ALBERT D. WHEELON

1929–2013

Elected in 1970

"Basic contributions to ballistic missile guidance, to radiowave propagation and communication, and to national security."

BY HANS MARK

ALBERT D. WHEELON died on September 27, 2013, and the nation lost one of its most talented practitioners of science, engineering, and management. Bud and I were almost exact contemporaries—we were both born in 1929, he on January 18 and I six months later. I met Bud for the first time in the spring of 1951 when we were graduate students at the Massachusetts Institute of Technology (MIT). Bud was about a year and a half ahead of me at MIT, receiving his PhD in 1952, and mine came in 1954. We were both in the Physics Department but he worked in the Research Laboratory for Electronics and I was in the Laboratory for Nuclear Science. Thus, I was not very close to Bud at that time but it was clear to all of us in the Physics Department that he was a superb student who would go on to great achievements.

Dr. Wheelon went to work at a newly established company founded by Simon Ramo and Dean Wooldridge in 1952. The mission of the Ramo-Wooldridge Corporation was to help the US Air Force develop the Intercontinental Ballistic Missile program. These weapons eventually were to become the land-based deterrent force of "Minuteman" missiles. Bud Wheelon participated in the mission of the company, but he also developed a very important scientific program. This was to study the detailed interactions between the atmosphere

and electromagnetic radiations. He published some seminal papers on this subject that proved to be very useful in calculating the propagation of radar and other electromagnetic radiations used for communications in the atmosphere. In addition, during his years at Ramo-Wooldridge (in 1958 it became TRW) he was an active adjunct professor at the University of California, Los Angeles.

In 1962 the director of Central Intelligence, John McCone, asked Bud to join the agency to become the first deputy director of Central Intelligence for Science and Technology. It was an auspicious time for Bud to be in that position because it gave him the opportunity to display his extraordinary capability as a superb engineer and a resourceful manager. This was the time when Lockheed's Skunk Works was headed by the legendary Clarence (Kelly) Johnson. Two unique reconnaissance aircraft were being built there, the supersonic SR-71 Blackbird, which was built to avoid being shot down because of speed (Mach 3), and the U-2 because of the altitude it could reach. Bud was the person in charge of the organization in the government to see to it that these programs would see the light of day and to make sure that they were employed effectively. Later he would play the same role with Corona and subsequent reconnaissance satellites.

In 1966 Bud left the government to accept an executive position at the Hughes Aircraft Company. He was recruited to Hughes by then CEO Alan Puckett, who assigned Bud to run a newly formed unit, the Space and Communication Group (often called SCG). This unit consolidated all of the nascent space activities at Hughes. Bud quickly formed a simple but effective organization with four major divisions: the Commercial Systems Division, NASA Systems Division, Defense Systems Division, and a supporting Technology Division that provided hardware and people to the three systems divisions. This gave Hughes a starting point for a newly growing space business. Over the next 15 years, under Bud's leadership, the SCG organization became a major player in the world's space program. Between 1970 and 1985 the three major business units of SCG achieved numerous successes.

The Commercial Systems Division became the dominant player in the rapidly growing communication satellite marketplace. In addition to highly successful Intelsat programs, a series of spin-stabilized satellites tailored for national systems opened up new markets. Companies in the United States, Indonesia, Canada, Australia, Brazil, and Mexico all bought SCG satellite systems. Like all good new markets, new and tough competitors emerged, but Hughes maintained a greater than 50 percent market share.

Some very powerful and creative strategies were developed by Bud and his team during this period; probably foremost was combining commercial and government programs under one leadership, which permitted cross fertilization of technologies and management processes as well as balanced workloads. These strategies combined with technology innovations led to the continued growth of SCG over the following decades. Ultimately many of these strategies were copied by competitors but none implemented them as effectively as SCG. This success was a team effort under the strong leadership of Bud. He met every morning for about an hour with the SCG leaders. Every Friday he would review the status of all programs with the program managers. He was a hands-on boss.

The most significant strategic move under Bud's leadership of SCG was the decision to form a subsidiary, Hughes Communications, to provide satellite services to commercial customers. In addition to manufacturing satellites, Hughes would arrange to obtain the necessary licenses and financing to launch, operate, and market the satellites directly to commercial customers, sometimes in competition with companies such as Intelsat or AT&T that were buying satellites directly from SCG. This strategy, though risky, was very successful and ultimately led to major new Hughes businesses such as DIRECTV.

In 1972, when I was director of the NASA Ames Research Center, we were given the task by NASA Headquarters to develop a program to explore the planet Venus. We engaged Donald Hunten and Richard Goody as the principal investigators to develop a strategy. We wanted to learn about the circulation of the atmosphere of Venus and to make a map of the

planet. We arranged for a competitive procurement process among satellite companies. The Hughes SCG NASA Division won the competition because Bud Wheelon was able to take one of the commercial satellites off the production line, cut the cylindrical spacecraft in half perpendicular to the axis of the satellite, and thereby create two smaller satellites. One of these would become the carrier of four atmospheric entry vehicles that would measure the motions of the atmosphere, and the second carried the imaging radar that made the map of the planet. In this way, we were able to completely meet the objective of the program at a modest cost. This was an example of the way Bud Wheelon operated. He had developed a profitable satellite system for communications and then, with an imaginative change, used the same vehicle to obtain some important scientific information.

In 1977 I was selected to be director of the National Reconnaissance Office (NRO). One of the documents that I was given was a "Legacy Report" written by Bud in 1977 to explain what was done during his tenure in office and also to make some predictions. I was astounded by the accuracy with which he listed what would happen in the technology during the 11 years since he had written the document. Real-time imaging was already in the works, and I was the director of the NRO when we launched the first real-time imaging satellite, so I knew something about it. In addition, Bud predicted radar imaging satellites and two still classified systems, all of which are now deployed. The Hughes SCG Defense Systems Division was heavily involved in this enterprise after he joined Hughes.

In 1985 Alan Puckett retired and Bud was promoted to take his place as president and CEO of Hughes Aircraft Company. The SCG continued to thrive and grow, a reflection of Bud's excellent succession planning and personnel development. Bud was truly an outstanding business executive as well as scientist.

Bud Wheelon left the Hughes Aircraft Company in 1988 following the purchase of the company by General Motors. He spent a year at MIT as the Hunsaker Professor lecturing on what he had learned about the management of engineering

projects. He applied his scientific talents to study in great detail and write a comprehensive treatise on this subject.

Bud secured an appointment at the National Environmental Technology Laboratory in Boulder, Colorado, as a visiting scientist. This provided him with an "intellectual home" because there were excellent library facilities and knowledgeable people with whom he would be associated. He also moved to a small estate in Montecito, a suburb on the eastern side of Santa Barbara, in 1990. It was here that he studied and wrote his monumental treatise, *Electromagnetic Scintillation*. There are two volumes: *Geometric Optics* and *Weak Scattering* (a third volume was not finished). I used these books when I was working on the behavior of laser beams traversing the atmosphere.

I remember visiting Bud and his wife Cicely a number of times during the 2000s. We always had wide-ranging discussions, and I was always amazed by the books he was writing—their breadth and exquisite explanations with many details.

I was not aware of Bud's illness; he never mentioned it to me. What was very important was that before he died, the National Academy of Engineering could inform him that he had been awarded the Simon Ramo Founders Award for Outstanding Achievements and Innovations in Engineering. It is altogether fitting that Bud holds this award named after his first mentor.

Bud was married twice; his first wife, the former Nancy Helen Hermansen, died in 1980, and his daughter, Elizabeth Wheelon, died in 2006. Bud's sister Marcia survives him, as well as his second wife, the former Cicely Evans, daughter Cynthia Wheelon, and a grandson.

Bud Wheelon was a "man for all seasons" because he had so many talents. I had a hard time writing this tribute because of our long friendship that developed over more than 64 years. I miss Bud and mourn his passing. My prayers are with him and I am sure that God holds him in the palm of His hand.

The author thanks Steven Dorfman for contributing to this tribute.