feet for the first time during World War II. She worked variously as a high school and college teacher, and as an engineer with the National Bureau of Standards, the Naval Research Laboratory, Aerovox Corporation, and finally her own firm, Harmon Technical Consultants, before her death in 1985.

Harmon was born in Texas on September 3, 1909. After obtaining a B.S. degree in chemistry, she taught at several high schools and a junior college in her native state. During this time, she also educated the employees of several firms in chemistry and physics. Tiring of her teaching career, Harmon began working part-time, first for Davies Fruit Company and later for Pan American Airways, while she furthered her studies. She earned an M.S. degree in biology from the University of Texas, and she performed graduate studies in engineering at George Washington University and in chemistry at the University of Maryland.

From 1938 to 1942, Harmon served as a consultant to Standard Oil Company, performing tests and analyses on crude oil. She continued teaching oil field employees during evenings. The turning point of her career, as she described it in the *Society of Women Engineers Newsletter,* occurred in 1942 when she accepted a position with the Army Ordnance in St. Louis, Missouri. "I got the feel of engineering and worked with engineering instruments and blueprints," Harmon said. "I was crazy about it."

Wartime Innovation Leads to Higher Altitude Flights

During World War II, Harmon improved the performance of carbon brushes which were part of aircraft generators. The brushes on American planes would disintegrate at altitudes above 15,000 feet, which meant the technologically advanced German aircraft could climb much higher. Harmon developed a method of extending the life of these brushes under high altitudes—a significant contribution to the war effort.

Harmon joined the Aircraft and Electrical Division of the Naval Research Laboratory in 1945, where in addition to her continued innovations on high altitude carbon brushes, she investigated the effect of fungus growth and oxidation on electrical equipment needed for various geographical locations. She also tested the chemical characteristics of various materials to learn how they would perform as sliding contacts in electrical equipment under stressful flight conditions.

In 1948, Harmon accepted a position with the National Bureau of Standards Ordnance Division. There she studied the application of printed circuitry to military equipment. Harmon then joined the staff of Aerovox Corporation, where she remained throughout the 1950s, developing a new methodology to produce printed circuitry for both military and commercial use. Harmon is said to have been inspired by a cosmetic display in a drug store which featured a picture of a woman's face, with the lips printed on a raised surface. She contacted the printer who created the display and adapted his technique for printing resistors on circuits at varying depths. This method has widespread applications within contemporary electronic circuitry. One of her innovations in printed circuitry resulted in a patent, which is for a hot die stamp method used to infuse silver conductors on polymerized materials.

Harmon joined American Bosch Arma Corporation as senior engineer of computer development for one year in New York before being named staff chief engineer, senior technical specialist at Autonetics in Anaheim (later North American Rockwell Division). She remained there until 1969.

She directed Harmon Technical Consultants until her death in 1985. She was a member of the American Chemical Society, the Texas Academy of Sciences, and the Institute of Radio Engineers. Harmon was honored in 1956 with the Society of Women Engineers Achievement Award "in recognition of her significant contributions to the area of component and circuit miniaturization."

SOURCES:

Books

Society of Women Engineers Achievement Awards, 1993 edition.

Periodicals

"E'lise Harmon Receives Award," *Society of Women Engineers Newsletter,* June, 1956, p. 3.

—Sketch by Karen Withem

Cyril Harris
1917-
American physicist and acoustical engineer

Cyril Harris made major contributions to the understanding and application of acoustics. His integration of research and its application to architectural design made him an expert in the design of

auditoriums and concert halls. Harris designed superior acoustics for many famous buildings, including the John F. Kennedy Center for the Performing Arts in Washington, D.C. He wrote or edited over seventy publications on vibration and acoustical design, several of which have become standard texts in the industry. Some of his publications have been translated into Chinese, Japanese, French, Spanish, and Rumanian editions. Harris has been honored with awards from the science, engineering, and architecture professions.

Cyril Manton Harris was born to Bernard O. and Ida Moss Harris in Detroit, Michigan, on June 20, 1917. He earned his Bachelor of Arts degree in mathematics from the University of California at Los Angeles in 1938 and his Master of Arts in physics from the same school two years later. In 1941 Harris began working as a researcher for the Carnegie Institute of Technology in Washington, D.C., moving that same year to New England to work at the Massachusetts Institute of Technology (MIT). At MIT, Harris joined the war research staff of the National Defense Council and became a teaching fellow. He also pursued doctoral studies while at MIT—his dissertation addressed the measurement of acoustics within rooms, a subject that would be a focus of his research for many years. In the years preceding World War I, Harris contributed to the country's defense efforts by working on the development of the proximity fuse, which detonated explosives when its sensor detected a target. And throughout the war, he applied his knowledge of acoustics to advance several types of sound-activated underwater mines.

Harris completed his graduate studies at MIT in 1945 earning his Ph.D. in physics. Following his graduation, Harris was employed at the Bell Telephone Laboratories as a research engineer, and he worked there for six years. During this time Harris worked primarily on the development of transducers for changing energy from one form to another, such as electricity into sound. He also researched a device for synthesizing human speech, for which he was awarded a patent. On July 12, 1949, while still a research engineer at Bell, Harris married Ann Schakne. They had two children, a son, Nicholas Bennet, and a daughter, Katherine Anne.

Work Establishes International Standards

In 1951 Harris was appointed a consultant to the United States Office of Naval Research, housed in the United States Embassy in London, England. While in Europe, he was also visiting Fulbright lecturer at the Technical University of Delft in the Netherlands during the 1951–52 academic year. A year later he became a member of the faculty of Columbia University in New York City, where he opened a research laboratory. This provided him with the means to study both the physical and architectural aspects of acoustics. Harris measured the rate of speed and absorption of sound as it travels through air in relation to temperature, humidity, and pressure. His work became the basis for defining international standards for the absorption of sound in air inside auditoriums, and as a factor in assessing noise radiation produced by aircraft. His knowledge contributed significantly to the development of equipment for acoustical analysis, effective noise control methods, and the evaluation of musical instruments.

Harris's interests expanded to include the impact of room shape and size on the listening experience of those inside the room. Harris was aware that people like some reverberation (the reflection of sound by physical boundaries surrounding a space after the source has stopped making the sound), but he also found out that too much reverberation can distort sound. Room reverberation can be measured by reverberation time. That is, how long it takes sound to soften to 1/1000th its original strength. However, room reverberation times can vary with different types of sound and with differing room sizes. Harris evaluated empirical data on people's preferences in a very important study which determined the reverberation times produced by different room sizes for different sound types. He used the results of his research in his work as a design consultant for several renowned auditoriums and concert halls, among them, the National Academy of Sciences Auditorium in Washington, D.C., and the Avery Fisher Hall at Lincoln Center in New York City, which was built in 1976. He also consulted on the acoustical design of concert halls outside the United States such as the National Center for the Performing Arts in Bombay, India.

While at Columbia, Harris held joint positions as professor of electrical engineering and architecture. He taught courses in both fields, as well as at the law school. In 1974 Harris became the chair of the Architectural Technology Division in the Graduate School of Architecture and Planning at Columbia University. During his tenure there, Harris also served in several acoustical, physics, and electrical engineering professional organizations. Additionally, he worked with the Noise Control Group of the National Research Council. Among the many honors Harris received, was the Franklin Medal from the Franklin Institute in 1977 and the American Institute of Architects medal in 1980. Harris contributed significantly to the understanding and use of acoustics in building design. His application of knowledge resulting from studies of reverberation and acoustical design auditoriums set architectural standards in auditoriums and concert halls.

SELECTED WRITINGS BY HARRIS:

Books

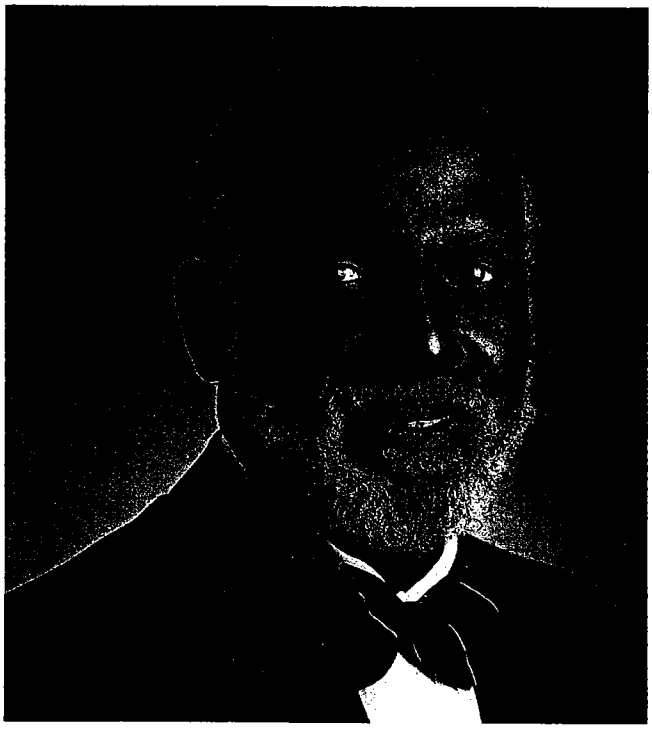
(Editor) *Historic Architecture Sourcebook,* McGraw-Hill, 1977.
(With Vern O. Knudsen) *Acoustical Designing in Architecture,* American Institute of Physics, 1978.
(With C. E. Crede) *Shock and Vibration Handbook,* McGraw-Hill, 1988.
(Editor) *Handbook of Acoustical Measurements and Noise Control,* McGraw-Hill, 1991.

SOURCES:

Books

Encyclopedia of Science and Technology, McGraw-Hill, 1982.
Greene, Jay E., editor, *Modern Scientists and Engineers,* McGraw-Hill, 1980.

—Sketch by David N. Ford



Wesley L. Harris

Wesley L. Harris
1941-
American aerospace engineer

As an engineer and an administrator for the National Aeronautics and Space Administration (NASA), Wesley L. Harris has participated in or directed a broad range of research initiatives that advanced aircraft, helicopter, and spaceflight technology. As an educator, he has increased opportunities for minority students and strengthened engineering education programs at three major universities.

Born in Richmond, Virginia, on October 29, 1941, Wesley Leroy Harris was one of three children of tobacco factory workers William and Rosa Minor Harris. Rosa Harris encouraged her children to educate themselves and learn all they could. For young Wes, that meant pursuing his fascination with airplanes. He not only read about them but built models of all types. When his elementary school held a writing contest on students' career ambitions, fourth-grader Harris won with his essay on his dream of becoming a test pilot.

Harris attended Armstrong High School in Richmond, where he found math and physics the most rewarding subjects. He also played football for a demanding coach, an experience he credited with teaching him that hard work and never giving up were the keys to success in any endeavor. Harris's imagination was sparked when the Soviet Union orbited *Sputnik I,* the first artificial satellite, in 1957, and his interest in aviation and space guided his life even more strongly from then on.

In 1960 Harris graduated from high school and went on to attend the University of Virginia. At the time only certain programs were open to black students, and Harris was not allowed to pursue his original idea of majoring in physics; he enrolled instead in aerospace engineering. He also married in that year. Despite the strain of having a family and being one of only a handful of African Americans at the school, Harris's determination made him a success. As a senior, he won an award from the American Institute of Aeronautics and Astronautics (AIAA) for his research on the turbulent flow of air over wing surfaces. Another honor was being chosen to introduce Dr. Martin Luther King, Jr., when the civil rights leader made a speech at the campus. In 1964 he received his bachelor's degree with honors.

On the advice of his professors, Harris moved on to Princeton University with the goal of earning a doctorate in engineering and becoming a professor himself. He earned a master's in aerospace engineering in 1966 and a Ph.D. in 1968 before returning to the University of Virginia as the school's first black engineering professor. He also became the first Afri-

NOTABLE TWENTIETH-CENTURY SCIENTISTS

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