Avco Corp. In 1966 he joined the MIT faculty, and in 1973 he moved to the Georgia Institute of Technology. Since 1988 he has held the Leonhard Chair in Acoustics at Pennsylvania State University and has been technical director of its center for acoustics and vibration.

The Silver Medal in Speech Communication went to Arthur S. House for "contributions to the understanding of speech production, perception and recognition." Among House's contributions is the series of studies he did on segment durations in speech. This work showed how large data bases can be measured and interpreted to yield significant information about speech in the conversational mode.

House earned a PhD in speech from the University of Illinois in 1951. He began working as a researcher at MIT in 1953 and became a professor of audiology and speech science at Purdue University in 1964. In 1971 he joined the Institute for Defense Analysis in Princeton, New Jersey.

ASA gave the Silver Medal in Psychological and Physiological Acoustics, Musical Acoustics and Noise to W. Dixon Ward, who was chosen for "furthering knowledge of auditory perception in psychological and musical acoustics and increasing the understanding of the etiology of noise-induced hearing loss." Ward's work relating pitch-shift effects and pitch variability to practical musical scales has "set the standard for research in this field," the citation said. He has also done research on the relations of acoustic exposure to temporary shifts in threshold auditory sensitivity.

After receiving a PhD in experimental psychology from Harvard in 1953, Ward worked at the Central Institute for the Deaf and then at the research center of the subcommittee on noise of the American Academy of Ophthalmology and Otolaryngology. In 1962 he became a professor of otolaryngology and communications disorders at the University of Minnesota, Minneapolis; since 1972 he has also been a professor of environmental health and psychology.

OBITUARIES

Arkady Migdal

The theoretical physicist Arkady Migdal died on 9 February 1991 in Princeton, where he was visiting at the time. He was an amazing, Renaissance-type man who left an unforgettable imprint on his colleagues, students and friends.

Migdal was born on 11 March 1911 in Byelorussia. In 1929 he entered Leningrad State University, but he was expelled in 1931 due to his "nonproletarian origin." That same year he was arrested and placed under investigation for several months. He worked at an electric plant from 1931 to 1936, when he was readmitted to Leningrad State University. When Migdal entered graduate school, also at Leningrad State University, his scientific adviser was an outstanding young physicist, M. P. Bronstein. Although their collaboration was tragically interrupted in 1938 when Bronstein was arrested and executed during Stalin's purges, his influence on Migdal was very important.

From 1939 to 1943, Migdal wrote several outstanding papers that became the basis for the doctoral degree he received in 1943. In those papers he developed a new method of approximation, "tossing," that allowed him to solve problems involving the ionization of atoms in collisions with neutrons and also to make extensive calculations of the atomic processes associated with α and β decays. Probably the most remarkable result was his prediction of the "giant" dipole resonance in photonuclear absorption, which is related to relative oscillations of protons and neutrons. This effect was discovered experimentally in 1947. Also in this period, Migdal first realized that in the low-temperature limit the specific heat of helium II must be dominated by phonons and hence exactly computable. This unpublished work had considerable influence on Lev Landau's subsequent theory of superfluidity.

In 1945 Migdal joined Igor Kurchatov's group in Moscow, which was developing the atomic bomb. He combined his mandatory duties with work in fundamental science. (Kurchatov maintained a benevolent attitude to these "distractions.") In 1950 Migdal reported that in nuclear reactions resulting in the creation of slow particles, the final stages of the interactions produce a very characteristic and universal energy dependence. Similiar work was done years later by Kenneth Watson.

During the 1950s Migdal worked in plasma physics and also tried to understand superconductivity. He fully realized the importance of the phonon–electron interactions and developed ingenious methods beyond perturbation theory for treating them. (The nonperturbative nature of superconductivity was obvious to him.) These methods have now become classics in the theory of metals. Migdal, and independently Walter Kohn, discovered the singularities in the phonon spectrum now known as the Migdal–Kohn singularities. By concentrating on the phonons rather than on electron–electron scattering Migdal missed discovering the true mechanism for superconductivity.

Arkady Migdal

Nevertheless, his phonon work was brilliant and was one of the first nontrivial applications of quantum field theory in solid-state physics. Developing this line of thought, Migdal discovered in 1957 a very general theorem for a system of interacting fermions: there exists a jump in the one-particle momentum distribution. This theorem became the cornerstone for the theory of Fermi liquids later developed by Landau.

During the next period of his work Migdal applied his newly acquired knowledge of superconductivity, Green's function methods and Feynman diagrams to nuclear physics. In 1958 he realized that superfluidity inside a nucleus should manifest itself in a drop of the momentum of inertia.

From 1958 to 1966 Migdal developed an extensive theory in which he treated a nucleus as a Fermi liquid, and using this theory he was able to express most of the nuclear properties in terms of several universal constants. This theory was the first rigorous treatment of strong interactions inside nuclei. In the 1970s Migdal complemented the theory by considering the fascinating possibility that a pion instability might lead to a pion condensation in some cases. Unfortunately, this phenomenon has not yet been found experimentally.

During the 1980s Migdal shifted gears to try to develop a new semi-

phenomenological approach to quantum chromodynamics in a nice "Migdalian" way, incorporating the ideas of strings and instantons. He predicted several interesting experimental consequences of his ideas. Migdal was very enthusiastic about this work, which engaged him until his death.

Arkady Migdal was a great teacher. He published several books that were translated into English, including a charming little textbook *Qualitative Methods of Quantum Mechanics*. He also influenced a book published by his former students Joseph Goldman and Michael Krivchenko, a book that consists of one of the best sets of problems in quantum mechanics.

Actually, Migdal influenced many fields as well as many people. He radiated intelligence, wisdom, charm and strength. He was a wonderful friend: In any difficult situation, be it in life or in science, we asked his advice and always, without exception, heard from him something wise and simple. Born in an unhappy country at an unhappy time, he managed against all odds to create an intense and brilliant life. For many of us, who still mentally talk to him, his life is a stimulating example.

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EDUARD SAPERSTEIN
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Paul E. Klopsteg

Paul Ernest Klopsteg, founder of the American Association of Physics Teachers, died on 28 April 1991, a little more than a month short of his 102nd birthday.

Klopsteg's contributions to the scientific community were remarkably diverse and productive. He was a notable administrator and organizer, particularly skilled in research and development, and a prolific inventor (he came to hold more than 50 patents). He was insistently interested in teaching and in the contributions of physics to the rest of society. He headed a number of important and effective committees, both governmental and nongovernmental. He founded AAPT in 1930, and he was instrumental in its becoming a found-