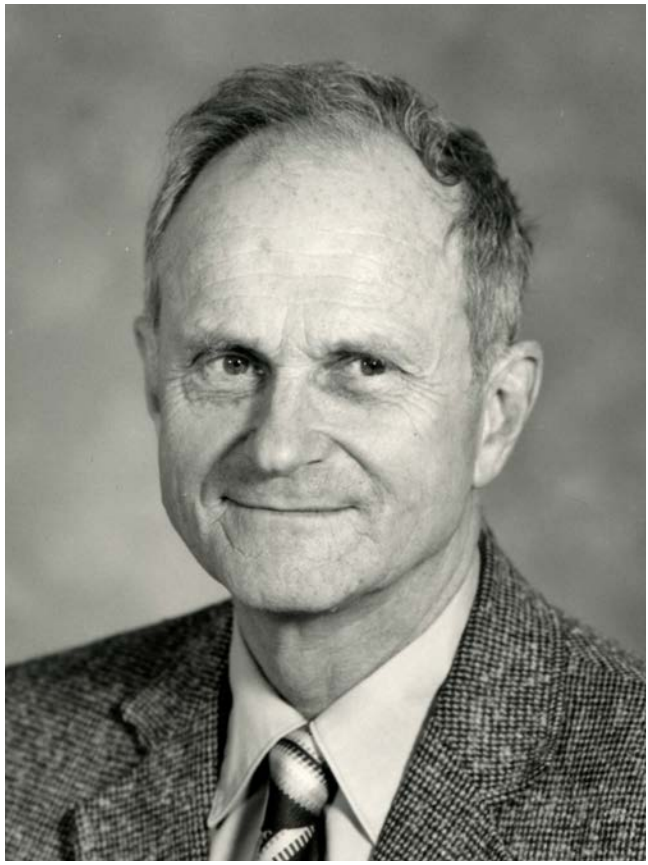

David S. Hoag

DAVID G. HOAG

1925–2015

Elected in 1979

"Contributions and leadership in development of guidance and control systems for the Polaris missile and the Apollo spacecrafts."

BY NORMAN SEARS
SUBMITTED BY THE NAE HOME SECRETARY

DAVID GARRATT HOAG died January 19, 2015, at age 89. He was born October 11, 1925, in Boston to Alden Bomer and Helen Lucy (née Garratt) Hoag. He grew up in Holliston, Massachusetts, and in 1943 enlisted in the US Navy, which assigned him to its V-12 program at the Massachusetts Institute of Technology. He continued at MIT after World War II and graduated with bachelor's and master's degrees in electrical and instrumentation engineering.

He then spent his entire career at the MIT Instrumentation Laboratory, which became the C.S. Draper Laboratory in 1973. During his more than 50 years—as a design and systems engineer, senior advisor, and consultant—he made many very significant contributions to the laboratory's design responsibilities for several national programs involving defense and space technologies. Dave earned and enjoyed a reputation as one of the laboratory's most outstanding engineering and management talents.

He worked on Navy fire control system designs that followed the MIT Instrumentation Laboratory's involvement in successful designs for World War II fire control development. These early fire control programs established a recognized design capability and a feasible contracting arrangement between government, university, and industry for large

national defense programs. This contracting and design capability was to set a pattern for the laboratory's future involvement in several programs of national importance with big technical challenges.

Dave's early design contributions were to advanced fire control systems sponsored by the Navy and Air Force. A specialized element of the general fire control problem is inertial guidance and navigation for long-range ballistic missiles. The Instrumentation Laboratory was a leader in the development of inertial guidance and participated in several ballistic missile programs.

One nationally important inertial guidance system development led by the laboratory was the Polaris Fleet Ballistic Missile program. Dave was the chief technical design engineer and program manager for this four-year program, which culminated in the successful launch of two Polaris A1 missiles from the submerged *USS George Washington* (SSBN-598) off Florida on July 20, 1960. This was a remarkable research and development effort involving Navy, university, and industry partners for the successful design of a major defense system. The *USS George Washington* began the nation's first strategic deterrent patrol, carrying 1,200-nautical-mile-range Polaris missiles in November 1960.

Dave often said that being the chief technical director of the Polaris inertial guidance system was a career dream for him. It turned out that July 20 was to become an even more important date for him later in the decade.

In 1961 NASA awarded the MIT Instrumentation Laboratory the first contract on the Apollo program to design and verify a self-contained guidance and navigation (G&N) system for spacecraft to land humans on the moon and return them to Earth. Dave was designated chief technical director and program manager to lead the effort, essentially the same role he had played for the Polaris program.

The G&N system consisted of an inertial measurement unit, optical alignment telescope and space sextant, and digital guidance computer. System weight and schedule limits were driving factors in its development. As a result, new

technology development was minimized. Inertial and optical designs were well established at the time, but digital computing for real-time applications was in its infancy. The Apollo G&N computer would be one of the first to use transistor integrated circuits that were just beginning to be manufactured. Weight limitations dictated that the G&N system be a single-string system rather than a redundant one. Component reliability was therefore a major program design and cost driver.

During the development phase of the system the laboratory was asked to integrate the flight control systems for both the Command and Lunar Modules as digital designs, and the G&N system became the GN&C system. This required significant additional design and verification. Dave directed the development of the system through prototype demonstration and verification tests to validate system performance.

The Apollo program extended the laboratory's design and support effort further than previous programs, in several areas that required significant technical and managerial support. The laboratory was responsible for the programming and test verification of both Command and Lunar Module GN&C computer programs for each Apollo mission. Over the course of the program this involved 12 missions of which 6 landed on the moon. The development of both digital and hybrid simulators was also a major part of this effort for software verification.

Moreover, the GN&C system was one of the more complex systems the flight crews had to work with throughout the mission, and extensive crew training support on system operation became an additional requirement. This crew involvement then extended into real-time flight support, which became very important in resolving system and mission issues on the Apollo 11, 13, and 14 missions.

Dave's role and leadership over the 12 years of the Apollo program were important and involved outstanding achievements of which he and the laboratory can be very proud. The successful Apollo 11 lunar landing on July 20, 1969, was a crowning achievement—echoing the first successful Polaris launch on July 20, 1960. Dave had a remarkable nine-year period of professional achievement.

After the Apollo program, Dave headed an advanced design and development group supporting the Space Defense Initiative effort for missile defense. This undertaking involved some of the most advanced technology at the laboratory in the areas of precision pointing and tracking for directed energy weapons and space-based surveillance, and required very senior and experienced designers. The effort required a leader of Dave Hoag's caliber, which he consistently displayed over many years.

Recognized both nationally and internationally as an outstanding engineer and technical leader, Dave received the Col. Thomas L. Thurlow Award (1969) from the Institute of Navigation, NASA Public Service Award (1969), Navy Certificate of Merit (1970), and in 1972 he and Richard Battin were presented with the Louis W. Hill Space Transportation Award (now called the Goddard Astronautics Award) from the American Institute of Aeronautics and Astronautics.

He also represented the laboratory at the Pugwash Conferences on Science and World Affairs, which started surveys for nuclear disarmament. His highest personal award was probably the respect and reputation he had from fellow design engineers over a very broad range of important programs. They all recognized and appreciated his technical capability for system design and development, coupled with a very effective operating style.

For all his outstanding accomplishments, David Hoag was a family man. Shortly after his marriage to Grace Griffith in 1952 they bought an 1800 house with lots of land. He built a two-car garage, workshop, and large porch. He had a pond dug for swimming, skating, and boating—and to provide a home for lots of frogs and fish and turtles. He also raised sheep, chicken, and bees. He had a tennis court built and of course there was room for basketball and baseball. It was a wonderful home to raise his five children and continues to be enjoyed by his grandchildren and great-granddaughter.

Much of the land is wooded and he made paths through it. Residents remember his guided walks for third-graders and their families who were working on a school leaf project.

He loved to relate interesting lore about the plants and animals that lived on his property, much of which will be preserved in perpetuity. Dave had a lifelong interest in natural resources and the environment. He was a charter member of the Medway Open Space Committee, for which he compiled many maps and the original catalogue of open spaces. He was also a board member of the Upper Charles Conservation Land Trust.

David and Grace also bought some land in Vermont with a former church on it for a vacation spot. He did not do a lot of remodeling because the family was there to enjoy the mountains.

He also had an appreciation for human cultures. He and Grace traveled to Asia, Europe, Africa, and South America. In sharing programs between engineers they visited the Soviet Union, Taiwan, and Scotland, and they hosted visitors from those countries in their home. Dave loved exotic food—and enjoyed cooking Chinese meals—as well as traditions and art from cultures around the world.

Dave was especially proud of his large family, whom he and Grace hosted each week at Sunday morning breakfast, an event started by Dave's parents when he was a boy. It continues still, and relatives, friends, and guests are always welcome. The family also hosted an annual Strawberry Shortcake Sunday for their many friends. Gatherings at the Hoag house always include a walk along a path known as "Papa's woodsy walk," which winds through the woods behind the house.

Dave is survived by his wife Grace; children Rebecca Hoag Atwood (Paul), Peter Griffith Hoag (Sarah Vincent-Hoag), Jeffrey Taber Hoag (Mary Clare Bergen), Nicholas Alden Hoag, and Lucy Hoag Peltier (Leonard); grandchildren Benjamin Emery Atwood, Julia Atwood Golebiewski (John), Caitlin Hoag Caswell (Bryan), Noah Janson Hoag, Chloe Griffith Hoag, Leah Frances Hoag, David Edward Peltier, and Thomas Jeffrey Peltier; and great-grandchildren Evelyn Grace Caswell and Coleman William Caswell.