James G. Baker

JAMES G. BAKER

1914–2005

Elected in 1979

"Innovation and design of optical devices for diverse, unusual, and exacting requirements."

BY WILLIAM T. PLUMMER AND STEPHEN D. FANTONE

JAMES GILBERT BAKER, renowned astronomer and optical physicist and longtime associate in research at the Center for Astrophysics of Harvard and Smithsonian Observatories, died at his home in Bedford, New Hampshire, on June 29, 2005. He was 90 years old.

Jim was born in Louisville, Kentucky, on November 11, 1914, the fourth child of Jesse B. Baker and Hattie M. Stallard. After graduating from duPont Manual High in Louisville, he attended the University of Louisville, where he majored in mathematics; an astronomy professor, Dr. Moore, often allowed him to use his telescopes. Jim also fabricated mirrors for his own telescopes and helped form the Louisville Astronomical Society in 1931. While he was still a student, he met his future wife, Elizabeth Katherine Breitenstein, of Jefferson County, Kentucky. In 1935, he received a B.A. and was a Woodstock Society medalist.

In 1936, Jim received his M.A. in astronomy at the Harvard College Observatory and was appointed a Junior Fellow (1937–1943) of the prestigious Harvard Society of Fellows. During an Astronomy Department dinner in 1942, the director of the observatory, Dr. Harlow Shapley, asked him to give an impromptu talk. According to *The Courier-Journal Magazine*, immediately following the talk "Dr. Shapley stood up and proclaimed an on-the-spot departmental meeting and asked for a vote on recommending Baker for a Ph.D. on the basis of the 'oral exam' he had just finished. The vote was unanimous."

At Harvard College Observatory, Jim collaborated with Donald H. Menzel, Lawrence H. Aller, and George H. Shortley on a landmark series of papers on the physical processes in gaseous nebulae. In addition to this theoretical work, Jim began designing a set of astronomical instruments with increasing resolving powers and wide field angles. In 1945, he was co-author, with George Z. Dimitroff, of *Telescopes and Accessories*. His design for the Baker-Schmidt telescope and the Baker Super Schmidt meteor camera were notable accomplishments.

In 1941, while still a graduate student, Jim was awarded a small research contract by U.S. Army Col. George W. Goddard to develop a wide-angle reconnaissance camera at the Harvard College Observatory. The next year, this project was expanded to produce huge quantities of an f/2.5 lens capable of covering a 5x5-inch photographic plate. More than 100 other projects were subsequently developed, with lenses up to 12 inches in diameter.

As director of the Observatory Optical Project at Harvard University from 1943 to 1945, Jim spent thousands of hours doing calculations on a Marchant calculator to produce his aerial cameras. He provided the optical designs, supervised the optical and machine shops, and risked his life operating cameras in early test flights that carried these photographic systems in unpressurized compartments. During this time, he also began a long consulting career with the Perkin Elmer Corporation. When World War II ended, Harvard University decided to terminate its war-related projects, and Jim's lab was moved to Boston University. The lab later became the basis of ITEK Corporation.

Jim was an associate professor and research associate at Harvard from 1946 to 1949. In 1948, he received the Presidential Medal of Merit for his work in the Office of Scientific Research and Development during World War II, as well as an honorary doctorate from the University of Louisville. That year, he also moved to California to spend two years as a research associate at Lick Observatory. He returned to Harvard in 1950.

To speed up the tedious process of design calculations, Jim introduced numerical computers into the field of optics. His ray-trace program was one of the first applications run on the

Harvard Mark II (1947) computer. He developed his own methods of optimizing the performance of his designs. During the 1960s and 1970s, the development of optical computer programs became a family affair when Jim's children developed programs, under his direction, to support his increasingly sophisticated work.

Jim was involved not only with cameras, but also with concepts for camera delivery systems. As chairman of the U.S. Air Force Scientific Advisory Board (1953–1954), he recognized that meeting national security requirements would entail using aircraft at extreme altitudes and optical designs of even greater resolving power. The concept of the U-2 system, consisting of a plane and a camera that functioned as a unit to create panoramic, high-resolution aerial photographs, was developed to meet those requirements. Jim formed Spica Incorporated in 1955 to perform the necessary optical design work. His final aerial camera design was a lightweight 36-inch f/10 system. Jim also designed the aircraft's periscope, which enabled pilots to see their flight path.

He continued to serve on the President's Foreign Intelligence Advisory Board and the Land Panel of the Killian Committee. Jim designed the Baker-Nunn satellite-tracking camera to support the Air Force's early satellite-tracking and space-surveillance networks, and, thanks to his foresight, a dozen of these cameras were in place around the world when Sputnik was launched in October 1957. For the next three decades, these cameras were used to determine the precise orbits of spacecraft. By 1958, Jim was almost solely responsible for all of the cameras used in photoreconnaissance aircraft. He himself figured the aspheric surfaces of the most demanding optical components, usually in his basement workshop.

Jim continued to advise top government officials as reconnaissance systems evolved during the 1960s and 1970s, and he helped create the camera systems used in the SR-71 Blackbird, the Air Force high-speed reconnaissance plane, which was in use from the 1960s to the 1990s. He also designed some of the lenses and camera systems for the Air Force Samos Satellite Program.

In 2000, in recognition of his work as an advisor to the U.S. Air Force and the National Reconnaissance Office, he received the Pioneers of National Reconnaissance Medal with the following citation: "As a young Harvard astronomer, Dr. James G. Baker designed most of the lenses and many of the cameras used in aerial over-flights of 'denied territory' enabling the success of the U.S. peacetime strategic reconnaissance policy." In 2002, the U.S. Air Force awarded him the Space Pioneer Award.

In 1966, Jim began a long, productive consulting relationship with the Polaroid Corporation. Dr. Edwin Land had persuaded him that only he could design the optical system for his new SX-70® Land camera, which was introduced in 1972. For the next 35 years, Jim also designed other remarkable, high-volume commercial products. He was most notably responsible for the mathematical design of the Quintic® focusing system for the 1986 Polaroid Spectra camera system, which involved a revolutionary combination of two free-form aspherics to adjust focus by a lateral rotation across the optical axis.

Jim maintained his affiliation with Harvard Observatory and the Smithsonian Astrophysical Observatory until he retired in 2003. After retirement, he continued to work at his home on a new telescope design he told his family he should have discovered in 1940.

Jim received many honors and awards during his long career. In 1958, he was made a fellow of the Optical Society of America (OSA), and, in 1960, he was elected president of OSA for one year, during which he helped establish the *Applied Optics* journal. He was the only individual to receive all four primary OSA awards in optics: the Adolf Lomb Award, Frederick Ives Medal, Joseph Fraunhofer Award, and David Richardson Medal. In 1993, he was made an honorary member of OSA. In 1976, he was the recipient of the Alan Gordon Award and, in 1978, the Gold Medal, the highest award of the International Society of Optical Engineers (SPIE). In 1953, the American Philosophical Society awarded him the Magellanic Medal. The Franklin Institute awarded him the 1962 Elliott Cresson Medal for his many innovations in astronomical optics.

Jim was an elected member of the American Academy of Arts and Sciences (1946), National Academy of Sciences (1965), American Philosophical Society (1970), and National Academy of Engineering (1979). He was also a member of the American Astronomical Society, the International Astronomical Union, and the Astronomical Society of the Pacific. He published more than 30 professional papers and received more than 50 U.S. patents.

A friend, a gentleman, a scholar, a patriot of the highest integrity, and a truly inspirational engineer of uniquely difficult and important accomplishments, Dr. James G. Baker will be greatly missed by all who knew him. He is survived by his wife, Elizabeth; his four children, Kirby Alan, Dennis Graham, Neal Kenton, and Brenda Sue; and seven grandchildren.