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Scientists are exploring the 'planet of the microbes'

By Robert S. Boyd

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WASHINGTON - Like explorers of old, scientists are venturing into the immense but little-known realm of the microscopic organisms that dominate our planet.

"It's an entire world that most of us have no idea about," said Alan Leshner, the chief executive of the American Association for the Advancement of Science.

Countless trillions of microbes - mostly bacteria and a recently discovered kingdom of one-celled creatures known as archaea - inhabit every cranny of the globe. They reshape their environment, make life possible and sometimes destroy it.

"We live on the planet of the microbes, but it's largely unexplored," said David Stahl, a microbiologist at the University of Washington in Seattle. "Like the Amazon basin before the age of discovery, it's a tremendous area that's just beginning to be recognized."

Scientists have known for centuries about the existence of bacteria, still informally called germs. Archaea (are-KEY-uh), however, were identified just 30 years ago. And microbes' sheer quantity and diversity, and the essential roles they play in the life of the planet, are coming into focus only now.

"It's time for microbes to have their due," Stahl said at an American Association for the Advancement of Science symposium in Washington last month.

Scientists' growing appreciation of these invisible strangers is due to recent advances in biology, chemistry and geology, all made possible by the latest technologies.

Last summer, for example, Anna-Louise Reysenbach, a biologist at Portland State University in Oregon, used a remote-controlled submarine to discover previously unknown species of bacteria frolicking in a pool of hot water at the bottom of the South Pacific.

At a temperature of 572 degrees Fahrenheit, "it was a wonderful little jacuzzi for microbes," Reysenbach told the symposium.

Li-Hung Lin, a geoscientist at National Taiwan University, recently found hordes of bacteria living in radioactive rocks 1.7 miles down in a South African gold mine. Although no energy from the sun can reach the bacteria, this deep subsurface biosphere "is capable of sustaining microbial communities indefinitely," Lin reported in the Oct. 20 issue of the journal Science.

Closer to home, researchers led by Steven Gill, a biologist at the University of Buffalo in New York, are analyzing bacteria and archaea inside the human intestine. Gill estimated that there are 10 trillion to 100 trillion of the little bugs in each person's gut, carrying out such essential functions as digesting food and eliminating waste.

"Humans are super-organisms ... an amalgamation of microbial and human attributes," Gill wrote in the June 2 issue of Science. "We're entirely dependent on this microbial population for our well-being."

"We're 10 parts microbes, one part human," Stahl said.

Despite their minuscule size, these creatures also have had an enormous effect on the land, water and air.

"Biological processes have profoundly changed the physical and chemical properties of the world," said Katherine Freeman, a geoscientist at Pennsylvania State University in College Park.

Micro-organisms manufacture oxygen, convert nitrogen into forms that plants can eat and drive the cycles of carbon, sulfur, iron and other elements essential to life.

"Microbes played a key role in the transformation of Earth to a habitable planet," said Jonathan Zehr, an ocean scientist at the University of California Santa Cruz. A microbe known as cyanobacteria is credited with producing most of the oxygen that made multicellular life possible about 2.5 billion years ago.

"Nitrogen fixation helped fertilize the planet," Zehr said. "The production and consumption of CO₂ is driven by microbes." CO₂, carbon dioxide, is a so-called greenhouse gas that's widely regarded as the primary cause of global warming.

Microbes in the soil release other greenhouse gases, such as methane and nitrous oxide, according to Bruce Hungate, an environmental biologist at Northern Arizona University in Flagstaff.

Micro-organisms know how to make a living in the rainless deserts of Chile, in acid baths and radioactive wastes, and deep below the ice in Antarctica.

Their ability to endure such extreme conditions raises hope among some scientists that primitive life forms may be found below the surface of Mars or other extraterrestrial worlds.

In October, astronomer Neill Reid at NASA's Space Telescope Science Institute in Baltimore reported the discovery of microbes that grow and reproduce at 30 degrees Fahrenheit, below the freezing point of water.

"The lowest temperatures at which these organisms can thrive fall within the temperature range experienced on present-day Mars and could permit survival and growth, particularly beneath Mars' surface," Reid said.

If microbes aren't already living on Mars, they will be when the first humans arrive several decades from now.

"When we step on Mars, we're not going alone," Stahl said. "Microbes will go with us."

For more about microbes, go to www.microbeworld.org