FERMI NEWS

FERMILAB A U.S. DEPARTMENT OF ENERGY LABORATORY

NuMI Construction Begins 2

Photo by Reidar Hahn

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INSIDE:

HOW to Tell a

Dixon Bogert, NuMI project manager

by Judy Jackson

Those who would fathom the secrets of that exotic will-o'-the wisp of the particle kingdom, the neutrino, will first have to deal with a more prosaic form of matter.

Dirt.

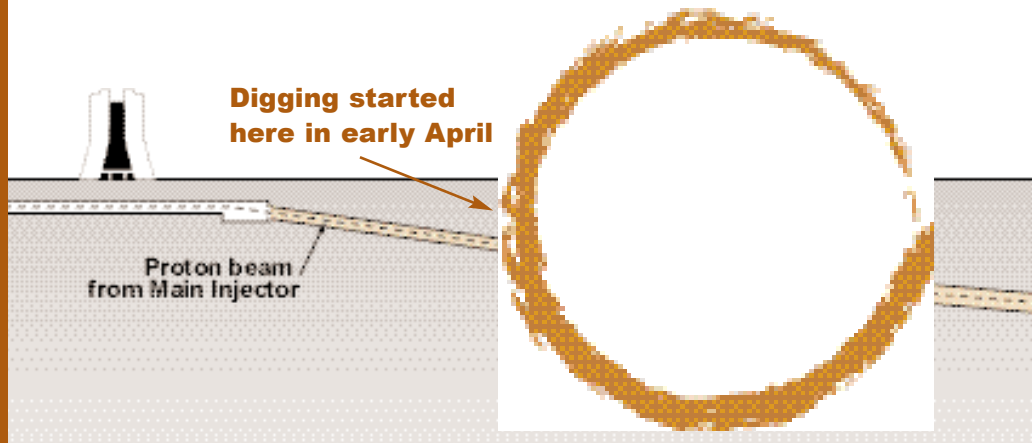
They will have to dig over a thousand cubic yards of it from its rightful home near the Main Injector's perimeter, creating a cylindrical hole 24 feet in diameter and 70 feet deep.

Then they'll hit rock. At which point, they'll have a blast. Quite a few blasts, in fact, using carefully controlled explosives to punch through the dolomitic limestone and shale that lie beneath the surface of northeast Illinois.

All that digging and blasting will produce a 200-foot-deep hole in the ground—and the main shaft for the target hall for the NuMI/MINOS experiment, the next step in the world-wide effort to understand neutrino mass.

The NuMI Project

The subatomic particles called neutrinos come in three flavors: electron, muon and tau. Although no experiment thus far has directly observed the change from one neutrino flavor to another, such a change, called oscillation, is quite possible.



Cover: Dig we must! Rush L. Syce, of subcontractor Tunnel Electric, Inc., does some early earth moving for the NuMI construction project.

from a Hole in the Ground

Scientists from Fermilab and some 30 other U.S. and foreign institutions have designed a set of facilities, collectively called NuMI, for "Neutrinos at the Main Injector," to search for neutrino mass by looking for evidence of neutrino oscillation from one neutrino flavor to another. The MINOS ("Main Injector Neutrino Oscillation Search") experiment will use these new facilities to take advantage of the unique capabilities of Fermilab's new particle accelerator, commissioned in 1999.

The digging that started in early April marks the start of construction for a new particle beamline. It will direct a nearly pure beam of muon neutrinos from the Fermilab Main Injector toward two detectors, "near" and "far," both capable of detecting and counting all three flavors of neutrinos. If the far detector, 735 kilometers from Fermilab in northern Minnesota, finds another neutrino flavor besides muon neutrinos, the experimenters will know that some of the muon neutrinos that started out at Fermilab must have oscillated, and hence must have mass.

To make the neutrino beam, physicists will send a beam of 120 GeV protons from the Main Injector to a graphite target, creating a secondary beam of pions and kaons. Some of the pions and kaons immediately decay into muons and muon neutrinos. The beam next passes through 750 feet of rock and steel, stopping the muons. Result: a nearly pure beam of muon neutrinos, northward bound.

The MINOS near detector will measure the number of neutrinos in the beam before it leaves Fermilab. The far detector will check the beam again 2.5 milliseconds later, after the neutrinos' near-light-speed trip to Minnesota.

In July, 1999, groundbreaking took place for the Minnesota end of the experiment, where MINOS experimenters will build a 5,000-ton steel and plastic detector half a mile underground in a newly excavated cavern in a historic iron mine.

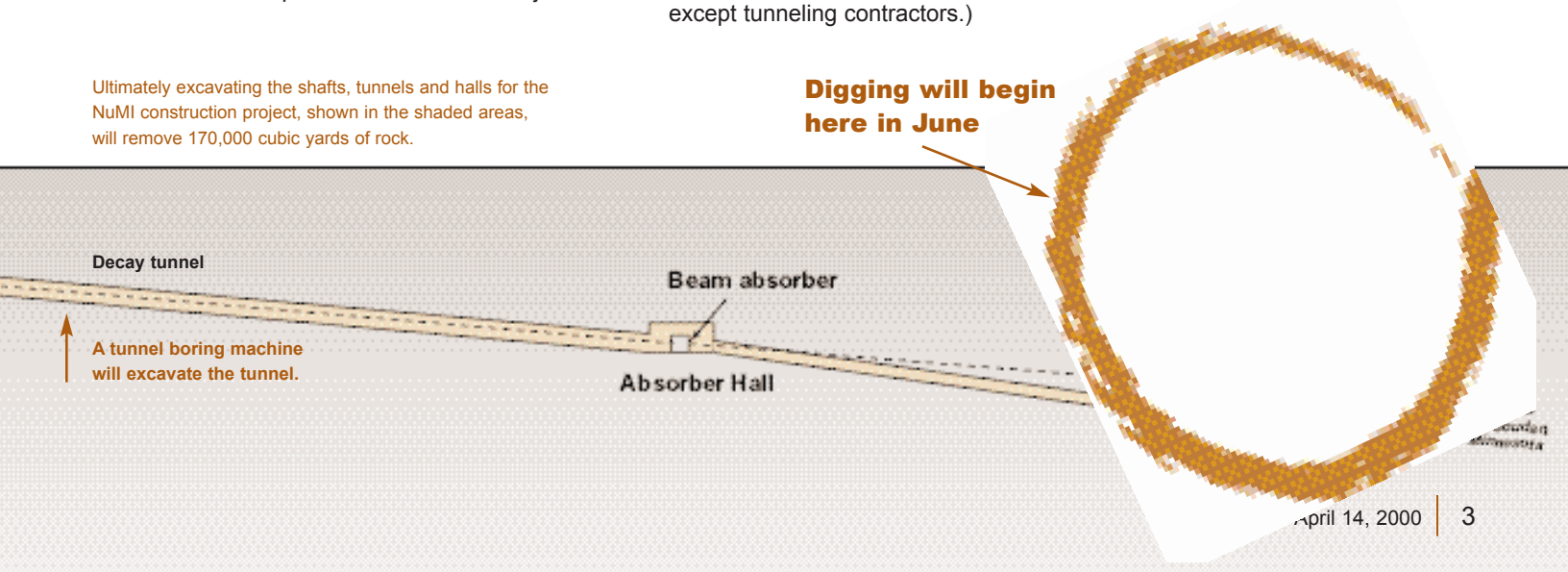
Now the time has come to build the Fermilab end of the project.

(Fortunately, since neutrinos can and do pass through the earth without so much as slowing down, there is no need for a 735-kilometer tunnel from Illinois to Minnesota—good news for everyone except tunneling contractors.)

Photos by Reidar Hahn

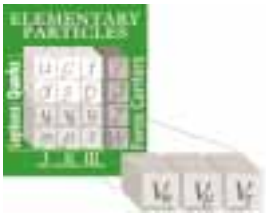
Fermilab's NuMI construction manager Chris Laughton

Ultimately excavating the shafts, tunnels and halls for the NuMI construction project, shown in the shaded areas, will remove 170,000 cubic yards of rock.



Sign of things to come: surface construction coordinator Ron Foutch, Chris Laughton and Dixon Bogert, of Fermilab, and S.A. Healy's Todd Paige.

"Our GOAL is to finish THIS PROJECT without ANY serious injury." —Fermilab's Dixon Bogert



Mining for Neutrinos

The 20-month excavation of the Fermilab site will create a main construction shaft; a target hall; a 600-foot "carrier tunnel" to bring protons from the Main Injector; a second, deeper shaft from the surface to the near-detector hall; and a 3,500 ft. tunnel connecting the target hall and the detector hall. It all amounts to a large-scale underground project, even by high-energy physics standards.

"It's like mining," said the project's Fermilab civil construction manager, Chris Laughton.

"It IS mining," corrected NuMI Project Manager Dixon Bogert.

The mining will be carried out by a subcontractor, the S.A. Healy Company of Lombard, Illinois, a firm specializing in underground construction. In February, Fermilab announced the award to Healy of a $30.5 million subcontract, the largest single construction contract, in absolute dollars, ever awarded by the laboratory. Like Fermilab, Healy is part of an international enterprise, Impregilo S.p.A,. Italy's largest contractor and the largest tunneling contractor in the world.

Healy will employ 180 workers in three shifts on the NuMI construction project, said Todd Paige, Healy's on-site spokesman and project safety manager. The project will require a combination of excavation techniques: soil excavation, "drill and blast," "raise-bore" drilling and the use of tunnel boring machines, or TBM's.

A tunnel boring machine of the type NuMI tunnelers will use.

Soil excavation will began in early-April, and in May an eight-week period of blasting will follow. A 100-ton crane will bring the raw rock to the surface, where an endless parade of trucks will carry it to a giant rock pile near the Kautz Road substation. (Attention joggers: Recreational use of Kautz Road will be temporarily suspended for the duration of the project.)

In November a still-larger crane will lower a TBM to the bottom of the hole, where it will head northwest at a downward grade of about 6 percent, digging a tunnel 21.5 feet in diameter at a rate of 90 feet per day, trailing an industrial-strength electric power cord behind it.

Workers will then dig a second shaft, this one 350 feet deep, connecting the MINOS near detector hall to the surface. For this shaft, Healy plans a different method, the raise bore technique, starting at the bottom and employing a 14-foot rotating drill bit to dig a center hole. A conveyor in the TBM-dug tunnel will carry the "spoil" to the surface, via the construction shaft. Drill-and blast-around the edges of the shaft will bring it to the required diameter.

Twenty months from the project's start in March, 2000, Healy will deliver to Fermilab a $30.5 million empty hole in the ground, ready to outfit as a neutrino experiment.

A Rough Business

As Fermilab and Healy prepare to break ground, safety concerns are foremost in every project manager's mind. In fact, safety issues influenced prequalification of bidders for the project, according to Fermilab's Laughton.

"We did not allow some contractors, including one large national firm, to bid, because of inadequate safety records," he said.

"Our goal is to finish this project without any serious injury," said Fermilab's Bogert. "This is a rough business, and it is inherently dangerous. But if attention is paid, we can reduce the hazards to an absolute minimum. That is our aim."

Healy's Paige echoed Bogert's determination.

"Nationally, mining is five times more hazardous than typical heavy construction," he said. "While the number of lost workdays per 200,000 hours is 2.2 for heavy construction, for mining and tunneling it is 10.8. For this job, I would love to have zero.

"All hands are responsible for safety. The lowest laborer on this job knows he can stop the work for safety concerns without repercussions."

Paige described a company safety policy similar to Fermilab's Integrated Safety Management, with hazard analyses for each task, frequent workplace safety meetings, and extensive and targeted safety training. And as part of the project contract, he said, personnel from the Fermilab Fire Department will receive specialized mine rescue training from Healy, creating an on-site mine rescue team, ready to act if the need arises.

"What was that?"

While much of the excavation will take place with little effect on surrounding areas, when blasting for the main NuMI shaft begins, people at Fermilab and in nearby neighborhoods will hear and feel it. However, according to Paige, the strength and duration of the blasts will be limited, to prevent damage to nearby accelerator tunnels.

"We will use less powder and a wider pattern for blasting than for some other jobs," Paige said. "Nearby neighbors will hear a series of sounds, something like a cannon in the distance. It won't shake their house, and it won't break their windows. There's a science to this. There won't be any flying rock."

Fermilab project personnel have carried out studies to establish baseline levels of ambient sound and ground vibration, and Fermilab and Healy staff plan to meet with neighborhood groups to let them know what to expect when the blasting starts.

"We don't expect any significant problems for our neighbors, but we don't want them to wonder 'What was that?'" Laughton said.

Ready to Go

As NuMI groundbreaking nears, there is a sense of sober excitement in the construction trailers that will be home to NuMI's Fermilab and subcontract staff for the next two years.

The first of a months-long parade of trucks arrives at the NuMI construction site.

"After working on government jobs in the past, I was a little leery of what it would mean working at Fermilab," Paige said. "But the people on this project know what they are doing. There is expertise in both above-ground and underground work. Clearly, Fermilab doesn't put unqualified people in these positions. All of them are very professional."

For his part, Laughton, a Ph.D. engineer with degrees in rock mechanics and mining, who has spent much of his own career as a tunneling designer and contractor, mused about the particular difficulties of the NuMI job.

"The main challenge for the contractor," Laughton said, "will be to make efficient use of a wide range of technologies. There's a learning curve associated with each one. It takes a certain amount of time for even an experienced crew to get into the rhythm of each task. Here, they'll just hit their stride and it will be time to change to something new."

And despite exhaustive analysis and careful planning, the nature of tunneling means that the construction project is bound to hold surprises, Laughton said.

"That's why you can't run tunneling jobs from an office. You need full-time experts underground. Because one thing you can be sure of is that things aren't going to turn out exactly the way you think."

Not unlike the story of neutrinos. □

Photos by Reidar Hahn

NuMI's Chris Laughton and Dixon Bogert stand on the circumference of the circle defining the project's main construction shaft. Near the center stake stands NuMI construction contract administrator Rich Farritor, the first to hold this post.

Fermilab creates a prestigious new fellowship...

Of the PEOPLES, by the PEOPLES, for the PEOPLES

...that accelerator physics and technology shall not perish from this lab.

by Judy Jackson

In high-energy physics, you're never done.

Perhaps more than in any other field, advances in particle physics depend on advancing technologies of the tools of research. An important part of the science of high-energy physics is the never-ending development of accelerators to reach ever-higher energies.

Last week, Fermilab recognized the importance of accelerator physics and technology to life on the energy frontier by announcing a new Fermilab scientific fellowship, named in honor of Fermilab Director Emeritus John Peoples. Like the Wilson and Lederman Fellowships named for Peoples' predecessors, it is designed to encourage and support outstanding young physicists. But unlike the earlier awards, the Peoples Fellowship is especially created to encourage world-leading research in accelerator physics and accelerator-related technologies.

"The Peoples Fellowship is an indication of the renewed emphasis in the U.S. on accelerator and technology development for the future of high-energy

Fermilab Photo

Fermilab Director Emeritus John Peoples built the Antiproton Source to create the capability for proton-antiproton collisions at Fermilab's Tevatron. "Advances in science are marked by advances in technology," Peoples said. "There is a strong need for new technological expertise and development in our field. Out of technology come the new ideas."

physics," said Technical Division Head Peter Limon. "There are fascinating and challenging research problems central to the developing future of our field. Solving them will require high technology, scholarly thought and deep science."

In announcing the Peoples Fellowship, Fermilab Associate Director Steve Holmes said the goal of the new fellowship is to put Fermilab in a position to attract first-rate accelerator scientists early in their careers.

"Ultimately," Holmes said, "the prestige of this fellowship will depend on the quality of the people we select, and we are aiming for the very best. We are trying to target top people, the rising superstars of the field. We need the best people we can find to help us figure out what the future of our field will be."

Fermilab physicist Jim Strait, project manager for the U.S. Large Hadron Collider accelerator effort, will chair the fellowship selection committee, which will accept applications through July 31, 2000.

"We will try to make the first selection by late summer or early fall, and we hope to have the first Peoples fellow in place by the end of the year," Holmes said. "We expect that most Peoples fellows will work in either the Beams Division or the Technical Division. There are many R&D problems to solve in the areas of the Next Linear Collider, the muon storage ring, superconducting magnet research, as well as in more operational areas, such as Main Injector fixed-target capabilities or luminosity extensions in Run II."

Unlike Wilson and Lederman fellowships that require several prior years of work in the field of particle physics, the Peoples fellowship committee will accept applications from physicists " right out of school," Holmes said. "It's an opportunity to get started early on a tenure-track position."

Holmes said Fermilab also wants to create an opportunity for experimentalists in the field to make a change.

"Look at John Peoples," Holmes said. "He did many things. He started out in life as an engineer and went on to get a Ph.D. in physics from Columbia. He became a successful experimental physicist and then turned his attention to building things, including Fermilab's Antiproton Source. In that same way, we believe that there are people who have concentrated on experimental physics who can make big contributions to accelerator technology."

Starting this year at Fermilab, talented young experimentalists who yearn to take a crack at exploring the physics of accelerators will have the opportunity to do just that. All they have to do is make the Peoples choice. □

The Nature of Science:

Believing We Can Understand the Universe

by Mike Perricone

Science is a system for weighing evidence; a set of instructions for how to think, not what to think, with the firm rule that a theory is valid only if it is capable being disproved.

Science beckons us to retrieve specimens and bring them back to show our colleagues, and to argue over the evidence: the livelier the argument, the better the results.

Science aims to "gradually reduce prejudice," as atomic scientist Niels Bohr once said. It leads us, physicist Richard Feynman said, to appreciate "the humility of the intellect": we learn how much we don't know.

Science, in all these aspects, begins with an act of faith.

"The act of faith is that we can understand the universe," said Fermilab theoretical physicist Chris Quigg, opening the Symposium on the Nature of Science at Wilson Hall's Ramsey Auditorium on Saturday, March 18.

Organized and conducted by Fermilab's Education Office, the Symposium on the Nature of Science brought together more than 425 educators from communities surrounding Fermilab, from Chicago, from neighboring states (Iowa, Wisconsin, Michigan and Indiana) and from as far away as New York. The Illinois State Board of Education supported the symposium with a grant to Friends of Fermilab.

The presentations ranged from dark matter to dinosaurs, from finch beaks to the big bang, from cosmochemistry to culture clashes, from education strategies to—yes, to evolution. The country's scientific community has been protesting the Kansas State Board of Education's exclusion of evolution and cosmology from its code of standards, but organizer Marge Bardeen cited broader goals for the symposium.

Marge Bardeen

"The motivation rose from the challenges about what to teach in science classes," said Bardeen, head of Fermilab's Education Office. "Our goal was to present a positive picture of what science really is."

That picture was positively compelling, in the eyes of a teacher who attended.

"Fermilab assembled gentle, human, entertaining scientists who were also some of the best minds in the world," said Alis Cheney, who teaches at a private elementary school in Chicago. "It was the best workshop I've ever attended."

“Nullius in verba”

(“Don’t take anyone’s word for anything!”)

Fermilab theorist Chris Quigg

—Motto of the 17th-Century founders of the Royal Society of London (translation by Chris Quigg)

But if not the major theme, the issue of evolution represented an important sub-theme of the day. In his talk, “Finch Beaks Break More Than Seeds,” evolutionary biologist David J. Anderson of Wake Forest University admitted: “Evolution has a perception problem.”

Anderson detailed his own work in the Galapagos Islands, replicating Charles Darwin’s original observations of variation in finch beak sizes depending on environmental conditions. His findings showed once again that the number of offspring depends on the parents’ success at life skills in the surrounding environment. Dry conditions, for example, yield a greater than normal proportion of large seeds, leading to a greater proportion of finches with large beaks for cracking those large seeds.

Len Bugel, a teacher and an experimenter on Fermilab’s MiniBooNE, described science as a process of fitting the pieces together, not just collecting facts.

As for the finch beaks breaking more than seeds, Anderson said they “crack woolly thinking about evolution.” He stressed the years of work, of banding and following the birds, of observing what they eat and how fast they change with conditions. It is the painstaking process of compiling evidence, springing from the act of faith that we can understand the universe—in this case, the finch world.

When we can’t observe, when data buried in the past leave experiments beyond our reach, then “sometimes analogy is all we have,” said Paul Sereno, the renowned paleontologist and hunter of dinosaurs (the precise term is “sauropods”), from the University of Chicago.

In addition to collecting and cataloging fossils, Sereno is adept at experiment-by-analogy. To find out how large dinosaurs might have moved and maintained their balance, he journeyed to an exotic locale: a zoo in Toronto.

Sereno videotaped motion studies of an elephant, then transported the elephant to a truck-weighing station to measure the weight distribution between front and rear “axles” (result: 60 percent front, 40 percent rear). Comparing the known quantity of the elephant with fossils and footprints of sauropods yields clues to the similarities between these huge creatures separated by such vast expanses of time.

More than 425 educators attended the Symposium on the Nature of Science.

Photos by Jenny Mullins

“Nullius in verba”

There are no greater expanses of time and space than the universe itself. As Fermilab astrophysicist Rocky Kolb explained, telescopes are like time machines. When we view the Andromeda galaxy, we see it as it was two million years ago: its light has taken that long to reach us. Looking farther out into space takes us further back in time, but reaching toward the limits of the universe’s estimated 14-billion-year lifespan takes us to the realm of what Kolb called “the primordial soup.”

Fermilab astrophysicist and humorist Rocky Kolb revealed that Galileo’s experiments with gravity involved “dropping graduate students from the Tower of Pisa.”

“Most of the universe is not matter as we understand it,” Kolb said. “We’re looking for the secret ingredient by recreating the primordial soup in the laboratory.”

The laboratory, specifically, is the Fermilab particle accelerator complex, where increasing levels of energy correspond to earlier stages in the formation of the universe. Those stages bring us to the ultimate questions of where we come from, and why we are here—questions that may seem to go beyond science.

Photos by Jenny Mullins

Fermilab and University of Chicago astrophysicist Michael Turner explored the question of dark matter and its role in an expanding universe.

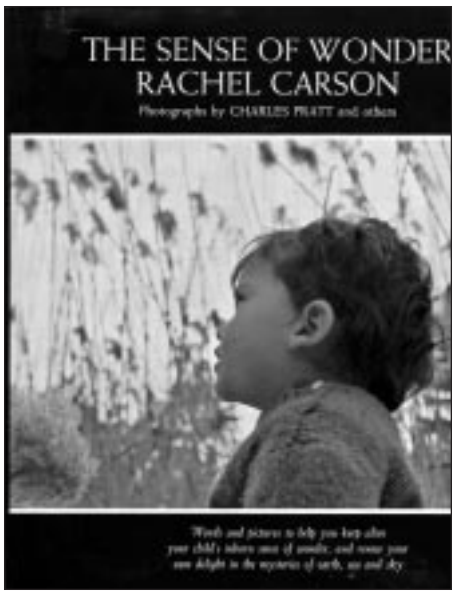
Princeton University astrophysicist James Peebles demonstrated that the scientific “act of faith” also draws thinkers dedicated to religious faith. He cited physicist Georges Edouard Lemaitre, a Belgian abbot of the Catholic Church, who combined Einstein’s relativistic theories with Hubble’s data on the recessional velocity of galaxies to postulate that an expanding universe must contain “fossil evidence” of its early state. A key element in the Big Bang theory, Lemaitre’s theory has been borne out, not by cosmic rays as he anticipated, but by the discovery of the cosmic background radiation.

Timothy Toohig personifies a “scientist of faith.” A physicist working for the Department of Energy, he is also a Jesuit priest and a professor at Boston College. In his talk, “Physics Research: Search for God,” Toohig cautioned that science and religion are separate and very different, and that trying to combine them has historically not been beneficial for either one. Yet he noted a striking similarity.

“Both religion and science contain a powerful sense that there is more there than we currently understand,” Toohig explained. “In science, this is what leads us, for example, to build new accelerators, as a way to reach beyond what we know, toward discoveries that we believe lie beyond.”

The daylong conference featured four general sessions in Ramsey Auditorium, including a wrap-up session, and 10 parallel sessions in smaller conference rooms around Wilson Hall. Whether their expertise was in primate social systems, or in science projects for K-12 classrooms, the speakers shared Quigg’s view of science as “radically conservative:” surrendering assumptions only when they’re proven wrong, yet celebrating doubt.

“We’d be disappointed if all our theories proved to be wrong, but we’d also be disappointed if they were all right,” Sereno said. “We’re truth-seekers.”



Using Rachel Carson’s noted book as an example, Quigg stressed the importance of “not killing that instinct of being dazzled by the world.”

MEMORIAL SERVICE

Robert Rathbun Wilson

10:00 a.m. Friday, April 28, 2000

Ramsey Auditorium, Wilson Hall
Fermi National Accelerator Laboratory
Batavia, Illinois

A burial service will be held at 9 a.m. at Fermilab's Pioneer Cemetery. All are welcome.

(Fermilab will also hold a Robert R. Wilson Symposium, at a date to be announced, in Fall 2000.)

CRONIN Puts MEDAL of SCIENCE Right to WORK

by Mike Perricone

Fermilab Photo

James Cronin in 1980 when he won the Nobel Prize

The 1999 National Medal of Science and the 1980 Nobel Prize are life-defining honors that James Cronin wouldn't trade for anything in the world.

But living in the real world of science, which runs on funding, Cronin knows the importance of trading on the prestige of those awards.

"It's a wonderful individual honor, but it does have a lot of practical value," Cronin said from Paris, where he holds the International Chair at the Collège de France.

The National Medal of Science, administered by the National Science Foundation, was established by Congress in 1959, with 374 recipients including 12 for 1999. Previous winners have included Robert R. Wilson, founding director of Fermilab, and Norman Ramsey, founding president of Universities Research Association, Inc.

In his presentation at the March 14 White House ceremony, President Clinton cited Cronin "for fundamental contributions to the fields of elementary particle physics and astrophysics and as a leader in creating an international effort to determine the unknown origins of very high-energy cosmic rays."

Cronin is co-leader (with Alan Watson of the University of Leeds, England) of the Pierre Auger Observatory, a collaboration of more than 250 scientists and engineers from 60 institutions in 19 countries *("The High-Energy Cosmic Mystery," FERMINEWS, Vol. 2, No. 8, April 16, 1999).*

High-energy cosmic rays carry an energy more than 100 times that of Fermilab's Tevatron, the world's highest-energy particle accelerator. When completed, in the Mendoza province of Argentina, the observatory will use 1,600 surface detectors (tanks holding 3,000 gallons of water) and four fluorescent detectors to investigate the cosmic ray mystery.

Fermilab is the host institution for Auger Project management, which has reached the stage of installing what is called the "engineering array": 40 prototype surface detectors and one fluorescent detector to test the designs before going into full production. Mounting an international experiment in a remote area of Argentina poses challenges that Cronin can confront more effectively with the help of the National Medal of Science and the access it offers.

"Winning this prize is extremely timely because the citation does not focus just on the past, but refers to the work I'm doing now," Cronin explained. "I made use of that right away."

National Sci. & Tech. Medals Foundation http://www.asee.org/nstmf/

Cronin receives the National Medal of Science from President Clinton at the White House.

In Paris, Cronin met with Koichiro Matsuura, who is the Director-General of UNESCO (United National Educational, Scientific and Cultural Organization) as well as Japan's ambassador to France. Cronin asked Matsuura for assistance in gaining waivers of customs duties on equipment bound for the Auger site in Argentina. Cronin noted that the U.S. is no longer a UNESCO partner, though the organization has longstanding ties to the Auger project.

"UNESCO was very important in the early days of the Auger project, helping us set up the international agreement to finance the project," Cronin said. "Whenever I can make use of my contacts, I try to encourage the U.S. to rejoin UNESCO."

The National Medal of Science and the Washington trip also offered domestic benefits.

"It permitted me to have meetings with Neal Lane, the President's chief science advisor, asking him to help influence the government of Argentina," Cronin said. "The new government of Argentina has financial difficulties and may not fulfill its commitment for Auger funds this year. I hoped we could use the power of our government to encourage the Argentine government."

Cronin has been a White House guest before. He was invited to the Oval Office by President Carter after winning the Nobel Prize in 1980, a time of turmoil during the Iran hostage crisis. Cronin also participated in a ceremony on the White House lawn, celebrating the inauguration of the ill-fated Superconducting Super Collider.

Fermilab Photo

Cronin is co-leader of the Pierre Auger Observatory, investigating the mystery of high-energy cosmic rays. This work is mentioned specifically in his National Medal of Science award.

The ceremony for the National Medal of Science, and for the National Medal of Technology administered by the Department of Commerce, took place in the Blue Room. Cronin remembered waiting with family members and other award winners for the proceedings to begin while the President spoke on the phone with British Prime Minister Tony Blair, formulating a policy statement on public access to all research in the Human Genome Project.

"That provided the substance of Clinton's speech before the presentations," Cronin said. "I was impressed that the President was so much at ease in speaking with us before the ceremony. He talked about how much he enjoys these [scientific] subjects, and clearly he was very much in command. He wasn't using note cards. He had given a talk at the University of Chicago graduation the previous year, and he chatted about the University, and how impressed he was by the standards there."

Following the ceremony, the award winners and their families were "given free reign of the public areas in the White House," as Cronin described it. The views looking outward, to the Washington Monument and the Jefferson Memorial, were moving.

"We're always complaining about the government, but that setting transcends those thoughts," Cronin said. "It was a wonderful reception, and very impressive. One takes satisfaction that the nation does honor its scientists." □

the of the

Linux for Smarties

In four years, CEO Robert Young and his partner, Marc Ewing, took Red Hat, Inc. from a tiny start-up to the leading global supplier of Linux, the legendary open source computer operating system invented by young Finnish computer whiz Linus Torvalds in 1992.

Torvalds, a university student, had the revolutionary idea of creating a clone of the Unix operating system and making it available free of charge, along with its underlying source code, to any user who wanted it. In 1995, Young and Ewing founded Red Hat, Inc. to market software packages that make Linux more user friendly. Red Hat put together Linux packages with third-party applications, documentation and technical support and sold them for about $50 apiece. Sales were brisk.

So brisk in fact, that Red Hat soon became the leading supplier of Linux-based operating system supplies. When the company made an initial public offering of its stock on August 11, 1999, the IPO was a major media event. The price of the stock soared from $14 to $52 in a single day.

Now, readers can get an inside account of Red Hat's brief but hectic life in *Under the Radar, How Red Hat Changed the Software Business and Took Microsoft by Surprise,* by Young and co-author Wendy Goldman Rom. (Coriolis Press, $27.50). The book tells how Ewing and Young went "from selling Linux out of our homes (to avoid getting real jobs) with few ambitions for great financial success, to being fought over by the world's two largest investment banks during our IPO."

It was, by all accounts a wild ride, and Fermilab was along for parts of it. In fact, Fermilab is on the scene as the curtain rises in *Under the Radar*'s opening chapter, "Inside the Tent":

There was a blip on the screen, something new in the field.

At first barely visible. It had appeared slowly and almost imperceptibly. Indeed, at first it had been difficult to see there was anything at all. No, this was not some dramatic sighting, no alien mother ship suddenly blazing its way across the screen.

The first time that engineers at silicon giant Intel Corp. had the first inkling of change was when scientific labs across the country began demanding that it port its "math libraries" to a new operating system.

For one, Dr. Yeh, a Taiwanese scientist at Midwest-based Fermilab, had made such a plea in early 1998. Fermilab, the federally funded atom-smashing think tank overseen by the U.S. Department of Energy, was a mecca for the world's top nuclear [sic] *physicists. It had quietly added a new flavor of system software to its roster of those driving the lab's network of computers.*

Such sites were known in the computer industry as "early adopters," technically savvy users that often were the first to install leading-edge products before the market had fully accepted them. One of the critical benefits of the new software that Fermilab had installed was that it was almost crash proof, and—even more importantly—scientists could freely tinker with its source code, the guts of any piece of software.

This was not the norm in the Microsoft-dominated software industry. Source code was like a secret chamber that few were allowed to enter. By keeping this code to themselves, software companies kept control of their customers, dictated technological change, and ensured continual revenue streams. With the source code kept secret and inaccessible, customers were locked into continual operating system upgrades dictated by the supplier. Likewise application software creators depended on the internal workings of the operating system and were often put at a disadvantage by the suppliers' secrecy.

"We need your math libraries to run under Linux," a number of Fermilab scientists repeatedly told Intel.

As we know, the blip on the screen has become a worldwide computing phenomenon, with an estimated 20 to 30 million Linux users, several hundred of them at Fermilab.

"Dr. Yeh," that "early adopter" from the federally funded atom-smashing think tank somewhere in the Midwest, was of course Fermilab physicist G.P. Yeh, who was indeed a leader in the laboratory's exploration, testing and ultimate adoption of Linux for Run II computing applications. Today, the Computing Division supports Linux, and its Fermilab applications continue to grow.

So it's fitting that the inscription on the flyleaf of Yeh's personal copy of *Under the Radar* should read "Thanks for your and Fermilab's help! Cheers, Bob."

—Judy Jackson

CALENDAR

Web site for Fermilab events: http://www.fnal.gov/faw/events.html

INTERNATIONAL FILM SOCIETY PRESENTS

Art Series Presents:

Jellyeye Drum Theatre, April 29, 2000. Ramsey Auditorium-Wilson Hall 8 p.m. Tickets are $16.00

FERMILAB LECTURE SERIES PRESENTS:

April 14,
Ramsey Auditorium-Wilson Hall $5.00

Chris Brochu of the Field Museum will discuss the museum's most famous resident, Dinosaur Sue.

APRIL 27

Daughters And Sons To Work Day

The kids are coming to Fermilab—both boys and girls—on Thursday, April 27, for DASTOW 2000 (Daughters And Sons To Work). Kids will see what goes on at the Lab and learn what their parents' work day is like. To volunteer as a Mentor or to help in other ways, contact Mike Perricone x5678 (mikep@fnal.gov).
Visit the DASTOW web site at http://www.fnal.gov/faw/dastow/.

Earth Day

Plant a tree, spread native prairie seeds and enjoy a picnic lunch on Earth Day at Fermilab, also on Thursday, April 27. Bring a shovel if you have one, and be prepared with boots and other appropriate clothing. Visit the Earth Day website at http://www.fnal.gov/ faw/dastow/arbor.html/.

ONGOING

NALWO is pleased to announce the free morning English classes in the Users' Center for FNAL guests, visitors, and their spouses have been expanded; The new schedule is: Monday and Thursday, 9:30am - 11am beginners (Music Room) and intermediates (Library) Monday and Thursday, 11am - 12:30pm advanced, emphasizing pronunciation and American idioms (Music Room)

NALWO coffee for newcomers & visitors every Thursday at the Users' Center, 10:30-12, children welcome. In the auditorium, International folk dancing, Thursday, 7:30-10 p.m., call Mady, (630) 584-0825;

BARN DANCES

All dances are taught and people of all ages and experience levels are welcome. Admission is $5, children under 12 are free (12-18 $2). The Fermilab Folk Club sponsors the dance. For more information, contact Lynn Garren x2061 garren@fnal.gov or Dave Harding x2971 harding@fnal.gov, or see http://www.fnal.gov/orgs/folkclub/.

MILESTONES

RETIRING

Victoria Davis, ID 9120, PPD, effective April 28.

Annie Jolliff, ID 4365 PPD-Engineering & Tech Teams, effective April 29, last day of work April 28.

Donald Tokarz, ID 67, FES-OP-Mechanical, effective August 18, last day of work April 28.

LUNCH SERVED FROM 11:30 A.M. TO 1 P.M. $8/PERSON

DINNER SERVED AT 7 P.M. $20/PERSON

Chez Léon MENU

FOR RESERVATIONS, CALL X4512
CAKES FOR SPECIAL OCCASIONS
DIETARY RESTRICTIONS
CONTACT TITA, X3524
HTTP://WWW.FNAL.GOV/FAW/EVENTS/MENUS.HTML

LUNCH
WEDNESDAY, APRIL 19

Roasted Salmon with Oriental Glaze

Asian Noodles with Ginger Cilantro Sauce

Lemon-Almond Buttermilk Loaf with Strawberries

DINNER
THURSDAY, APRIL 20

Rigatoni with Bacon, Spinach and Two Cheeses

Rib Lamb Chops

Cannelini Beans with Tomatoes

Salad of Greens with Gorgonzola Dressing

Warm Lemon Pudding Cake with Raspberry Cream

LUNCH
WEDNESDAY, APRIL 26

Shish Kebabs

Hummus, Baba Ganoush, Tabbouleh

Grilled Pita

Baklava

DINNER
THURSDAY, APRIL 27

Smoked Salmon and Potato Cakes with Dill Cream

Beef Tournedos with Morel Sauce

Cauliflower and Horseradish Gratin

Linzertorte

FERMINEWS

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The deadline for the Friday, April 28, 2000, issue is Tuesday, April 18, 2000. Please send classified advertisements and story ideas by mail to the Public Affairs Office MS 206, Fermilab, P.O. Box 500, Batavia, IL 60510, or by e-mail to ferminews@fnal.gov. Letters from readers are welcome. Please include your name and daytime phone number.

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CLASSIFIEDS

FOR SALE

■ '99 Goldwing SE (Silver) with Extras Price lowered to $1,500 less than Kelley Blue Book (3/27/00 $16,500) Priced at $15,000 11K Miles - Excellent Condition and Runs Great. Lots of extras. Call Terry X4572 or e-mail skweres@fnal.gov

■ '92 Mitsubishi Mirage, 4dr. 129K, A/C, automatic, AM/FM. No rust, good condition. $1200 obo. Anotoly, 630-840-2878 or 630-851-3074.

■ '90 GMC V1500 Jimmy, SLE 92K, vgd cond't inside and out, 5.7 Litre V8, auto trans, AC, security system, $8975 obo. waw.fnal.gov or x3168, hm 630-325-4608.

■ '90 Subaru Legacy Sedan LS, 135K, 4WD, sunroof, cruise control, AM/FM cassette, in very good condition and all service done by the dealer. $3000 x6396 or mccusker@fnal.gov

■ '90 Chevy Cavalier, 138K, 2dr, A/C, automatic, AM/FM-cassette, new tires, brake pads and battery. Rusty doors and fenders. Runs good. $700/obo. Call Anatoli x6367 or e-mail cherepakhin@fnal.gov

■ '86 Mercedes Benz, 190-D silver, 4 door sedan, 5 cyl, 2.5 liter 4 speed automatic, sun roof, memory seats, PS.PB AC, cruise control, cassette am/fm radio, 40 mpg city, 50 mpg hwy. $5200. Must Sell. Must See, obo. Mike x3924, home 847-426-1596 after 5 pm.

■ Electric Range, Magic Chef Slide-In, White w/self cleaning over, Ceran glass smooth top, all electronic controls. Like new, used very little, $500 ($1,000 new). barb@fnal.gov or ext. 4136.

■ Buffet table with extended table, 6 leaves plus folding chairs $300 firm. Ceramic bird collection 40 + $75.00. Ron Rissman 896-3211.

■ Home For Sale: Lombard (Butterfield East Sub) clean beautiful family neighborhood California Ranch, 4 bedrooms, new carpet, new kitchen, AC, large deck & patio, two car garage, 5 minutes to I 88-355 back yard meets with large park. School and Park District in neighborhood $209,000. Must see to appreciate Contact Laura at 708-301-3542 or James x3821/james@fnal.gov.

■ Lawn Care - Mowing, trimming weed control and fertilizing. Self owned business for 11 years. Call 630-859-3789 or rtreend@aol.com.

FOR RENT

■ Wheaton Townhouse, 2 bedroom 1-1/2 bath, remodeled, new kitchen appliances/washer and dryer AC, 1 car garage plus 1 parking space, club house and pool. $975, call (630) 462-1315.

■ FREE two healthy parakeets. One blue one green, food, cage, etc, james@fnal.gov or 840-3821

■ FREE firewood. Large tree sections up to 3' diameter x 2' thick. You split and haul. Call Gerry at x3930 or e-mail gerryb@fnal.gov.

WANTED

■ Used washing machine. Call 630-305-4558 (answering machine until 4/26), or lehnerf@fnal.gov.

TIME SHARE FOR SALE

2-weeks at Acapulco/Puerto Vallarta/ Mazatlan, 1-bedroom unit/sleeps 4-6 appraised at $15,900. Call Duke 815-372-2368 evenings after 7:00PM and/or anytime weekends.

FISHING

Great Lake Michigan Sport Fishing... via King Olaf Charters. We specialize in multi-boat charters. All equipment provided. Call Captain Bill Penn 630-554-3155 (day) or 630-554-3828 (evenings) for more information. Please call Carol Magnuson (x3451) if you have any questions regarding this ad.

TICKETS FOR SALE:

At Chicago's Old Town School of Folk Music: Guy Clark & Jesse Winchester (Folk) - Saturday 4/22, 3 tickets ($19 each). Special Consensus - 25th Anniversary concert (Bluegrass) - Saturday 5/6, 2 tickets ($17 each). Contact Roni at (630)548-4955.

GOLFERS

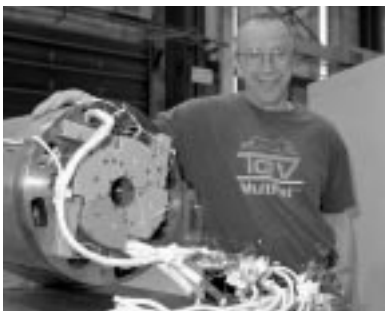
Have an urge to hit something with a stick? The Tuesday Prestbury Golf League has openings for singles or teams. For more information contact Dean Sorenson deans@fnal.gov, x8230 or Rod Klein rklein@fnal.gov, x4682.

BIBLE STUDY

The noon Bible study course will begin its one-year survey of the Bible on Wednesday, April 19, in the Huddle located in the Cross Gallery. If interested contact Jeff Ruffin x4432, or ruffin@fnal.gov .

CORRECTION

Why is this man smiling? Because he's in the Technical Division, not the Computing Division, as *FERMINEWS* erroneously reported last issue. John Konc IS a computing specialist, however, and he DOES volunteer at SciTech. Here he presents one of his division's newest products, a model magnet for the quadrupole magnets that the Technical Division (not the Computing Division) will build for the Large Hadron Collider at CERN.



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