P.A.M. Dirac, 1902-1984

Fermilab

"I was not trying to solve directly some physical problem but to look for some pretty mathematics." Paul Adrien Maurice Dirac frequently used words of that sort to describe his work. His life was a search for beauty in mathematics, particularly the mathematics of physics, a search for symmetry, balance and simplicity (SN: 6/20/81, p. 394). In spite of the repeated disclaimer of physical intent, his formulations often had the most surprising physical consequences. For Dirac the search ended Oct. 20, when he died in his home in Tallahassee, Fla., at the age of 82.

Of P. A. M. Dirac's many contributions to physics, perhaps the best known is his prediction of the existence of negative energy states, that is, antimatter. A few years ago, when a colleague proposed to name an equation for him, he declined the honor saying, "So many things in physics are already named for me." A true mathematical physicist, he never worried whether experimenters were able to confirm the physical effects of his predictions. One of the important ones, the existence of magnetic monopoles, is still outstanding 50 years after it was made, and is the object of an intense experimental search.

Dirac was born in Bristol, England, on Aug. 8, 1902, the son of a teacher of French. In 1921 he received a B.Sc. degree in electrical engineering from the University of Bristol. Not finding work in that field, he matriculated at Cambridge University as a graduate student in physics. He received his Ph.D. in 1926, and was appointed a fellow of St. John's College, Cambridge. In 1932 he became Lucasian Professor of Mathematics, the chair that Isaac Newton had held. In 1933 he shared the Nobel Prize with Erwin Schrödinger, both being honored for work in quantum mechanics. In 1937 he married Margit Wigner, sister of another famous physicist, Eugene Wigner. In 1969 he retired from Cambridge University, and in 1971 became professor of physics at Florida State University in Tallahassee, a post he held until his death. —*D. E. Thomsen*

Making snow the microbial way

Earlier this year, a federal court blocked the University of California's release of a genetically engineered microbe aimed at preventing frost damage to crops (SN: 5/26/84, p. 325). Now, a Berkeley, Calif., company is marketing the natural form of the microbe — which triggers, rather than blocks, ice formation — as a snowmaking device at ski resorts. The microbial snow will demonstrate its fluff at a number of Rocky Mountain ski slopes this season after three years of field-testing at Copper Mountain in Colorado.

The frost-forming organism that damages $1 billion worth of crops annually in the United States is a natural for snowmaking; it may even play a role in cloud formation. The bacterium, *Pseudomonas syringae,* makes a protein complex in its outer membrane that serves as a nucleus for ice crystal formation. On leaves, where the bacteria naturally exist, the protein complex induces ice crystals at temperatures just below freezing that a plant could otherwise withstand. Added as a freeze-dried powder in a snowgun, the bacteria make snow more efficiently by triggering freezing at higher temperatures. Water is normally supercooled with compressed air — the expensive part of snowmaking — to about −10°C before it will crystallize, but the bacteria can form ice at about −3°C. "Basically, you don't need as much compressed air to cool the water," says Thomas Dyott, president of Advanced Genetic Sciences (AGS), which markets the bacteria as Snomax.

The company purchased rights to the bacterial snowmaking method from the University of Wisconsin in Madison, where Steven Lindow, now working on bacterial frost damage at the University of California at Berkeley, first struck upon the use of the ice-forming organism to make snow. The company, unaffected by the ruling against the University of California experiment, is also preparing to test the altered form of the bacteria in field crops (SN: 6/9/84, p. 356). Although Snomax is a naturally occurring strain, the company's researchers have developed genetic variants with improved ice-nucleating ability for potential future use. Right now, the company is increasing production of the natural strain for large-scale marketing next year. Dyott estimates a ski resort could use 200 to 1,000 pounds of bacteria to ice up about 200 million gallons of water in one season.

Are there any dangers to microbial snow? AGS bacteriologist Trevor Suslow thinks not, since the cells are debilitated with gamma-radiation so they can't reproduce in the environment. Because the snowmaking bacterium is not genetically altered, it was not included in the suit filed by the Foundation on Economic Trends against the University of California, though foundation Director Jeremy Rifkin says the introduction of the bacteria could "change the balance" of the ecosystem. Bacteriologist John Ingraham of UC Davis says the snow-related use is probably benign. —*C. Mlot*

Cautious optimism on Alzheimer's finding

Preliminary success using direct infusion of a drug into the brains of Alzheimer's disease victims, presented in the October NEUROSURGERY, has generated great interest and publicity. But the word from both the researchers and others in the field is caution — the treatment was tried on only four patients, and evaluation has only been short-term.

Four patients at the Dartmouth-Hitchcock Medical Center in Hanover, N.H., who had memory loss and other behavioral signs of Alzheimer's, were fitted with pumps in their abdomens connected to their brains by tubes. Tiny samples from the brain surface were taken at the time of surgery to confirm the diagnosis.

Following surgery, all four patients received bethanechol chloride, a compound similar to the neurotransmitter acetylcholine, via the pumps. Alzheimer's victims are deficient in acetylcholine. The drug was alternated with a placebo at three- to four-week intervals; what the patient was getting was known to the researchers but not to the patients or their families. The patients' cognitive test scores didn't improve while on the drug, but the families reported better functioning corresponding to drug treatment, and a return to baseline during placebo administration.

Notes David W. Roberts, one of the Dartmouth researchers, "These are very preliminary observations." Adds coauthor Robert E. Harbaugh, "All the positive data are from patients and their families."

Among the concerns of other researchers: The treatment is invasive and addresses only the acetylcholine lack, not other changes seen in Alzheimer's.

"It has quite a few limitations but nevertheless is quite exciting," says Zaven Khachaturian of the National Institute on Aging in Bethesda, Md. "The value is that it shows that direct application of certain [drugs] works, but it needs a lot of work before we can jump to the conclusion that it's safe and effective."

Notes Peter Whitehouse of Johns Hopkins University in Baltimore, "There's a certain skepticism about it among Alzheimer's researchers, because of the small number of patients studied and the manner of assessment used." —*J. Silberner*