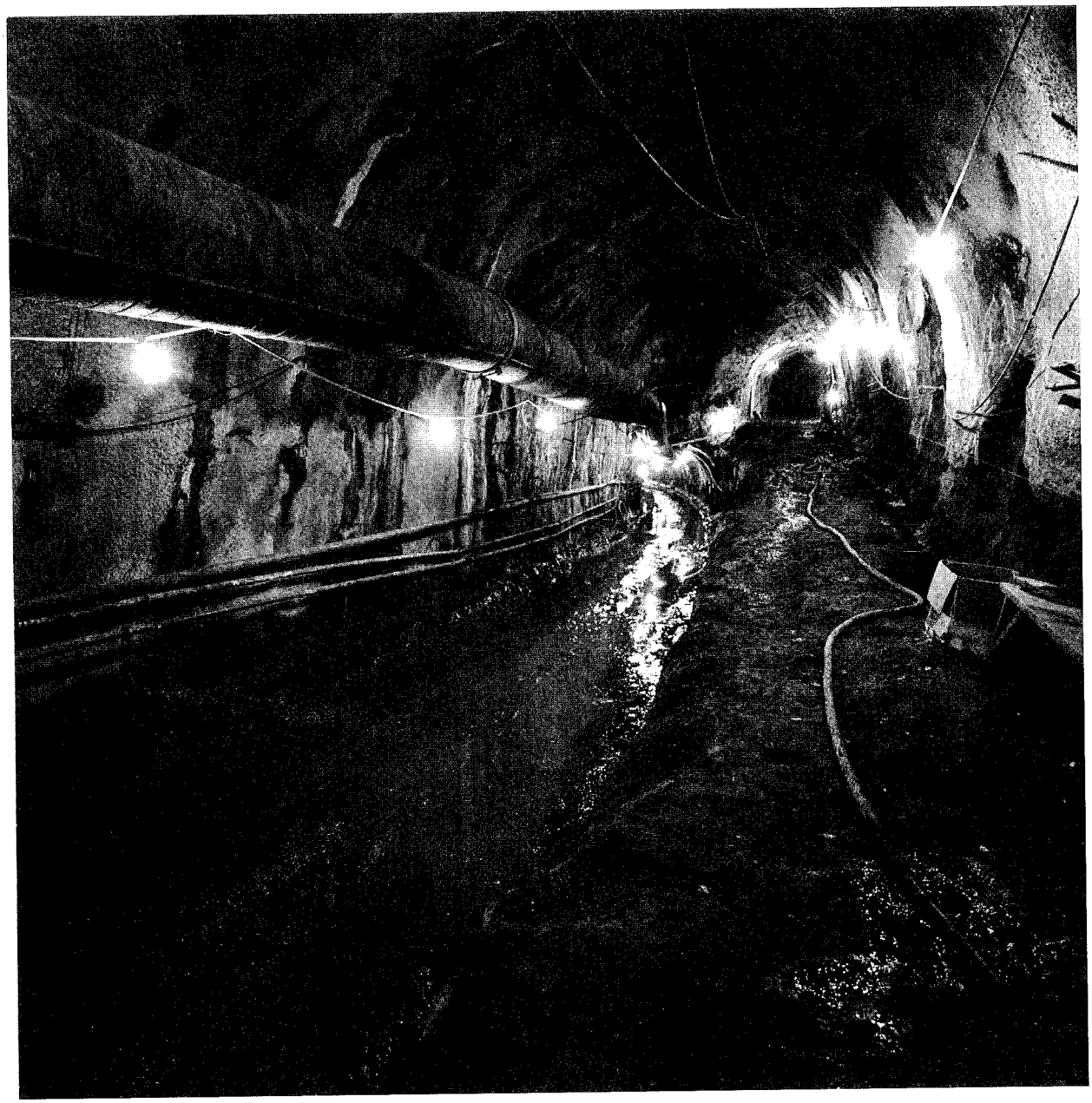
SLAC BEAM LINE

"All composite things decay. Strive diligently."
--Buddha (his last words)

Volume 9, Number 11 November 1978



In Joe Faust's photograph above, the North beam-injection tunnel in shown curving down from the right to join the main PEP ring tunnel in Region 9 of the PEP site. The articles on pages *3-5* of this issue of the *Beam Line* describe how some of this tunneling work was carried out. PEP construction is moving ahead toward the scheduled turn-on date of October, 1979, now less than a year away.

In This Issue

SOME NOTES ON THE *BEAM LINE*

During the last several years, the *Beam Line* has consisted of two different parts: (a) the regular monthly issue, with news, announcements, and whatever; and (b) occasional fairly long (8-24 pages) articles on physics, accelerators, etc., that have appeared 2-3 times a year. These occasional technical articles have sometimes been bound in with the regular monthly issues, but more frequently of late have been issued as separate things. We plan to separate the two kinds of *Beam Line* contents a little more now, by identifying the technical articles as Beam Line Reports.

The first example of these reports is the article on "Parity violation in polarized electron scattering" that is being distributed along with the regular November *Beam Line*. This article's heading looks something like this:

SLAC Beam Line Report No. 8 October 1978
SLAC, Stanford, Calif. 95305

Future articles will also have an identifying heading of this kind and will appear independently of the monthly issue of the *Beam Line*.

The reason that the first Beam Line Report is No. 8 is that there are seven earlier articles that still get used in various ways, so we decided to give them Beam Line Report numbers after the fact. So here's a list of the first eight Beam Line Reports:

1. An introduction to colliding-beam storage rings, Aug. & Sept. 1974.
2. "We have observed a very sharp peak," Dec. 1974. (Discovery of the psi particles.)
3. More new particles, Oct. & Nov. 1975.
4. Charmed particles, July 1976.
5. Richter Nobel Prize issue; includes a review of SPEAR and its physics, Nov. 1976.
6. PEP: An introduction, Apr. & June 1977.
7. High energy physics: An introduction. Part One: Apr. 1978. Parts Two & Three: Uncertain, sometime during 1979.
8. Parity violation in polarized electron scattering, Oct. 1978.

Because there will be less general interest in these Beam Line Reports than in the regular monthly *Beam Line*, the SLAC distribution list for the Reports has been set initially at 50% (about 800 copies) of the regular distribution list. The distribution to persons outside SLAC will be the same for both. We'll try to keep some supply of most of these Reports on hand to fill requests for copies. Please address any requests to either

Roslind Pennacchi, Bin 80, x2605
Dorothy Ellison, Bin 20, x2723

--Bill Kirk

SEVENTH ANNUAL SLAC RACES

The Seventh Annual SLAC Races will be held this year on

THURSDAY, NOVEMBER 30, 1978
12:00 NOON, SECTOR 30

Several people had questioned the wisdom of holding the race during a week that had two holidays, so we decided to delay it until the Thursday after Thanksgiving--November 30.

We plan to have three events: the 4-mile run, the 2-mile run, and a 100-yard dash. If there is a large turnout for the dash, it will be run in several heats. All events will start at Sector 30. The dashes will be run after the distance runners have started.

Prizes will be awarded to the:

First man and woman finishing 4-mile race
First SLAC man and woman finishing 4-mile race
First SLAC man and woman finishing 2-mile race
First SLAC man and woman finishing 100-yard dash

Runners from the entire Stanford community are invited to participate.

We plan to run, come rain or come shine, and there will be beer and soft drinks for the participants. If you don't feel like running yourself, come and cheer for your friends.

--SLAC Race Committee

SLAC CHRISTMAS CELEBRATION

Reserve the following times and dates for the annual SLAC Christmas celebration:

Wednesday, December 13

Noon-1:00 PM: Tree trimming in the lobby of the SLAC Auditorium (bring ornaments).

Friday, December 22

11:30-1:00 PM: Special holiday lunch

12:00-2:00 PM: Punch and homemade cookies

1:00 PM: Greetings from the Director

1:15 PM: Turkey raffle

Note: Raffle tickets will be distributed in mid-December by ID mail. Watch for them!

PEP NOTES

"You Got Boots?"

It won't be long before the final tunneling operations at PEP are finished and we are left with a quiet, well-lit white subway. I wanted to see what it takes to get there, so I asked, not really expecting more than a conversation with the people who were doing it.

That's when the question above got asked, followed by, "Your pants will get dirty. Maybe your shirt, too. And maybe your camera."

Well, sure, what's a little dust. After all, it hasn't rained in six months.

The joint venture of PBQ&D and Kaiser Engineers has three trailers in the construction yard near the Alpine Gate (for those who no longer recall the good old days of that short-cut home, it is on the far, east side of the SLAC research yard, near the new PEP Region 4). In the middle trailer I met Jon Keyak, a young Civil Engineer working as an inspector for Kaiser on the tunneling project of the large PEP contract for the beam housing and interaction areas. In the next trailer are the boots--just the kind I used to wear in Eastern mudpuddles but without the little red stripe that endeared them to me.

The tunnel face is some 40 feet under the Beam Switchyard and is reached through an entrance by the old garden site (more nostalgia; you gardeners would never recognize the place). Leading to the tunnel portal in the sheer 50-foot excavated face is the floor of the PEP ring. This is a fairly civilized business, with concrete-slab base, rebar, steel forms for pouring the walls, and a large crew progressing. Beyond this, the gravel road of the tunnel floor disappears into a very thick, brown river of variable and slippery depth, which generally matches the height of the boots. "Ground water," says Jon over the roar of the compressor near the portal, and he points to the pump lines bringing more of the stuff out into a series of baffles.

A few steps into the tunnel and the noise goes away, along with most of the light and fresh air. A string of lamps along the arch is enough for the eye, after some accomodation, but the camera should have stayed at home, at least according to the light meter. The atmosphere is New Jersey summer night with fog, and the occasional rumble is probably a truck on the loop road above. They tell me later that you never hear the outside when you're inside, but that knowledge probably wouldn't have made me feel any better.

(Continued on next page)

Slogging along a little further, the noise begins to pick up, and we step into the alcove in Region 10 to let a "mucker" pass. The mucker is a squat, diesel-powered front-end loader nearly the width of the tunnel, which makes a lot of noise and shuttles back and forth from the tunnel face to a stockpile outside and carries, well, muck.

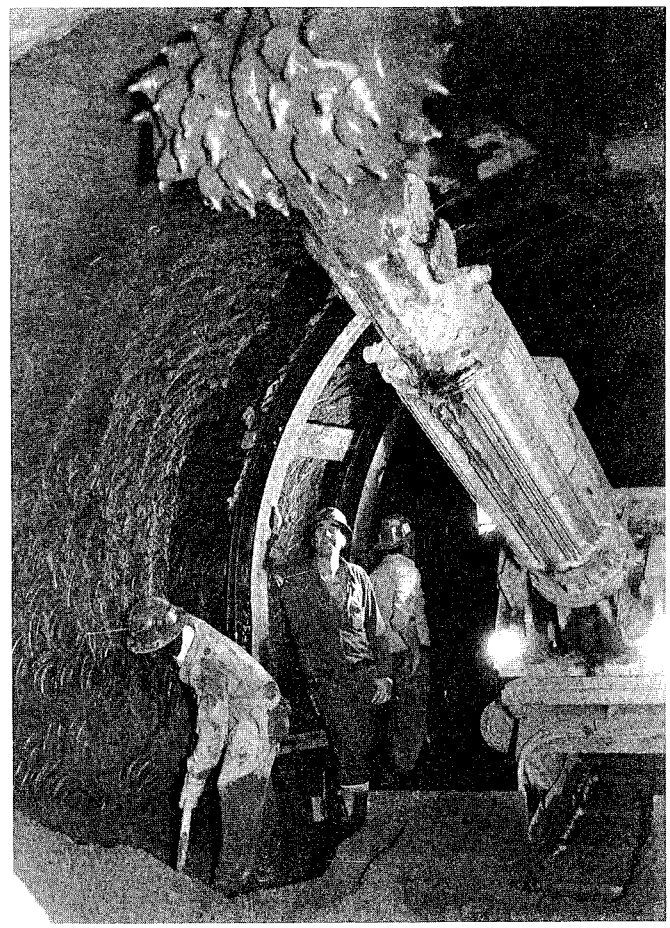
You don't make your presence known down here with a shout or brightly colored clothes. Flashlights seem to work very well, and there is a protocol which I didn't figure out but which resulted in the mucker stopping for some conversation.

The tunnel here is about 14 feet across and 12 feet to the arched top. It has been reinforced with steel wishbones spaced every 15 feet or so, and the walls have been covered with a few inches of "Shotcrete" (sprayed concrete), which produces a rough, dirty-white surface. The final surface will be much thicker and will seal off the present occasional ceiling drip. Also, a finished floor will do away with the need for boots.

We move on now under the Beam Switchyard to the tunnel heading, where the light is a bit better because of a few spotlights. For the moment the digging machine, an "Alpine Miner," sits idle as a half-dozen miners clean up the debris from the last operation and mark the wall for the next. A laser aimed by the surveying crew from about 30 feet away makes a red spot on the wall, and a large compass made from a meter stick and steel tubing is being centered on the red dot. One man holds the point of the compass centered while a second climbs to the claw of the Alpine Miner. Then the claw is moved carefully around with the compass while the second man uses a spray can to mark a red circle on the wall. Just like sitting on the elephant's trunk.

Another flashlight signal, a few shouts, and Jon says to climb back under the Miner's boom. I hope the understanding is mutual. We find a place to stand, and the Miner starts up again and inches toward the tunnel heading with its cutting teeth spinning. The mucker also moves forward to the back of the Miner to receive the debris which is conveyed back. Now it is really noisy, hot and dusty.

The works settles into a rhythmic concentration, with the claw smoothly and slowly scanning the face and spinning off a steady stream of dirt. The dirt is a dull gray color and crumbly, like Halvah. Two men at the cutting-face sides shovel the debris into a mouth at the bottom of the cut, and two mechanical arms work continuously to scoop it in and backwards. The man operating the Miner is completely absorbed in his work. He runs the operation with two hands on a control



panel that he never looks at. Occasionally, when the claw works into harder rock, the Miner goes into an up-and-down shuddering motion, and the operator's attention to the work seems to intensify.

Every few minutes, the mucker backs away and swings its bucket up to shake the muck down toward the back. The rocks bang loudly in the process and the diesel comes up to full power. There is a call for more air, and the compressed air line behind my ear hisses in response. It relieves the heat a little, but I can still hear the ringing sound. Now the tunnel is a foot or two longer than it was. My presence doesn't seem to be particularly noticed. The crew is well-knit together, and their efforts bring slow but tangible results. There is continuous progress toward a goal now less than 100 feet away.

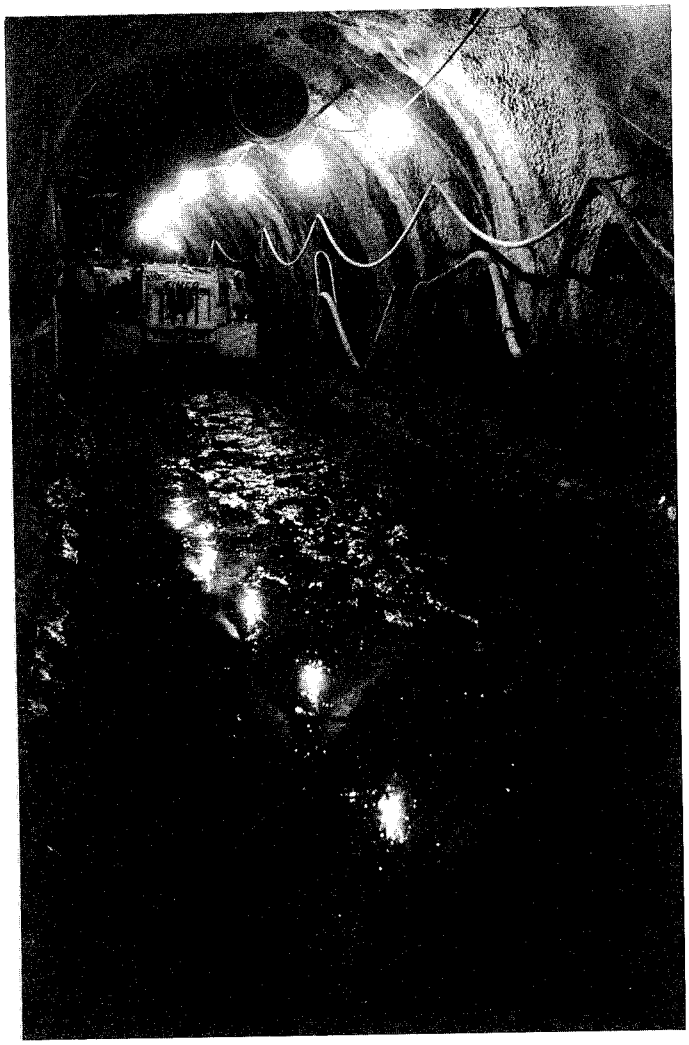
It is exciting being here, but I also remember that it's deep underground. When you climb a mountain, you don't look down. When you tunnel, I don't know what to do, so I pick up a small rock to carry out with me.

We leave the heading sometime after the mucker has departed with its full load. Halfway out, it returns, and we step aside and inhale to let

(Continued)

it growl by. Almost out, Jon stops to exchange a few words with an older miner. He is standing up to his shins in mud, leaning on his shovel, and smiling like a proprietary gatekeeper. I wonder what good the shovel does, and whether he knows about Mephisto.

--Bill Ash



PEP Tunneling

Most readers of the *Beam Line* appreciate the importance of the PEP storage ring for physics but may not realize the magnitude of the construction effort that is required to make the PEP ring a reality. The PEP machine will sit on a level floor that has a total length of 7218 feet. Owing to the topography of the site, the housing for the machine requires construction on fill, in cut and cover, and by tunneling. The tunnel construction will be the subject of this article.

The joint-venture firm of Parsons, Brinkerhoff, Quade and Douglas, and Kaiser Engineers (PB/KE), is the designer and construction manager for the project. The firm of Fred J. Early is the tunnel contractor, woking on a subcontract to PB/KE. The tunnel in Region 3 is 786 feet long, while that in Regions 9, 10 and 11 is 1712 feet long.

Prior to the tunnel-mining operation, Early developed the tunnel portal, using shotcrete, wire fabric and rock dowels to protect the portal slopes. With the portal secured, mining began, using the F-13 Alpine Miner, a machine that weighs 15 tons and is powered by 480-volt electric motors. The rotating twin cutterhead at the end of the Miner's boom removes the poor- to well-cemented sandstone as the boom moves horizontally and vertically across the tunnel face.

The "muck" (material removed by the cutterhead) is directed by two rotating collector arms to the middle of the Miner and onto a conveyor belt, and is then carried back to an Eimco 915 loader (mucker) which has a 10-cubic-yard skip. When the mucker is loaded, it moves back out of the tunnel to dump its load, then returns to the tunnel heading to complete the cycle. Two muckers are used in the mining operation.

Ground support is by shotcrete, steel sets, and rock dowels. Shotcrete is similar to concrete; both consist of cement, water, and fine and coarse aggregate. Shotcrete also contains an "accelerator" to quicken the setting time of the material. The shotcrete materials are mixed in a portable batch plant. Compressed air forces the mix through a hose; water enters the mix at the end of the hose under the control of the nozzleman.

Depending on the tunnel geology and geometry, an initial application of shotcrete between two and four inches thick is applied to the crown and walls of the tunnel to protect the men and equipment working there. When the mining is complete, steel frames are installed to support the PEP utilities, and an additional three inches of shotcrete is applied over wire mesh to form the finished surface of the tunnel. The steel frames as well as the structural steel sets at the portals and other designated areas are embedded in the shotcrete to become an integral part of the finished tunnel structure.

Rock dowels (1"-diameter steel reinforcing bars) are inserted into drilled holes filled with epoxy grout from 6 to 16 feet long around the perimeter of the mined tunnel for additional support. The work remaining after the shotcrete surface has been completed includes a concrete floor slab, weep holes for drainage, and spray painting.

On a personal note, I have enjoyed the involvement with constructing the tunnel for the PEP machine and the thought that someday important revelations about the "essence of matter" will be realized here.

Jon Keyak
--Kaiser Engineers

1978 SUMMER SCIENCE PROGRAM

The 1978 Summer Science Program was held at SLAC between June 19 and August 25. The Program was offered to 30 undergraduate students who were chosen from among about 200 applicants, all of whom had indicated a strong interest in science, mathematics or engineering. The 30 students in the Program were placed in jobs at SLAC by a group that included Ron Koontz, Richard Blumberg, Bernie Tice, Dorothy Ellison and Sue-Von Gee. This group of SSP coordinators had also been involved in the student-selection process.

The students selected for SSP were studying for degrees in the following fields: physics, mathematics, computer science, engineering, computer science, and biology. Their academic levels ranged from graduating high school seniors to graduating college seniors. Half of the students were funded by Associated Western Universities, while the remaining half were funded by SLAC.

The academic program occupied about 25% of the student's time and consisted of the following courses:

1. Introduction to WYLBUR (Roger Chaffee, SLAC).

2. Introduction to FORTRAN (Roger Chaffee, SLAC).

3. Accelerator physics (Dr. Greg Loew, SLAC).

4. Elementary particle physics (Dr. Helen Quinn, SLAC).

5. Research at DOE: Current and future (Dr. Jose Luis Cortez, DOE).

6. Bubble chamber physics (Dr. Vicente J. Llamas (Director, SSP).

7. History & science of matter (Dr. Carl Spight, Morehouse College).

The following special lectures were also included in the Program:

"Lasers" (Dr. Arthur Schawlow, Stanford)

"History of klystrons" (Dr. Marvin Chodorow, Stanford).

"High energy physics" (Dr. Ernest Coleman, Executive Director, SSP).

"The new particles" (Dr. Sidney Drell, SLAC).

The students spent about 5% of their time touring nearby sceintific and industrial laboratories, including the Lawrence Livermore Lab, the Stanford Artificial Intelligence Lab, the International Business Machines Labs, the NASA-Ames Lab, and the Varian Associates research labs.

At the end of the program, the Summer Science students conducted a public seminar, during which each student presented a brief report on some facet of the research or engineering activities that he or she had participated in during the summer. A general report which summarizes the experiences of the students is available for inspection in the SLAC Affirmative Action Office.

Any questions, comments or criticisms regarding the Program should be directed to:

Director, Summer Science Program
SLAC, Bin 10
P.O. Box 4349
Stanford, California 94305

Dr. Vicente J. Llamas
Director, SSP

Dr. Ernest Coleman
Executive Director, SSP

WALTER LEE HAWKINS

Lee Hawkins, a long-time member of the SLAC Klystron Department, died on October 8, 1978, in a drowning accident while scuba diving at Pigeon Point on the San Mateo County coast. He was 51 years old.

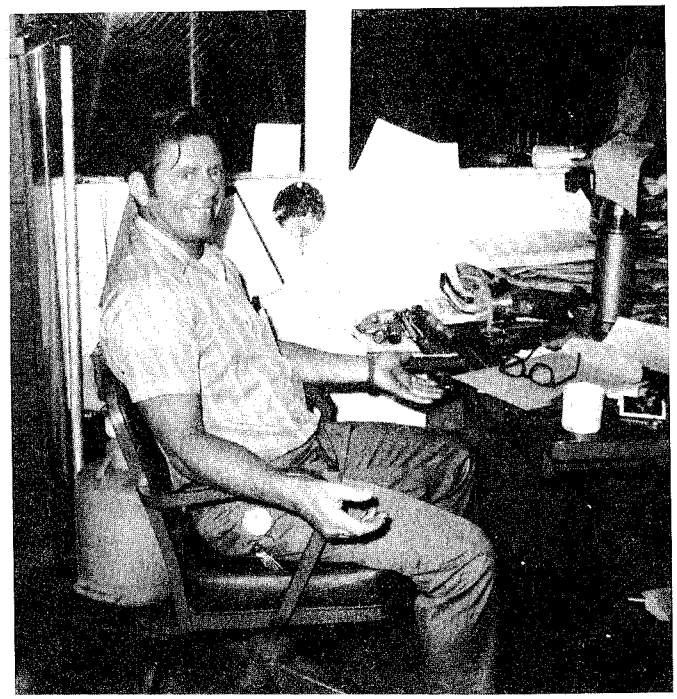
Lee came to SLAC in January, 1963, to work for the Klystron Department, which was then located at the M-1 Building on the Stanford campus. He was a skilled, all-round technician who always seemed to have the talent needed to finish the task at hand. In the early days of SLAC, Lee was instrumental in helping to set up the transportation and handling systems for the RCA-, Sperry- and SLAC-built klystron tubes. His welding, brazing, machine-shop and general mechanical skills helped to put together many prototype pieces of equipment.

Right from the start Lee served as a leadman in the Klystron Mechanical Group. He was a capable leader and had a good talent for organizing his work to meet schedules. He was called upon for a wide variety of jobs, including transporting klystrons, building experimental klystron handling gear, working on the accelerator vacuum system, modifying klystron test stations, building oil-processing stations, and building vacuum-pumping stations. He supervised the mechanical quality control on hundreds of klystrons purchased from Sperry, Litton, RCA and Eimac. He designed and improved upon much of the X-ray lead shielding used on the klystrons.

Lee had a good way of adjusting to the various demands of his job, which at times could get quite hectic. He took it all in stride, confident that he could accomplish whatever was needed.

Over the years, Lee developed into an excellent vacuum specialist. He took formal coursework and studied on his own, as well as gaining valuable insight from his on-the-job experience. He took charge of the day-to-day maintenance of the accelerator ion-pumped vacuum system, and was often called upon to trouble shoot and repair vacuum problems. He helped with the vacuum system for the PEGGY polarized electron source, the positron source, and the RF-separator systems in the research yard.

Lee was also involved in many extra-curricular activities at SLAC. He spent a number of years as a member of the Credit Union supervisory committee. He was a member of the SLAC Bridge Club and played for the SLAC team in the local industrial duplicate bridge league. Last year he was the captain of one of the teams in the SLAC Bowling League, and this year he was Vice-President of the League. Lee frequently served as one of the cooks for SLAC Family Day,



and for many years he was the organizer and cook for the Klystron Department's monthly "birthday luncheon." He also spent quite a few Saturday evenings picking up cheese and meat for an informally organized SLAC cheese co-op. Lee was a person who didn't mind spending his spare time doing things for his fellow employees.

Lee had many close friends in the Klystron Department and among other groups at SLAC. We are all very saddened by his death, and we will miss his friendship and always-helpful manner.

--Ted Johnston

OCTOBER ISSUE OF *PHYSICS TODAY*

The October, 1978, issue of *Physics Today* is devoted largely to the subject of detecting particles. The cover photo of the magazine shows Bill Davies-White, Keith Jobe and Tom Phillips of SLAC along with the Mark II detector that was installed at SPEAR last summer and will eventually to move to PEP. The four lead articles in the issue are the following:

"Multiwire and drift proportional chambers," by Georges Charpak.

"The large spectrometers," by William J. Willis.

"The high-resolution streamer chamber," by Jack Sandweiss.

"The time projection chamber," by D. R. Nygren and J. N. Marx.

There is a great of interest to SLAC readers in all of these articles.

Len Genova of SLAC's Electronics Department called our attention to the addresses on some mail received here at SLAC:

Stamford Excelleration Center . . .

Stanford Linear Exhilirated . . .

Southern Los Angeles College
W. T. Tomlin
P. O. Box 4349
Stanford, California 94305

Win a few, lose a few.

MEDICAL DEPARTMENT NOTES

It is possible that an employee who has been treated in the SLAC Medical Department will call after hours or on weekends, seeking the physician or nurse. Since the SLAC Medical Department is staffed by the Palo Alto Medical Clinic, coverage is available of a 24-hour, 7-day-a-week basis at the Clinic. The Clinic phone number is 321-4121.

LEON LEDERMAN IS NEXT FERMILAB DIRECTOR

Appointment of Professor Leon M. Lederman of Columbia University as the next Director of the Fermi National Accelerator Laboratory has been announced jointly by Norman F. Ramsey, president of the Universities Research Association, Inc., and John M. Deutch, Director of Energy Research, U.S. Department of Energy.

URA, a corporation formed by 53 universities in the United States and Canada, operates Fermilab for the U.S. Department of Energy.

Because of previous commitments at Columbia University, Dr. Lederman will not take office full time until June 1, 1979. He will serve as Director Designate and intends to take an active role in all major policy questions in the intervening months.

Dr. Lederman is internationally known in high energy physics. He has been associated with Columbia University as a student and faculty member for more than 25 years. He is the Higgins Professor of Physics at Columbia and is director of Nevis Laboratories in Irvington, New York, which is the present Columbia physics department center for experimental research in high energy physics. With colleagues and students from Nevis, he has led an intensive and wide-ranging series of experiments which have provided major advancement in the understanding of the weak interactions.

Dr. Lederman has participated in many of the most important discoveries in high energy physics, including the first observation of the nonconservation of parity in muon decay and the demonstration of the existence of two different kinds of neutrinos.

In 1977, he led the team of experimenters which discovered the Upsilon particle at Fermilab, indicating the existence of one and possibly two new quarks as constituents of the fundamental structure of matter. . . .

Philip V. Livdahl will continue to serve as Acting Director until June 1, 1979. He was appointed to that post on July 17, 1978.

Robert R. Wilson who served as Director of Fermilab since the time of its inception, will continue to participate actively in Fermilab on a joint appointment with the University of Chicago, where he holds the Peter B. Ritzma Professorship in the College. He will continue to work on the design and construction of the Energy Doubler/Saver (also known as the "Tevatron"), a superconducting device first proposed by Dr. Wilson that will both save electrical energy and make possible external target experiments up to 1,000 GeV (1 TeV). These new devices will open new vistas for research at Fermilab.

--Reprinted from *Ferminews*
October 26, 1978

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Bill Kirk, Bin 20, x2605 *Editor*

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