

# THE PIONEERS OF THE LANDSAT PROGRAM

## WILLIAM A. FISCHER

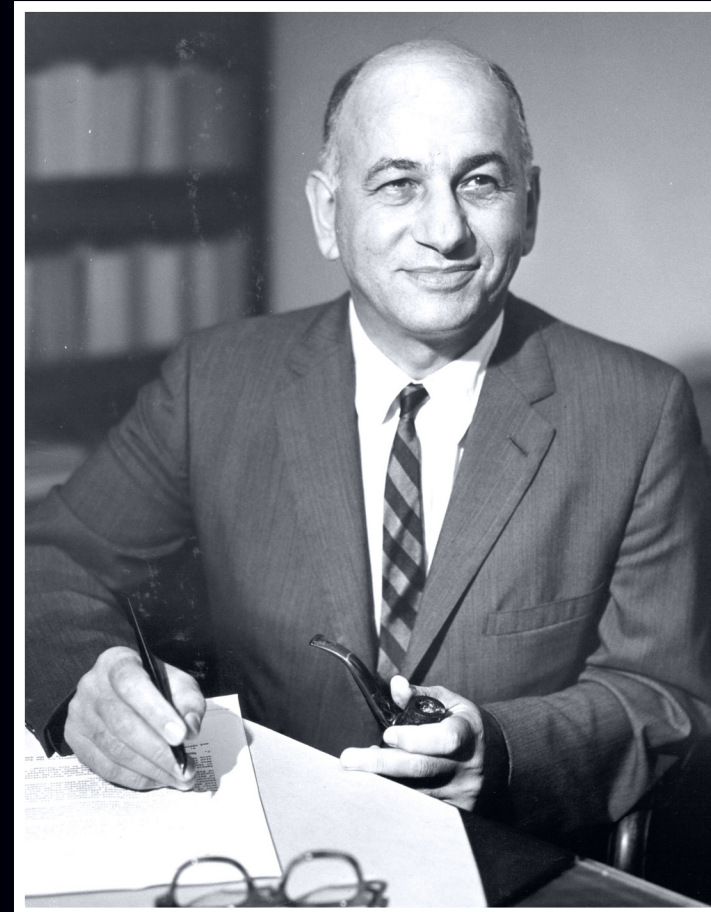
January 6, 1919 - July 29, 1980



William A. Fischer was an internationally recognized photogeologist and photogrammetrist. He obtained a geology degree from McKendree College in 1940 and he completed advanced courses from the University of Illinois. He joined the USGS in 1942 as one of the nation's first photogeologists. From 1944 to 1946, Fischer served in the US Navy as a photointerpretation officer. His career at the USGS continued in the Branch of Theoretical Geophysics and he served as Chief of the Photogeology Section. Fischer became immersed in remote sensing research and he was an early advocate of Earth-observing systems. In 1962, he represented the USGS at the First Symposium on Remote Sensing of Environment at the University of Michigan. Due to his expertise and imagination, he served as Research Coordinator for the Natural Resources Program and the Earth Orbiter Program. Through his research, he was able to demonstrate the value of an Earth observing satellite system. He partnered with Robinove and Pecora to produce a proposal that would eventually lead to the EROS Program. Fischer served multiple roles under the EROS Program, including Research Coordinator, Senior Scientist, and Program Manager.

## WILLIAM T. PECORA

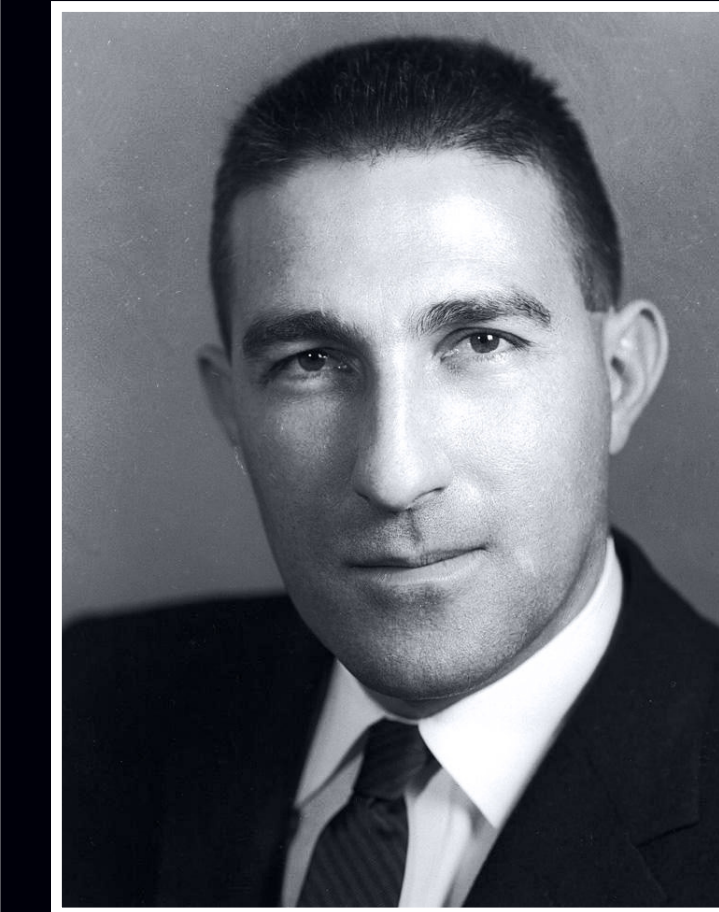
February 1, 1913 - July 19, 1972



Dr. William T. Pecora was an accomplished geologist and visionary leader with a background in geologic engineering, mineralogy, petrography, and geochemistry. He received a BSE degree from Princeton University in 1933 and a PhD degree from Harvard University in 1940. He started his career at the USGS in 1939 as a Research Geologist. He later served as Chief of the Branch of Geochemistry and Petrology (1957-1961), Chief Geologist (1964-1965), and Director (1965-1971). As Chief Geologist and Director of the USGS, Pecora recognized that conventional methods of acquiring environmental data were not providing information as rapidly as needed. He believed that aircraft and spacecraft would gather valuable data in a timely, effective, and economic manner. Accordingly, he actively supported research in photogeology and remote sensing. In fact, he formed an association with NASA in 1964 that enabled the USGS to accelerate its remote sensing research and to initiate studies that assessed the potential value of surveying Earth from space. He ultimately led the development of the EROS Program by working closely with Fischer, Robinove, and Udall.

## STEWART L. UDALL

January 31, 1920 - March 20, 2010



Stewart L. Udall was a devoted and enthusiastic conservationist, politician, lawyer, author, and scholar who had an immense impact on American environmental stewardship. During World War II, Udall served in the Air Force. In 1948, he received a law degree from the University of Arizona. Udall served as an Arizona Congressman from 1954 to 1961, where he was instrumental in persuading Arizona Democrats to support Senator John F. Kennedy. After Kennedy was elected as President of the United States on January 20, 1961, Udall was appointed as Secretary of the Interior. Udall served under both Presidents Kennedy and Johnson until 1969. Under his leadership, Udall aggressively promoted the expansion of federal lands and the enactment of environmental legislation. Since Udall was passionate about land and environmental conservation, he appreciated the idea of an Earth-observing program and mission. With the assistance of Pecora, Fischer, and Robinove, Udall boldly announced Project EROS on September 21, 1966. During the press release, Udall stated that "EROS is a program aimed at gathering facts about the natural resources of Earth from Earth-orbiting satellites."

## CHARLES J. ROBINOVE

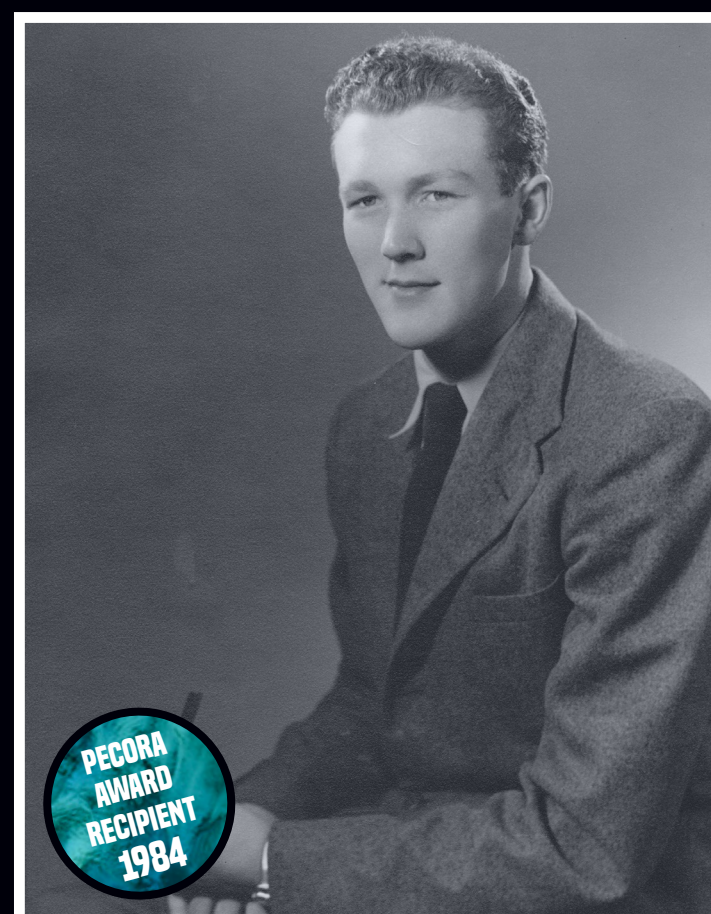
October 31, 1931 - March 25, 2022



Charles J. Robinove was an exceptional hydrologist who was an early advocate of using remote sensing to improve water resources management. Robinove received a BS in Geology from Wayne State University in Detroit, Michigan, in 1953. He joined the USGS in 1954 and he was employed there until his retirement in 1986. Robinove started working in the Ground Water Branch of the Water Resources Division (WRD) where he conducted a number of studies in North Dakota and Wyoming. In 1961, Robinove began working with Fischer to use airborne thermal infrared imagery to measure surface-water temperature and ground water discharge. In 1965, when NASA established the Natural Resources Program, the WRD was awarded some funds to conduct airborne research activities. As a result, a new Office of Remote Sensing in the WRD was established and Robinove was asked to serve as the first Chief. In this position, he coordinated remote sensing studies, he worked closely with Fischer and Pecora to develop the EROS proposal, and he demonstrated the value of an Earth observing satellite system. After the EROS Program was established, Robinove served as the Associate Program Manager.

## ARCHIBALD B. PARK

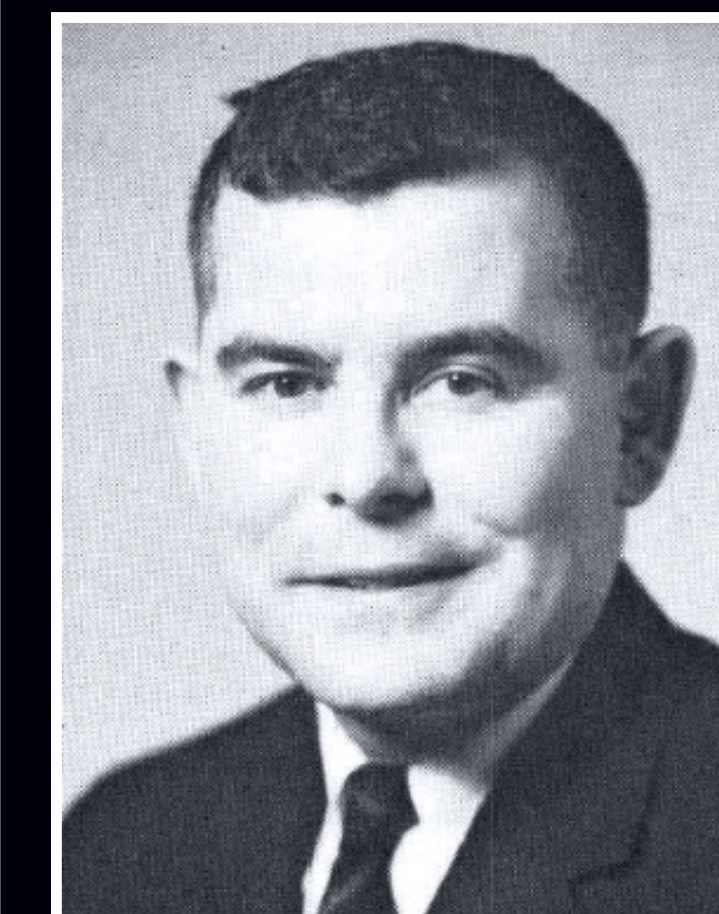
September 18, 1925 - July 28, 2003



Dr. Archibald B. Park was a widely talented scientist and he successfully performed in a number of different roles throughout his career. Park was a veterinarian for the State of Maryland, an agronomist and remote sensing coordinator for the USDA, Chief of the NASA Earth Resources Survey Program and Earth Observation Program, ERTS Program Scientist, a private remote sensing consultant, Chief Scientist for Landsat-D at General Electric Space Systems Division, and Assistant Secretary for the Maryland Department of Agriculture. Park was born in Ontario, Canada, and he received a BVSc degree from Ontario Veterinary College at the University of Guelph and a DVM degree from the University of Toronto in 1950. He started working for the USDA Agricultural Research Service in 1955. In 1965, Park was hired by NASA to conduct remote sensing studies that would define Earth orbital programs. In this role, he used his exceptional skills to build conceptual and quantitative models and to develop the concepts and parameters for the ERTS-A mission. He had the foresight to integrate emerging technologies, including a multispectral scanner sensor, into the Earth-observing satellite system.

## PETER C. BADGLEY

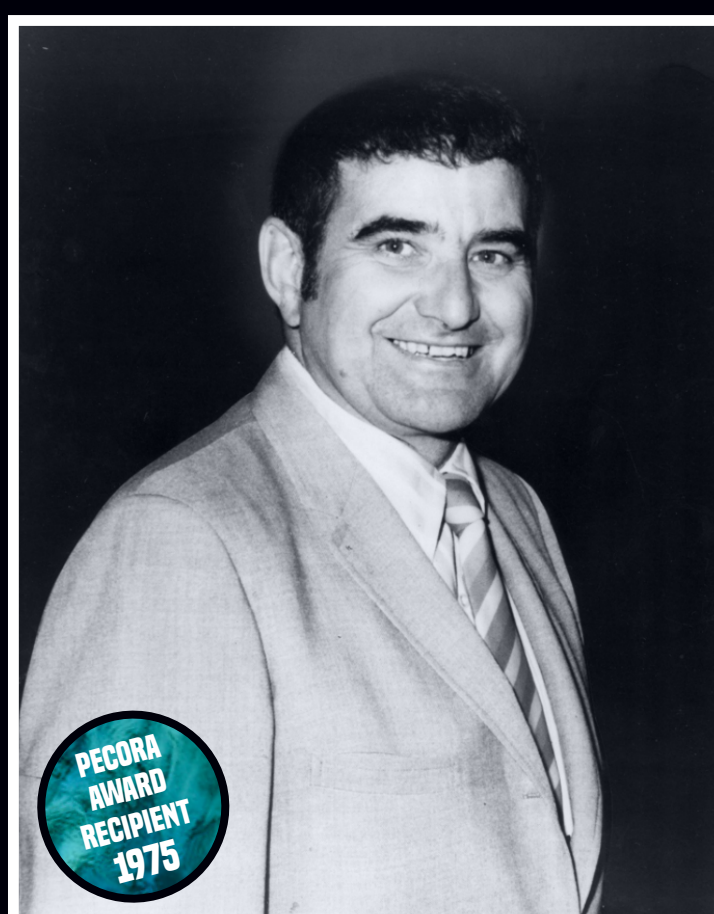
May 15, 1925 - September 2, 2005



Dr. Peter C. Badgley was a geologist, scientist, academic, author, and administrator who had a lasting impact on Earth observation programs. Badgley was born in Montreal, Canada. He served as a pilot officer for the Royal Canadian Air Force from 1943 to 1945. He received a BS degree from McGill University in 1948 and a PhD degree from Princeton University in 1951. After completing his doctorate, he moved to Calgary and worked in the field of oil exploration. In 1956, he moved to Colorado where he accepted a faculty position at the Colorado School of Mines. In 1963, Badgley was hired by the Office of Manned Space Science at NASA to improve the scientific program for the Earth-Orbital Apollo Extension System. In this role, he became interested in the technology and sensors used to observe Earth from space. In 1965, Badgley became Chief of the newly established Natural Resources Program (later renamed the Earth Resources Survey Program). He coordinated extensive remote sensing studies in order to determine optimal instrument design for Earth-observing satellites and he provided mounting evidence that there was immense value in observing Earth's natural and cultural resources from space.

## WILHELM (WILLIAM) NORDBERG

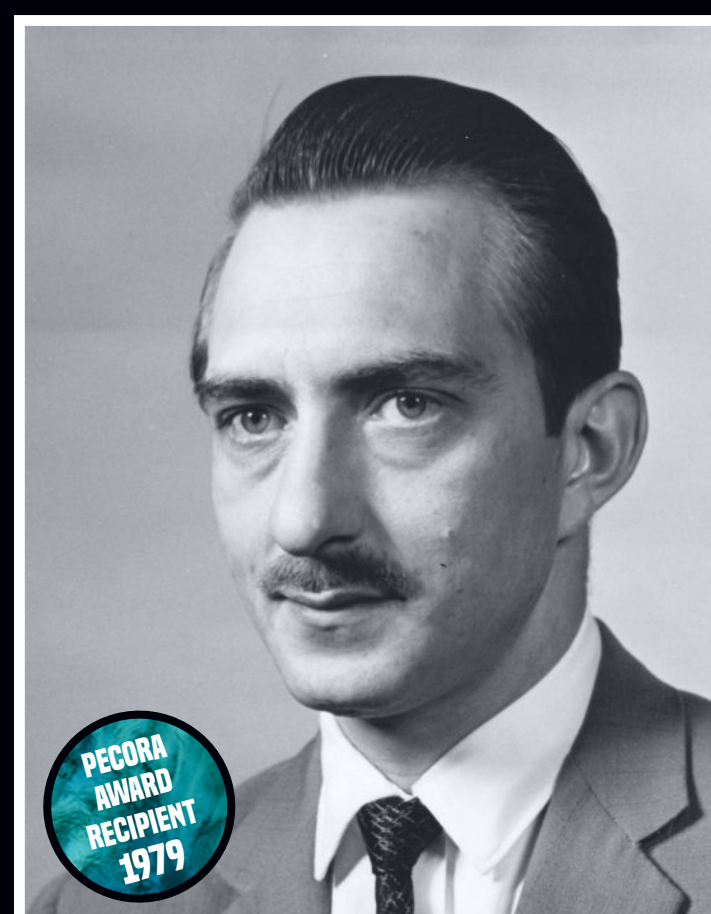
March 31, 1930 - October 3, 1976



Dr. Wilhelm Nordberg was an Austrian-American physicist and meteorologist who is often referred to as the father of weather and remote sensing satellites. Nordberg was born in Fehring, Austria. He received a PhD in Physics, summa cum laude, from the University of Graz in 1953. At the invitation of the US Army, he emigrated to the United States in 1953 to work as an atmospheric scientist in the Meteorological Division of the Army Signal Research and Development Laboratory. In 1959, Nordberg transferred to the NASA Goddard Space Flight Center to work in the Meteorology Branch of the Satellite Applications Systems Division. Under his leadership, the first weather satellite, TIROS-1, was successfully launched into space in 1960. After working on the TIROS Program, he played a pivotal role in the Nimbus Program as Nimbus Project Scientist, where he developed long-term scientific objectives and advocated the use of new instruments. Due to his exceptional versatility in the Earth sciences and his excellent leadership skills, Nordberg was assigned the role of ERTS Project Scientist in 1967. In this position, he coordinated the design and implementation of the ERTS-A spacecraft and sensors.

## JOHN M. DENOYER

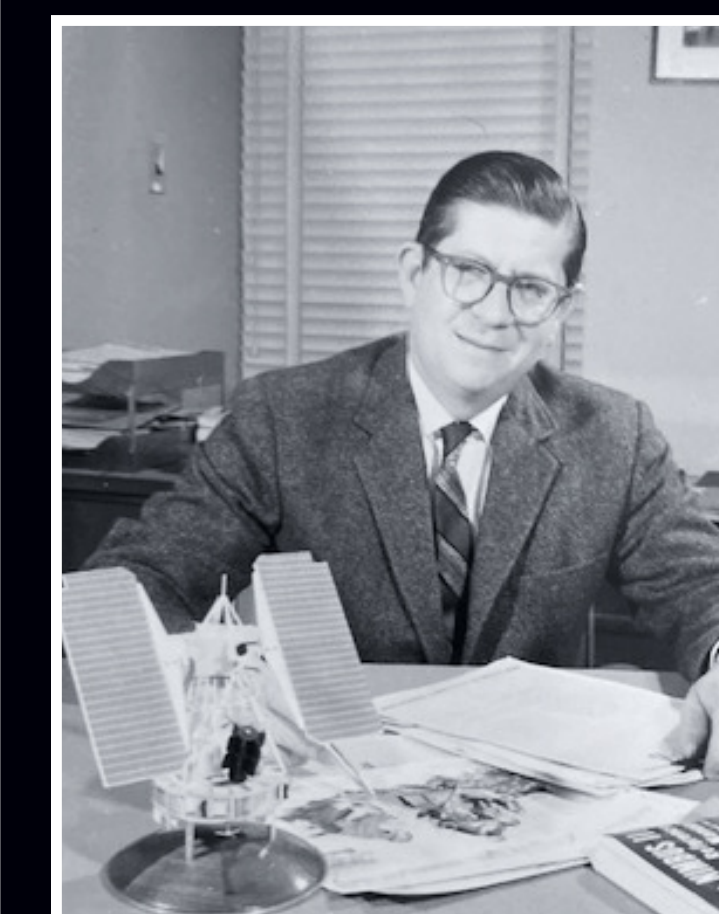
May 19, 1926 - June 6, 2016



Dr. John M. DeNoyer was a gifted geophysicist and a dedicated administrator who played an instrumental role in developing the first Earth observation remote sensing program. DeNoyer was born in Burma when his parents were serving a mission. In 1933, he and his family moved to Texas. He served as a medic in the US Army during World War II and during the Korean conflict. He received a BA in Mathematics from Chico State College in 1953. He then attended graduate school at the University of California, Berkeley, where he received an MA in Geophysics (1955) and a PhD in Geophysics (1958). DeNoyer became an expert in seismology and was hired as a faculty member in the Department of Geology and Mineralogy at the University of Michigan. In 1965, he became the Deputy Director for Nuclear Test Detection at DARPA. In 1967, DeNoyer joined the USGS as Assistant Director for Research. In 1969, he transferred to NASA to become the Director of the Earth Observations Programs, where he oversaw the development of ERTS-A and worked closely with Nordberg and Schardt. In 1972, DeNoyer returned to the USGS where he became the EROS Program Director, a position he held until 1979.

## BRUTON B. SCHARDT

October 15, 1922 - May 2, 2016



Lieutenant Colonel Bruton B. Schardt served as the first ERTS Program Manager where he worked diligently to ensure the successful launch of ERTS-A. Schardt graduated from the United States Military Academy (West Point) in 1944 and he received an MS in Electrical Engineering from the Georgia Institute of Technology in 1955. He served in the US Army and the Coast Artillery Corps until 1964, achieving ranks of Second Lieutenant, First Lieutenant, Captain, Major, and then Lieutenant Colonel. After retiring from the military, Schardt was hired by Honeywell where he worked in optics. In 1968, he was employed by NASA to serve as the Deputy Nimbus Program Manager. In 1970, he became the Nimbus Program Manager, and in 1972, he became the ERTS-Nimbus Program Manager. In these positions, he worked closely with DeNoyer to coordinate the selection of the proposed instruments, to develop hardware programs, to manage science programs, to review contracts, and to resolve the numerous political and budgetary issues. Schardt served as ERTS Program Manager until 1974. He continued his career at NASA by working on the first Space Shuttle scientific payload system and the Large Format Camera.

## VIRGINIA T. NORWOOD

January 8, 1927 - March 26, 2023



Virginia T. Norwood was a brilliant mathematical physicist, engineer, and inventor who played a pivotal role in the development of the Multispectral Scanner System (MSS) sensor. She graduated with a degree in mathematical physics from the MIT in 1947. She started working at the US Army Signal Corps in 1948 where she gained expertise in developing antennas, communications equipment, and optics. Norwood then joined Hughes Aircraft Company in 1954, where she worked for 35 years. Hughes was awarded a contract to design a spaceborne scanner system for ERTS-A and Norwood took the lead on the project. Norwood's in-depth understanding of physics, training, and work experience made her uniquely qualified to develop the sensor. Hughes had previously designed a meteorological sensing instrument, called a scanner, for the early ATS weather satellites, and Norwood believed that this would serve as the foundation. Norwood partnered with Jack Lansing, an experienced engineer at Hughes, to design and build the four-channel MSS sensor. While the MSS sensor was considered an experiment at the time, it proved to be an indispensable instrument that supported a broad range of applications.

## STANLEY C. FREDEN

December 5, 1927 - March 17, 2011



Dr. Stanley C. Freden was a skilled physicist who studied nuclear emissions and the Earth's Van Allen radiation belts. As his career progressed, he played a prominent role in the development of the Landsat Program where he evaluated sensor performance and coordinated scientific research. Freden received his BS and MS in Physics from UCLA. He proceeded to receive his PhD in Nuclear Physics from the same institution in 1956. He taught physics at UCLA for several years before joining the Lawrence Livermore National Laboratory. In 1961, he became Director of the Geoparticle Section at The Aerospace Corporation, where he worked on Air Force satellite and space programs. In 1968, he joined NASA as the Chief of the Space Physics Division at the Manned Spaceflight Center (Johnson Space Center). In 1970, Freden accepted the position as Assistant Director of the Atmospheric Sciences Laboratory at the NASA Goddard Space Flight Center. In this position, he worked under Nordberg to better understand the effects of atmospheric scattering on satellite imagery. In 1972, Freden became the ERTS-A Project Scientist, where he coordinated a number of scientific studies and conducted research symposia.

## VALERIE L. THOMAS

February 8, 1943 -



Dr. Valerie L. Thomas is an astute physicist, inventor, data analyst, mathematician, and educator who became the lead expert in processing ERTS/Landsat data. Thomas attended Morgan State College in Baltimore, Maryland, where she was just one of two women majoring in physics. She received her bachelor's degree in 1964 with honors. She later earned a master's degree in Engineering Administration from George Washington University in 1985. She then received a doctorate in Educational Leadership from the University of Delaware in 2004. In 1965, Thomas accepted a position at NASA as a data analyst. She initially developed programs to process data from the Orbiting Geophysical Observatory (OGO) satellites. In 1970, she started working on the ERTS Program where she developed and managed the image processing software systems that translated the raw data transmitted from the satellites into usable formats. Her expert knowledge of ERTS data landed her a lead role in the Large Area Crop Inventory Experiment (LACIE) Project. In this position, she developed a detailed image processing system. She also oversaw a team, conducted research and development, and managed the hardware and software systems.