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**James Van Allen and Astrobiology**（图）

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[ 摘要 ] Nov 13, 2006: In a lifetime devoted to instrumentation and rocket science, James Van Allen made immense contributions to the exploration of the space environment and its astrobiological potential.
[ 关键词 ] James Van Allen;Astrobiology;space environment

A little before midnight, on January 31, 1958, a countdown reached zero and a rocket hesitated on its launch pad at Cape Canaveral. Around the Cape, birds soared screeching into the night sky, suddenly awoken by the deafening engine and its dazzling flame. The rocket ascended with its unique payload, scientific instruments of a kind never flown in space. On the ground the scientists and engineers watched as the exhaust flame rose overhead, 60 miles above the Earth. Explorer 1 had on

One person at Cape Canaveral, James Van Allen, was excited by the flawless launch. He had helped launch the U.S. into the space race, and by doing so started a completely new science: space science. Another new science, astrobiology, lay decades in the future, but it would rely heavily on the achievements of rocket scientists for the exploration of the solar system.

Van Allen participated in 24 Earth satellite and planetary missions, a record never equalled by other space scientists, and he therefore had an immense impact on the way astrobiology missions were conducted in the solar system.

Van Allen initially trained as a nuclear physicist. After his doctorate he joined the Carnegie Institution in Washington, working in the Department of Terrestrial Magnetism, where he took a close interest in cosmic rays, the high

-energy particles streaming through space.

Noting that cosmic rays are hazardous to human space missions, Van Allen decided to devote his future research efforts to understanding the energetic protons and bare atomic nuclei hurtling through the space environment.

Simulated Van Allen Belts generated by plasma thruster in tank #5 Electric Propulsion Laboratory at the Lewis Research Center, Cleveland Ohio, now John H. Glenn Research Center at Lewis Field. Credit: NASA

Exploration of the world beyond Earth's atmosphere requires rockets. In 1946 Van Allen initiated a program to develop the Aerobee, a high-

performance American rocket for scientific research. More than 1,000 of these were launched, mostly for scientific purposes.

The International Geophysical Year 1957 -

58 (IGY) proved to be a crucial turning point for this new science of space exploration. On October 4, 1957, the Soviet Union launched Sputnik I as its contribution to IGY.

In response to Sputnik's triumph, the Jet Propulsion Laboratory in Pasadena, California hurriedly assembled Explorer I in just 84 days. At JPL Van Allen took charge of the instrumentation, insisting that Explorer I must carry a Geiger counter to detect cosmic rays. (JPL made two satellites. You can see the back

-up Explorer I in the Milestones of Flight Gallery of the National Air and Space Museum in Washington DC.)

The Geiger counter's findings puzzled Van Allen. At low altitudes it gave a signal consistent with the detection of cosmic rays, but at high altitudes, farther out in space, the counter fell silent. This made no sense, because if cosmic rays could be detected close to Earth then surely they must be detectable at greater distances.

For the follow-

up mission Explorer III, Van Allen improved the counting technique. This time his instruments recorded the exact location in the satellite orbit where the count fell abruptly to zero. Van Allen now saw that the periods of zero count occurred because the intensity of radiation was so high that it swamped the counter. "Wow! Space is radioactive!" one of his colleagues exclaimed.

The three men responsible for the success of Explorer 1, America's first satellite, launched Jan. 31, 1958. From left, William H. Pickering, James Van Allen and Wernher von Braun.

Credit: NASA.

Following Van Allen's discovery, two other spacecraft, Explorer IV and Pioneer III, mapped the two radiation belts that girdle the Earth. Each is a torus (shaped like an auto tire) in which Earth's magnetic field traps energetic particles. The outer belt contains only electrons, while the inner belt includes very energetic protons, which creates a hazard for human exploration and satellite instrumentation. Van Allen's discovery quickly became the highlight of IGY.

The commitment of the US to space exploration now advanced by leaps and bounds. President Eisenhower signed NASA into law on 19 October 1958. Civilian space scientists, rather than military personnel, now guided the space program.

Van Allen played a crucial role in determining the conduct of scientific research in space. As a member of the federal government's Space Science Board he became an advocate of exploratory missions to the outer planets.

With his interest in planetary magnetic fields, he emphasized the need for missions to Jupiter. The fruits of his advocacy included Pioneer 10 and Pioneer 11.

Launched in 1972 and 1973, the Pioneers had tools to measure energetic particle properties in the environment of Jupiter. Van Allen had insisted on this, and won through in a vigorous national competition for payload space. Both spacecraft provided spectacular data on Jupiter's enormous and powerful magnetic field, which is 10,000 times stronger than Earth's.

Impact on Jovian moon, Europa, thought to have up to a 4-mile-thick sheet of ice. Credit: NASA/JPL/Galileo

Pioneer 10 continued on an escape trajectory out of the solar system, and now it is the most distant artefact made by humans. Its weak signal continued to be tracked by the Deep Space Network as part of a study on interstellar communication technology, but the power source on Pioneer 10 finally dropped below the threshold for detection on February 7, 2003.

Two Voyagers rocketed into space in 1977. Each zoomed by Jupiter and Saturn. Subsequently Voyager 2 encountered Uranus (1986) and then Neptune (1989), thereby fulfilling Van Allen's dream to have a single spacecraft make a Grand Tour of the four giant planets.

Van Allen took the lead in planning the Galileo mission. It made 34 orbits of the Jovian system, and proved to be an enormous boost for astrobiology because it extended our knowledge of the range of solar system objects with the potential for life. Galileo found evidence of subsurface saltwater on Europa, Ganymede and Callisto, and revealed the intensity of volcanic activity on Io.

It is no exaggeration to say that the astrobiological exploration of our solar system owes a great debt to Van Allen's half a century of leadership and inauguration in the field of space mission design. He was truly a pioneer of both space science and astrobiology.

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