Arthur Taylor Winfree FREE

Special Collection: Print Obituaries

Steven Strogatz

Physics Today **56** (6), 74–75 (2003);
https://doi.org/10.1063/1.4776726

Gary Purdy, University Professor in the department of materials science and engineering at McMaster University in Hamilton, Ontario, Canada

Evgeny Velikhov, president of the Russian Research Center at the Kurchatov Institute, in Moscow.

In Brief

This month, physicist **Robert A. Eisenstein** is taking office as president of the Santa Fe Institute (SFI), a New Mexico research organization that encourages multidisciplinary collaborations among visiting and resident scientists from the physical, mathematical, biological, computational, and social sciences. Eisenstein was NSF's assistant director for mathematical and physical sciences from 1997 to 2002 and, during the past year, has been on leave at CERN. He succeeds **Ellen H. Goldberg**, who became president in January 1996. She stepped down this past January, when she was appointed as a research professor at SFI and codirector of the initiative entitled Santa Fe Institute Consortium: Increasing Human Potential.

Albert Chang, professor of physics at Purdue University, will be joining the physics faculty at Duke University on 1 August.

Brian DeMarco has been awarded the 2003 Michelson Postdoctoral Prize Lectureship by Case Western Reserve University in Cleveland, Ohio, for his "seminal contributions to the field of trapped atomic gases, including the creation, with his collaborators, of the first degenerate Fermi atomic gas and his work on quantum computing using trapped ions." DeMarco, National Research Council postdoctoral fellow at NIST in Boulder, Colorado, spent a week in late April in residence at CWRU, where he gave three seminars and a colloquium on the quantum behavior of trapped Bose and Fermi gases and on quantum computing using atomic and optical systems. In August, he will be joining the physics department at the University of Illinois at Urbana-Champaign as an assistant professor.

Last month, **Edwin Lyman** joined the Union of Concerned Scientists in Washington, DC, as a senior staff scientist in the global security program. He had been president of the Nuclear Control Institute in Washington, DC.

The Chinese government has announced that **Joseph Hamilton** is the recipient of the 2002 International Scientific and Technological Cooperation Award of the People's Republic of China. The award honors Hamilton, Landon C. Garland Distinguished Professor of Physics at Vanderbilt University, for his "important contributions, along with Chinese scientists and engineers, toward the development of science and technology in China." The ceremony, originally scheduled for April, has been postponed until later this summer.

The Royal Swedish Academy of Sciences will award the 2003 Gregori Aminoff Prize in Crystallography to **Axel T. Brunger** and **Alwyn Jones** at a ceremony in Stockholm, Sweden, this September. The academy is recognizing Brunger for his "development of refinement techniques for macromolecules." He is an investigator at the Howard Hughes Medical Institute and a professor of molecular and cellular physiology at the Stanford University School of Medicine. The academy is citing Jones, professor of structural biology at Uppsala University in Sweden, for his "pioneering development of methods to interpret electron density maps and to build models of biological macromolecules with the aid of computer graphics."

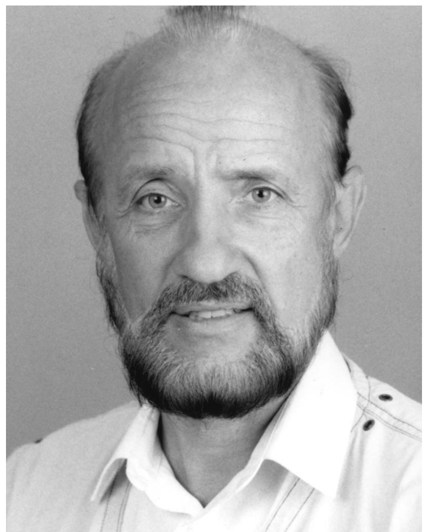
This month, the Abdus Salam International Centre for Theoretical Physics is awarding its ICTP Prize for 2002 to **Mohit Randeria** at a ceremony in Trieste, Italy. According to the ICTP, he is regarded as "the world's expert in the implications of the Angle Resolved Photoemission (ARPES) experiments for the properties of strongly correlated electron systems." He also is being acknowledged for contributing his "theoretical interpretation of experiments on the pseudogap state in the normal state of high-T_c superconductors." Randeria, theoretical physicist at the Tata Institute of Fundamental Research in Mumbai, India, is on sabbatical for 2002–03 as the George A. Miller Visiting Professor at the University of Illinois at Urbana-Champaign.

Obituaries

Arthur Taylor Winfree

Arthur Taylor Winfree, a distinguished theoretical biologist whose discoveries repeatedly opened new lines of inquiry in physics, died of brain cancer on 5 November 2002 in Tucson, where he was Regents' Professor at the University of Arizona.

Art was born on 15 May 1942 in St. Petersburg, Florida. As a boy fascinated by the mysteries of the living world, he decided somewhat paradoxically that the best strategy was to acquire the quantitative tools and training of a physicist. He majored in engineering physics at Cornell University and received his BS in 1965. His senior thesis gave another early hint of his unconventional way of thinking. Motivated by the phenomenon of circadian rhythms, Art devised a model based on an enormous collection of coupled, self-sustained oscillators. Those hypothetical oscillators were supposed to represent multiple cellular clocks whose collective behavior would be mirrored in an animal's activity. Because no mathematical methods existed for analyzing large systems of nonlinear oscillators, Art built a gadget that he called the firefly machine, consisting of 71 flickering neon lamps, each coupled electrically to all the others. His hunch was that the aggregate output of that system, when plotted in the format



Arthur Taylor Winfree

used by circadian biologists, might suggest new ways of interpreting their data.

His experiments led to his first publication, in 1967, on the population dynamics of limit-cycle oscillators. Art discovered that, under appropriate conditions, such oscillator populations can spontaneously synchronize. As the variance of their natural frequencies is reduced, the oscillators remain incoherent until the dispersion falls below a certain threshold. Then synchrony breaks out cooperatively in a manner reminiscent of a second-order phase transition. In the years that followed, that novel nonequilibrium phase transition stimulated extensive theoretical research in nonlinear dynamics and statistical mechanics, most notably by Yoshiki Kuramoto and his colleagues.

Art received his PhD in biology from Princeton University in 1970 and worked in the lab of Colin Pittendrigh, an expert on circadian rhythms. Contrary to the prevailing dogma of the time (most vigorously espoused by his own adviser), Art demonstrated that biological clocks could be stopped by surprisingly mild stimuli. He predicted that result by ingenious topological reasoning about maps between circles, and then confirmed it experimentally in studies on fruitflies. In 1970, he showed that a brief pulse of light administered at just the right time in a fruitfly's circadian cycle could nudge its biological clock to a "phase singularity" at which all phases of the cycle converge and the rhythm's amplitude drops to zero. In the years since then, similar phase singularities have been documented for diverse kinds of biological oscillators, with possible medical implications for sudden infant death syndrome, cardiac arrhythmias, and other disorders involving abrupt termination of a biological rhythm.

Art held faculty positions as an assistant professor of theoretical biology at the University of Chicago (1969–72), and then as an associate professor (1972–79) and professor (1979–86) of biological sciences at Purdue University. From the late 1960s to the late 1980s, he focused his attention on the Belousov–Zhabotinsky (BZ) chemical reaction. In its quiescent form, the BZ reaction appears rusty red, but a sufficiently strong stimulus can trigger the propagation of a blue wave of oxidation, like a grassfire spreading across a prairie. As the wave travels, the liquid remains motionless; the pattern of chemical activity spreads by pure diffusion. Again using topological reasoning, Art convinced himself that a thin, two-dimensional layer of BZ reaction could not support a persistently rotating wave unless the medium had a hole in it. When he tried the experiment, he found otherwise. He wrote, "It came as a bewildering surprise, on October 10, 1970, to behold several perfectly stable spiral waves sedately rotating in a dish of this chemical reagent." Since then, spiral waves analogous to the ones that Art discovered have been found in heart tissue (where they are associated with tachycardias and other arrhythmias, thus accounting for much of the applied interest in spiral waves); in aggregation patterns of slime mold (a key example in developmental biology); in surface catalysis; and in calcium waves in cells.

In the 1980s, he pioneered the study of scroll waves, the three-dimensional counterpart of spiral waves. He found that the ends of the scrolls typically join together to form closed rings that could be diversely linked, twisted, and knotted in a discrete set of ways quantized by a topological exclusion principle. Those structures represent the basic particlelike solutions of the field equations for excitable media. Aside from the fundamental importance of scroll waves, Art always believed they were likely to be important in cardiac arrhythmias, especially ventricular fibrillation.

In 1986, Art accepted a position as professor of ecology and evolutionary biology at the University of Arizona and, in 1989, was named a Regents' Professor. He spent the final years of his career exploring the dynamics of scroll waves in supercomputer simulations, seeking the laws of motion for how they slither and writhe, and trying to understand their curious stability.

Art's impact on diverse fields was recognized with several awards. In 1984, the John D. and Catherine T. MacArthur Foundation named him a MacArthur fellow for his work in theoretical biology. He received the Einthoven Award in cardiology in 1989 from the Einthoven Foundation and the Norbert Wiener Prize in Applied Mathematics in 2000 from the American Mathematical Society and the Society for Industrial and Applied Mathematics. His magnum opus was his 1980 monograph *The Geometry of Biological Time* (Springer-Verlag). Art's sense of humor, irreverence, and creative spirit leap off every page of this masterpiece. In a section about the menstrual cycle, titled "Statistics ('Am I Overdue?!')," he plotted 15 years of data collected by his own mother. The book is aimed especially at students, with suggestions for which research problems are ripest. In many ways, it reads like a map for fortune hunters, a guide to future discoveries.

In his teaching as well, Art loved to help students develop their creativity. He taught a popular course called "The Art of Scientific Discovery," and he was forever fascinated by puzzles and games. Art will be remembered for his playfulness, his honesty, and his contagious sense of wonder.

Steven Strogatz
Cornell University
Ithaca, New York

Charles Kincaid Bockelman

Charles Kincaid Bockelman, retired professor of physics and deputy provost at Yale University, died on 6 June 2002 following a series of strokes.

Bockelman was born on 29 November 1922 in San Francisco, California. His parents moved back to their native Midwest, and he grew up in Milwaukee, Wisconsin. That he was interested in science from boyhood is apparent in a clipping from the Steuben Junior High School newspaper in Milwaukee that shows a picture of Bockelman as the 13-year-old president of his graduating class. The accompanying story says that his ambition was to be a physics professor.

After graduating from high school in 1940, he obtained a job, through his mother's intercession with an old family friend, as a Riding Page in Senator Harry S Truman's office in Washington, DC. There, he attended George Washington University to study physics and chemistry while acting as Truman's mail clerk. Truman, who took an avuncular interest in him, wrote several personal letters to the young soldier after he entered the US Army in 1942.

Following his discharge in 1946, Bockelman, with financial aid from the GI bill, enrolled at the University of Wisconsin as a physics major. There, while still an undergraduate, he began a five-year span working in experimental nuclear physics with Heinz Barschall, and received his PhD in 1951. During those years, Bockelman played an important role in the Barschall group's studies of the nuclear scattering and absorption of neutrons with energies ranging from about 100 keV to a few MeV. His thesis crowned a series of 11 papers, with Bockelman as coauthor, describing work that both demonstrated the existence of broad, well-defined energy levels at those energies in elements as heavy as lead and revealed unexpected patterns of the cross sections averaged over resonances. The analyses of the discrete resonances contributed to the evidence that established the importance of spin–orbit coupling in nuclear forces, and the analyses of the cross sections, averaged over resonances, provided the foundation of the "cloudy crystal ball" model of nucleon–nucleus interactions developed by Herman Feshbach, Victor Weisskopf, and Charles Porter.