we hear that

Technology, Halpern joined Pennsylvania in 1947. Before going there he did nuclear research at the University of Michigan and the University of California. In 1970, he received the Carnegie-Mellon University alumni merit award.

Georg von Békésy

Georg von Békésy, an authority on acoustics and the 1961 Nobel laureate for Medicine, died on 13 June. He was 73 years old.

Békésy's path to the Nobel Prize began a century ago, when Hermann von Helmholtz perceived the essential principle that, in order to sense each different frequency as a different pitch, the ear must somehow separate one frequency from another and direct the excitation from each tone to a separate nerve channel. He thus left hanging a question that Békésy would later resolve. Helmholtz had appealed to simple resonance, suggesting that the fibers of the basilar membrane may resemble piano strings, each swinging to its own favored note. Beginning in the 1920's Békésy, then a young telephone engineer in Budapest, set about to discover how the ear does in fact respond to sound waves and how the cells and membranes in the tiny coiled-up cochlea vibrate in response to different frequencies.

BEKESY

Békésy launched a two-pronged attack. He constructed dynamic models of the inner ear from which he learned new facts about the vibratory behavior of a flexible membrane that varies in elasticity from end to end and is placed between two columns of liquid. He also delved into the anatomy of the human cochlea itself and observed stroboscopically the motions of the

sensory receptors riding on the vibrating basilar membrane. Both the model and the ear told the same story: an applied vibration sets up a wave that sweeps along the basilar membrane, growing to a maximum amplitude and then rather quickly dying out. Already, then, in 1928 Békésy had discovered the traveling wave—a discovery for which 33 years later he received the Nobel Prize.

Békésy's genius lay in the experimental art. His deft proficiency laid open not only the human ear but the inner ears of birds and mammals of many sizes, including the cochlea of an elephant that died in the Budapest zoo. He observed the microscopic vibrations of the membrane and measured many of the mechanical parameters of the moving parts. He contrived novel tools—drills, scissors, and micromanipulators—with which to explore the labyrinthine elegance of the delicate auditory organ, the only complex mechanical system in the human body.

Békésy was born in Budapest on 3 June 1899. His father was a diplomat who for several years looked after the interests of Hungary as a *chargé d'affaires* in Bern. Thus, it was that Békésy obtained his baccalaureat in Bern in 1916. Being judged too young for the University, he did nothing for one glorious year, a year that he later remembered as an enchanting stretch of freedom. A call to the colors in 1918 sent him back to Hungary, but he returned to the University of Bern after the Hungarian revolution in 1920. By the next year the turmoil had quieted down in Hungary and Békésy transferred to the University of Budapest, where he received his doctorate in physics in 1923.

There was then a year in Berlin with the apparatus firm of Siemens and Halske, after which he entered the laboratory of the Hungarian Post, Telephone and Telegraph. He later found his way back to the university as *privat-docent* in 1932, and he became professor of experimental physics in 1940.

In 1937 I visited Békésy's laboratory at the PTT, hoping to see whether the stream of miraculous experiments in far-off Budapest could stand close-up scrutiny. They could indeed. Békésy complained that only his spare time was available for the auditory research, the main job being to solve problems for the PTT. But for Békésy, ever a bachelor, the working day was a long one, and his research was his passion.

Seven years later, with the Russians and the Germans shelling each other across the Danube, Békésy lost almost everything he owned and barely escaped with his life. He was invited to Stockholm in 1946 and then to the Harvard Psycho-Acoustic Laboratory in 1947. There, as Senior Research Fel-

Dipole Array

The Lincoln Laboratory, a research center of the Massachusetts Institute of Technology, is engaged in research and development in advanced electronics, with emphasis on applications to national defense and space exploration. The program of research extends from fundamental investigations in selected areas, through technological development of devices and components, to the design and development of complex systems. All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin. Lincoln Laboratory, Massachusetts Institute of Technology, Box 15 Lexington, Massachusetts 02173.

Radio Physics
Air Traffic Control
Space Communications
Solid State Physics
Digital Signal Processing
Optics
Re-entry Physics
Computer Systems

A description of the Laboratory's work will be sent upon request.

we hear that

ow in Psychophysics, he was at last ree to devote his full attention to his esearch. That arrangement endured for 19 years. Then at the age of 67, with the prospect of retirement stirring anxieties, he packed up once more and moved to a new laboratory, custom-built to his needs at the University of Hawaii. There he died.

Békésy was a solitary person—at once friendly, yet reserved. He was warily secretive about his research. In 19 years of almost daily association he seldom told me what his projected inquiries would be about. We could discuss any subject under the sun except his unfinished experiments. In making the yearly request for our government grant, I learned to state as Békésy's next year's goal the projects already completed and in press. He almost never collaborated with others or shared his workbench with students. He was lonely in a way, and he liked it that way. Yet every day he made the rounds of the laboratory, visiting and gossiping with others.

Besides his research he lavished much attention on primitive and oriental art, and he enlivened his workroom with an exhibit of one or another artistic treasure. When not in the laboratory, he could often be found in a museum.

His appearance was deceptively frail, a marked kyphosis hunching his back into the stoop of an old man. Yet he could stand on his feet longer than most people, and when he visited my New Hampshire farmhouse he proved a demon at sawing wood. That was until he discovered that a violent use of the gross muscles increased the tremor in his fingers and interfered with the delicate manipulations that had become the hallmark of his work on the ear.

Békésy pursued some of his problems into the other sense modalities, and he even built a cochlear model on which a man could place his forearm to let the touch receptors serve as analogues to the hair cells in the ear. The observer could then feel a localized pulse on the arm that changed position when the frequency changed. Békésy's greatest victories though were won in the tiny coiled-up cochlea where sound is transduced into nervous energy. His rapture before the charm of some ancient carving rekindled itself as he contemplated the beauties of vibration patterns propelling themselves through the almost endless variety of coupled systems that he built and photographed in order to achieve a deeper understanding of the ear.

S. S. Stevens
Laboratory of Psychophysics, Harvard University □