

BNI Lecture: Blood Cell Labeling

Last September, a medical kit developed at BNL for labeling human red blood cells with the radioisotope technetium-99m received an I-R 100 Award, as one of the top technological



Mort Rosen

Suresh Srivastava

achievements for 1986. But this kit is more than a marker for a single year: It is the result of several years of research and development at BNL and heralds a new phase for the field of blood cell labeling.

The Laboratory's role in technetium chemistry research and blood cell labeling — past, present and future — will be discussed by kit-developer Suresh Srivastava, head of the Radionuclide and Radiopharmaceutical Research Division in the Medical Department, in the 232nd Brookhaven Lecture. His talk, entitled "State of the Art (and Science) of Blood Cell Labeling," will begin at 4:30 p.m., on Wednesday, February 18, in Berkner Hall.

Srivastava draws the title of his lecture from the fact that the art of blood-cell labeling has only recently become scientifically precise. The ability to obtain reproducible and predictable results in the human body has made blood cell labeling, particularly with

technetium-99m (^{99m}Tc), an important tool in nuclear medicine. Today, 85% of all diagnostic imaging procedures done worldwide use ^{99m}Tc .

In his lecture, Srivastava will briefly describe the history of ^{99m}Tc , which was developed at BNL beginning in the 1950's. The use of ^{99m}Tc for non-invasive diagnostic imaging grew in the 1960's, after BNL researchers developed a generator for individual hospitals to make their own ^{99m}Tc .

Later, extensive research began to be carried out at BNL to devise kit techniques for labeling a variety of radiopharmaceuticals with ^{99m}Tc for the imaging of just about every organ system in the body. A BNL red-blood-cell-labeling kit, introduced in the 1970's, was the predecessor to the award-winning version developed by Srivastava.

Focusing on red blood cells, Srivastava's talk will explain various mechanisms for transporting ^{99m}Tc through a cell membrane and maintaining it within the cell. He will also discuss how one mechanism — monoclonal antibodies (MAb) — seems to offer further improvements and the best prospects for the future. When labeled with suitable radioisotopes, MAbs have the potential to act as "magic bullets" of radioactivity, either for diagnostic imaging (e.g. with ^{99m}Tc) or for destroying tumors (α - and β -emitting nuclides).

There has been a major emphasis in Srivastava's group on research on diagnostic and therapeutic applications of labeled MAbs, including for cell labeling. Emphasizing future research efforts and the need to be able to label cells other than red blood cells, Srivastava will explain why he believes, "In the next five years, we will probably not see anyone using anything other than monoclonal antibodies to label various cell types selectively in a whole blood sample or in vivo."

Suresh Srivastava received his Ph.D. in Inorganic/Analytical Chemistry from the University of Allaha (Continued on page 3)

Neutrino Oscillation? No Conclusion Yet

Do muon-neutrinos transform themselves into electron-neutrinos? If you can definitively answer the neutrino oscillation question, you might win yourself more than \$64,000 — you might win yourself a Nobel Prize.

Possibly yes was the answer given by two sets of experimenters presenting their preliminary results of early data to over 75 participants at the BNL Neutrino Workshop, held February 5-7. However, results from two other experiments discussed at the workshop contradict these findings.

"The evidence is not compelling on either side," said Workshop Chairman Alan Carroll, Alternating Gradient Synchrotron (AGS) Department. "As there are uncertainties in the results and the differences are not so great, their data could end up being consistent."

As Frank Merritt of the University of Chicago stated during his summa-

tion of the workshop, "Since there are contradictions, it is not now possible to draw a conclusion about neutrino oscillation, and it is most likely that we have not yet settled the question."

Neutrinos are electrically neutral particles, which experience only the weak force associated with radioactivity and nuclear decay. Neutrinos are thought to come in three "flavors," one of which, the muon-neutrino, was discovered at BNL in 1962. The first neutrino to be found was the electron-neutrino; the tau-neutrino, though strongly indicated, has yet to be directly observed.

Neutrinos were thought not to have any rest mass, but it is now suggested that neutrinos may have a small mass. As there are many neutrinos in the universe, their small masses could add up to be the mysterious "missing mass" in the universe.

(Continued on page 2)



Mort Rosen

BNL Neutrino Workshop organizing committee members (standing, from left) Wonyong Lee, Columbia University, of E776; Francois Vanucci, University of Paris and Boston University, of E816; (seated, left) Michael Murtagh, Physics Department, of E734; and Workshop Chairman Alan Carroll, Alternating Gradient Synchrotron Department, discuss the agenda with Workshop Secretary Katherine Einfeldt, Director's Office.

Mapping Crystal Structure

Though they look like cartographer-drawn contour maps of some changing landscape, these diffuse scattering maps were actually drawn by computer and show how synchrotron radiation scatters when it is directed at a single crystal sample.

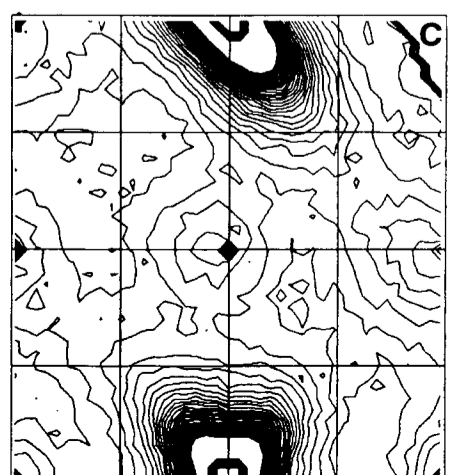
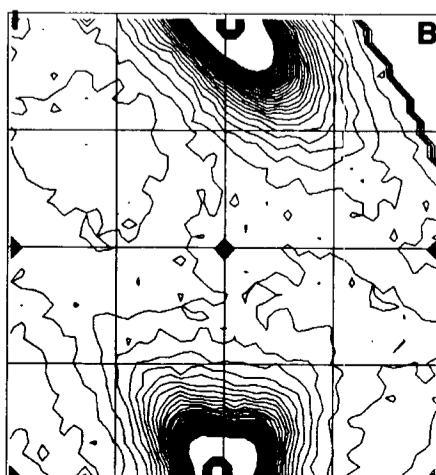
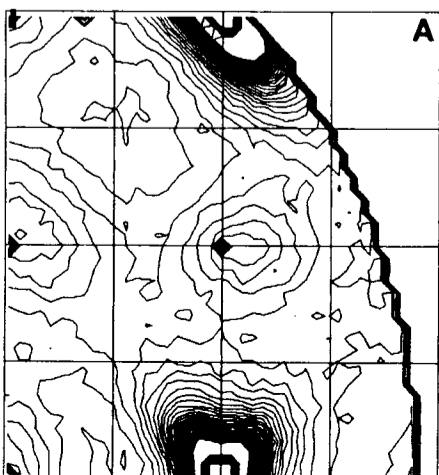
The maps were produced by bathing a single crystal of the alloy nickel-80, iron-20 ($\text{Ni}_{80}\text{Fe}_{20}$) in the synchrotron radiation available at beam line X-14 of the National Synchrotron Light Source (NSLS). The contour-like maps show Oak Ridge Laboratory (ORNL) scientists an unusual short-range order peak in this $\text{Ni}_{80}\text{Fe}_{20}$ sample.

Short-range order means that, on average, the alloy's iron atoms will be next to nickel atoms and vice versa, though at great distance, their placement will be random. Though short-range order has been credited with altering the properties of many materials, its effect on such things as strength and ductility is not yet well-known because it is difficult to measure.

In maps such as these, a short-range-ordered alloy will form a peak near the position indicated by the diamond in the center of each grid. Normally, the contours around the

peak would be expected to be symmetrical around the grid's center point. "But these peaks are unusual," explained Physicist Gene Ice of ORNL, "in how unsymmetrical they are and in the way the peak changes position with x-ray energy."

In map A, the peak was set to the right when x-ray beam energy was 7.092 thousand electron volts (keV). In map B, as the x-ray energy was raised to 8 keV, the peak disappeared. In map C, the energy rose to 8.313 keV and the peak reappeared, shifted to the left.



Ice said that this is the first time such an unusual pattern has ever been measured. "This is significant," he said, "because it tells us that the iron and nickel atoms are different sizes in the crystal structure. If atoms are different sizes, the big ones tend to push little ones away, creating a kind of disorder that shows up by shifting the position of the short-range-order peaks."

"This size effect has been theorized in recent work at Oak Ridge," continued Ice, "as being most likely due to differences in magnetic properties

of the atoms that cause materials to become short-range ordered, rather than clustered, where like atoms group together. This may be verification of that theory."

To study this further, the group is preparing to analyze additional samples at the NSLS, before the x-ray ring's scheduled shutdown in late February. "Experiments such as this," Ice said, "are made possible by the high intensity and stable beam available at the National Synchrotron Light Source."

Valentine's Day Vignettes

At a scientific laboratory such as Brookhaven, it's appropriate that there should be lots of good chemistry. And over the Lab's 40 year history, good chemistry has resulted in dozens of happy couples. For this Valentine's Day, five BNL couples who met here and later married share their Laboratory love stories.



Dolores & Jeff Knighton

Dolores and Jeff Knighton — "We liked each other's type and style," jokes Dolores, punning with some of the jargon she and Jeff share in their positions as Senior Specialists in the Photography & Graphic Arts Division (P&GA). That's where they met, in 1975 when Dolores first came to BNL; Jeff had already been with P&GA for 12 years.

After they had worked together for a while, "I asked her out," recalls Jeff, "and she turned me down for the longest time."

Explains Dolores, "I didn't want to fraternize with the 'hired help,' but Jeff was so persistent that I decided to go out with him once. That was it. But it wasn't love at first sight — I knew him, I liked him, we got to be friends. I married my best friend."

Though Dolores and Jeff were married in September 1979, they still act as if they are courting. Not only do they work together (on Thursday they even share a work room while Dolores lays out Bulletin pages and Jeff strips in the week's photographs), but they also take all their breaks together. "We bring our lunch in the same paper bag," says Dolores.

What accounts for this togetherness? Jeff summed it up for both of them, saying, "There is no one I'd rather be with."



Ruth and Sean Coughlan — Ruth and Sean met at a party in May 1983. Ruth, a Chemical Engineer in the Department of Applied Science, was living in Wading River with four friends, all of whom worked at BNL. They decided to have a party, and, she recalls, "We invited everyone we knew, so we would have a good mix."

Sean, who is a Biochemist in the Biology Department, was one of the guests. After they were introduced, Ruth said, "We sat on milk crates, because we had very little furniture, and we talked for about two hours. We took a liking to each other from the start."

That initial conversation had to last for a while because, Sean remembers, "I left for a month-long trip to Europe for a conference about a week after. But luckily, she decided to wait for me, and we took it from there."

To the altar was where they took it: Ruth and Sean Coughlan were married in September 1985.



Beth & Slim Blevins



Edy and Frank Thornhill — Now a Project Engineer in the AGS Department, Frank starting working at the Lab in August 1957, in the Cosmotron Department. "On one of my first days at the Cosmotron," he says, "I went the wrong way through the door and slammed into Edy. I literally knocked her off her feet."

Edy, who had joined the department four months earlier says now that it "was very funny, though at the time I was as embarrassed as he was."

Shortly after that, Frank recalls, "By way of apologizing and, of course, wanting to meet a pretty lady, I asked her out to dinner." They began dating and were married in November 1958.

Edy left the Cosmotron Department and the Lab in 1959 to have their first child. She returned in 1975, to the secretarial pool, and today is a Senior Personnel Assistant in the Office of Scientific Personnel. And today, five children and two grandchildren later, Frank says, "I'd do it all over again."



Ruth & Sean Coughlan

Beth and Slim Blevins — In 1978, Beth was working in the Research Library. There, she remembers, Slim came by "in the line of duty." Slim is a Custodial Supervisor in Plant Engineering Division and, says Beth, "It's the nature of his job to check on many buildings during the course of a day."

So, when Slim went to check on the Research Library, he was introduced to Beth and they got to know each other. To Slim, "Beth kind of stood out in a crowd. I see a lot of people during the day. She just seemed special, and we struck up a kind of acquaintance thing for a while."

The acquaintance thing became a dating thing around 1980, then a marriage thing in April 1985, when Beth and Slim were wed. Though Beth now works in the Director's Office and has changed buildings, Bldg. 460 is on Slim's current route, and she looks forward to seeing him on his rounds.



—photos by Rosen



Frank & Edy Thornhill

Neutrinos (cont'd)

If neutrinos change back and forth from one flavor to another, this oscillation would be proof of their having mass.

To prove that neutrinos oscillate and hence have mass, experimenters at the AGS and around the world are looking for muon-neutrinos to change into electron-neutrinos. They do this by searching for electrons that are supposed to arise when muon-neutrinos oscillate within a massive detector. If oscillation does not occur, then no electrons would result, as muon-neutrinos normally produce only muons.

In addition to neutrino oscillation, however, electrons can result from two background sources and be a source of experimental error, explained Neil Baggett, Special Assistant to the Associate Director for High Energy & Nuclear Physics, Robert Adair. First, the muon-neutrino beam could be contaminated with electron-neutrinos, which produce electrons. Or, second, electrons could arise from other interactions of muon-neutrinos.

Preliminary analysis of partial data suggests that an excess of electrons was seen by AGS Experiments 776 and 816, which completed their first runs last May.

E776, a Columbia University, University of Illinois and Johns Hopkins University collaboration using a 250-ton detector one kilometer away from the neutrino-producing target, estimated the excess to 17 electrons above background, which is significant.

E816, the combined effort of Boston University, BNL, CERN and the Uni-



Ellie & Dick Adams

Ellie and Dick Adams — Ellie, a Senior Executive Secretary for Associated Universities, Inc., shares an office area with Marge Stoeckel, Fiscal Division. And they were working together back in 1975, when Marge persuaded Ellie to fill a gap on her BNL bowling team. Though Ellie had never bowled before, she agreed to bowl on her friend's team.

Then as now, the Men's League played at the Port Jefferson lanes on the same night as the Women's League. Dick, a Supervisor with the Reactor Division, was on the same team as Jim Roesler, Safety & Environmental Protection Division. Jim, it turned out, had gone to Port Jefferson High School with Ellie, and he introduced Ellie to Dick.

Recalls Dick, "I had gone to Port Jeff years before, and we knew some of the same teachers. I was infatuated with her when we met, and I still am."

And Ellie says, "I had never seen him before. I also had never bowled before. I am still a terrible bowler, but I have a wonderful husband."

Ellie and Dick became husband and wife in December 1976.

Notice

The Laboratory will be closed on Monday, February 16, in observance of Presidents' Day.

versity of Paris, also reported a significant excess — 35 electrons, seen with their ten-ton detector, which is 150 meters from the target.

However, workshop participants agreed that E776 and E816 need to refine the error analysis of their data. Commented Carroll, "These are difficult experiments and there are doubts, so the best way to resolve them is to discuss them in detail at a workshop such as this."

Results from the Big European Bubble Chamber at CERN and another AGS experiment, the recently completed E734, which is a joint project of BNL, Brown University, State University of New York at Stony Brook, University of Pennsylvania, and Japan's Hiroshima University, KEK and Osaka University, found no evidence for neutrino oscillation in their data. In fact, they put upper limits on the oscillation that would seem to exclude the positive observations of E776 and E816.

"The discovery of neutrino oscillation would be fantastic — but it has got to be done cleanly," added Merritt. To settle the question cleanly, he suggested that excess electrons assumed to result from oscillation be looked for over a distance from the source of neutrinos. That means the use of at least two detectors per experiment, each at a different distance from the target.

Participants at the workshop had suggestions for the positioning of two detectors, ranging from adding another detector at 300 meters from the AGS neutrino source, to having a detector floating in the Long Island Sound, to locating one in Canada.

— Marsha Belford

In Memoriam

It has been learned that **Walter (Dutch) Becker**, who retired in June 1965, died on February 1. He was 86 years old. At the time of his retirement, Becker, who came to the Lab in March 1947, was a Site Maintenance Supervisor in the Plant Maintenance Division. He lived in East Patchogue and is survived by his son and daughter-in-law, Walter and Kathy Becker, both in the Department of Nuclear Energy; another son, Manfred Becker of Connecticut; and a daughter, Ida Koskinen of East Patchogue.

Pick a Student

Completed applications for the 1987 Summer Student Program will be available for review in Room 5-31, Bldg. 490, Medical, from February 23 through March 6.

Guidelines regarding the selection of summer students have been distributed to research department offices. If interested, please contact your department coordinator. Staff members are invited to review applications to select students who will work under their supervision from June 1 through August 7.

Lecture

(cont'd)

habad in 1961. From 1962 to 1965, he was an AEC Fellow in Chemistry at Louisiana State University. After that, he came to BNL for the first time, spending two years in the Department of Nuclear Engineering. He returned to BNL in 1975, in the Department of Applied Science, and two years later joined the Medical Department, becoming head of his division in 1983.

In addition to the I-R 100 Award, Srivastava received the NATO-ASI Award in 1986. Also last summer, he directed and organized a two-week international meeting in Italy, devoted to the subject of radiolabeled monoclonal antibodies.

All those interested in getting together after the lecture are invited to go with the lecturer to a restaurant off site. Anyone who would like to be part of this group should call Naomi Pappas, Ext. 3699.

Inside Info

Frances Bernstein, a Chemistry Department Programmer/Analyst, and Herbert Bernstein, a Department of Applied Science Research Collaborator, are proud of their 15-year old son, Daniel, for being one of the 40 winners of this year's 46th annual Science Talent Search, sponsored by Westinghouse Electric Corp. and the Westinghouse Education Foundation.

Daniel's mathematics project, "New Fast Algorithms for π and e ," was one of 1,295 entries. Daniel, a senior at Bellport High School, has been accepted by Princeton University.

As a Westinghouse winner, Daniel will attend the five-day, all-expenses-paid Science Talent Institute, in Washington, D.C., beginning February 26. There, he will compete for \$140,000 in Westinghouse science scholarships and awards.

Daniel follows in his father's footsteps, as in 1961 Herbert Bernstein was one of the 40 Westinghouse winners, also for a mathematics project, but in game theory.

John J. Downey, an Industrial Physician with the Medical Department who retired in 1980, has been elected a member of the American Association of the Sovereign Military Order of Malta. His investiture by John Cardinal O'Connor took place at St. Patrick's Cathedral on January 16. Before coming to BNL in 1969, Downey was a Captain in the Medical Corps of the U.S. Navy.

Letter to the Editor

To the Editor:

Last week on my way to work, I hit an icy spot on the ramp from Route 25 to William Floyd Parkway and skidded into a snow bank. Many BNL people stopped and offered to help. One had a shovel, and five men dug and pushed me out. I certainly appreciated everyone's concern and help. Thank you one and all.

— Harriet Tobin

Candidates Named For BERA Board

The BERA Nominating Committee has selected the following slate of candidates for the 1987 BERA Board election: Haskell Frei, Reactor Division; Jean Ramirez, Department of Nuclear Energy; Sharon Smith, Physics Department; and Edward Sperry IV, Accelerator Development Department.

During the week of March 16 through 20, eligible BERA members, including employees of BNL, AUI, DOE and all other permanent on-site employees, will be invited to cast their ballots to elect two of the four candidates to serve on the BERA Executive Board.

More information on the candidates and the election will be published in the March 6 issue of the Brookhaven Bulletin.

HMO Enrollment

Representatives of the various Health Maintenance Organizations that are being offered as additional health care options to active BNL employees will be at Berkner Hall on Wednesday, February 18 and 25, between 11 a.m. and 2 p.m., to answer employees' questions about their plans. Employees are reminded that the deadline for HMO enrollment is February 27, with coverage effective March 1. Those wishing to enroll in one of the optional HMO plans must send their completed applications to Personnel Services, Bldg. 185, Ext. 2877.

Exercise & Bodybuilding Club

Dues for the Exercise & Bodybuilding Club will be collected at noontime, in the gymnasium, from February 16 through February 20. New memberships will also be accepted. For more information, call John Rubino, Ext. 3397.

Arrivals & Departures

Arrivals

Bessie M. Gardner Plant Eng.
Stephen D. Unwin DNE

Departures

This list includes all employees who have terminated from the Laboratory, including retirees:
Mikhael Pritsker AGS
Edward G. Samsel Chemistry



A Murder for Your Valentine

This Valentine's night, curdle your blood with "Crimes of Passion," an evening of murderous love stories dramatically presented by crime historian E.J. Wagner, pictured here at the piano. Wagner finds clues for her tales of fatal passion by researching fact and fiction from medieval to modern times. Brookhaven Women in Science is sponsoring the evening to benefit the Renate W. Chasman Scholarship Fund. At 8 p.m., February 14, in Berkner Hall, the "Crimes" begin, and the event is open to the public. The \$5 admission tickets, which are tax-deductible, can be purchased in advance from:

Name	Bldg.	Ext.
Pat Aud	120	7560
Penny Baggett	902B	5154
MaryAnn Castrogivanni	535A	3898
Alyce Daly	197D	5203
Eena-Mai Franz	703	7103
Rae Greenberg	510A	3743
Louise Hanson	815	7709
Pat Harlin	725B	4828
Maggie Marsch	426	3275
Harriet Martin	477A	3487
	911C	4853
Flo O'Brien	475	4953
Mary Phillips	801	3289
Sharon Spark	515	4111
Jean Stafford	185A	3336
Pat Webster	1005	4628
Bonnie Wesolowski	555A	4301

Aviation Club

Larry Leipuner and Doug Sweely will conduct a ground school for the private pilot rating. The classes will be held at BNL for three hours a week for 15 weeks. A preliminary meeting will be held Monday, February 23, at noon in the Berkner Hall lobby. There is no fee; however, participants will be required to purchase a text and supplies. Please call Doug Sweely, Ext. 4237, to register.

Bowling

Red/Green League
High games were bowled by E. Sperry IV 244/200/610 scratch, J. Connelly 243/221/663 scratch, H. Marshall 216/600 scratch, G. Meinken 235, F. Griswold 202.

Pink League
Ellie Kristiansen had games of 200/194, Ellie Adams 188, Maryann Reynolds 179, Andrea Epple 172, Joanna Hanz bowled 55 pins over average.

Purple League
High games were bowled by Karen Vogel 180, Millie Connolly 178, John Connolly 204/201, Mary Adessi 189, Mary Scheidet 225, Rich Scheidet 202.

White League
Ed Meier rolled a 211, Ted Erickson 204, Ken Riker 200, Sue Pepper 187, Jeannette Thiede 187.

Scotch doubles coming up March 15. For information, call Maria Apelskog, Ext. 3138.

Basketball

Game 1

Longshots - 69	Runaways - 68
W. Cummings 25	J. Desmond 24
J. Cyr 21	R. Moran 20
J. Garrison 8	G. Shepherd 12
L. Walcott 8	T. James 8
L. James 5	M. Annerella 4
F. Molone 2	

Game 2

Hollywood - 60	Celtics - 57
E. Meier 21	R. Garapolo 19
G. Mack 11	J. Gaeta 11
D. Nordstrum 10	M. Fulkersen 10
W. Gunther 6	P. Brown 9
R. Domenech 4	T. Farmer 4
G. Smith 4	N. Schaknowski 4
R. Kowalski 2	
M. Williams 2	

Volleyball

Standings — Week of February 2

Open League	
Phoenix	33-3
Dakota	32-4
Odds & Sods	19-17
Target	18-18
Rowdy Radicals	17-19
Court Jesters	15-21
Duituits	6-30
Out of Control	4-32

League I	
Dinkers	28-5
Upfagrabs	25-5
Xrayted	15-15
Phoubars	11-19
Bumpers	8-22
Net Results	6-27

League II	
Cannonballs	24-6
Nuts & Bolts	20-4
TNT	18-6
Fossils	17-10
Chunga's Revenge	12-18
Upton Ups	3-21
Misfits	2-25

League III	
Floater	23-7
Foul Ups	21-9
Printouts	19-11
Screwballs	14-16
Sourcerers	13-17
Not Yets	12-21
Odd Couples	6-24

Fabulous Forty Footnote

After publication of the history of the BNL pool (see Brookhaven Bulletin, January 30, 1987), it was learned from Research Collaborator Raymond Davis, Chemistry, that the pool had been the proving ground of his now famous experiment to detect neutrinos from the sun.

Davis's solar neutrino detection experiment, begun in 1967 one mile underground in the largest gold mine in the western hemisphere, astounded the astrophysics and nuclear physics communities by measuring a neutrino flux one-third of the predicted value. As a result, scientists have been forced to question the assumptions underlying the theories of stellar structure and evolution.

"In 1964, when we were designing the neutrino detector, we wanted to test some nozzles, measure flow rates and gas distribution," explains Davis. "We were looking for some deep water, and the only deep water around was the pool — so we got permission to use it on a day when it was closed."

The idea behind the actual experi-

ment in the Homestake Mine, South Dakota, was to bubble helium gas through the nozzles into a 100,000 gallon tank of liquid perchlorethylene, C₂Cl₄. When a solar neutrino passed through the tank, an isotope of chlorine, chlorine-37, would absorb it and become argonne-37. As a purging gas, helium would be bubbled into the liquid to remove argonne-37. In decaying back to chlorine, the argonne isotope would release the neutrino, which then could be counted.

To test the nozzles, Davis had a model of his detector tank lowered into the pool; the pool's chlorinated water substituted for the perchlorethylene and air was bubbled through the nozzles instead of helium. Reports Davis, "I had completed one of the first aqualung courses at the pool, so I was able to swim around underwater using scuba gear during the test — when I enrolled in the course, I had never thought that scuba diving would come in handy for my research."

— Marsha Belford

Concert Tonight!

The Concord String Quartet continues a series of all-Beethoven concerts tonight, beginning at 8:30 p.m. in Berkner Hall. Tickets will be available at the door at \$9 general admission, \$6 for students and those over 65, and \$5 for those under 18.

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