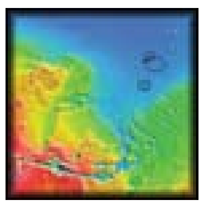
Smithsonian

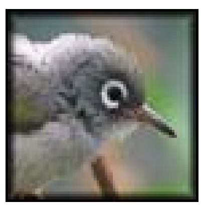
Spotlight on Science at the Smithsonian

Bi-Weekly Newsletter | Vol. 4, No. 23 | 22 December 2006

- Introduction from Dr. David Evans, Smithsonian Under Secretary for Science



- Looking Beneath the Sands of Mars



- White-eyes on Indian Ocean Islands

- Bee Evolution: Out of Africa

- Print, Podcast, Download MP3

Spotlight on Science at the Smithsonian

Spotlight on Science at the Smithsonian is a bi-weekly electronic newsletter about Science at the Smithsonian. It is produced for the Smithsonian community by the Office of the Under Secretary for Science. To subscribe to the newsletter or Podcast, visit science.si.edu.

- Dr. David Evans, Under Secretary for Science
- Theresa Mellendick, Editor, mellendickt@si.edu

Vol. 4, No. 23 | 22 December 2006

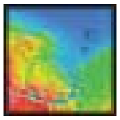
Introduction from the Under Secretary for Science

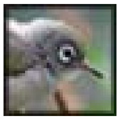
In this installment of Spotlight on Science join Thomas Watters of the National Air and Space Museum as he probes the subsurface of Mars using sounding radar. The buried impact basins he found give clues to the planet's early history.

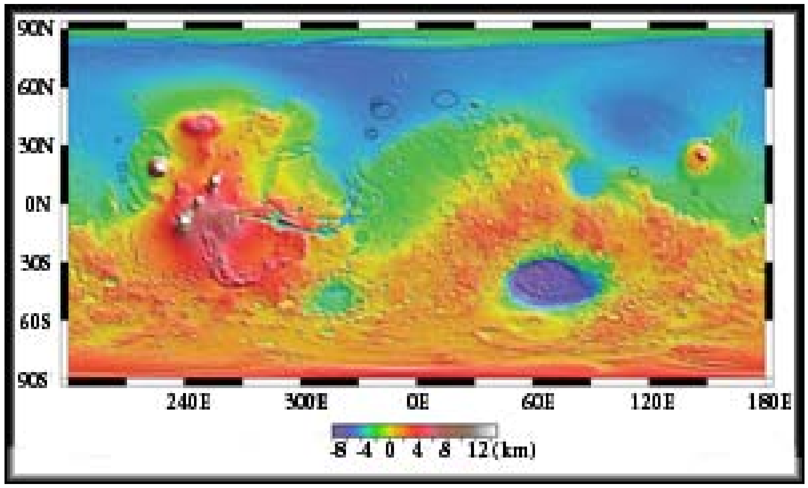
Next, Eldredge Bermingham of the Smithsonian Tropical Research Institute uses molecular biology to follow the path of island-hopping song birds in the Indian Ocean. And Sean Brady of the National Museum of Natural History looks at the deep history of bees and flowers, and finds that it probably all began in Africa.

Spotlight on Science at the Smithsonian

Vol. 4, No. 23 | 22 December 2006







The northern hemisphere of Mars is dominated by smooth lowlands (blue), while the southern hemisphere is far more rugged with higher elevations (red and orange). The locations of eleven ancient buried basins discovered by radar sounding are shown as black ovals. Image courtesy of Thomas R. Watters.

Looking Beneath the Sands of Mars

Ever since the first space probes sent back detailed images of the Martian surface, scientists have wondered why the southern hemisphere of Mars is so rugged and pock-marked with craters, while the northern hemisphere is mostly smooth, low-lying plains. The stark hemispheric dichotomy presumably reflects something fundamental about the planet's geologic development — but what?

Smithsonian geologist/geophysicist Thomas Watters of the National Air and Space Museum's Center for Earth and Planetary Studies is using sounding radar aboard the European Space Agency's Mars Express spacecraft to get a first-ever glimpse beneath the surface of another planet. And he is finding clues that may help solve the mystery of the great Martian dichotomy.

To many scientists, the crustal dichotomy on Mars is reminiscent of the dichotomy on Earth. The Earth's crust is made up of high-standing continents and low-standing ocean basins. The Earth's continents are not bunched all in one hemisphere, but at times in the past they have been. Could the Martian dichotomy be evidence that during its geologically active past Mars had plate tectonics similar to Earth?

A key to the question is the relative ages of the two kinds of crust. On Earth, oceanic crust is constantly being formed at mid-oceanic ridges and destroyed at oceanic trenches. So it tends to be geologically younger than the more stable continental crust.

But Watters and a team of scientists have found that the basement crust buried beneath the smooth plains of the Martian north is as rugged and probably as old as the crust in the south. Radar echoes of large impact basins indicate that this buried crust was already present during the earliest phase of Martian history more than 4 billion years ago, when the planet was bombarded by asteroids and other objects.

The early age of this crust makes it unlikely that the dichotomy is explainable by Earth-style plate tectonics. It also rules out other processes that would require hundreds of millions of years to operate. Whatever the cause of the Martian dichotomy, it happened very early in the planet's history. In fact, its formation may be connected to the development of the earliest crust of Mars from a magma ocean.

Reference

Thomas R. Watters, Carl J. Leuschen, Jeffrey J. Plaut, Giovanni Picardi, Ali Safaeinili, Stephen M. Clifford, William M. Farrell, Anton B. Ivanov, Roger J. Phillips and Ellen R. Stofan. (2006) MARSIS radar sounder evidence of buried basins in the northern lowlands of Mars. *Nature* 444, 905-908 (14 December 2006).

Spotlight on Science at the Smithsonian

Vol. 4, No. 23 | 22 December 2006

The Mauritius Olive White-eye (*Zosterops olivaceus chloronothos*) is endemic to the island Mauritius. White-eyes have colonized more islands globally than any other group of songbirds. Photo courtesy of Vikash Tatayah, Mauritian Wildlife Foundation.

White-eyes on Indian Ocean Islands

White-eyes are small, warbler-sized birds that live throughout the Old World tropics. Nearly all have bold white circles around their eyes, which give them their name and a look of perpetual astonishment. Compared to many other tropical birds, white-eyes are not particularly flashy: their plumage varies from yellowish to grayish. Still, they are extremely diverse. Among birds, white-eyes have the second-most species of any genus in the world.

Eldredge Bermingham of the Smithsonian Tropical Research Institute in collaboration with his PhD student Ben Warren from the University of East Anglia is sorting out the evolutionary history of these widespread little birds. A number of species are unique to islands in the western Indian Ocean. Thanks to data from DNA sequences and the geologic ages of the islands, a picture of how the species evolved is beginning to emerge.

White-eyes probably originated in Asia, and colonized the Indian Ocean islands in two waves, the first from Asia nearly 2 million years ago. The birds probably made the crossing when sea level was lower and more islands were available to serve as stepping stones across the ocean basin. Based on the distribution of the living species it is likely that many species from this first immigration wave have since become extinct, but the region was repopulated by a second wave closer to a million years ago, from Africa this time.

The result is an odd patch-work of species relationships. One species, the Mount Karthala White-Eye, lives at high elevations on Grand Comore Island, just off the coast of Africa. Its closest relative is not the white-eye species in the lowlands of the same island, or even the white-eyes on neighboring islands, but another white-eye species in distant Nepal.

The Mount Karthala White-Eye is a survivor from the first, most ancient wave of immigration. Like the other white-eye lineages, it arrived on its current home after a long history of island-hopping. But even as its history is beginning to come to light, its future has become uncertain. Many of the white-eye species in the study are threatened, one is already extinct.

Reference

Ben H. Warren, Eldredge Bermingham, Robert P. Prys-Jones, and Christophe Thébaud (2006) Immigration, species radiation and extinction in a highly diverse songbird lineage: white-eyes on Indian Ocean islands. *Molecular Ecology* 15 (12), 3769-3786.

Spotlight on Science at the Smithsonian

Vol. 4, No. 23 | 22 December 2006


The rapid evolution of flowering plants during the Cretaceous was partly attributable to the co-evolution of insect pollinators, mostly bees. The first bees probably evolved in Africa, not Australia or South America, as previously thought. Photo courtesy of PDPhoto.org.

Bee Evolution: Out of Africa

The co-evolution of bees and flowering plants is one of nature's most spectacular success stories. Besides giving the world pleasant things like flowers and honey, the evolutionary partnership has produced more than 250,000 species of flowering plants and more than 16,000 species of bees. Dr. Sean Brady of the National Museum of Natural History and his colleagues are using molecular biology to lay a new foundation for our understanding of how and where it all began.

Both flowering plants and bees first arose during the age of dinosaurs, more than 100 million years ago in the Cretaceous Period. It's generally been thought that the bees living today most closely related to the ancestral bees are bees in the family Colletidae. These have short, forked tongues similar to the wasps from which bees are thought to have evolved. They also tend to be generalists, visiting plants of several species for nectar and pollen, instead of focusing on a single kind of flower. Colletid bees live today primarily in Australia and South America, and it seemed likely that bees originated on one bees, including the family Melittidae, a family most abundant today in Africa.

In a study recently published in the *Proceedings of the National Academy of Science*, Brady and his colleagues combined anatomical data and DNA sequencing to produce a new family tree for bees. It is the largest such study to date, and it has turned the conventional model around.

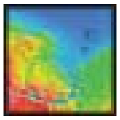
Despite their primitive features, colletid bees are not especially close to the ancestral type. The study put melittids and so-called long-tongued bees at the base of the tree. It appears, then, that Africa is the most likely candidate for bees' evolutionary homeland. Interestingly, melittid bees are not generalists, but stick to one species or a few closely-related species of flowers. So the tight link between bees and flowers probably began very early in their evolution.

Reference

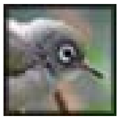
Bryan N. Danforth, Sedonia Sides, Jennifer Fang, and Séan G. Brady (2006) The history of early bee diversification based on five genes plus morphology. *Proceedings of the National Academy of Science* 103 (41):15118-15123.

Spotlight on Science at the Smithsonian

Vol. 4, No. 23 | 22 December 2006



Looking Beneath the Sands of Mars



White-eyes on Indian Ocean Islands

Bee Evolution: Out of Africa

Spotlight Your Way - Printable PDFs, Downloadable MP3s, and the Spotlight Podcast

Want to print and carry Spotlight with you, or share it with a friend? Click the PDF PRINT ME icon and, if you have the Adobe Acrobat Reader installed, a new version of Spotlight will open that is optimized for your printer.

PDF PRINT ME

Want to listen to the audio edition of Spotlight on your computer or MP3 player? Click the MP3 DOWNLOAD icon and the file will download to your computer.

MP3 DOWNLOAD

Want to ensure you never miss an audio edition of Spotlight? Copy the web address next to the Podcast Icon below and paste it into any podcast application to subscribe to the Spotlight Podcast and automatically receive every new episode on your PC or MP3 player. A podcast subscription is much like a subscription to our email newsletter, except you will automatically receive an audio version of the newsletter via podcast receiver software.

Podcast

There is a lot of free software allowing you to subscribe to podcast feeds. When you copy an address like ours above into the software, it will automatically and periodically check our website for new audio editions of Spotlight. Whenever the software finds a new edition, it will download it to your PC, and into your MP3 player if you desire. Juice is a free podcast receiver for Windows and Mac OS X. Many others can be found here: http://www.podcastingnews.com/topics/Podcast_Software.html.

We hope you enjoy and take advantage of these new features we created for your convenience.