. The vast majority of living things has evolved adaptations matched to a specific habitat. However, Potts believes that in the case of early humans, extremes of environmental change, expressed over the long term, caused genetic selection that adapted our ancestors to novel settings. The result: adaptations not linked to any one habitat.

Rick Potts is shown here holding a cast of a 1.6 million-year-old Homo erectus *skull found in Kenya. To the left is a modern human skeleton. (Photo by Carl Hansen)*

An example of variability selection at work, Potts says, is bipedality. The first human ancestors that walked on two legs were australopithecines, who begin showing up in the fossil record about 4 million years ago. While early australopithecines moved efficiently on their feet, they retained powerful apelike arms suited to climbing trees.

Human resiliency and versatility also account for the incredible dispersal of our species across the globe, Potts says. "One of the things that no theory of human evolution has really explained very well is the tremendous transformation that has taken place over the course of human origins. We start out as apelike creatures confined to Africa, and now we're all over the world."

Variability selection explains the "gradual decoupling of the human species from any one particular environment," Potts says. "And you have to have that in order to have this amazing dispersal of human beings all over the world, which is the geographic and ecological story of our species."

But humans are more than just ubiquitous. "Humans have tremendous abilities, as we all know, to impact and change environments," Potts adds.

Adaptations that evolved to help us cope with unpredictable environments now allow people to alter the world in ways that may lead to more ecological instability.

"The irony," Potts says, "is that our evolutionary origin, according to this hypothesis, was driven by environmental instability, and now human beings are an agent of that instability that has been added to an already dynamic system of the Earth."

Human changes to the environment, he says, "are a new variable, and we have never had an Earth system operate with that new variable." If that human factor helps usher in a new Ice Age, global warming or some as yet unimagined environmental test for our species, then variability selection and our very human ability to adapt to novel worlds will prove as necessary to our survival as it was to our beginnings. ■

Inside...

RESEARCH VISTAS

Talk about the Smithsonian's research on alien species invasions, and you may get a few raised eyebrows, but the work is a matter of scientific fact, not science fiction. For the last seven years, the Smithsonian Environmental Research Center in Edgewater, Md., has been actively engaged in the study of how tiny aquatic plants and animals move from their native habitats to other distant ports of call, often wreaking economic and environmental havoc. Estuaries like the Chesapeake Bay are particularly susceptible to these invasions of nonindigenous species because of their association with modern commercial shipping.

Almost all commercial vessels carry ballast water. For example, since bulk carriers and tankers make only one-way trips, these large ships destined to carry U.S. exports of grain, coal or oil overseas arrive loaded with millions of gallons of ballast water. This water, pumped into dedicated tanks or holds at their home ports in order to maintain balance and stability on the voyage, is then released at the destination port. Because ballast water usually is taken on in bays and estuaries, where the waters teem with minute organisms and the larvae of fish and invertebrates, it is considered the single largest transfer mechanism in marine biological invasions.

Researchers at SERC were the first to conduct a comprehensive analysis of marine invasions for any site on the U.S. Atlantic coast. Since 1993, the team has reconstructed the pattern of invasions over the last 400 years and gathered data on each of more than 160 species known or presumed to be alien to the Chesapeake Bay. This effort has expanded in recent years to include nonindigenous marine and estuarine species in the Indian River—near the Smithsonian Marine Station at Fort Pierce, Fla.—and in Prince William Sound, Alaska. In addition, the team has studied the physical and biological characteristics of ballast water from approximately 200 ships arriving in the Chesapeake Bay and 200 more arriving in Prince William Sound.

Congress first passed legislation aimed at controlling the introduction and spread of aquatic nuisance species in 1990, then extended the breadth and reach of the original law by enacting the National Invasive Species Act of 1996. The law directs SERC, in conjunction with the U.S. Coast Guard, to develop a clearinghouse to collect, analyze and interpret information about ballast-water-mediated invasions.

In response, the National Ballast Water Information Clearinghouse was established at SERC in 1997. Every ship entering U.S. waters from outside the 200-mile-wide Exclusive Economic Zone coastal boundary must file a report with SERC about the vessel and its voyage, identifying its ballast water volume, as well as the date and location of intake and discharge. SERC now receives more than 30,000 such reports annually, assimilating and analyzing for the first time information on national patterns of ballast water management and alien species invasions.

SERC is now expanding its analyses of marine invasions to create a national-scale database of highly detailed information on each nonindigenous species known from coastal waters of the United States. This expanded information resource will include species identification, source region, geographic distribution, means and date of introduction, life history, environmental tolerances, ecological interactions and economic impact.

The SERC invasions program, the largest marine invasions research group in the country, fills a previous void in our knowledge of species invasions and provides a framework for formal, standardized comparisons of invasion patterns and species characteristics on regional, national and international scales.

SERC scientists have set the standard for invasive species study and already are collaborating with research groups elsewhere in the United States and abroad with the intent of establishing a network of sites to document invasion patterns, attributes and impacts.

—Dennis O'Connor, Provost, Smithsonian Institution

Richard Fiske uses a high-precision analytical balance to measure the specific gravity of a pumice sample taken from a Japanese volcano. He hopes to learn how deep in the ocean pumice can be formed and to be able to estimate the depth at which it can be erupted. (Don Hurlbert photo)

VOLCANOLOGY

Scientists find 'pot of gold' while studying underwater volcanoes

By Michael Lipske
Special to Research Reports

Dreaming of a fortune in gold? Cruise south from Tokyo 250 miles, then dive straight down through 4,000 feet of cold, dark ocean. There you will find it, cupped in the crater of a volcano at the bottom of the sea: a mineral deposit containing gold, silver and other metals as big as the Pentagon building and twice as high.

Alas, treasure seekers, this submarine bonanza belongs wholly to Japan, in whose waters it was recently discovered. "It's one heck of a lot of gold," says Richard Fiske, volcanologist at the National Museum of Natural History and a member of the team of geologists that found the immense ore mass in 1996. "I did a back-of-the-envelope calculation, just a crude estimate based on samples collected at the surface of the deposit, and the gold alone approaches a billion dollars," he says.

But Fiske is even more impressed by the pot that holds the gold—the caldera, or crater—which was formed thousands of years ago by a huge volcanic eruption on the floor of the Pacific Ocean. Named Myojin Knoll Caldera, the volcanic structure measures almost 4½ miles across, nearly the size of Crater Lake Caldera in Oregon.

Until recently, geologists questioned if submarine calderas even existed. "Part of the debate was whether or not you could have pumice erupt under the ocean," Fiske says. A spongy, lightweight rock, pumice is commonly erupted from volcanoes on land. It forms when foaming magma, spouting from deep within the volcano, solidifies upon reaching air. Some geologists maintained that, deep in the ocean, water pressure would retard this foaming action, thus preventing the kind of volcanic eruption that leads to formation of a submarine caldera.

But Fiske says that while no such calderas had been found, geologists had not really searched for them. Then, in 1991, he says, "I was looking at a Japanese scientific publication, and there they had bathymetric maps of this string of volcanoes running south from Japan, and four or five of them

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From obscurity, an African American photographer's life comes into focus

By Jo Ann Webb
Smithsonian Office of Public Affairs

While at a Smithsonian National Board luncheon in October 1996, National Portrait Gallery Director Alan Fern appealed to board members for support of gallery purchases, such as the small daguerreotype of abolitionist John Brown that appeared in the photograph Fern held in his hand. Little did Fern know that Betty Adler Schermer, the wife of a board member, was a descendant of one of the men who helped Brown conduct slave revolts and that she was willing to help fund the purchase of Brown's daguerreotype.

Her donation helped pave the way for Ann Shumard, assistant curator in the National Portrait Gallery's Department of Photographs, to conduct research on the daguerreotypist who had taken the image of Brown.

"From almost the first day that the daguerreotype of Brown went on display in the museum, it was the subject of great interest," Shumard says. This keen interest from the public made her want to learn more about the daguerreotypist, Augustus Washington, an African American who was born into freedom in Trenton, N.J., in 1820 or 1821, and emigrated to the West African nation of Liberia in 1853 to avoid racism in America.

Prior to the acquisition, Shumard adds,

This daguerreotype (detail) of John Brown was taken by Augustus Washington, circa 1847, when Brown was 47 years old and running a wool brokerage in Springfield, Mass.

he was not familiar to her. He is now one of only a handful of African American daguerreotypists whose work has been identified and collected and whose career has been documented.

"Others had researched portions of Washington's life," Shumard says, "but no one had fully investigated his life and career—from start to finish." It is this story that Shumard hopes to tell through the exhibition "A Durable Memento: Portraits by Augustus Washington, African American Daguerreotypist," which opens at the museum on Sept. 24 and closes on Jan. 2, 2000.

As Shumard commenced her research, nearly every day brought new thrills and surprises. "I had no pre-existing notions about what I was to find," she says, still with a hint of excitement in her voice. "And each day that I discovered another piece of the puzzle to his life, I'd get so excited. Every tidbit was rewarding."

The project began in February 1997, Shumard says, with fragments of information. She began researching published materials on Washington, including newspaper articles, census records and books, in hopes of finding enough information for the project to pick up momentum.

Her research was twofold—to locate other daguerreotypes by Washington that could be assembled for a museum exhibition and to construct his biography—from birth to death.

"Finding daguerreotypes by Washington," she says, "was much easier than assembling his biography." In fact, she has yet to find any supporting documentation that pinpoints his year of birth, nor has she been able to find a single portrait of the man she has come to "know" so well.

Assembling personal information on Washington, who was born to a South Asian mother and an African American father, who was a former slave in Virginia, was not easy. In fact, she likened it to a scavenger hunt. "And you never knew if you were on the right path or heading up the wrong one until you got to the end. You either came to an opening or you hit a brick wall," she says.

Two published articles gave Shumard invaluable insight into Washington's years in Hartford, where he ran a successful daguerreotype studio. Another article focused on his life in Liberia. "While these articles gave me good leads, there were major pieces missing."

Information in the articles on Washington's Hartford days led Shumard to the Connecticut Historical Society, a source of additional research material, as well as a small but choice collection of Washington's daguerreotypes. While in Connecticut, she also visited the Connecticut State Library, where issues of the Charter Oak, the weekly newspaper of the Connecticut Anti-Slavery Society, yielded two letters written by Washington in January 1846.

These letters, Shumard says, proved to be the richest sources of information about Washington's early years and his struggle to obtain an education.

Shumard learned that, at the age of 16, Washington organized a small school for black children in Trenton, N.J., where he taught for several months. Then, desiring to resume his own studies and feeling inadequate as a teacher, Washington wrote to an abolitionist in New York who advised him to apply to the renowned and predominately white Oneida Institute in Whitesboro, N.Y. "Washington remained there for nearly 1½ years until mounting debts forced him to abandon his studies and return to work," Shumard says.

He settled in New York City for a short

Ann Shumard holds a daguerreotype of John Brown, which was purchased by the National Portrait Gallery in 1996. The daguerreotype, taken by Augustus Washington, is among the more than 31 images that will be on view in an exhibition on Washington. (Photo by Jo Ann Webb)

while before accepting a teaching position at the African Public School in Brooklyn, N.Y. By 1841, he was anxious to continue his own education. He enrolled in Kimball Union Academy in Meriden, N.H., and two years later entered Dartmouth College, where he was the only African American student.

Plagued by a persistent lack of funds, Washington learned to make daguerreotypes during the winter of his freshman year at Dartmouth with the hope that income from this endeavor would aid him in meeting his education expenses, Shumard explains.

While his decision to practice daguerreotypography drew criticism from several sources, including his parents and the president of Dartmouth College, Washington was undeterred. His daguerrean enterprise attracted the patronage of townspeople and faculty members alike, "but Washington soon laid his camera aside because he found that it took too much attention away from his studies," she adds.

Unable to keep pace with his growing college debts, Washington was forced to suspend his studies at Dartmouth. He moved to Hartford, Conn., in the fall of 1844 to teach at the North African School, one of the city's two schools for black students.

He left the school in 1846 and later that year opened one of Hartford's first daguerreotype studios. It was while in Hartford that he met and daguerreotyped John Brown, Shumard says. "However, it is unclear if Brown, who was living in nearby Springfield, Mass., came to Washington's Hartford studio or if Washington actually traveled to Springfield to take Brown's likeness," she says.

"Nonetheless," she adds, "there is every reason to believe that the two men were traveling in the same circles because of their mutual commitment to the cause of abolition. It was this shared activism that probably brought them together."

During his years as a daguerreotypist, Washington developed quite a large clientele, Shumard adds. The exhibition brings to life some of these very subjects.

Even though business was good, Washington was becoming increasingly despondent about the future of African Americans in this country, Shumard says. His concerns deepened with the enactment of the Compromise of 1850 and the Fugitive Slave Law, which allowed slave owners to snatch a black person off the street and claim him or her as a slave.

"Washington felt that as much as he loved America," Shumard says, "his destiny was in Africa. There, unfettered by prejudice, racism and all the restrictions that hindered blacks from advancing in the United States, he hoped to build a better life for himself and his family."

When Washington set sail for Liberia in November 1853, Shumard says, he was accompanied by his wife, whom he had married in 1850, and their two small children. He also carried with him his daguerrean equipment.

Shumard tracked Washington's career after his arrival in Liberia, through several American publications, including the African Repository, the journal of the American Colonization Society, which founded the colony that became the Republic of Liberia in 1847.

Shumard discovered that while Washington was in Liberia, he prospered. During the dry season, he farmed his sugar plantation, where he employed as many as 60 workers. During the rainy season, he traveled to other nearby countries to make daguerreotypes. He also was actively involved in Liberia's political scene, becoming both Speaker of the House of Representatives and a member of the Senate. In addition, he was owner and editor of a local newspaper, the New Era.

When Shumard succeeded in finding Washington's death date, "I couldn't help but feel that I had lost a friend. I felt sad because I felt as if I knew this man so well." Prior to her research, the date of his death—June 7, 1875—had not been published.

"This project changed my life," Shumard says. "The history that I've studied in reconstructing Augustus Washington's life is such an important part of the fabric of this nation's history. Yet, it's a history that much of the public is unfamiliar with."

The following people provided Shumard with invaluable assistance in weaving together the life of Augustus Washington: Judith Ellen Johnson, genealogist and reference librarian, and Gary Wait, head catalog librarian, both from the Connecticut Historical Society; Bette Epstein, archivist at the New Jersey State Archives; Carol Johnson, assistant curator in the Library of Congress' Prints and Photographs Division; and Kimberlee Staking, a Smithsonian intern and graduate student at the University of Maryland, College Park. ■

Engineering innovations help SAO operate at the forefront of technology

By Meagan Watzke
Smithsonian Astrophysical Observatory

On the morning of March 25, 1999, the 6.5-meter-diameter mirror of the Multiple Mirror Telescope, or MMT, was gingerly inserted into its support structure on the summit of Mount Hopkins in Arizona, essentially completing that instrument's conversion to a giant, single-mirror telescope. The facility, a joint project of the Smithsonian Institution and the University of Arizona, is the latest in a host of ground-based facilities and space-borne observatories that are helping astronomers open new windows on the universe.

With many more new instruments slated to become operational in the next few years, including an impressive handful developed at the Smithsonian Astrophysical Observatory in Cambridge, Mass., astronomy may truly be heading toward a new golden age.

While the scientific discoveries of such missions are usually heralded by press and public, the design, construction and maintenance of the hardware that make them possible are often overlooked. But not at SAO, where its unusual Central Engineering Department works closely with the scientific staff to create many of the basic tools—from pint-sized computer controls to the mega-ton MMT—needed to probe the cosmos.

Central Engineering was established in 1982 to consolidate the many independent engineering efforts supporting individual projects at the observatory. Today, it is a well-coordinated team of approximately 100 people devoted to the design of complex hardware, including detectors, receivers and optical systems, which can function in deep space or from remote sites here on Earth.

"The formation of Central Engineering provided an unusual opportunity to build an engineering organization with a depth of technical expertise and experience unique among facilities such as SAO," Bruce Dias, Central Engineering's architect and manager, says. "And because of our structure, we are able to provide all SAO scientists with the same access to state-of-the-art engineering services, regardless of the size of their projects."

Science and technology form a tight synergism. Fundamental discoveries in many branches of science lead to advances in technology, which, in turn, enable further scientific discoveries in all branches.

However, "a cosmic phenomenon cannot be discovered until the technical means exist that make the discovery possible," as Martin Harwitt, former director of the National Air and Space Museum, noted in his classic book *Cosmic Discovery*. "An X-ray star cannot be discovered unless we construct telescopes sensitive to X-rays."

Perhaps the earliest example of technology enabling rapid and significant astronomical discovery was Galileo's use of the then newly conceived optical telescope in 1609. After fastening together two simple lenses in a rough tube, Galileo found satellites orbiting Jupiter, saw craters on the moon and discovered that the Milky Way was made up of thousands of individual stars.

In a remarkable feat of engineering achievement and high-altitude logistics, staff from the Smithsonian Astrophysical Observatory guide the replacement mirror through the narrow confines of the telescope struts and into the support structure and cell below. (James Cornell photo)

Astronomy has continued to lurch forward in the same manner ever since Galileo's era. Entire fields of astronomy have been opened from rather small—and sometimes accidental—steps in technology. Radio astronomy, for instance, was developed after Karl Jansky of Bell Telephone Laboratories designed a huge antenna to track down mysterious background noise on telephone lines. That "noise" turned out to be radio emission coming from the center of the Milky Way, a phenomenon previously unknown to scientists.

Of course, SAO's Central Engineering Department does not merely rely on the "accidental" to advance astronomy. Rather, it has developed a deliberate, thoughtful and directed approach for engineering projects, based on the expressed needs of the scientists.

"A scientist might come up with an idea," says Lester Cohen, chief engineer of the Structural Analysis and Design Group, "and then it is up to the engineers to figure out the details on how to make it work."

In addition to looking at fainter and deeper objects in visible light, astronomers increasingly need to probe the sky in wavelengths normally invisible to optical telescopes. Information about the universe arrives at Earth in radiation across the "electromagnetic spectrum," ranging from long, "cold" radio waves to short, "hot" X-rays and gamma rays.

Instruments that are sensitive to these different types of cosmic radiation are not exactly the type that can be found in a local hardware store. Rather, these are often the first-of-their-kind instruments that must be designed and built from scratch.

Engineers and scientists construct detectors that can catch faint and fleeting bursts of radiation, much of which is absorbed by the Earth's atmosphere or simply passes through conventional mirrors. In addition, they must also engineer instruments to withstand the harsh environments—from the heights of arid mountaintops to the frigid plains of Antarctica to the emptiness of space.

"These astronomical instruments require an exceptional amount of creativity and expertise in both the engineering and scientific realms," Dias says, "and SAO can deliver that like few other organizations in the world."

One example of this innovative work is the Submillimeter Array, a facility currently being constructed atop Mauna Kea on the island of Hawaii to observe the heavens in submillimeter waves, the narrow band of radiation lying between infrared and radio, sometimes known as "the last frontier" of ground-based observational astronomy.

Astronomers have long theorized about what might be seen in submillimeter radiation, which is associated, for example, with clouds of star-forming gas and dust. However, studies of this radiation have been limited because the necessary technology has not existed until recently. But advances in antenna fabrication, detector design and computer support, much of this work done at SAO, is finally opening the submillimeter window of the sky to observation.

Similarly, the Chandra X-ray Observatory—the latest in the National Aeronautics and Space Administration's series of great observatories and now scheduled for launch in July—carries both mirrors and a high-resolution detector developed by SAO scientists and engineers. And its possible successor, the Constellation-X satellite, is now under design at SAO.

"Engineers at SAO work hand-in-hand with scientists on all of these projects," says Bill Podgorski, a systems engineer in the Central Engineering Department. "We have different capabilities, and together, we form a team to build these instruments."

Just as building a skyscraper requires a mix of experts, including architects, masons and electricians, the construction of complex astrophysical instruments requires a gamut of engineering skills.

Indeed, SAO's Central Engineering Department includes specialists in electrical, mechanical, computer and systems engineering, as well as structural analysis and design, quality assurance, drafting, computer systems administration and other supporting functions. This wide range of capabilities means SAO engineers can be involved in a scientific program from its conception to its construction to its continuing operation.

And sometimes, the engineers are the source of the scientific ideas themselves. Recently, a team led by a department staff engineer, Peter Chiemets, and consisting of scientists and engineers from seven other institutions submitted a proposal to NASA to investigate the development of new technology needed to deploy and operate instruments carried by a Mars-based balloon.

"Our engineering staff and facilities at SAO help us explore the heavens in ways never done before," Irwin Shapiro, director of SAO, says. "In fact, engineering innovations have kept SAO at the forefront of astronomy and astrophysics for the past two decades."

As an example, one needs simply to look again to the MMT and its tradition of pioneering new technology. Many of that facility's innovative design concepts, including multiple primary mirrors, active secondaries, altitude-azimuth mounts, computer controls and rotating building, have been incorporated into almost every modern large telescope. No wonder the MMT has been nominated for the General Services Administration's Presidential Millennium Award for Design Excellence, a tribute to all of those at SAO who have created—and continue to create—some of the finest scientific machines in the world.

More of the Central Engineering Department's work can be found on its Web site at ce-www.harvard.edu. ■

Photographer devoted life to documenting American Indians

By Brenda Kean Tabor
Special to Research Reports

People like Michelangelo, who have a single-minded obsession to complete a project and give up everything else to do it, have always intrigued Smithsonian Institution Libraries Head of Special Collections William Baxter. One of these people is photographer and ethnographer Edward S. Curtis, whose images of American Indians Baxter first saw as a teen-ager while working at the Historical Society of Princeton in New Jersey. Nearly 100 years ago, Curtis abandoned a successful career as a studio photographer and a happy marriage to spend 30 years documenting the cultures of North American Indians.

So when SI Libraries Director Nancy Gwinn offered Baxter space for one year in the SI Libraries Exhibition Gallery on the first floor of the National Museum of American History in Washington, D.C., he knew that, "without question, my first show would be about Curtis," he says.

SI Libraries owns "a complete set in mint condition of Curtis' rare 20-volume ethnographic work *The North American Indian*," Baxter says. Folio-sized photogravures that accompanied those volumes are on display in the SI Libraries exhibition "Frontier Photographer: Edward S. Curtis." These, along with other photographs and objects, give great insight into the lives of Native Americans, as well as the life of a man obsessed.

Curtis was born in Wisconsin in 1868. As a boy, he dabbled in photography. After his family moved to Seattle, he bought into a photographic studio and quickly established himself as an accomplished studio photographer. He had "an aristocratic appearance, with a Van Dyke beard and dashing manner," Baxter says. "You were not rising in Seattle society unless you had been photographed by Curtis."

In his spare time, Curtis, an avid outdoorsman, became a member of the Mount Rainier Climbing Club. One day in 1898, while conducting a tour of the mountain, he came across three distinguished, but lost, scientific explorers.

"Curtis dried off and fed these tenderfoots, then befriended them and showed them his work," Baxter says. As a result, the following year, two of the scientists, George Bird Grinnell and Clinton Hart Merriam, invited Curtis to accompany them on an expedition to Alaska. There, "Curtis met scholarly and influential people and that's how he got much of his education," Baxter says, adding that a volume from the expedition report is on display in the exhibition.

In 1900, Curtis had a life-altering experience. Grinnell invited him to watch a sundance by Blackfoot, Blood and Algonquin Indians on the Piegan Reservation in Montana. "While Curtis was taking photographs, Grinnell told him that he would probably never again see pure Indian culture untouched by European or American influences," Baxter says. Curtis was seized by a compulsion to catalog the North American Indian culture before it vanished. He began this massive undertaking in his spare time, using his own resources.

"Mother and Child" (detail), a 1927 photograph taken in Alaska by Edward S. Curtis, is featured in the exhibition "Frontier Photographer: Edward S. Curtis," currently on view in the National Museum of American History. (Photo courtesy of Smithsonian Institution Libraries)

Edward S. Curtis, self-portrait, 1899 (Photo courtesy of Smithsonian Institution Libraries)

Meanwhile, in 1904, Curtis entered a photograph in the Ladies' Home Journal's "Prettiest Children in America" contest. Curtis won First Prize, attracting the attention of President Theodore Roosevelt, who invited him to the White House to take photographs of the Roosevelt children. There, Curtis managed to convince Roosevelt of the merit of his project.

In 1906, Roosevelt introduced Curtis to financier J.P. Morgan who "agreed to give him $15,000 a year for five years to fund his field expeditions," Baxter says. Morgan urged Curtis to publish his photographs in fine books and sell them by subscription.

And so began a spectacular saga during which Curtis traveled by wagon, horse, mule, canoe, train and automobile, photographing, recording music and cataloging, in detail, the lives of 87 western tribes. Accompanied sometimes by interpreters and transcribers, but sometimes traveling alone or with his daughter, Curtis encountered dust, hail and wind storms and suffered exhaustion and injury. He broke his hip when he was hit by the tail of a whale and thrown overboard while filming a Kwakiutl whale hunt in 1911.

J.P. Morgan's initial investment was soon used up but was later supplemented by a grant from Morgan's son. Money, however, was always scarce, and Curtis started a traveling show called "The Indian Opera," in which, to raise money, he showed his images and played recordings of Indian music he had made on wax cylinders.

Curtis also took on other jobs, working for a time in Hollywood as a still cameraman for Cecil B. De Mille's motion picture "The Ten Commandments" and trying his hand at making a movie documenting Kwakiutl culture.

All of his projects, and proceeds from the 300 book subscriptions he eventually sold, failed to raise enough money to keep him solvent. His wife divorced him, and he was at one time imprisoned for failure to pay alimony. After his project of documenting Native American culture was completed in 1930, Curtis suffered a nervous and physical breakdown from exhaustion.

Curtis died in 1952. He never lived to see the revival of interest in American Indian culture, but his work is now considered invaluable, Baxter says. "No one had done what he did."

Curtis was, indeed, a singular man, with a singular purpose—to document the Indian tribes of the American West. "Frontier Photographer: Edward S. Curtis" is on view through Sept. 27.

In conjunction with American Indian Heritage Month last November, SI Libraries and the National Museum of Natural History's National Anthropological Archives hosted a symposium on Curtis and his work. Descendants of Native Americans photographed by Curtis were among the guest speakers at the symposium. Anne Makepeace, an award-winning documentary filmmaker, is producing a film for public television about Curtis' life and works. ■

'Gold,' continued from Page 2

were gorgeous calderas. I couldn't believe my eyes."

Fiske studied at the University of Tokyo in the 1960s and has maintained friendships with Japanese volcanologists. Not long after seeing the maps of undersea calderas, Fiske and three Japanese geologists teamed up to study the Myojin Knoll Caldera. The four scientists have made 14 dives into the crater, in a submarine operated by the Japan Marine Science and Technology Center.

One of Fiske's goals is to learn how deep in the ocean pumice can be formed. After collecting pumice samples from different elevations along the steep wall of the caldera, he hopes to be able to estimate the depth at which they were erupted. He will then analyze the samples for differences in the abundance and shape of their bubbles.

"My belief is that there will be virtually no difference between this pumice," says Fiske, holding out a rock hurled from a land volcano, "and one erupted at 1,000 meters [6 miles] underwater. If it turns out there is little difference, the implication is that frothy pumice can be erupted even deeper than that."

One member of the research team, Kokichi Iizasa of the Geological Survey of Japan, was searching for evidence of mineral deposition in the volcano. He made several dives into the immense caldera without success. "When you're in a submersible, in order to find something, you have to drive right up on it," Fiske explains. "It's completely dark down there, and the only illumination is from the lights on the outside of the submersible."

In August 1996, Iizasa's luck improved. "He hit the jackpot," says Fiske, who was on the research ship the day his colleague surfaced from the caldera having collected a "sparkling gold-colored" rock sample, about the length of a baseball bat, from the edge of a giant ore deposit.

Iizasa's sample was one of the many chimneys through which the volcano vents heat and water from its magma reservoir several miles below the seafloor. As it rises, the hot water leaches metals from broken rock inside the volcano. When the heated, metals-laden water hits cold seawater, valuable minerals precipitate out on the floor of the caldera.

The glittering gold color of the sample came from light striking the crystal surfaces of pyrite and other minerals. The actual gold in the ore deposit exists as tiny, hidden particles contained in the mineral sphalerite.

The research team described the ore deposit as "notably rich in gold and silver" in a report in the Feb. 12, 1999, issue of Science magazine. According to Fiske, the average gold content of the dozens of samples since collected from the caldera by Japanese scientists is 40 times greater than that found in similar ore deposits, called Kuroko-type deposits, on land.

Moreover, unlike the ancient metal deposits on land, the submarine bonanza is still growing, with the volcano's hydrothermal system continually depositing fresh minerals into the caldera. Already measuring 1,300 feet across and 100 feet thick, "this is one big deposit," Fiske says. "And on top, there are chimneys another 100 feet high, many belching black smoke."

The Science report describes a fantastic underseascape, where "the lower parts of tall chimneys have coalesced with neighboring chimneys to form spectacular castellated walls." Crabs, sea anemones and other creatures congregate near the chimneys.

Whether it will prove economically feasible to mine the deep-sea ore deposit and whether eight unexplored calderas that stretch south in an arc from Myojin Knoll also contain precious metals remain to be determined. "The Japanese are looking very carefully at this," Fiske says. "But it's one of these situations where, to a significant extent, basic research has paid off. The chief incentives for making the initial dives were not economic, they were to understand this submarine caldera."

To that end, Fiske will climb back into the Shinkai 2000 submersible this summer to continue his part in the world's first study of the origin and structure of an undersea caldera. Although he will be gathering pieces of pumice rather than gold nuggets, Fiske says, "I hope to touch down on the mineral deposit and see it. I'd love to bring back a baseball-bat chimney for display here at the Smithsonian." ■

Researcher charts progress of African honeybees for more than two decades

David Roubik, an entomologist at the Smithsonian Tropical Research Institute in Panama, has been studying the African honeybee, nicknamed "killer bees" by the media, in Latin America since 1976. A decade ago, it was predicted that these aggressive insects would quickly overrun the millions of colonies of docile European honeybees in the United States. Research Reports writer John Barrat recently asked Roubik, who lives in Panama with his wife and three children, a few questions about African bees.

Q. *What were your thoughts when the first nest of African honeybees was found in the United States?*

A. It was late 1991 when African bees were first verified near Nuevo Laredo, Texas. I thought, "Oh boy. Now we'll see if I was right or not."

In 1986, I had predicted that they would not make any substantial incursions into the United States. My reasoning was simple: Tropical bees that are native to the Americas do not live farther north than Mexico. So why should tropical honeybees from Africa do well in this temperate zone?

The colder temperatures of the United States was also a consideration. Most tropical bees cannot maintain a core nest temperature in cold weather, or cannot maintain it for extended periods. In 1988, Ed Southwick, a world authority on honeybee temperature adaptations who has since died, and I conducted a study demonstrating that African honeybees are able to maintain nest temperatures during periods of freezing cold. No one thought that African honeybees could do this. We were the first to prove that they could.

We put colonies of African and European honeybees side-by-side in a refrigerator and found they were both very much alike. Each was able to maintain a core nest temperature of about 30 degrees Celsius (86 degrees Fahrenheit), although the African honeybees were not as efficient.

Essentially, it is still a toss-up as to just how successful African honeybees will be in the United States. In Texas, the bees are moving at a remarkably slow pace, not even one-tenth of the rate at which they moved through the tropics, which was about 300 miles, both north and south, each year. Their populations have had a little growth spurt in the last two years, however, and this is really interesting.

Q. *Why have African honeybees done so well in South America?*

A. African honeybees are native to the woodlands and savannas of eastern and southern Africa and are tropically adapted. They colonized the entire area between Mexico and northern Argentina, up to 10,000 feet elevation in the Andes, in about 30 years. One big reason for their success is that there were virtually no honeybees living in the natural habitats of tropical America before African honeybees were released in 1956.

After extracting nectar from the stomach of an African honeybee in Mexico, David Roubik uses a refractometer to measure the sugar content of the nectar in order to determine its richness. African honeybees select the richest kinds of nectar available. (Photo by Carl Hansen)

The European honeybee, a bee adapted to temperate climates, had been given centuries of opportunity to colonize this same area—it was introduced by beekeepers to Latin America in the 1600s—and had never gotten anywhere.

One reason the advance of African honeybees has slowed in the temperate area of the Rio Grande Valley is because this is an area where feral honeybees of European descent are already well-established.

Q. *What impact are African honeybees having on the environments in the Americas where they now thrive?*

A. African honeybees are a mixed blessing, and I will not dwell on the fact that they do, in reality, cause a lot of death and suffering for animals, from chickens to oxen, and, of course, people. They have a mixed impact on pollination of flowering plants, both negative and positive. They are remarkably widespread and pervasive, more than any other flower visitor.

One of their big impacts is on coffee. Coffee plants are self-pollinated, but I found that the wild African honeybees were responsible for augmenting the productivity of coffee plants by making their fruit and seeds 25 percent bigger and the quantity of fruit produced per tree 25 percent greater. This is no small impact, since coffee is the single most important cash crop in the tropics. For all the myriad native plants in the Americas, some are well served and others, unfortunately, are not.

The original question I asked when I began studying the ecology of African honeybees 23 years ago was whether they drove local, competing bees to extinction. I am happy to say that, for the moment, the African honeybee in the Americas has not done substantial damage to native bees here and other pollinator insect populations.

European honeybees kept by beekeepers are another story. In Latin America, African honeybees have absorbed them; wrecked their hives; out-competed them for food, mates and nest sites; and then moved on to other conquests.

Q. *Are there any advantages to keeping hives of Africanized honeybees in the tropics?*

A. When conditions are barely adequate for a thriving honeybee colony to carry on its daily obligations, African foragers keep it coming in, somehow. Where conditions are lousy, these bees get by. They are also hard to rustle. Beekeepers in South America attest that their resistance to being ripped off by marauding honey or hive thieves is one of their redeeming values.

Q. *Do you have any predictions about how far African honeybees will spread into the United States?*

A. After the current rainy/drier-than-normal cycle—called the El Nino-Southern Oscillation—has departed, I believe there will be a kind of remission of African honeybees in the southernmost United States. Wild honeybees of all kinds will find food less abundant when normal climatic conditions return. They also will probably take flak from the heavy use of pesticides on such crops as cotton. There is also an exotic mite on the loose that may continue to make honeybees scarce in the United States. I will not say more, because I can't predict the future.

However, I am pleased that my general prediction of wild African honeybees not moving rapidly into the United States has proven true. I'll not keep it a secret when I know exactly why this is so. ■

BOOKS & RECORDINGS

Sundays by the River: Photographs by Willy Ronis (Smithsonian Institution Press, 1999, $24.95). Spanning nearly a half-century, this collection of 48 black-and-white images by noted documentary photographer Ronis captures Parisians in moments of unalloyed leisure.

Dance: Photographs by Jeanloup Sieff (Smithsonian Institution Press, 1999, $24.95). Focusing primarily on dancers who have performed with the Paris Opera Ballet, this portfolio of 46 black-and-white photographs taken between 1953 and 1994 pays homage to the art as revealed in dancers' bodies.

The Pheasants of the World: Biology and Natural History, by Paul A. Johnsgard (Smithsonian Institution Press, 1999, $50). This second edition, which incorporates new information on the conservation outlook for this important group of birds, is a comprehensive reference not only for ornithologists and conservationists but also for aviculturists and others who want to better understand these splendid birds.

Settlement Pattern Studies in the Americas: Fifty Years Since Virú, edited by Brian R. Billman and Gary M. Feinman (Smithsonian Institution Press, 1999, $65). Seventeen distinguished scholars recount the history of settlement pattern archaeology and detail current case studies ranging from Alaska to Oaxaca to Peru.

Woody Guthrie: Buffalo Skinners, The Asch Recordings, Vol. 4 (Smithsonian Folkways Recordings, 1999, $14 CD). This fourth and final volume of the series features songs about cowboys, outlaws and other western themes.

Mademoiselle, Voulez-Vous Danser? Franco-American Music From the New England Borderlands (Smithsonian Folkways Recordings, 1999, $14 CD). Lively dance tunes and poignant songs reveal the musical legacy of French Canadians who emigrated to New England.

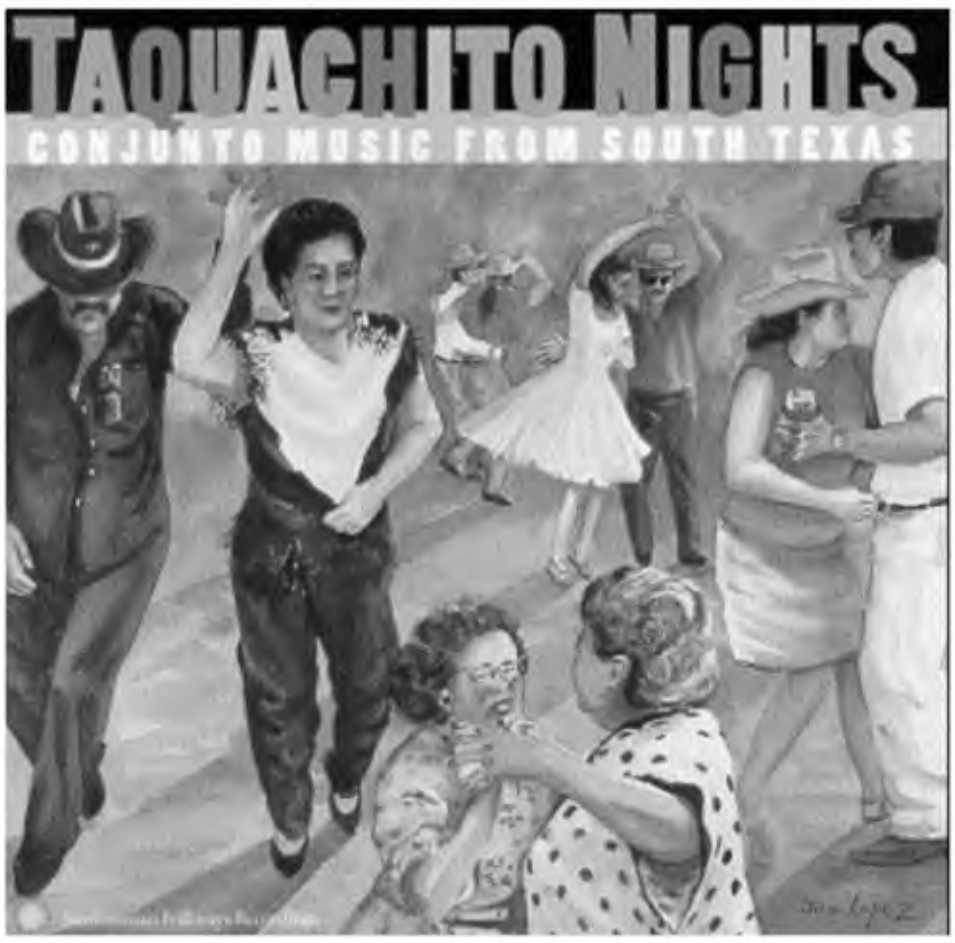
Presidential Campaign Songs, 1789-1996 (Smithsonian Folkways Recordings, 1999, $14 CD). This collection, sung by Oscar Brand, includes a song from the presidential campaign of every president, from George Washington to Bill Clinton.

Pete Seeger: Headlines and Footnotes (Smithsonian Folkways Recordings, 1999, $14 CD). Accompanying himself on banjo or guitar, Seeger performs some of his best songs about prominent events and themes of the 20th century.

Taquachito Nights, Conjunto Music From South Texas (Smithsonian Folkways Recordings, 1999, $14 CD). Recorded live at the 1998 Conjunto Festival in San Benito, Texas, these recordings give a spirited overview of popular Tex-Mex music.

Books published by Smithsonian Institution Press can be ordered from P.O. Box 960, Herndon, Va. 20172-0960. To order by phone or for more information, call 1 (800) 782-4612. There is a $3.50 postage and handling fee for the first book ordered and $1 for each additional book.

Smithsonian Folkways Recordings can be ordered by writing to Smithsonian Folkways Mail Order, 955 L'Enfant Plaza, Suite 7300, Washington, D.C. 20560-0953. To order by phone or for more information, call (202) 287-7297 or 1 (800) 410-9815. There is a $4 fee for shipping and handling of the first three recordings ordered; call for other shipping prices.



This compact disc features live conjunto music from south Texas.

RESEARCH HIGHLIGHTS

New journal. Artefacts: Studies in the History of Science and Technology, a new journal, has been launched by the Smithsonian, the Science Museum in London and the Deutsches Museum in Munich, Germany. It features articles that relate to the use of objects in the study of the history of science and technology. The first volume in the series, being published by Harwood Academic Publications, focuses on medicine. The second issue focuses on electricity. For more information, call 1 (800) 545-8398.

Satellite donation. In May, the Motorola Satellite Communications Group donated to the National Air and Space Museum one of the low-Earth-orbit satellites it designed and manufactured for the Iridium system. It is the first commercial satellite accepted in the museum's permanent collection. The museum is considering displaying the satellite in its Beyond the Limits Gallery. Introduction of the LEO satellites signaled the increasing use of space to serve markets and individuals. Commercial ventures now play a significant role in the development of space. This change, as exemplified by the donated satellite, has fostered innovations in satellite design and manufacture to meet the special demands of a commercial undertaking.

Cheetahs on loan. The National Zoological Park's Cheetah Conservation Station has been loaned two male and two female cheetahs as part of the Cheetah Species Survival Plan Breeding Program. The National Zoo will try to breed cheetahs for the first time since the Cheetah Conservation Station opened in 1993. Although cheetahs were first displayed at the Zoo in 1913, none have ever been born there.

New owl species. During the past year, research conducted by Pamela Rasmussen, an ornithologist at the National Museum of Natural History, and colleagues has resulted in the description of two new species of scops owls, one from Great Nicobar Island in India and the other from Sangihe Island in Indonesia. Other unnamed species from Indonesia, Madagascar and Taiwan have been identified during this research but await publication. The birds were recognized as new taxa based on studies of museum specimens and tape recordings of their vocalizations.

Hsing-Hsing update. Hsing-Hsing, the National Zoological Park's giant panda, is being treated for a life-threatening illness. At 28, Hsing-Hsing is very old for a panda. Following a brief period of lethargy and loss of appetite and weight, he was anesthetized for a medical examination on May 15. The results of the examination, which included sonograms and blood analysis, revealed that the panda has severe kidney dysfunction. The condition, according to National Zoo veterinarians, may not be reversible. Veterinarians and animal keepers at the National Zoo are doing everything they can to treat this serious illness and to keep Hsing-Hsing comfortable. Dialysis has been ruled out because it would require the panda to be anesthetized every day for several hours. This would be very stressful for an animal of his age and could cause fatal complications. A kidney transplant is not practical because there are no giant panda kidneys available.

The illusive giant squid. Clyde Roper, a zoologist at the National Museum of Natural History, has completed a third quest for the giant squid *(Architeuthis)* from Kaikoura Canyon, off the coast of New Zealand's South Island. The 22-day expedition, which began at dawn on March 4, failed to turn up sightings of the giant squid, which lurks in the depths of oceans around the world. The creature, which can grow up to 60 feet in length and weigh up to a ton, has never been seen in its natural habitat or captured on film. Using a manned submersible capable of diving up to 3,000 feet into the deep, Roper and his research team, including experts from New Zealand's National Institute of Water and Atmospheric Research, the National Aeronautics and Space Administration, Cornell University and Whale Watch Kaikoura, had hoped to learn more about the connection between the giant squid and its chief predator, the sperm whale.

Clyde Roper examines a giant squid specimen that was recovered by fishermen trawling for deep-sea fishes. (Photo by Ingrid Roper)

SERIES PUBLICATIONS

The following publication on research in paleobiology was issued during the period Feb. 1 through April 30, 1999, by Smithsonian Institution Press in the regular Smithsonian series. Diane Tyler is managing editor. Requests for series publications should be addressed to Smithsonian Institution Press, Series Division, 470 L'Enfant Plaza, Suite 7100, Washington, D.C. 20560-0950.

Smithsonian Contributions to Paleobiology

• 85 *Atlas of Paleocene Planktonic Foraminifera*, by Richard K. Olsson, Christoph Hemleben, William A. Berggren and Brian T. Huber, editors, 252 pages, 37 figures, 71 plates.

Off the Shelf

Backbeat: Earl Palmer's Story

By Tony Scherman (Published by Smithsonian Institution Press, 1999, $24.95)

Weaned on the vaudeville circuit and later the New Orleans rhythm-and-blues community, Earl Palmer had a lasting effect on the American music scene. He is inarguably one of the most important figures in the development of popular music in the second half of the 20th century, says author Tony Scherman.

In *Backbeat: Earl Palmer's Story*, Scherman combines Palmer's autobiographical narrative with historical context, giving readers a picture of a fascinating American life and one musician's long career.

As a music journalist and historian, Scherman had long known about Palmer as a legendary figure in creating rock 'n' roll. However, it wasn't until Scherman went to the New Orleans Jazz and Heritage Festival in 1991 to do a story on Palmer that he realized he wanted to write a book as well.

"I wanted to write the book for three reasons," Scherman says. "First, Palmer's vernacular poetry charmed me as a writer. Secondly, he was extremely important in the history of American pop music. And I was amazed at the ins and outs of his musical journey through life that began at the age of 6 as a featured tap dancer with black vaudeville troupes. Yet, he has lived his life below the threshold of fame."

Scherman began working on the book in late 1993. While most of the work was on a part-time basis, a grant from the National Endowment for the Humanities allowed him to work exclusively on the book.

Born in 1924, Palmer grew up in the Tremé, a lively neighborhood in New Orleans and the oldest black urban neighborhood in North America. According to Scherman, Palmer's talent and character were shaped by the rich cultural matrix of his neighborhood. He never knew his father but was told that he was a cook on a whaling ship and was killed at sea. His mother, Thelma Theophile, a professional dancer and showgirl, was one of the Theophile Sisters, a popular singing act. Thus, Palmer grew up around music.

Earl Palmer has been called one of the most important figures in the history of American pop music. He is shown here in a studio in Los Angeles, circa 1961.

He entered show business at the age of 6 as a tap dancer in little shows organized by his mother. He was drafted into the touring dance act that starred his mother and his aunt, Nita, and spent much of the 1930s traveling the country and playing nightclubs, theaters and tent shows with Ida Cox's Darktown Scandals Revue and other black vaudeville troupes.

Palmer enlisted in the Army at the outset of World War II and was posted to Europe. After being discharged, he returned to New Orleans and his old neighborhood, where he immersed himself in the city's booming postwar nightlife scene.

"In the Tremé," Palmer says in the book, "they had bars on every corner."

Palmer took up the drums and enrolled in the Grunewald School of Music on the G.I. Bill. He enjoyed private drum instruction and learned to read and arrange music.

By 1947, he had established himself as "the new sensation on the tubs" and took over the drum chair in Dave Bartholomew's popular jump band, the number-one musical attraction in the city. "By the time you got in Dave's band, you knew you were a musician," Palmer says in the book.

"Earl was better than any other drummer they had in New Orleans," Bartholomew told Scherman. "He was the talk of the town."

By 1949, the band had established its reputation. It was opening for Louis Armstrong and had cut the first of what would be more than a hundred Fats Domino tunes. As a session musician, Palmer would go on to play background for a lot of other celebrities, Scherman says.

But long-term opportunities were limited in New Orleans. "I knew that I didn't have no future in New Orleans," Palmer says. In February 1957, tired of life under segregation and eager to earn big-time money, he moved to Los Angeles.

In Los Angeles, his career continued as an in-demand sideman for a wide range of musicians. The hardest music he ever had to play was the soundtrack for the "Tom and Jerry" cartoon. His versatility also led to considerable work in film soundtracks.

"By '61, I was getting calls for dates with no rock 'n' roll on them at all," Palmer says. He propelled himself to the top of the studio heap as a first-call percussionist who could sight-read while adding an unmistakable edge to any ensemble he played with.

"His combination of technique and musical instinct—what sounded right in any instance—just blew my mind," Scherman says.

Palmer, now in his 70s, is semi-retired. He recently appeared in New Orleans at its annual Jazz and Heritage Festival.

"It took me two years to realize how great a musician Earl really was," Scherman says. "He is a storied character for both his music and his larger-than-life personality."

—Jo Ann Webb

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