NATIONAL ACADEMY OF SCIENCES

PETER CARL GOLDMARK

1906—1977

A Biographical Memoir by

ERNST WEBER

Biographical Memoir

Courtesy, CBS Technology Center, Stamford, Conn.

Peter Goldmark

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December 2, 1906 – December 8, 1977

BY ERNST WEBER

WIDELY RECOGNIZED as one of the world's leading electronic innovators and inventors, Peter Carl Goldmark also had the initiative to translate his ideas into cultural contributions of the first order. Though color television as now brought into homes worldwide is a different system from his invention—the so-called field sequential system—without his initiative, introduction of color television might have been long delayed. Although several efforts toward producing long-playing records were in progress, Goldmark's concentration on 33-1/3 r.p.m. succeeded. When President Carter presented to him the National Medal of Science in 1977, just a few days before his death, he added to the citation the personal remark that he was particularly grateful to Dr. Goldmark for developing the long-playing record.

Peter Carl Goldmark was born on Aradi Street No. 60, in Budapest, Hungary on December 2, 1906. Little is known about his early years. From his autobiographical book, *Maverick Inventor,* which he published with the aid of Lee Edson, a free-lance writer, we take it that his mother was very musical. She played violin and tried to have Peter learn piano, but since he apparently hated the teacher his mother then arranged cello lessons with a more compatible instruc-

tor, and Peter eventually joined in the chamber music ensemble in their home. He thus grew up in a classical musical environment, which had strong influences on his decisions in later life.

At the end of World War I in 1919, the family moved to Vienna to escape the communist regime that took over Hungary. In that post-war period—with utter confusion and disorganization everywhere in Europe—Peter's interest in radio led him to study science or engineering. Unable to register at the Technische Hochschule in Vienna, he spent the year 1923–1924 at the equivalent institution in Berlin-Charlottenburg, where he became acquainted with Dennis Gabor, a doctoral student. Returning to Vienna, he eventually earned his Ph.D. degree in physics in 1931. During these years he also visited with John Logie Baird in London. Baird had carried the early television in black and white to the point where the BBC transmitted experimental programs of very small image size. Because he was unable to obtain a job with Baird, Goldmark accepted a position as television engineer at Pye Radio, Ltd., in Cambridge, England. The general depression took its toll, and in 1933 the company discontinued operations. Goldmark returned to Vienna, and by fortunate chance he encountered the radio correspondent H. V. Kaltenborn of CBS (Columbia Broadcasting System), who suggested that he travel to America. Indeed, Goldmark left Vienna and arrived in New York, with little savings, on September 8, 1933. Not wanting to use the introduction to CBS that Kaltenborn had given him, Goldmark worked in odd jobs and as an independent consultant from 1933 to the end of 1935. On January 1, 1936, he was able to begin more appropriate work as Chief Television Engineer at CBS, a position he held until 1944. He started with two engineers, one of whom was John Hollywood, who was to stay with him for most of his professional life.

His staff soon expanded rapidly. In addition to improving the CBS black and white television system and components, he concentrated early on his research efforts in color television, using mechanical methods that he brought to a high level of perfection. He first demonstrated the system publicly on August 27, 1940, in New York, with sequential projection of the three primary colors, resulting in full color of the image at the rate of twenty pictures a second. The demonstration was broadcast from the top of the Chrysler Building in New York, and it impressed the technical community. War clouds were gathering, however, requiring a redirection of his efforts.

In the spring and summer of 1942 the Radio Research Laboratory (RRL) was established at Harvard University, and Goldmark and four associates, including John Hollywood, joined RRL. Goldmark was put in charge of a group developing electronic countermeasure receivers. The arrangements with the Columbia Broadcasting System allowed Goldmark's group to continue as employees of CBS, and the CBS laboratory was converted to work for RRL. Goldmark took considerable initiative in developing an interest in a branch laboratory to be based in England, and was one of the moving spirits in getting it started. When in the fall of 1943 the American British Laboratory (ABL) of Division 15 of the National Defense Research Committee (NDRC) was established under contract with Harvard University to work closely with the British Telecommunications Research Establishment (TRE) in Malvern, England, Goldmark was made technical supervisor of the laboratory, and then acting director. He returned to the United States in December 1943 to organize a supporting activity at Columbia Broadcasting System, and he became director of the Engineering and Research Department at Columbia Broadcasting System in 1944, continuing his association with Harvard University.

After the end of the war, Goldmark again took up the development of color television using the field sequential method. He received unexpected support when it became apparent that closed-circuit black and white television was found to lack realism in operating-room class demonstrations. With his associates, Goldmark could develop a demonstration system in live color that was successfully shown at the American Medical Association's annual meeting in Atlantic City in December 1949, and led to many further uses of television in medical education.

On the basis of such success, in 1949 Goldmark proposed to the Federal Communications Commission (FCC) that color television broadcasting be authorized using his three-color sequential transmission of images at the rate of twenty-four pictures per second. Though the FCC adopted this recommendation in 1950, and transmission started in New York in 1951, it was generally recognized that the system was incompatible with the well-established electronic black and white television system, for which about ten million receivers were then in use. General use of the new color system would have required the acquisition by the public of second, different receivers for color television that could not be used for the monochrome transmissions. The impracticality of such a scheme brought the pioneering broadcasts to an end in late 1951.

Though the basic requirements for a compatible color television system had been developed by the First National Television System Committee (NTSC) before the action of the FCC, it now became urgent to translate these into an acceptable practical standard. The second National Television System Committee succeeded in 1953 in making a definitive system proposal to the FCC, which accepted it. In 1954 color television broadcasting started with the fully electronic system that is now in use, and represents a

remarkable achievement that might have been many more years in development had it not been for the challenge by Goldmark's daring initiative.

Paralleling Goldmark's work on color television, the Columbia Record Division, and others, had started to develop alternate means for improving the quality of sound recording systems, including use of speeds lower than the standard 78 r.p.m. and finer grooves with less noise background. As a talented musician, Goldmark loved classical music; it was his initiative that launched the 1948 "long playing record," a disc recording of 33-1/3 r.p.m. with microgrooves, that quickly won worldwide approval.

In 1951, CBS created the CBS Laboratories with Goldmark as vice president. In 1954 he assumed the presidency, a position he held until his retirement on December 31, 1971. Under Goldmark's leadership, the scientific and engineering staff expanded to over 200, and the laboratories, which were transferred to new buildings in Stamford, Connecticut in 1958, became one of the leading electronic and communication research centers in the country. As a result of the Laboratories' work, his field sequential color television system—which had become lighter and smaller than the original version—was used by the Apollo Astronauts in 1969 to bring man's first landing on the moon to televisions everywhere on the globe.

Some of the important innovations that Goldmark's group initiated were the first ultra-high-speed, computer-tape driven photo composing system; the high-resolution photographic system of NASA's *Lunar Orbiter*; the Electronic Video Recording (EVR), which was instrumental in stimulating industrial endeavors leading to video disc technology; and contributions to magnetic recording, data storage, and display. The more than 160 inventions for which Goldmark was either directly or collaboratively responsible covered the

fields of acoustics, television, phonograph recording, and film reproduction. Among them were the first "high fidelity" packaged, integrated phonograph, which used the volume of air within its enclosure to enhance the quality of sound; a pioneering reverberation generating device for livening the quality of recorded and broadcast music; a "talking book" phonograph, the size of a cigar box, capable of four hours of recorded sound on a single 7-inch disc; a "crispening system" for sharpening television images; a rapid transmission system for recording up to thirty educational TV programs on a one-hour reel of magnetic tape; and a music-teaching program. During his last decade as head of the CBS Laboratories, Goldmark devoted considerable time and effort to educational technology. He believed firmly that in such manner it would be possible to bring education to both children and adults who otherwise would be unable to afford it. His endeavors in the direction of electronic video recording were designed to make available—at relatively low cost—the best of filmed lectures, courses, textbooks, and other cultural programs to people who might otherwise not seek such opportunities or who would not be able to achieve such contacts.

Upon his mandatory retirement from CBS Laboratories, Goldmark founded his own firm, the Goldmark Communications Corporation, in Stamford, Connecticut, and served as president and as director of research. He continued research and development in the areas of cable television and satellite communications, as well as others that he felt had the potential to improve the quality of life for mankind.

Goldmark devoted considerable time and effort to work for the National Research Council, serving on the Committee on Telecommunications of the National Academy of Engineering from its organization in 1968 until 1974, and as

chairman of its Panel on Urban Communication from 1968 to 1972, when it rendered its final report.

Stimulated by these activities, Goldmark sparked the somewhat visionary concept of a new rural society that would call for the imaginative use of telecommunications to revitalize rural towns. In fact, he conceived the idea of a national pilot study, "The New Rural Society" (NRS). Upon the request of a Presidential Advisory Committee in 1970, the National Academy of Engineering selected a panel of experts to study, under Goldmark's direction, ways and means to reduce substantially the critical problems of crime, pollution, narcotics and overcrowding in the large cities, while at the same time searching for ways to make rural towns more attractive for living, as well as to encourage the establishment of industrial plants in rural America by applying established communications technology in novel ways. The principal aim was to reverse the long trend of migration from rural areas into cities and to offer a real choice between living in urban or in rural areas. With funding from the Department of Housing and Urban Development (HUD), Goldmark organized a study project with Fairfield University in Stamford. He selected, upon suggestion by the governor of Connecticut, who took keen interest in the study, the area of Windham County in northeastern Connecticut, with Willimantic as its main city, as a model. Unfortunately, Goldmark did not live to carry this project to full fruition.

Goldmark had always been interested in causes of human rights and the improvement of living conditions. He served as chairman of numerous civic programs, including The Urban Coalition in Stamford, Connecticut, and the Anti-Poverty Agency. In particular, he spearheaded a nationally recognized rehabilitation and training program for some five hundred low- and middle-income families of Stamford's

Southfield Village. He also served as trustee of the Connecticut Education Telecommunications Corporation.

From its beginning in 1972 until his death, Goldmark served on the Bay Area Rapid Transit (BART) Impact Program Advisory Committee. The group was to advise, from an engineering as well as a multi-disciplinary point of view, the Department of Transportation and the Department of Housing and Urban Development as they proceeded with the program management of an extensive series of studies underway on the impact of the BART system on the San Francisco Bay Area.

Additionally, when the National Research Council was reorganized, Goldmark served during 1975–1976 on the Executive Committee of the Assembly of Engineering, which took over the administration of the committees formerly administered by the Council of the National Academy of Engineering. He also served on the Space Applications Board of the Assembly of Engineering (1974–1975) and on the General Advisory Committee for the Academy Forum, National Academy of Sciences (1972–1973). During 1977, shortly before his death, he was also invited to join the Metropolitan Communications Systems Study Steering Committee, under the umbrella of the Committee on Telecommunications, now in the Assembly of Engineering.

Peter Goldmark was a member of a number of professional societies and associations and was elected to the fellow grade in most of them. He also received many awards, which are listed following this text, together with a list of the more important publications that bear upon his interests and achievements.

In everyday contact, Peter was a soft-spoken gentleman who could, nevertheless, be quite impatient when meeting resistance. He always had visions of what might be or should be, and he could be rather persistent in pushing his convic-

tions. He contributed many new ideas in numerous technical areas, although they were not always fully evaluated or consistent with penetrating analysis. He was a very talented musician, which explains his strong interest in acoustics and high-fidelity audio devices. He demanded much of his associates, though he always drove himself with even greater intensity.

In the book *Maverick Inventor, My Turbulent Years at CBS,* published with Lee Edson (Saturday Review Press/E. P. Dutton & Company, New York, 1973) Goldmark described rather vividly his experiences within CBS and admitted that at times his intense dedication to work must have been hard on his family. Actually, he was a good family man, with four children from his first wife Frances Trainer, from whom he was divorced in 1954, and two children from his second wife Diane Davis, his former secretary.

His untimely death in an automobile accident on his way to New York, on December 8, 1977, shocked the world and robbed it of a valued citizen, driving innovator, and many-sided inventor.

I AM INDEBTED particularly to Benjamin Bauer, close associate of Peter Goldmark, for his own version of a memoir that he prepared for the National Academy of Engineering; to John Dyer (who was an associate of Goldmark until World War II) for valuable suggestions; to Fred Terman for some personal notes; and to John M. Hollywood, who worked with Goldmark at CBS from 1936 until 1971 with only four years' interruption, and then joined Goldmark Communications Corporation in Stamford, for valuable comments.

MAJOR HONORS AND AWARDS

1942 Election to Fellow, Institute of Radio Engineers
1945 Morris N. Liebman Memorial Prize, Institute of Radio Engineers
1954 Television Broadcasters Association Medal
1960 Achievement Award, Professional Group on Audio, Institute of Radio Engineers
1961 Vladimir K. Zworykin Prize, "for outstanding technical contribution in the field of electronic television," Institute of Radio Engineers
1967 Election to membership, National Academy of Engineering
1968 National Urban Service Award "for his efforts in the War on Poverty"
Fellow, Society of Motion Picture and Television Engineers
D. Sc. (Hon.), Fairfield University, Connecticut
1969 David Sarnoff Gold Medal, "for outstanding scientific contribution to the Advancement of Television Technology," Institute of Electrical and Electronic Engineers
Elliott Cresson Medal, "for his many outstanding contributions to the Field of Electronics," Franklin Institute, Philadelphia, Pennsylvania
D. Eng. (Hon.), Polytechnic Institute of Brooklyn, New York
American Women in Radio and Television Award
1972 Election to membership, National Academy of Sciences
Election to Fellow of American Academy of Arts and Sciences, Boston, Massachusetts
Carnegie-Mellon Institute Medal, "for continuing leadership and contributions to the betterment of Science for Mankind"
Industrial Research Institute Medal
1976 Election to membership in the Connecticut Academy of Science and Engineering
1977 National Medal of Science, "for contributions to the development of the communications sciences for education, entertainment, culture, and human service."

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