

and reported on science and technology to two prime ministers, Rajiv Gandhi and P. V. Narasimha Rao.

Praveen was a gifted speaker and an excellent motivator who could get others excited about his ideas. He cherished competition, yet he maintained an open door for science discussions and went out of his way to help others with their careers. He switched with ease between hands-on science and demanding management positions, never losing his touch in the lab nor his skills in the conference room. He is greatly missed.

Supratik Guha

Robert Rosenberg

*IBM Thomas J. Watson Research Center
Yorktown Heights, New York*

Jochen Mannhart

*Institute of Physics
University of Augsburg
Augsburg, Germany*

Manfred Robert Schroeder

Internationally known acoustician Manfred Robert Schroeder died at his home in Göttingen, Germany, on 28 December 2009 after a brief illness. He was renowned for his work in such diverse fields as speech synthesis, architectural acoustics, computer art, and number theory.

Manfred was born on 12 July 1926 in Ahlen, Germany. He studied mathematics and physics at the University of Göttingen and received his doctorate for his thesis on the distribution of acoustic normal modes in enclosures as a student of Erwin Meyer in 1954. Later that year he joined Bell Labs in Murray Hill, New Jersey; he was appointed head of the acoustics research department in 1958 and director of the acoustics and speech research laboratory in 1963. Soon thereafter he assumed responsibility for all areas of Bell's acoustics, ultrasonics, and mechanics research.

In 1969, still maintaining some of his responsibilities at Bell Labs, Manfred was appointed professor of physics and director of the Third Institute of Physics at the University of Göttingen. After retiring from his positions at Bell Labs and the university in 1987 and 1991, respectively, he continued his activities as a scientist and teacher until shortly before his death.

One of the fields Manfred was always enthusiastic about was room acoustics, to which he made many fundamental and far-reaching contributions. The area had already fascinated



Manfred Robert Schroeder

him during his thesis work. In later publications he described the relations between the eigenmodes and the frequency response of rooms and explained the random character of the response above a certain frequency, today known as the Schroeder frequency.

Other ingenious contributions to room acoustics followed. Among them were the integrated-tone-burst method for measuring reverberation times of enclosures and the use of frequency shifting to suppress feedback in public address systems. Another outstanding achievement is Manfred's invention of pseudo-random surface structures, or Schroeder diffusers, based on number-theoretical schemes. Such devices scatter sound waves in all directions to provide lateral sound reflections and thus improve the acoustics of concert halls.

Receiving great public interest was Manfred's involvement in activities to improve the acoustics of Philharmonic Hall (now Avery Fisher Hall) in New York City's Lincoln Center. Soon after the hall opened in 1962, musicians, conductors, and music critics detected grave deficiencies in its acoustics. Asked along with other acoustic consultants to objectively evaluate the acoustics, Manfred used a novel measuring method based on digital signal generation and processing. Preparation, performance, and evaluation of the experiments turned into a scientifically challenging project for him and his coworkers. Later, while in Göttingen, Manfred and his students evaluated 20 of the world's major concert halls by subjective auditory comparison, and in the process they gathered significant information about lateral reflections and other acoustic parameters. Apart from

AUDIO ENGINEERING SOCIETY



HighFinesse-Ångström Wavelength Meters

**Accurate Like Your Research
Redefining Performance**

- Most stable and reliable
- Pulsed & cw for 192 – 2250 nm
- Fastest measurement: 200 Hz
- Multichannel 1 to 8 lasers

TOPTICA
PHOTONICS
A Passion for Precision.

Phone: (585) 657-6663
sales@toptica-usa.com
www.toptica.com
www.highfinesse.com

the new digital measuring techniques, Manfred developed versatile computer simulation methods for large halls. His methods have become increasingly important in the planning of new auditoriums.

Manfred was among the first to recognize the importance of digital signal processing not only in room acoustics but also in other areas and to actually employ those methods. He used them to generate artificial reverberation and artificial stereophony and applied them in ultrasonics, speech, and electroacoustics. Manfred was also an innovator in computer graphics; his application of concepts from mathematics and physics to the creation of art gained him top honors in the 1969 International Computer Art Competition.

Among Manfred's achievements in speech and hearing acoustics are the invention of the voice-excited vocoder in 1960 and the introduction of linear predictive coding in 1967. LPC remains an important technique for analyzing and synthesizing speech and music signals. He also worked on the early development of the concept of surround sound. His mathematical model of the inner ear has inspired much of the work that followed in auditory research.

His interest in mathematics and es-

pecially in number theory motivated Manfred in 1984 to write his treatise *Number Theory in Science and Communication*, now in its fifth edition. The book differs from other texts on the topic in its intuitive approach and emphasis on the application of number theory to such diverse fields as cryptography, physics, computing, and self-similarity. Similarly, his 1991 book *Fractals, Chaos, Power Laws: Minutes from an Infinite Paradise* illustrates the far-reaching influence of the concept of self-similarity on science, music, and the visual arts. Both books are marvellous examples of how to present difficult subjects with clarity and humor. His third book, *Computer Speech: Recognition, Compression, Synthesis*, first published in 1999, connects speech recognition and synthesis to monaural and binaural hearing and to modern signal analysis. In addition to those works, Manfred published more than 150 papers and was awarded 45 US patents.

Manfred was a founding member of the Institut de Recherche et Coordination Acoustique/Musique in Paris. His scientific achievements earned him such honors as the Rayleigh Medal from the British Institute of Acoustics in 1987, the gold medal of the Acoustical Society of America in 1991, the

Helmholtz Medal of the German Acoustical Society in 1995, and the Technology Prize of the Eduard Rhein Foundation in 2004.

Everyone who met Manfred experienced his kindness, humor, cheerfulness, and ease of communication. His death is a profound loss to the art of combining mathematics, science, and engineering to create outstanding innovations. His many colleagues, students, and friends all over the world deeply miss him.

Charles Schmid

*Acoustical Society of America
Bainbridge Island, Washington*

Gerhard M. Sessler

*Darmstadt University of Technology
Darmstadt, Germany* ■

Letters and opinions are encouraged and should be sent by e-mail to ptletters@aip.org (using your surname as "Subject"), or by standard mail to Letters, PHYSICS TODAY, American Center for Physics, One Physics Ellipse, College Park, MD 20740-3842. Please include your name, affiliation, mailing address, e-mail address, and daytime phone number on your attachment or letter. You can also contact us online at <http://www.physicstoday.org/pt/contactus.jsp>. We reserve the right to edit submissions.

CRYOGENIC PROBE STATIONS



Temperatures from 1.5 K – 475 K
Measurements from DC to 67 GHz
Probe up to 4-inch wafers
Up to 6 micro-manipulated probe arms
Vertical or horizontal field magnets
Cryogen-free ■ Load-lock ■ High vacuum

Visit us in Booth 302 at the MRS Spring Meeting April 6–8



LakeShore®

Phone: (614) 891-2244 Fax: (614) 818-1600
info@lakeshore.com www.lakeshore.com