MACARTHUR FOUNDATION CONFERS FIVE PHYSICS-RELATED FELLOWSHIPS

Five of the 31 MacArthur Fellowship winners announced last July work in physics or closely related fields. Each will receive a total of $230 000–$325 000 over the next five years. The fellowships are intended to provide individuals of exceptional creative promise with the financial freedom to pursue whatever sort of work they choose.

The five physics winners are Charles Archambeau, a theorist working in geophysics at the University of Colorado, where he is an adjunct professor; Helen T. Edwards, head of the accelerator division at Fermilab; Raymond Jeanloz, a professor of geology and geophysics at the University of California, Berkeley; Robert S. Shaw, an independent researcher of chaotic systems; and Noel M. Swerdlow, a historian of science who is a professor in both the department of astronomy and astrophysics and the department of history at the University of Chicago.

Archambeau is a geophysicist specializing in seismology; he helped negotiate, and later oversaw, the installation of three seismic stations near the Semipalatinsk nuclear test site in the USSR. The information from these and other stations about the geological character of the test site helped establish a stronger scientific basis for a nuclear test ban treaty. Archambeau also formulated theories of explosion-induced tectonic stress release (an earthquake-like phenomenon caused by nuclear testing), enabling him to distinguish its signal from the ordinary spherical waves generated by an explosion. His work has helped build a good quantitative understanding of seismic energy sources and of how to identify them through remote seismic observations. Archambeau has also worked on other, less political aspects of seismology, such as determining the detailed structure of the Earth's mantle. His work has led him to develop a variety of methods for nonlinear signal detection and analysis.

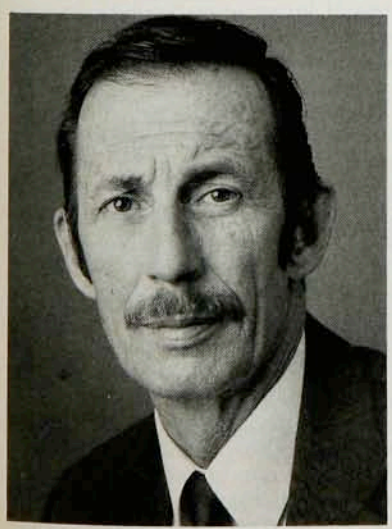
Archambeau received a BS from the University of Minnesota in 1955 and a PhD from Caltech in 1965, both in geophysics. He is an adjunct professor of geophysics at the University of Colorado, Boulder, and a research associate of the Cooperative Institute for Research in the Environmental Sciences, which is jointly sponsored by the University of Colorado and the US Department of Commerce.

Edwards is an accelerator physicist who has worked on the construction and commissioning of several accelerators at Fermilab, most recently as deputy to the project manager for the construction of the Tevatron. She was responsible for supervising and integrating the technical aspects of building the Tevatron, which is the first successful superconducting proton accelerator and the highest energy accelerator in operation. Edwards hopes that the proton–antiproton beam collisions at the Tevatron (at present around 0.9 TeV per particle) will result in the first observation of the top quark. Equally (or even more) exciting would be the discovery of a particle from a fourth generation of quarks and leptons.

Edwards received both her BA (1957) and PhD (1966) in physics from Cornell. She joined the staff at Fermilab in 1970 and has worked on several accelerator projects there, culminating in her appointment as head of the accelerator division two years ago. She will be head of the accelerator systems division for the Superconducting Super Collider.

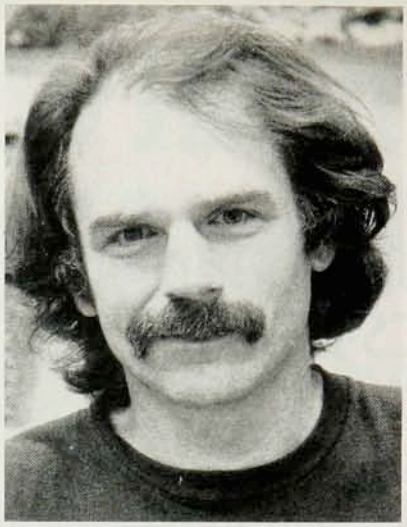
Jeanloz has designed high-tempera-

Charles Archambeau

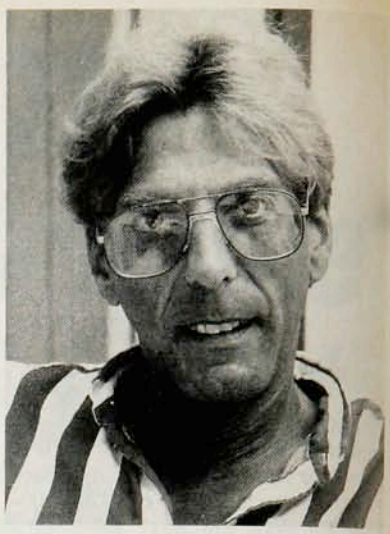


Helen T. Edwards

Raymond Jeanloz



Robert S. Shaw



Noel M. Swerdlow

ROBERT P. MATTHEWS

ture, high-pressure experiments to gain a better understanding of the interior of the Earth and other planets. He was part of a group that found that the Earth's core is hotter than the surface of the Sun.

The technology Jeanloz uses to study materials under such extreme conditions has been developed in the past five years. A solid sample is squeezed in a diamond-tipped vice and exposed to a continuous laser beam, which passes through the transparent diamond. Using this technique, Jeanloz can maintain pressures of 2- to 3-million atmospheres and temperatures of 1000–7000 K for hours at a time. These extreme conditions facilitate the study of the strength and nature of the interatomic bonds in the sample. The object of such experiments, Jeanloz explains, is to give solid-state theorists "a real hint of where the theory is succeeding and where it's failing—what sort of approximations you can get away with."

The attainment of very high pressures has also introduced a component of materials engineering into Jeanloz's research: His group has worked to create new materials that cannot be synthesized at ordinary pressures. These include ultra-hard, diamond-like substances, as well as very dense amorphous materials with unusual mechanical and electronic properties. Jeanloz and others have found a novel, if indelicate, method for creating amorphous materials: they simply squeeze a substance until all its structure disappears.

Jeanloz received a BA in geology from Amherst College in 1975 and a PhD in geophysics from Caltech in 1979.

Robert S. Shaw studies chaotic systems on both the theoretical and experimental fronts. He has developed techniques for analyzing data from these systems using information theory. In particular, he found that certain information-theoretic quantities could be used to describe nonlinear physical systems in much the same way as entropy, temperature and pressure describe thermodynamical systems. These quantities, each of which gives a different measure of the unpredictability of a system, provided Shaw and others with a language appropriate to the study chaotic phenomena.

Shaw received a BS in physics from Harvard in 1972, and a PhD in physics from the University of California, Santa Cruz, in 1980. From 1983 to 1985 he was a postdoctoral researcher at the Institute for Advanced Study, and from 1985 to 1988 he worked in the Center for Complex Systems Research, University of Illinois, Urbana–Champaign. The fellowship has enabled Shaw to set up a private computer laboratory in Santa Cruz, where he is trying to extend the uses of information-theoretic parameters to spatially extended systems, such as fluids or spin systems.

Swerdlow's technical analyses of the writings of Ptolemy and Copernicus have provided a better understanding of the historical development of astronomy. Swerdlow has translated and commented on Copernicus's early astronomical work, the *Commentariolus*, in which Copernicus first presented his heliocentric planetary theory. With Otto Neugebauer (Brown University and Institute for Advanced Study), Swerdlow coauthored *Mathematical Astronomy in Copernicus'* De Revolutionibus (Springer–Verlag, New York, 1984), which provides a nearly exhaustive exposition of Copernicus's principal work, *De Revolutionibus Orbium Coeles-*

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tium [On the revolutions of the heavenly spheres]. Currently, Swerdlow is writing the first volume of an introductory history of mathematical astronomy from Ptolemy to Copernicus. (The second volume will cover the period from Kepler to Newton.)

Swerdlow received a BA in music and history from the University of California, Los Angeles in 1964, and an MA in music in 1967 and a PhD in medieval studies in 1968, both from Yale.

—MATTHEW SIEGEL

AAPT TOP HONORS AWARDED TO FRENCH AND BIRGENEAU

At its joint winter meeting with The American Physical Society in San Francisco, the American Association of Physics Teachers presented a full complement of awards and honors. The Oersted Medal, AAPT's highest honor, was presented to Anthony P. French of MIT. Robert J. Birgeneau, also of MIT, delivered the 48th Richtmyer Memorial Lecture; five distinguished service citations were given; and AAPT members who received US Presidential awards for excellence in science and mathematics teaching were publicly recognized at the meeting.

According to the Oersted Medal citation, French's well-known series of introductory textbooks "played a role similar to that of the Feynman lectures—buttressing the level of understanding of the teachers in preparation for instructing their students." Before coming to MIT in 1962, French was a nuclear physicist with strong interests in undergraduate education and the history of physics. He arrived at MIT on an invitation to spend a semester at the newly created science teaching center. When the semester ended, French accepted an offer to remain at MIT working on science education.

In his early years at MIT the main objective for French and his colleagues was to infuse the undergraduate program—which then consisted almost entirely of classical physics—with atomic physics, quantum mechanics and relativity. He wrote a series of textbooks: *Special Relativity* (W. W. Norton and Co., 1968), *Newtonian Mechanics* (Norton, 1971), *Vibrations and Waves* (Norton, 1971), and *Introduction to Quantum Physics* (Norton, 1978, co-authored with Edwin F. Taylor). These books, he feels, did a good job of filling the voids that he had identified in the undergraduate physics curriculum.

French is currently "going to bat again," trying to reinvigorate the freshman curriculum, which has begun to suffer from some of the same problems as it did in the early 1960s. As he noted in his acceptance address, "there seems to be a relentless tendency for curriculum innovations to decay exponentially." He also discussed the merits of teaching physics from a historical perspective and of creating undergraduate curricula that are truer to "our current picture of the physical world."

French received his BA from the University of Cambridge in 1942. After work in the Cavendish Laboratory and with the British Mission to Los Alamos during World War II, he completed his PhD in physics at

Anthony P. French

Robert J. Birgeneau