to the next higher state—meaning that they can't absorb any energy from the flow at all, making it frictionless. This lets the fluid flow without viscosity through tiny fissures and up the sides of containers.

Helium-3 atoms, with one fewer neutron and a half-integer spin, are "fermions," subject to rules that forbid any two of these atoms from being in the same state. Atoms can slosh around in the resulting sea of different energy states, exchanging energy and causing friction. But in 1956, John Bardeen, Leon Cooper, and Robert Schrieffer (BCS) explained the lack of electrical resistance in low-temperature superconductors by showing that spin-1/2 electrons can pair off and act like bosons. Shortly afterward, says Anthony Leggett, a theorist at the University of Illinois, Urbana-Champaign, "a whole lot of people predicted that helium-3 should become superfluid by the same mechanism."


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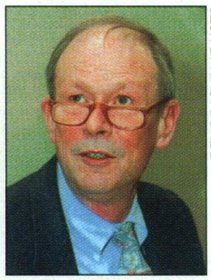
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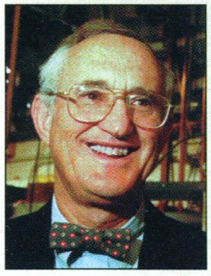

MICHAEL OKONIEWSKI/AP PHOTO

Superfluid helium's three. Osheroff *(top left)*, Richardson *(above)*, and Lee.

Unfortunately, says Leggett, just how the helium-3 pairing should occur was uncertain, so that the predicted temperature of the transition "bounced around" and eluded numerous experimental searches. The Cornell effort, originally designed to search not for superfluidity but for magnetic anomalies in solid helium-3, stumbled on the pressure glitches by luck. As it turned out, they marked a series of superfluid phase transitions in the liquid helium-3.

The team eventually uncovered three different superfluid phases with much more complex pairing structures than those envisioned in BCS theory. Because the cooperative interactions among the pairs of atoms waltzing through the liquid leave a magnetic signature, the team was able to unravel some of these interactions using nuclear magnetic resonance, a technique they were skilled in. Such work took "8 months of solid experimentation," says Lee. "It was a very enjoyable period. One beautiful thing after another happened in the laboratory."

The novel pairings, says John Ketterson of Northwestern University, "make for a very rich structure that initially surprised a lot of folks." For example, says Ketterson, superfluid helium-3 has bizarre modes of oscillation that have no counterpart in normal fluids, and its pairing mechanisms may serve as models for understanding how electrons pair up in high-temperature superconductors, which are still mysterious. With those kinds of riches to explore, it's no surprise that "a whole generation of students studied the material for the next 20 years" after its discovery, says Ketterson. "And people like me are still doing it."

–James Glanz

WINNING INCENTIVES FOR TRUTHTELLING

The 1996 Nobel Memorial Prize in Economic Science was awarded to William Vickrey and James Mirrlees for their studies of humans and the truth: how to get people to tell the truth in economic transactions, and what to do when they don't. In related lines of work that Robert Wilson of Stanford University's graduate school of business calls "fundamental and useful," Vickrey and Mirrlees have changed how economists and businesspeople structure everything from contracts to taxes and auctions.

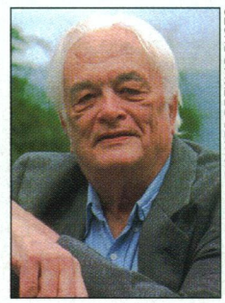
Vickrey, who died suddenly last week, and Mirrlees opened up the study of "informational asymmetries"—situations in which people on different sides of a transaction have incomplete and differing information. In the mid-1940s, Vickrey, who was a professor emeritus at Columbia University, explored the effects of these asymmetries on taxation. He pointed out that the government has incomplete information about incomes, which is why people can cheat on their taxes. He also noticed that taxes can have the effect of lowering people's productivity by reducing their incentive to work. People offered a promotion may have less incentive to take the new job if it catapults them into a higher tax bracket.

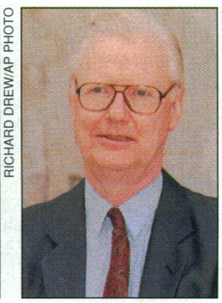
Vickrey made great headway in designing an optimal income tax which wouldn't reduce incentives to work and would distribute the tax burden fairly. But it fell to Mirrlees a quarter century later to sort through the problem's complicated mathematics. In 1971, Mirrlees, currently a professor at Cambridge University, devised a new analytic method that simplified drastically the mathematics of not only Vickrey's optimal tax problem, but a host of other tough economic problems where parties don't share the same information. According to Avinash Dixit, professor of economics at Princeton University, "[Mirrlees's ideas] have provided the basis for almost all the subsequent progress in areas as diverse as taxation, regulation, contracts, and auctions." Indeed, Mirrlees's methods soon gave rise to the "revelation principle," which states that the solution to an incentive problem with informational asymmetries is to set up a situation in which it is to everyone's advantage to disclose private information—truthfully.

Back on the other side of the Atlantic, Vickrey had discovered how to do just that—at least in auctions. In an ordinary sealed-bid auction, people often have little incentive to bid an object's true value: Objects go to the highest bidder, and, in general, buyers deflate bids, hoping to get a bargain. Only in bidding wars do people reveal what they are truly willing to pay. In the early 1960s, Vickrey solved the problem when he came up with the "second-price" auction, now called a Vickrey auction. This scheme awards the object to the highest bidder—but she pays only the amount of the second-highest bid. Thus, a bidder has a strong incentive to bid the object's true value: She knows up front she won't have to pay her full offer, and if she submits a low-ball bid and loses, her competitor winds up getting a big price break.

Vickrey's and Mirrlees's work has had an enormous impact on the business world. The recent Federal Communications Commission auction of bandwidth was a direct descendant of the Vickrey auction, for instance. The federal government is also beginning to experiment with an application of the revelation principle known as a uniform price rule in auctions of treasury bills. Instead of auctioning off T-bills in the standard way, the government combines bids to determine demand. They then sell the entire lot at the same "uniform" price. According to Stanford's Wilson, the design of the deregulation of one of America's biggest industries—the power industry—is also based upon principles founded by Mirrlees and Vickrey. Soon, generators, power plants, and raw materials will go on the block.

–Charles Seife


RICHARD DREW/AP PHOTO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Honesty honored. Vickrey *(left)* and Mirrlees *(right)* revolutionized auctions.

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