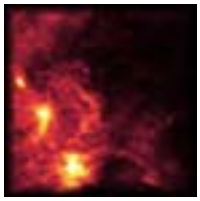
Smithsonian

Spotlight on Science at the Smithsonian

Bi-Weekly Newsletter | Vol. 4, No. 17 | 22 September 2006

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



- A Universe Aglow with Light

- Freeing the Genie from the Bottle

- Ant Gardeners and that Morning Cup of Java

- Print, Podcast, Download MP3

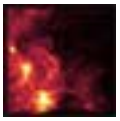
Spotlight on Science at the Smithsonian

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

Spotlight on Science at the Smithsonian

Vol. 4, No. 17 | 22 September 2006



A Universe Aglow with Light

Freeing the Genie from the Bottle

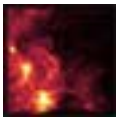
Ant Gardeners and that Morning Cup of Java

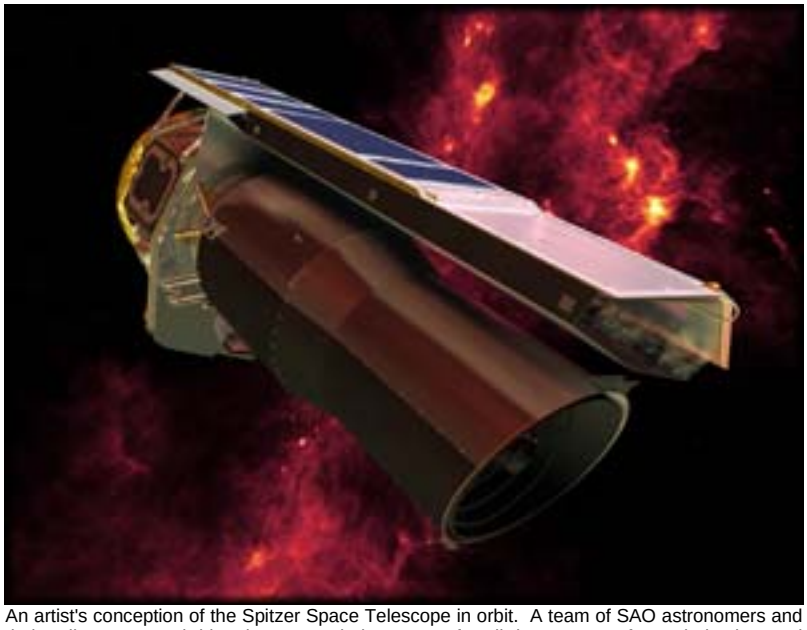
Introduction from the Under Secretary for Science

In this installment of Spotlight on Science, we will start by looking at the work of researchers from the Smithsonian Astrophysical Observatory. They are looking at the sources of background radiation in the universe, and have found that distant galaxies are a contributor at some key wavelengths. Next, we will examine efforts led by National Museum of Natural History scientists and their international collaborators to effectively extract DNA from museum specimens. With 83 million biological specimens in the Smithsonian collection, DNA provides valuable information to researchers. Finally, researchers at the National Zoological Park's Migratory Bird Center are examining the relationship between ants and coffee production. They have found that shade-grown coffee plants have more species of ants than coffee grown in direct sun, and that ants prey on one of the more important coffee pests.

Spotlight on Science at the Smithsonian

Vol. 4, No. 17 | 22 September 2006





An artist's conception of the Spitzer Space Telescope in orbit. A team of SAO astronomers and their colleagues used this telescope to help account for all the sources of cosmic background radiation. They found that distant galaxies are responsible for about one-third of residual background light, at least at some key infrared wavelengths.

A Universe Aglow with Light

Reference
S. Dye*, et al*., "An Investigation into the Submillimeter Background Radiation Using SCUBA and Spitzer", 2006. *Astrophysical Journal*, **644**, 769.

The universe is aglow with light—electromagnetic radiation that spans the entire spectrum, not only the optical portion we can see with our eyes. Of course, the nearby stars and galaxies contribute most of this radiation. But when astronomers try to account for all of the background radiation that their telescopes detect, they discover that depending somewhat on the particular wavelength under study, a significant part comes from sources other than nearby stars and galaxies. By far the most dominant contribution to this latter component comes from the cosmic microwave background radiation, the remnant 2.7K radiation from the time of the early universe. The 2.7K radiation is very well understood and has been successfully modeled by cosmologists. When it is likewise taken into account, there is still some unexplained light remaining, especially at infrared wavelengths. This light presumably holds clues to the faint constituents of the cosmos, and scientists have been working to understand its origins.

The Spitzer Space Telescope has obtained very sensitive infrared images of a location in the sky with comparatively few nearby stars or galaxies. The spot was chosen because submillimeter-wavelength cameras on ground-based telescopes have been successfully staring here, straining to image very distant galaxies known to emit infrared and submillimeter radiation because of their warm dust. These galaxies are typically so far away that their light has been en route to the Earth for roughly nine billion years. For Smithsonian Astrophysical Observatory astronomers, Matthew Ashby, Jiasheng Huang, Pauline Barmby, and Giovanni Fazio, together with a team of seven of their colleagues, have now discovered that these distant galaxies are responsible for about one-third of residual background light, at least at some key wavelengths. The astronomers used the detection of the individual faint galaxies by Spitzer successfully to pinpoint locations in the submillimeter images for detailed analysis. The result is an important step in accounting for the sources of all known radiation, and in completing our knowledge of the constituents of the universe.

Spotlight on Science at the Smithsonian

Vol. 4, No. 17 | 22 September 2006


National Museum of Natural History fish collection.

Freeing the Genie from the Bottle

An extremely valuable asset of the Smithsonian Institution and other museums is the information contained in the research collections of biological organisms. Scientists all over the world study these collections. The Smithsonian has 83 million such specimens in its collections. Biological specimens are preserved in a variety of ways. Some are preserved dry in controlled-environment enclosures or in deep freezers. Many specimens are preserved in alcohol-filled jars, which were initially 'fixed' in formalin. This formalin fixation hinders the ability to extract DNA from the preserved specimens.

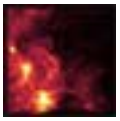
Now that gene sequencing from DNA has become a standard research method in many fields, the DNA from old specimens is becoming extremely important. Due to "the formalin problem," scientists are unable to obtain genetic data easily from the collections of rare and extinct species, natural populations that pre-date human habitation, and victims of historic epidemics.

A group of experts recently gathered for a workshop organized by the Consortium for the Barcode of Life (CBOL). CBOL is an international initiative devoted to developing a technique for describing organisms using specific short DNA sequences, "DNA barcoding". At the workshop, scientists discussed the future of DNA recovery from formalin-preserved specimens in natural history collections.

The National Academies Press has issued the report of the workshop, "Path to effective recovering of DNA from formalin-fixed biological samples in natural history collections." The report presents a research agenda that could release a bounty of genetic information from wet collections. CBOL plans to work with the Smithsonian's Laboratory for Analytical Biology at the Museum Support Center, and a network of other museums and labs, to implement the suggested research. The report is available online at: http://www.nap.edu/catalog/11712.html.

Spotlight on Science at the Smithsonian

Vol. 4, No. 17 | 22 September 2006



A Universe Aglow with Light

Freeing the Genie from the Bottle

Ant Gardeners and that Morning Cup of Java

Azteca instaiblis ants in a coffee farm in Chiapas, Mexico attacking a coffee insect. Photo taken by Shinsuke Uno.

Ant Gardeners and that Morning Cup of Java

Coffee is traditionally cultivated below a very diverse and dense shade canopy that often resembles native forest. However, worldwide coffee production has been intensified from traditional diverse farms into a number of different types of systems. At the most extreme are sun coffee plantations with few or no shade trees. The intensification of coffee plantation has led to loses of species of mammals, birds, and several arthropod groups. Intensification may also be linked to the failure of important ecosystem services.

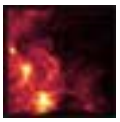
Scientists at the National Zoological Park's Migratory Bird Center (SMBC) have long advocated the return to traditional shade-grown coffee for its importance as a habitat for migratory birds. In continuing studies of coffee ecosystems, they have found another benefit of retaining the natural forest system—ants. Ants, extremely diverse and abundant predators in tropical ecosystems, are better able to perform services in shaded systems.

SMBC researcher Stacy Philpott, Inge Armbrecht (Universidad del Valle, Cali, Colombia) and Ivette Perfecto (University of Michigan) sampled ants in Costa Rica, Chiapas, Mexico, and Colombia to determine how intensification affects ants diversity and the composition of ant species in these assemblages. They found that ant richness declines with coffee intensification. Ant assemblages in sun coffee systems and other intensive coffee systems shared many fewer species with forests that traditional coffee farms. Species similarity also declined with coffee intensification. These were the result of three possible mechanisms: changes in the microclimatic conditions, loss of available nesting sites and lower quality nesting sites.

They then examined the functional importance of ants by looking at their relationship with the coffee berry borer, one of the more important coffee pests. The borers burrow into coffee fruits where they damage the coffee berries (seeds). More than 20 species of ants prey on the coffee berry in both shaded and sun plantations in Colombia. Ants also removed borers directly from coffee fruits and free-living borers from traps in both types of coffee plantations. Data indicated that they performed this service more in shade coffee systems. In addition, ants have a mutualistic or beneficial relationship with scale insects, which can be a pest in intensive coffee farms. Finally, when ants were absent from plants for 8 months, there was a higher incidence of two fungal diseases, coffee leaf rust and coffee leaf spot. Thus, ants are important in removing both insect pests and controlling fungal diseases in coffee ecosystems. Ants function better in the shaded plantations compared to the sun plantations.

Spotlight on Science at the Smithsonian

Vol. 4, No. 17 | 22 September 2006



A Universe Aglow with Light

Freeing the Genie from the Bottle

Ant Gardeners and that Morning Cup of Java

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.

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.

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.

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.