no. 35 Spring/Summer 2017

Leakey Grantee Finds Oldest Primates of India

THIERRY SMITH, LEAKEY FOUNDATION GRANTEE, ROYAL BELGIAN INSTITUTE OF NATURAL SCIENCES

In 2004, Professor Kenneth D. Rose from John Hopkins University invited me to lead a small team of paleontologists planning to explore lignite (brown coal) mines in India. The goal was to prospect for Paleocene-Eocene deposits (66-34 million years ago), which could yield ancient terrestrial mammals. Ken thought the screen-washing technique we used to find small fossil mammals in Wyoming would work well in India.

I went to Mumbai with a student, Pieter Missiaen, and we travelled about 250 mile north to the Vastan mine in Gujarat to meet our Indian colleagues for the first time. I remember well that on the second day in the mine, it was hot, and I was nervous because we were six persons sharing only two hammers to look for fossils in a sticky clay layer.

I suggested to my colleague, Professor Rajendra Singh Rana, that he ask a miner to remove the lignite layer above the clay layer to make things easier for our team. After brief digging with a huge mechanical shovel, a dark deposit five meters long and 30 centimeters thick suddenly appeared between the two layers. I looked at this strange deposit and immediately found many fish spines and vertebrae. A few minutes later, one of the Indian students found



Thierry Smith screenwashing sediments for small remains of earliest Indian primates *Photo: Annelise Folie*

a mammal incisor the size of a human incisor. It was the beginning of our Indian adventure!

This deposit was so rich that we collected all the matrix and screenwashed it completely. Each sieve contained small mammal teeth or jaws, small snake vertebrae or tiny bat bones. I felt like Gulliver discovering a Lilliputian fossil world. At the end of the third day, we found our first primate jaw in the washing residue that was drying under the last rays of the sun. In this way we found the oldest primates of India in the early Eocene Cambay Shale Formation of Vastan mine (about 54.5 million years old). We published this jaw with four teeth under the new name *Asiadapis cambayensis*, and today this specimen is the reference of the family Asiadapidae.

The Vastan mine was a paradise for paleontologists. It yielded the oldest Cenozoic land mammals of India, including primates of modern aspects (euprimates) and a great diversity of early bats, rodents, and small ungulates. Along with these classic groups, we found endemic groups only found in India, such as cambaytheres, the sister group of today's horse, tapir and rhinoceros. We also discovered fossil

Survival

Symposium

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The mission of The Leakey Foundation is to increase scientific knowledge, education, and public understanding of human origins, evolution, behavior, and survival.

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Letter from the President

▼ he report Belgian researcher Thierry Smith gave in India was a reminder that we fund research in many diverse locations, and that our grantees come from around the world. They are answering basic questions about human origins that can go back to the beginning of primates. New technology has advanced research, but the technology is expensive. The fact is, doing more diverse research in many different places costs a lot.

Thierry Smith works in the lignite mines of Gujarat, India, that expose subsurface beds that are about 54.5 million years old. This date is close to the transition date when euprimates (or true primates) most likely evolved. Some characteristics of euprimates are that they are adapted for leaping, have forward-facing eyes, more complex brains, hands and feet adapted for grasping, and teeth adapted to eating herbs. The oldest fossils of euprimates date back to 56-55 million years ago.

Where euprimates originated is a mystery. Even though early fossils have been found in Northern Africa, transitional fossils have not been found. Since India was floating free and unattached before hitting the continent of Asia and forming the Himalayas, it is thought that perhaps India might be their place of origin.

I find it such a privilege as a Leakey Foundation member and Trustee to be part of this cutting edge research into primate origins. To discover what changes took



place in the anatomy to create true primates and to understand the forces at work in the evolutionary process is exciting. And, to hear about the research taking place on the subcontinent of India while traveling there, looking at rock art of early man, made it all the more meaningful. The euprimates search is part of the same story of who we humans are and where we came from.

This excellent and creative research needs funding. Again this year, we have a generous matching fund up to \$1 million to add to our ability to make grants to these worthy projects. But, in order to receive these matching funds, we must raise more money. So far we have raised about 50% of what we need to complete the match. Please remember that every donation helps. If you donate \$1,000, it becomes \$2,000 towards a possible breakthrough in understanding our world.

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Camilla Smith President, The Leakey Foundation

Support Science!

Your gift will help fund scientific research and educational outreach. Your donation will be doubled up to one million dollars.

See page 11 or visit leakeyfoundation.org/donate

Leakey Grantee Finds Oldest Primates of India (continued from front page)



From left: Ken Rose, Rachel Dunn, Rajendra Rana, Kishor Kumar, Waqas Mirza, Emtiaz Annelise Folie & Thierry Smith at Tadkeshwar mine

birds, frogs, lizards and many kinds of snakes. But for sure, the most interesting things we found were the primates because they are some of the most primitive euprimates in the world. This important discovery on the Indian plate from the time it was drifting northward toward Asia has recently reopened the debate about the strepsirrhinehaplorhine divergence.

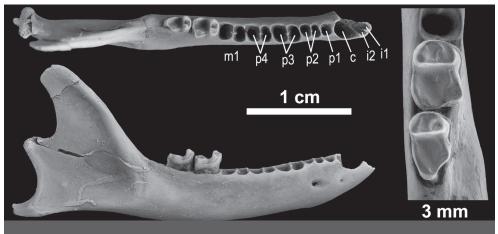
The primate fauna we discovered consists of at least two primitive adapoids (*Asiadapis cambayensis* and *Marcgodinotius indicus*) and two omomyids (*Vastanomys gracilis* and *V. major*) as well as a putative basal anthropoid (*Anthrasimias gujaratensis*). It appears likely that some of these

are the sister taxa of all later primates, ultimately including humans.

Bones from the fossil primates we found are the oldest well-preserved euprimate postcrania known to date. Their primitive anatomy suggests that they are very close to the initial split between strepsirrhines (wet-nosed primates) and haplorhines (dry-nosed primates).

In 2012, Vastan mine was closed and filled in. Our dream there was over, but we did not give up! We identified three nearby mines we thought had high potential to produce additional mammal fossils, including primates.

With support from The Leakey Foundation, we returned to India in



Lower jaw of the small primate *Marcgodinotius indicus* from Tadkeshwar mine *Photo: Thierry Smith*



Outcrop of the Cambay Shale Formation in Tadkeshwar mine showing the position of the vertebrate-producing layer *Photo: Thierry Smith*

March 2015 and focused our attention on a mine called Tadkeshwar.

The first interesting vertebrate remains we discovered in Tadkeshwar were not teeth of primates nor even of mammals but vertebrae of giant snakes that are related to a group that is known from older deposits in India and Madagascar. Tadkeshwar is not as rich as Vastan, but it yields some new forms that weren't found in Vastan. Moreover, the preservation is generally excellent. At Tadkeshwar we found the first complete lower jaw of the small primate *Marcgodinotius indicus*.

The overall research objectives of our Indian-American-Belgian team are:

1. To study the diversity of early Eocene euprimates from Gujarat and to compare them to other early euprimates, including earliest anthropoids; and

2. To learn more about the role of India in the basal radiation of euprimates that led to our anthropoid ancestors. Therefore, it is essential that our field team finds more complete specimens in the new Tadkeshwar lignite mine in order to determine their significance.

Awarded Grants Fall 2016

Behavioral

Margaret Crofoot (Gordon P. Getty Grant recipient), University of California, Davis: *Dominance, social stability and the emergence of collective decisions in complex societies*

Piotr Fedurek, University of Roehampton: *The effect* of social integration on physiological stress levels in a small-scale society

Brenna Henn, Stony Brook University: *Testing for ancient population structure in southern Africa via extensive DNA collection*

Charles Menzel, Georgia State University: *Studies of chimpanzee episodic memory and foraging*

Liza Moscovice, Emory University: *Explaining* patterns of within and between-group cooperation among LuiKotale bonobos

Carina Schlebusch, Uppsala University: *Genotype* variation in populations with Khoe-San ancestry from southern Africa

Erin Vogel, Rutgers, The State University of New Jersey: *Coping with a challenging environment: Nutritional immunology in wild Bornean orangutans*

Monica Wakefield, Northern Kentucky University: *Genetic census and habituation of bonobos at Iyema (Lomako, DRC)* Meike Zemihn, Leiden University: Tracing the origins of language: Syntax in common marmosets (Brazil)

Paleoanthropology

Hilary Duke, Stony Brook University: *Taking shape: Investigating the earliest Acheulean at Kokiselei, Kenya* (1.8-1.76Ma)

Paul Manger, University of the Witwatersrand: *Ape brains in a comparative perspective, South Africa*

Fredrick Manthi, National Museums of Kenya: *Further investigations of Middle Pleistocene sites in Natodomeri, northwestern Kenya*

Emma Mbua, National Museums of Kenya: *Further fieldwork research at Kantis Fossil Site*

Kelly Ostrofsky, The George Washington University: *Comparison of vertical climbing and suspension in wild African apes*

Brian Schilder, The George Washington University: *The evolution of the hippocampus and adult neurogenesis: Novel insights into the origins of human memory*

Stephanie Schnorr, University of Oklahoma: *Physiological relevance of salivary amylase copy number variation for starch digestion in human evolution*

Sileshi Semaw, CENIEH: *Gona Palaeoanthropological Research Project*

Ron Shimelmitz, University of Haifa: *New excavations at Skhul Cave, Mount Carmel, Israel*

Thierry Smith, Royal Belgian Institute of Natural Sciences: *Diversity and relationships of earliest Euprimates from Tadkeshwar Mine, India*

Matt Tocheri, Lakehead University: *New archaeological excavations at Liang Bua (Flores, Indonesia)*

Scott Williams, New York University: *Skeletal contributions to lumbar lordosis in recent and fossil hominins*





Brian Schilder at the Laboratory for Evolutionary Neuroscience at the George Washington University



Emma Mbua at the Kantis Fossil Site outside of Nairobi, Kenya

Read more about Leakey Foundation Grantees at leakeyfoundation.org/blog

Director's Diary: The Leakey Foundation

Weaving- verb 1. Method of textile production in which two distinct sets of threads are interlaced to form cloth, fabric or tapestry.

group of ten intrepid travelers joined the Foundation in India from January 28 - February 9, 2017, for The Leakey Foundation's Annual Fellows Tour, an adventure intertwined with culture, science, religion and politics. This trip included visits to ten UNESCO World Heritage sites- almost a third of all heritage sites in India! The Foundation relied on scholars,



researchers and raconteurs to weave together the many threads of Indian civilization and prehistory.

Leakey Foundation grantee Thierry Smith brought us back to (possibly) the beginning by providing a presentation on Leakey Foundation funded research on the earliest fossil primates. Our minds were swirling with excitement about the implications of this discovery in the mines of India.

Indian rock art scholar Meenakshi Dubey-Pathak was our guide in exploring the art adorning rock shelters. A frequent collaborator with Jean Clottes, Dr. Dubey-Pathak brought us to the Adamagarh rock shelter and the UNESCO site of Bhimbetka. For many the highlight was traveling by jeep deep into the jungles of the Saptura Tiger Reserve to see the hidden site of Churna. We hiked to a remote site high above the jungle floor to see a rock shelter decorated with red and yellow-ochre painted elephants, warriors in battles scenes, leopards, and even an ant-eater. Afterwards, while enjoying lunch beneath a mango tree, Dr. Dubey-Pathak shared her goals for preserving the art. (You can read more about her work at www.leakeyfoundation.org/blog)

On our journey we were joined by two former Indian Consul Generals of San Francisco and their wives: Deb and Purobi Mukarji, and Sushil and Brinda Dubey. We also met archaeologist Dr. P. Ajithprasad from the University of Baroda



Don Dana and Jeanne Newman at the Amber Fort, Amer, India

who studies the ancient paleoenvironment of India.

Over a thirteen day period the group visited the UNESCO sites of the Taj Mahal, Agra Fort, Humayun's Tomb, and the Indo-Islamic masterpiece Fatehpur Sikri. The tour also included the Amber Fort, the Gandhi Smriti (his last home and site of his assassination) and the largest mosque in India, the Jama Masjid.

To reach all of these destinations, we utilized every mode of transportation including planes, buses, rickshaws, a private speed boat, and even a tiny steam engine train on Elephanta Island. In 1987, UNESCO designated Elephanta a heritage

SHARAL CAMISA, EXECUTIVE DIRECTOR

Fellows Tour: India 2017



Naoma Tate and Tim White at Agra Fort, Agra, India

site. The dates of the Hindu caves are disputed, but there is no debating the grandeur of this place that was hewn from solid basalt rock. Fifteen large relief carvings surround the main cave, including "Sadashiva," a masterpiece depicting three aspects of Shiva that reaches 22' tall. We arrived before the main gates opened to the public, and so our small group was able to silently marvel at the splendor of a space that UNESCO describes as "the most magnificent achievement in the history of rock-architecture in western India."

The Ajanta Caves are also rock-cut cave monuments that date from 2nd century BCE to 650 CE. Sitting 110' above the

river, these thirty Buddhist monastic caves are among the finest surviving examples of ancient Indian art. Almost every surface inside the caves is covered with sculptures and dry fresco paintings. My favorite was a ceiling that was painted to look like a decorative tent canopy blowing in the wind!

The UNESCO site of Ellora showcases three principal religions of India: Buddhism, Hinduism and Jainism. Dug in high cliffs of basalt, the monasteries and temples co-exist side-by-side in an area that extends more than three miles. The Hindu megalith Kailasa Temple (Cave 16) was crafted by vertical excavation and features five detached shrines. The temple appears to be "dropped" on the backs of massive, stone carved elephants; it's scale is hard to decipher until you see a 6' man standing beside it.



Taj Mahal, Agra, India

Danielle Dana at Ajanta Caves, Aurangabad, India

We saw art flourishing everywhere! At the National Museum in New Delhi and the Prince of Wales Museum in Mumbai, the group saw miniature paintings, bronze statues of deities, and a photo exhibit of Gandhi. There were lots of laughs enjoying Rajasthani puppetry. Under the stars, the group enjoyed music performed using bowls of water and bamboo sticks. We enjoyed folk and tribal dance performances from several different regions of India.

In Amber we visited the private fabric block-printing atelier of Brigitte Singh, where artisans used small chisels to carve wood blocks, and they printed each layer/color by hand. In Aurangabad

we spent time at a weaving co-op where the production of handloom saris are vital for economic development in that rural area.

India abounds with many contrasts like the miles of black tar roads punctuated by women walking in saris of saffron and hot pink. Like those beautiful handwoven saris, our intimate group of travelers wove an experience like a vivid tapestry that they will forever view with awe.

Traveling with The Leakey Foundation is a benefit for donors at the Fellow's level. Are you interested in joining our 50th Anniversary Fellow's Tour in 2018? Please email Sharal Camisa at travel@leakeyfoundation.org

Survival Symposium

BOSTON 2016

"Science, properly used, can not only further elucidate man's past, but can also guide in planning man's future." Dr. Louis S.B. Leakey

species ur facing is an unprecedented set of challenges, including climate global change, population exponential emerging growth and diseases. Examining these and other challenges using the lens of evolution is an immportant part of The Leakey Foundation's mission to "increase public understanding of human origins, evolution, behavior and survival."

In September 2016 The Leakey Foundation brought together seven worldrenowned speakers and researchers for a series of short talks focusing on these challenges from an evolutionary perspective. The Survival Symposium was held at WGBH in Boston and was moderated by Emmy Award-winning journalist Miles O'Brien. The speakers were Ruth DeFries, Daniel Lieberman,

Stuart Pimm, Steven Pinker, Pardis Sabeti, Daniel Schrag and Richard Wrangham. These speakers explored topics ranging from extinction and biodiversity, to violence, food resources, and the future of human health.



From left to right: Miles O'Brien, Stuart Pimm, Ruth DeFries, Daniel Schrag, Pardis Sabeti, Richard Wrangham, Daniel Lieberman, Steven Pinker *Photo credit: Chris O'Flaherty*





Pardis Sabeti speaking on emerging disease and evolution *Photo credit: Chris O'Flaherty*

> The *Survival Symposium* was presented by The Leakey Foundation in partnership with the Harvard University Department of Human Evolutionary Biology, NOVA, NOVA Labs, SMASH, and WGBH.



Daniel Lieberman speaking on stage at WGBH *Photo credit: Chris O'Flaherty*

Watch and share the Surival Symposium videos at leakeyfoundation.org/ outreach/survival

Margaret Crofoot Receives Gordon P. Getty Grant

The Gordon P. Getty Grant was established in 2013 to commemorate Chairman Gordon Getty's forty years of generosity and commitment to the science of human origins. The grant is awarded once a year to a researcher or researchers who show extraordinary originality and dedication in their intellectual and professional pursuits as well as a multidisciplinary approach to human origins research. project entitled "Dominance, social stability and the emergence of collective decisions in complex societies." Dr. Crofoot said, "This grant from The Leakey Foundation is going to let us take our research on collective decisionmaking in some really exciting new directions."

Her newly funded project will investigate how groups of monkeys make decisions about when and where to eat. Crofoot

will study capuchins and spider monkeys, two species that live in the same forest in Panama and have some "really interesting differences" in their social structure. "Capuchin monkeys live in these cohesive groups that travel together as a unit all the time," says Crofoot. "In contrast, spider monkeys live in fissionfusion societies where groups

break into subgroups that are quite fluid with some members breaking off and foraging together for a while and then coming back and joining with another subgroup."

Capuchins and spider monkeys also

differ in the importance of dominance relationships within their social groups. Capuchins have what might be thought of as "typical" primate social organization "where dominance is important and you have strong dominance relationships amongst both the males and females in the group. Whereas in spider monkeys, dominance rank seems to be less important."

Crofoot's project will investigate a very specific question. "If you're a monkey foraging in a fruit tree, when is the right time for you to leave that particular food patch and move to the next one?" She says social foraging theory predicts there will be conflicts of interest amongst group members over when to leave a food patch. With this funding she hopes to learn how these two different species of primates resolve those conflicts of interest and how they decide the issue of timing as a group.

Learn about Dr. Crofoot's work in Episode 21 of Origin Stories leakeyfoundation.org/originstories



Geoffroy's spider monkey in Tortuguero, Costa Rica Photo credit: Artuo de Frias Marques CC BY-SA 3.0



argaret Crofoot is an assistant professor at the University of California at Davis and a research associate at the Smithsonian Tropical Research Institute. She is interested in the evolution of complex social systems, specifically understanding how group behaviors emerge from interactions among individuals and how group traits impact individual fitness. She uses remote tracking technology in conjunction with field-based experiments and observational methods to explore group movement and decision-making, coordinated territorial defense, and other collective behaviors in primate social groups.

The Gordon P. Getty Grant is the first Leakey Foundation grant Margaret Crofoot has received. The grant was awarded in December 2016 for her

From the Archive: The Photo Album Mystery

MEREDITH JOHNSON, COMMUNICATIONS MANAGER

hen Carol Broderick volunteered to help The Leakey Foundation prepare our large collection of photographs for digitization, she didn't realize she would end up helping to solve a mystery about one of our most treasured collections.



Carol has been interested in human evolution, primates, and paleoanthropology since she was a student. In the 1980's she volunteered for the Institute for Human Origins (IHO), where she helped at lectures, painted educational

casts of Lucy fossils, and cataloged their library. After IHO

moved Arizona State to Carol became University, involved with The Leakey Foundation. When she learned of the Foundation's archive digitization project, she volunteered to help.

She was given the task of preparing a photo album of Louis Leakey's 1934-35 East African expedition for digitization. The album is part of the large collection of photographs of Louis Leakey's early life and work, which was donated by Founding Trustee Joan Travis. There was no record of who had made the album. It was a big mystery we hoped to solve.

caption "Self, Peter, Mr. Turner,

the Doc, the Prof, Kent." Morell's book has every person named. Through cross-referencing, Carol

found that "Self" referred to Stanhope (Sam) White, Louis Leakey's surveyor during the 1934-35 expeditions. Stanhope kept photo albums White throughout his career and donated them to institutions such as the Bodleian Library. The mystery was solved!

Carol Broderick and her fellow volunteer Jo Rodgers are still working to prepare our archive for digitization. If you would like to help, please contact us by email at info@leakeyfoundation.org.

The album is filled with photos of Louis Leakey, the people he worked with, and African animals and landscapes from Rusinga to Olduvai. The photos were pasted on brown pages with handwritten captions describing the scene and naming the people in the photos by first name or by nicknames. Louis Leakey is referred to as "the Doc" throughout the album.

Thank you to Jim Carty and Pat Randall, and Sally Carty and Barry Schaitkin for their support of our archive digitization project.

Help preserve the history of science leakeyfoundation.org/donate

PETER, MRTURNER. THE DOC

Members of Louis Leakey's fourth East African Archaeological Expedition 1934-35. From left to right: Stanhope (Sam) White, Peter Bell, Allan Turner, Louis Leakey, Percy Boswell, Peter Kent

Preparing items for digitization is a painstaking process. Carol examines each image to identify people, places, and important keywords associated with the image. Carol notes everything from the names of trees to features of the landscape such as mountains or volcanoes and enters the information into a database.

It can take some detective work to confirm the information in the photo captions. Carol has been using biographies of Louis Leakey as a fact-checking tool, and she said, "Reading the books at the same time has been fun because I can read about him doing these things and look at the pictures at the same time."

Carol had a eureka moment after seeing a group photo in Ancestral Passions, Virginia Morell's book about the Leakey family. She remembered seeing the same photo in the Foundation's mystery album. The picture shows a group of people at their field camp in Kanam. Our album had the

Grantee Spotlight: Piotr Fedurek

Piotr Fedurek is a PhD candidate from the University of Roehampton. He was awarded a Leakey Foundation Research Grant during our fall 2016 cycle for his project entitled "The effect of social integration on physiological stress levels in a small-scale society."

y research on the effect of social integration on physiological stress in a small-scale society is conducted in a hunter–gatherer society, the Hadza (Tanzania). Working with the Hadza is of particular interest for the project as it allows me to control for the potential confounding factors common in studies conducted on Western, industrialized societies, such as material wealth and institutionalized social hierarchy.

In order to measure a level of social integration of the Hadza, I use interviews to assess self-perceived integration (the method usually used in studies with humans), and I apply Social Network Analysis on observed social interactions (the method usually used in non-human primate studies). Levels of chronic stress of the study participant will be extracted from the hormone cortisol from hair samples. This method, which is minimally invasive, will allow me to measure long-term indices of stress over a period of weeks as opposed other commonly to methods, such used salivary cortisol, as which only allows for the evaluation of acute stress responses over a period of hours. Other health measures used in this study include percentage of body fat and Body Mass Index.



Piotr Fedurek in the field in Tanzania

The results of this study will not only allow me to assess how well self-reported social networks link to actual observed social interactions but also the extent to which social integration affects human health, thereby significantly furthering our understanding of social bonds in individual well-being. Similarly, by looking at the adaptive values of social integration, potential findings of this study will shed light on the role of social bonds in human evolution.

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