PERSONALITY PORTRAIT—LXXI

The Magnetic Family

MOTHER EARTH'S ATTENTIVE SON JAMES

From the Van Allen Branch of the Clan

THE Straits of Magellan were named in an era when man could, by courage, perseverance, and employment of one of his natural senses, become immortal. Later the world became so complex that merely to see what others could see, or hear what any ears could detect, was not enough. The elite must now engage thoroughly trained, intuitive minds and couple this investigation with data compiled by intricate instruments to reveal an existing—though previously undetected—phenomenon. The Van Allen Radiation Belts have been so detected and named for their discoverer, Dr. James A. Van Allen of Iowa.

Deemed the greatest discovery of the International Geophysical Year (1 July 1957- 31 December 1958), the Van Allen Belts have influenced the entire concept of exploration. Like a giant moat, they guard the universe, challenging man to cross from his home planet earth through their deadly radiation. At the same time their enveloping configuration provides two inviting openings—the areas at earth's northern and southern poles—as drawbridges into space.

After one lengthy scientific question-and-answer exchange with news gatherers, Van Allen was bombarded with queries about the threats and dangers inherent in these belts. At last a participant in the discussion pleaded, "Can't you tell us anything good that has come from the discovery of the radiation belts?"

"Yes," Van Allen replied, smiling: "I've made a good living off them!"

Science is making a good living off them, too, and a comfortable income is likely to continue for a long while. For what the first man-made moons of earth originally saw as two distinct doughnut-like rings of electrically charged particles encircling the planet are now discerned with increasing clarity as mere parts in a vast natural mechanism by which the light and heat of the sun are transported across 93,000,000 miles of space and through earth's atmosphere to create and sustain life.

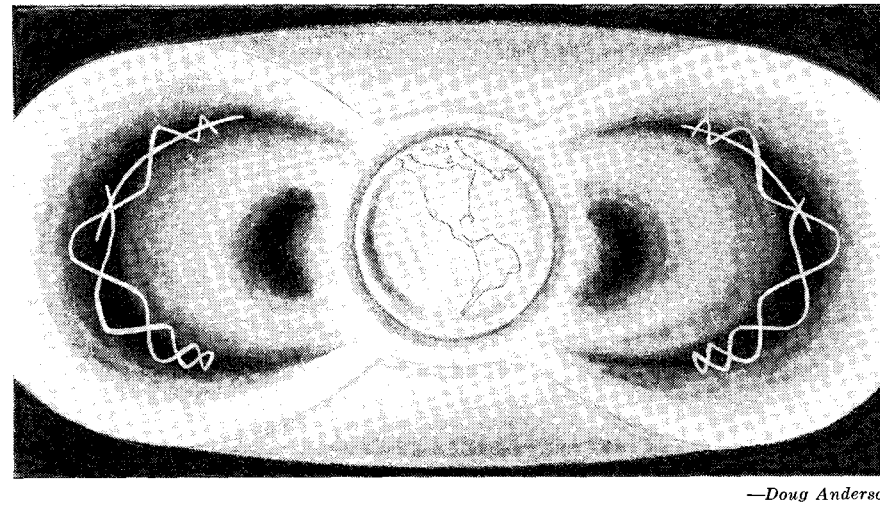
It is difficult to trace precisely the threads of Van Allen's accomplishments to their real sources. While many influences played upon his forming career, the inner core was a family habit of study. His father, Alfred—lawyer, town councilman, school board member and onetime Mayor of the county seat of Mount Pleasant—read aloud to his four children from "The Book of Knowledge" every night. At the age of ten, James already looked forward to those nights when the reading would be about electricity and the laws of physics. When Jim was about twelve, he and his younger brother Maury together built a high-voltage machine. In the half-dark of the cellar, it was exciting to make "lightning." On weekends, while they raked the grass in the yard around the house, he and Maury would talk about other inventions. And in Mount Pleasant high school, physics teacher C. A. Cottrell often had to "sweep Jimmy Van Allen out the door" so the laboratory could be locked at the end of the day.

At Iowa Wesleyan College, growing Jim spent all possible moments in the three-story, vine-covered brick physics building. That is where he studied under Professor Thomas Poulter. Poulter, now director of Poulter Laboratories at Stanford Research Institute, recalls: "Colleges and professors all too frequently like to take credit for developing their students into scientists or other outstanding personalities. I have no such illusion about Jim. Even as a student I preferred to think of him as a professional associate rather than as a student, for he was a better scientist as an undergraduate student than many college professors."

Professor Poulter was chief scientist on the Second Byrd Antarctic Expedition of 1933-35, and he credits Van Allen with "invaluable assistance in the development and checking of instrumentation" for use on the expedition. This work involved observation of meteor showers and required young Jim to measure cosmic rays.

Though cosmic rays had been identified around the turn of the twentieth century, very little was yet known about their origin. It had been confirmed that earth's atmosphere absorbs but does not produce the primary rays; that was about the limit of knowledge.

After earning his doctorate at the State University of Iowa with a thesis on disintegration of the nuclei of hydrogen atoms and the dependence of that process on bombarding energy that might come from cosmic rays, Van Allen became a research fellow of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, D.C. When World War II broke



—Doug Anderson

THE MAGNETOSPHERE OF EARTH, sketched above, is now known to trap electrical particles in varying densities to a distance of 60,000 miles. Dark arcs suggest original conception of Van Allen Belts. Note spiraling along magnetic lines.

out, he and others at Carnegie transferred to the Applied Physics Laboratory of The Johns Hopkins University in Silver Spring, Md. The assignment at the Laboratory was to build a fuse which would explode a bomb or shell at the instant a tiny radio inside the fuse said the target was close enough to be destroyed. This called for the designing of extremely delicate instruments that could stand the shock of being fired from cannon.

While he was working at Johns Hopkins, Van Allen was thrown—literally—into the company of his future wife, Abigail Fithian Halsey II. She "bumped into him." Her automobile backed into his. The wedding took place in Southampton, Long Island, in the fall of 1945.

IN terms of time, the marriage symbolized a gathering together of vital elements in James Van Allen's life. His earlier interest in cosmic rays and his experience with the proximity fuse crystallized into a single precipitate when the then U.S. Army Colonel (now Major General) Holger N. Toftoy asked Carnegie's Dr. Merle Tuve to assign some lively young man to plan scientific experiments in the upper atmosphere for a hundred V-2 rockets captured from the Germans.

The V-2 testing had hardly begun before Dr. Tuve requested Van Allen to survey the possibilities of obtaining additional rockets for use after the V-2s had all been launched. Van Allen set out to find a company in the United States that could deliver a rocket capable of high performance yet modestly priced. After months of consideration, a contract was concluded for delivery of twenty 2600-pound thrust rockets, able to carry 150 pounds of instruments to an altitude of 300,000 feet. Taking the first syllable from the name of the manufacturer, Aerojet Engineering Corporation, and the second syllable from the Bumblebee family of missiles developed at the Applied Physics Laboratory, Van Allen coined a name for the new rocket that has been used ever since—Aerobee.

Dr. Sydney Chapman (former Oxford University professor, now at the High Altitude Observatory in Boulder, Colorado), one of the world's foremost geophysicists, was in Washington in the spring of 1950. He mentioned to his friend, Van Allen, that a visit with other geophysicists would be enjoyable. A small dinner was arranged at the Van Allen home. Out of what Van Allen calls "a postprandial discussion" the idea for the IGY emerged.

Among those present that evening were Dr. S. F. Singer, an imaginative young physicist at the Applied Physics Laboratory, and Mr. Lloyd Berkner, associated with the State Department in organization and direction of the first military assistance program of the North Atlantic Pact. Berkner proposed the IGY as a means of bringing about global cooperation and communication among scientists. Singer suggested the launching of an earth satellite. Van Allen had actively campaigned for such a satellite as early as 1948 in a paper he read before the International Union of Geodesy and Geophysics in Oslo.

In the year after this to-be-historic after-dinner conversation at Silver Spring, Van Allen accepted an invitation to return to the State University of Iowa as head of the physics department. There he quickly enhanced his reputation for "getting the most for the least" by designing the Rockoon—a rocket that took off from a balloon already floating fifteen miles high above the earth. Since Rockoons couldn't very well be launched from an Iowa cornfield, Van Allen persuaded the Coast Guard to carry his sky vehicles to the waters off Greenland and Newfoundland. This put him in position to study cosmic rays at high latitudes and at altitudes where the power of the rays could be measured before they were deflected or absorbed by the atmosphere of the earth.

Thirty miles above the sea off Newfoundland, instruments in the Rockoons revealed that the cosmic rays were far more intense than scientists had expected. To the north and to the south, the intensities were what had been expected. But here in this zone of frequent auroras, greater activity seemed to be centered. Was this coincidence? Or was it perhaps circumstantial evidence that the high cosmic ray count and the aurora were somehow linked?

Van Allen was still pondering this question when the launching of an earth satellite was finally approved as an IGY project in 1955. The U.S. Navy's not yet completed Vanguard rocket had been chosen as the vehicle. Van Allen favored Dr. Wernher von Braun's Jupiter-C rocket for the assignment because the Jupiter-C already had flown 3100 miles and reached an altitude of 682 miles. The Iowan took the precaution of making his package of cosmic ray detectors of such dimensions to fit either into the Vanguard satellite or into the nose cone of the Jupiter-C.

After the Russian Sputniks went up in the fall of 1957, and the first Vanguard launchings failed, a Jupiter-C rocket put the Explorer I satellite into orbit on 31 January 1958 with Van Allen's cosmic ray counters aboard. The rest of the story everyone knows.

The counters didn't count above 600 miles. Other counters were sent up in Explorer III; they, too, failed to note any radiation above 600 miles. Van Allen was stumped until one of his university associates, Carl McIlwain, reminded him that if the counters had been called upon to count above a certain level of intensity, the mechanism would have jammed. Explorer IV took up new counters designed to count radiations only above a certain power, and those counters found the very intense activity in the Van Allen Belts (darkest arcs in sketch, page 42).

—*Wide World*

Dr. James A. Van Allen

Because Van Allen's second generation of cosmic ray counters were set to register only certain powerful radiations, the first impression they brought back was of two distinct doughnut-shaped rings. From other evidence accumulated by rockets, satellites and space probes since then, it has been determined that these are only two of many rings bounded by particular lines of force in the curvature of earth's magnetic field. It is now assumed that radiation of varying intensities is likewise trapped within other lines of the same field as far as 60,000 miles out from the earth. At that distance the planet's magnetosphere, as the whole mechanism has come to be called, apparently becomes tangled with the more turbulent magnetic field of the sun. According to present theory, what Dr. James Van Allen discovered is really a huge electrical storage bin that alternately fills with energy from the sun (see sketch, page 44) and then empties this energy into earth's atmosphere in ways yet imperfectly understood.

—SHIRLEY THOMAS

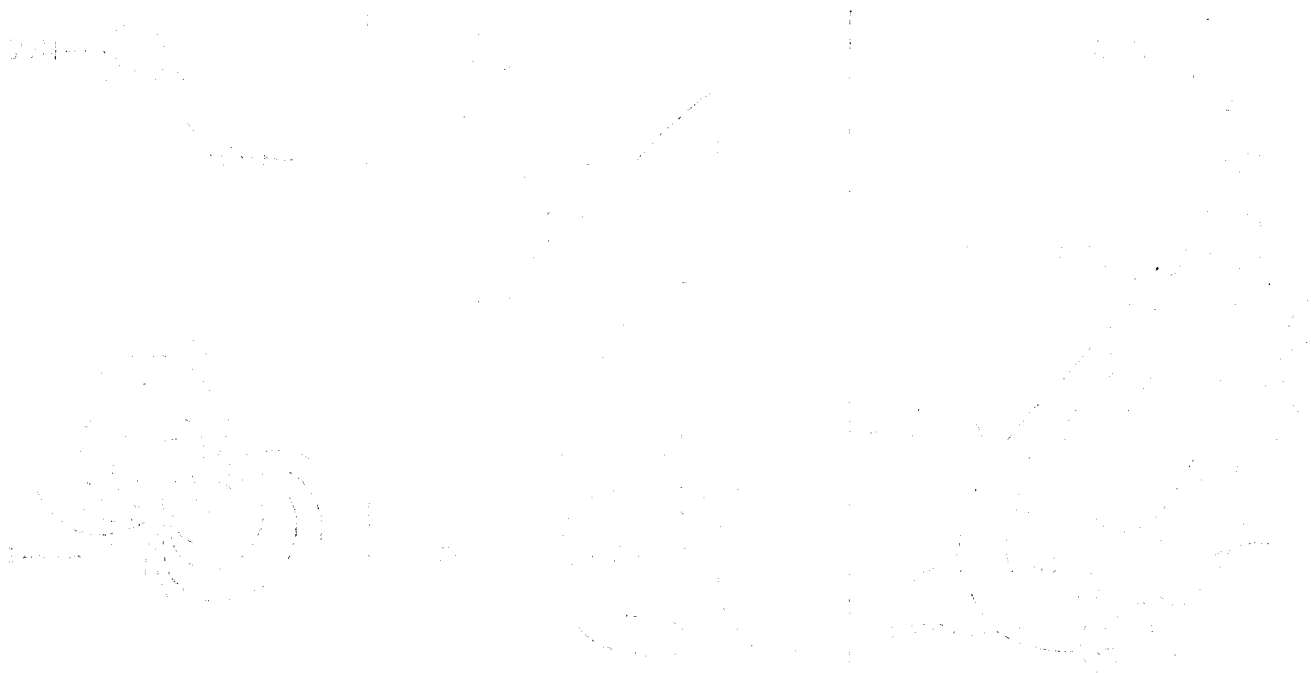
Dr. James A. Van Allen is one of the characters in Shirley Thomas's book, "Men of Space," published by the Chilton Company.

SCIENCE IN BOOKS

The Magnetic Family

HOW FATHER SUN WOOS MOTHER EARTH

A Most Energetic and Fruitful Relationship Is Beginning To Be Understood



The wherewithal of life and warmth are transferred in this fashion across 93,000,000 miles of space

WE know that the surface of the sun boils and bubbles actively, from time to time ejecting huge clouds of charged particles and streams of X-rays into the space between the sun and the planets. These solar eruptions are known as flares. If the flares occur in the right position on the sun's surface, the clouds of charged particles travel across space to collide with our atmosphere.

Although the energy carried by these solar particles averages less than one millionth of the energy radiated by the sun in the form of visible light, and their effects are usually not noticed by the man in the street, they can, nonetheless, be very important. They produce communications blackouts, magnetic storms, and auroral displays; and they also produce violent changes in the intensity of the Van Allen belts, which are apparently related, in a manner not yet clearly understood, to other atmospheric effects.

The entire matter of sun-earth relationships, including the formation of the Van Allen Belts and their possible role in geophysical phenomena, is at the moment the most exciting and fruitful field of space research.

In the great flares of 1960 we obtained for the first time an understanding of the complete sequence of events during one of these eruptions. These were the flares of March, September, and November of that year. At various times during these events we had the Explorer VII satellite in orbit near the earth, the Pioneer V spacecraft out in interplanetary space, and a large number of experimenters simultaneously taking observations on the ground.

The combination of the space flight data and the ground observations revealed a fascinating picture. It appears that a tongue of plasma, i.e., of relatively slow-moving charged particles, erupted from the surface of the sun at the site of the flare, and moved out across interplanetary space at a speed of about 1,000 miles per second. At this rate it took the plasma cloud about one day to reach the earth. The cloud dragged with it lines of solar magnetic force, which were frozen into the cloud and forced to move with it by the laws of electro-magnetism. These lines of magnetic force had their roots on the surface of the sun in the vicinity of the flare, but as the plasma tongue moved across space the magnetic lines were drawn out with the plasma like loops of taffy.

When magnetic force lines become distended in this manner they lose their strength. By the time these lines reached the earth they were some 500 times weaker than they were at the surface of the sun. However, the magnetic field within the plasma tongue was still sufficiently strong to screen the earth partially from the cosmic rays which normally bombard the planet.

—ROBERT JASTROW,
in "NASA's Scientific
and Technical Programs,"
(U.S. Gov't Printing Office, $1.50).

EDITOR'S NOTE: *Dr. Robert Jastrow is chief of the theoretical science division of the National Aeronautics and Space Administration. He points out that whereas his report above was written after the facts were established, what is written below was written when only a few tentative observations were available. Consequently, it ranks as a brilliance of intuitive science.*

IF COSMIC rays can be excluded from a certain region, it follows that they can also be confined in that region if they are produced inside it. Particles