SPIE Professional July 2009

SPIE Gold Medal

NASA's Richard Hoover makes small things a big deal.

By Beth Kelley

Richard Hoover, a NASA astrobiologist who has searched for the origins of life in Antarctica and in the far reaches of the universe, is the 2009 recipient of the Gold Medal of the Society in recognition of his work in X-ray and EUV optics, using microscopes to telescopes.

SPIE also recognized Hoover, an SPIE Fellow and past SPIE President, for his extraordinary dedication and service to optics and to the Society.

Hoover conducts research in microbial extremophiles and astromaterials at the National Space Science and Technology Center Astrobiology Laboratory at NASA, travelling from Santorini in Greece to Siberia for his work. He has authored or edited 35 books and more than 250 papers. His work has led to discoveries of a new genus, Anaerovirgula, and several new species of bacteria and archaea throughout his career.

Richard Hoover (third from left) visited Russia's Lebedev Physical Institute in 2001 as SPIE president. (Photo courtesy of Richard Hoover.)

Hoover credits the beginning of his career and interest in diatoms to his wife Miriam. Hoover had just received a new camera, and "this cute girl at Sunday school" invited him to photograph a collection of diatoms she had recently inherited. Hoover quickly made a career out of his photographs, and he authored the very first article on diatoms to appear in National Geographic in June, 1979.

In 1973, Hoover was invited by the Royal Zoological Society of Belgium to study and photograph the Henri van Heurck diatom collection. Hoover discovered the organization had a functioning Anton van Leeuwenhoek single lens microscope and asked if he could use it to look at the diatoms.

"We spent the whole day looking through this microscope at diatoms," says

Hoover. "Amazingly, this single lens microscope displayed images that were almost as crisp as the multi-lens microscopes we use today." Hoover continued his relationship with the Royal Zoological Society for several years, working to inventory and provide insight into diatoms.

Hoover has simultaneously studied and done research in X-ray optics, and his famous full-disk images of the sun in the X-ray and EUV wavelengths are among his many innovative advances for that field. He has also used X-ray mapping to analyze extremophiles—bacterium and other microorganisms that live in conditions inhospitable to most living things.

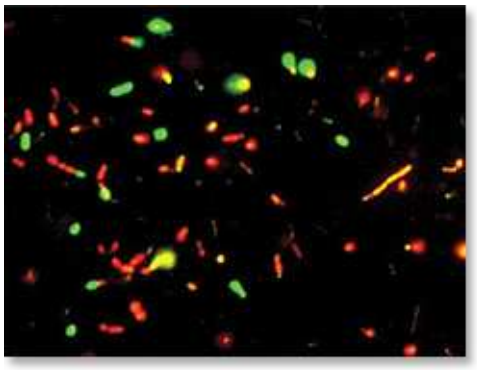
Extreme Expedition for Extremophiles

Extremophiles have become the main focus of Hoover's work over the years, and he has concentrated his search on complex filamentous microstructures. During his career, Hoover has traveled to glaciers and hot springs, from dark caves to hypersaline desert pools, in search of new life. He has faced wolves, geysers, flesh-eating bacteria, and overly-friendly ermines in order to collect samples. Hoover was elected a Fellow of the Explorer's Club for work done in such hostile environments.

Astrobiologist Richard Hoover on a research trip to Schirmacher Oasis, Antarctica, in February 2009. (Photo courtesy of Richard Hoover.)

"The cyanobacteria are truly amazing extremophiles, capable of inhabiting almost all of the most hostile environments on Earth," Hoover says. He has found microbial species falling into the Oscillatoria, Phormidium, Microcoleus genera growing in ice in Siberia, Alaska, and Antarctica, but he also found those same genera growing in hot springs and geysers in Yellowstone National Park, Alaska, California, and Arkansas.

In 1999, Hoover and his research partner Elena Pikuta of the University of Alabama discovered the Carnobacterium pleistocenium, a species of living bacteria from the Pleistocene age, and they were the first to publish this breakthrough. They also discovered a new species of extremophiles, Spirochaeta Americana, in Northern California's Mono Lake.



A live/dead stain image of a 32,000-year-old bacterium Carnobacterium pleistocenium. Green cells are alive and red cells are dead.

Hoover's interest in extremophiles and their ability to survive for 32,000 years has led him to also explore extraterrestrial sources. As evidence of their extraterrestrial source, Hoover has found many meteorite microfossils to have a near total lack of nitrogen and to be permineralized with magnesium sulfate minerals.

"I have never observed these elemental compositions in modern cyanobacteria, or in ancient hair and tissues from Peruvian or Egyptian mummies and Pleistocene Woolly Mammoths, which contain nitrogen levels similar to living biological organisms," he says.

Microbiologist Elena V. Pikuta and astrobiologist Richard Hoover culture extremophiles, microorganisms that can live in extreme environments, in the laboratory. The scientists discovered a new species of extremophiles, Spirochaeta Americana, in Northern California's Mono Lake. (Photos courtesy of: NASA/Marshall Space Flight Center.)

Hoover believes the ability of bacteria and other microorganisms to live cryopreserved in ice is a way life may be distributed throughout the universe, similar to how winds transport bacteria, pollen, and airborne seeds from one place on Earth to another.

"Despite enormous efforts on many of the best scientific minds of this century, we still simply do not know how, when, or where life as we know it on Earth began," Hoover notes.

His long-term interest in the field has led to his long chairmanship of the cross-disciplinary Instruments, Methods, and Missions for Astrobiology conference, to be held again this year at SPIE Optics+Photonics where he will accept his award. Hoover served as SPIE President in 2001.

Hoover is currently analyzing samples from a recent expedition to Antarctica and is excited by the results. "I found bacteria and archaea in every sample of ice from the Schirmacher Oasis Lakes and the Anuchin Glacier ice. These bacteria were alive and resumed their motility as soon as the ice melted," he says.

Gold Medal of the Society

The Gold Medal of the Society is the highest honor SPIE bestows. It has been awarded since 1977 in recognition of outstanding engineering or scientific accomplishments in optics, electro-optics, or photographic technologies or applications.

Recipients have made an exceptional contribution to the advancement of a relevant technology. The honorarium for the award is $10,000.

Microbes in Space

Hoover has found a diverse array of microfossils in samples from the Orgueil meteorite, a large carbonaceous chondrite that fell near the French town of Orgueil in 1864.

"Some of the stones are very rich in specimens of recognizable biogenicity, and in others these most interesting microstructures are fairly rare," he says.

Using environmental- and field-emission scanning electron microscopy and 2D X-ray mapping, Hoover detected forms similar to cyanobacteria that grow on Earth. However, the cyanobacteria on Earth form only underwater and with sun. The specimen Hoover studied has not been submerged since landing on Earth or it would have dissolved, nor was its interior open and exposed to sunlight on Earth before the sample was taken.

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DOI: 10.1117/2.4200907.19

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