James Alfred Van Allen

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Citation: Physics Today **59**(12), 77 (2006); doi: 10.1063/1.2435692
View online: http://dx.doi.org/10.1063/1.2435692
View Table of Contents: http://scitation.aip.org/content/aip/magazine/physicstoday/59/12?ver=pdfcov
Published by the AIP Publishing

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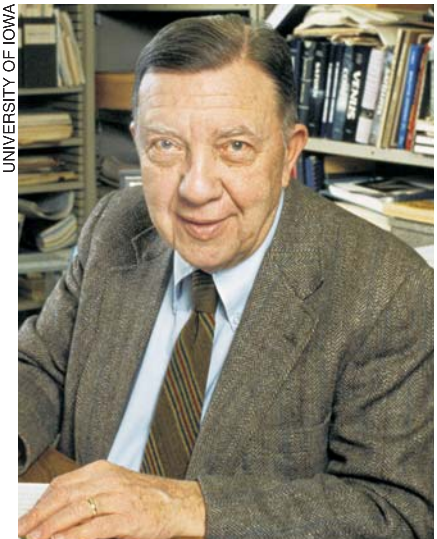
James Alfred Van Allen, who led American science into space, died of heart failure on 9 August 2006 at the age of 91 in Iowa City, Iowa. His 1958 discovery of what are now known as the Van Allen radiation belts produced great excitement in both the scientific community and the general public and marked the beginning of the modern era of space science.

Van Allen was born in Mount Pleasant, Iowa, on 7 September 1914. He showed an early interest in mechanical and electrical devices, and a high-school teacher inspired his fascination with science. At Iowa Wesleyan College, he majored in physics, helped prepare seismic and magnetic equipment for one of Richard Byrd's Antarctic expeditions, and graduated in 1935. He earned his PhD from the University of Iowa in 1939 with a thesis on nuclear physics.

As a research fellow at the Carnegie Institution of Washington's Department of Terrestrial Magnetism, Van Allen continued his work in nuclear physics. He became interested in geomagnetism, cosmic rays, and solar terrestrial physics through acquaintance with Scott Forbush and Harry Vestine and the work of Julius Bartels and Sidney Chapman. In mid-1940 he joined DTM's national defense effort developing proximity fuses and moved with the program when it was transferred to the Johns Hopkins University Applied Physics Laboratory. In late 1942 he was commissioned as a naval officer; he introduced to the South Pacific fleet radio-proximity fused projectiles and reported on their effectiveness. After the war he returned to APL, where he organized a high-altitude research group and initiated development of a new high-performance sounding rocket, the Aerobee.

From 1947 to the creation of NASA in 1958, Van Allen was chairman of the group that became the Rocket and Satellite Research Panel. This informal group played a key role in fostering upper atmospheric research and the initial group of satellite experiments.

In 1950 Van Allen returned to the University of Iowa to head the physics department, a position he held until his "retirement" in 1985. He continued studying cosmic rays and how to get above the shielding of Earth's atmosphere in a practical and inexpensive way. For the latter he followed up on an idea to launch rockets from high-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altitude balloons ("rockoons"), had nose cones and large tail fins machined for military rockets in the Iowa machine shops, and had students assemble and test the payloads. Various payloads of single Geiger counters, ionization chambers, scintillation counters, and proton precession magnetometers were launched on four expeditions to Thule, Greenland, during the summers of 1952–54 and on extensive Arctic and Antarctic flights throughout the 1957 International Geophysical Year. One significant finding was a new "soft" charged-particle component of low-energy electrons in the auroral zone, the first direct confirmation of the particles producing auroral luminosity.

On 31 January 1958, some four months after the Soviet Union launched *Sputnik 1*, the University of Iowa cosmic-ray experiment—a single Geiger counter developed by Van Allen and graduate student George Ludwig—was placed in orbit on *Explorer 1* by a Jupiter C rocket. The limited data from *Explorer 1* were confusing, with periods of normal counting rates, periods of rapid changes, and intervals of zero counts. The confusion was clarified by *Explorer 3*, launched on 26 March 1958, which contained the Iowa experiment and a miniature magnetic tape recorder. Van Allen, Ludwig, graduate student Carl McIlwain, and former student Ernest Ray, an Iowa assistant physics professor, realized the satellite was encountering vast regions of intense radiation that at times saturated the Geiger-counter response, producing a null counting rate; the regions were later named the Van Allen radiation belts.

Over the next several years, Iowa was the center of the new world of space science. Van Allen and his group provided the principal scientific instrumentation for the five Explorer and first four Pioneer missions in 1958–59. Seven of the missions established the existence of inner and outer radiation belts and a general understanding of the boundaries and properties of the trapped radiation.

The Iowa space group grew steadily, evolving into one of the world's premier institutions for space physics. Van Allen's instruments were on *Mariner 2*, the first mission to another planet—Venus—in 1962 and on *Mariner 4*, the first mission to Mars, in 1965. Although no radiation belts were found at either planet, his instruments yielded valuable observations of cosmic rays and solar energetic particles, topics he enthusiastically followed even in his post-retirement research.

In the late 1960s, as a member of the National Academy of Sciences space science board and of NASA's lunar and planetary missions board, Van Allen was a tireless advocate for exploration of the outer planets. His efforts came to fruition when his Geiger Tube Telescope was selected for the Pioneer payload and contributed to results from the *Pioneer 10* and *11* flybys of Jupiter in 1973 and 1974 and the *Pioneer 11* flyby of Saturn in 1979. The GTT weighed only 1.64 kg and consumed just 25 mA from the power supply. On the three planetary encounters, his experiment hit pay dirt: Jupiter's enormous magnetosphere contained incredibly intense radiation belts and magnetospheric phenomena, and Saturn had an extensive magnetosphere. One aspect of the Pioneer encounters with Jupiter and Saturn that Van Allen particularly enjoyed was the observation of the interaction between the radiation-belt particles and the neutral material in Keplerian orbits about the planets; he was able to announce the detection of several previously unknown satellites through their absorption signatures in the energetic particle data. Compared with later planetary missions, Pioneer was small. But it looms large in the history of the planetary program, and in many ways it was Van Allen's most satisfying mission since 1958–59.

The foundation laid by Pioneer allowed exploration of the outer planets to proceed with confidence, and Van Allen continued to provide leadership and advocacy for the new missions that followed. When the "Grand Tour" mission to take advantage of the once-in-179-years alignment of Jupiter, Saturn, Uranus, and Neptune fell victim to budgetary issues in 1972, he was instrumental in helping recoup the opportunity and chaired the initial science working group planning the Mariner Jupiter–Saturn (Voyager) mission. As he said in his autobiography, "It did not escape our attention that the configuration of the outer planets was independent of budgetary-political considerations in the White House and the Congress" (*Annual Review of Earth and Planetary Sciences*, volume 18, 1990, page 24).

After the Jupiter and Saturn encounters, Van Allen's Pioneer instruments continued to blaze a knowledge trail through the outer heliosphere, and the data from *Pioneer 10* and *11* extending to beyond 75 AU allowed Van Allen to return to cosmic-ray studies. Over the period 1975–97, the landscape of energetic particle and interplanetary phenomena was constantly evolving with the 11-year solar cycle, large-scale disturbances from the Sun, and the ever-increasing heliocentric distance. At great distance, Van Allen's basic philosophy of simplicity and reliability was rewarded once again: The aging *Pioneer 10* spacecraft power source was so limited that only his experiment could be operated, and on 31 March 1997 it provided the last science measurements from the Pioneer mission—a fitting finale to a remarkable journey through the space age.

Among Van Allen's many awards for his contributions to space science were the National Medal of Science, the Crafoord Prize of the Royal Swedish Academy of Sciences, and the American Geophysical Union's Bowie Medal. Van Allen served as AGU president from 1982 to 1984.

The consummate teacher and mentor, Van Allen took delight in teaching introductory undergraduate astronomy, and his graduate students were always the heart of his research teams. He guided his students to 47 MS degrees and 34 PhDs, and many went on to positions of leadership and influence in the field. Most important, he treated all his students with respect, listening to them, learning from them, and guiding them with wisdom and kindness. He was an inspiration to the generations who followed his lead into the fascinating world of space research.

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