SLAC BEAM LINE

"There are therefore Agents in Nature able to make the Particles of Bodies stick together by very strong Attractions. And it is the Business of experimental Philosophy to find them out." -- Isaac Newton, Opticks (1704)

Volume 7, Number 3 *March 1976*

IN THIS ISSUE

Beam Line photographer Joe Faust took the photograph shown above on the day, early last month, that snow fell at SLAC. It was the first time in 13 years that a snowfall heavy enough to cover the ground had occurred. On pages 5-8 of this issue we present more photographs that were taken by various SLAC people during this rare occurrence.

. . . AND THEN THERE WERE NONE

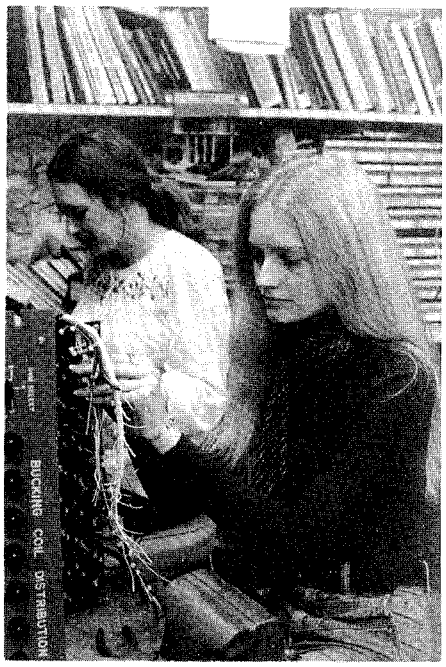
(Photos by Ted Jenkins)

Like the ten little Indians, the Skills Training Program at SLAC is still shrinking. Once as large as 20 students, the STP has gradually dwindled to its present size of only one student, Pauletta Fountila, with scarcely a whimper. Employees like Anthony Tilghman and Ray Ortiz, now electronics techs, were once hitting the books and learning resistor color codes in the program. Technical illustrator Dave Thomas and programmer Bob Nicholson also went the route, as did a number of others, many of whom have now left SLAC for greener pastures. More than 30 students have gone through the program since its inception.

SLAC hasn't let its affirmative action training die away, however, like the Indians in the poem. Since there aren't any full-time SLAC employees who are interested in entering the STP at the moment, a companion program is underway for half-time students. Instead of working full time year round with only one class per quarter, as STP students do, these alternative students attend school and work in alternate quarters. They are Foothill College students, not SLAC employees, who are paid only during the quarters they work at SLAC, and who take a full load of classes when attending school.

Kim Morgan, with 3-year-old daughter Heather to support, is one of these alternative students. Having completed electronics course E-51, she is now in her first working quarter at SLAC, gaining practical experience in electronics fabrication in Frank Generali's shop. Next quarter she will be back at Foothill taking E-52, Math 72 and a few other classes. Ann Graham and Barbara Elder have been here long enough for us to know them pretty well (this is their third working quarter at SLAC). Ann, who lives with her mother and grandmother, calls her life "pretty uninteresting," then proceeds to tell about her pet chinchilla that died of asthma. At the moment she is working with Steve Shapiro on electronics systems for LASS. Barbara's husband, whom she'll talk about at the drop of a hat, besides being an electronics technician himself, is the bass guitar player in a local band with the uninformative name of COLUSA. "He picked the name from a street sign," she explains--and why not? Both women have completed E-53 and are currently enrolled in E-58, thus giving them quite a back-

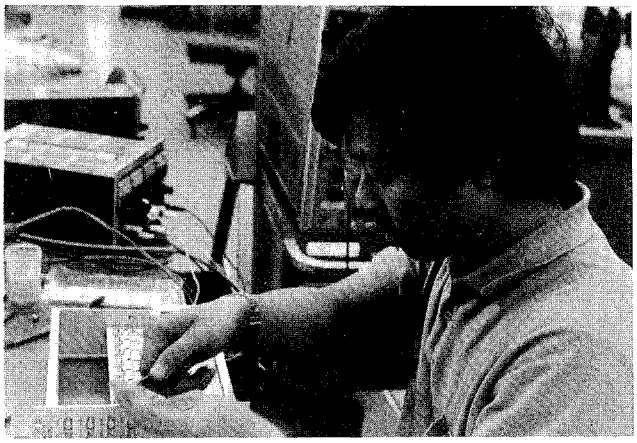
Kim Morgan is spending her first quarter at the cool end of a soldering iron in Frank Generali's shop.



Contract worker Cathy Jurgensen and student Ann Graham are sharing work for the LASS project.

Student Barbara Elder and co-worker Bob Filippi are shown at the Stanford Synchrotron Radiation Project (SSRP).

(Continued on next page)



First quarter student Quang Trang is already working on some pretty sophisticated electronics for LASS.

ground in electronics (prospective SLAC employers please note).

The STP program has its ups and downs. Walter Murphy had to have his spine fused for a second time, and is currently on leave from the program. Cheryl Mills found the pressures of raising two children while working or attending school too great, and so has dropped out. Then there is first-quarter student Quang Trang, a 19-year-old Vietnamese refugee, who is driven to work by one of the Foothill teachers, Paul Evans, because he has no transportation, and who rides home with one of three SLAC employees. He is presently learning some of the basics of LASS while improving his English at the same time.

The STP is always looking for new students from within the SLAC working force. The big push will be to bring them in next October when a new school year starts. Alternative students seem to enter anywhere from October to March. So, even though the enrollment isn't full at the moment, both programs are alive and kicking.

Anyone at SLAC who is interested in finding out more about STP or about the alternative program can get information by talking with either Ted Jenkins (x2345) or Gerry Renner (x2351).

--Ted Jenkins

SPRING CHARTER FLIGHTS

1.	SF/Honolulu	March 20	$179 Round Trip
	Honolulu/SF	March 28	
2.	SF/New York	March 19	$189 Round Trip
	New York/SF	March 29	
3.	SF/Paris	June 17	$263 One Way

A.S.S.U. Travel Service
Tresidder Student Union
497-4437, ext. 74437
Mon.-Fri., 10:30-4:30 P.M.

NEW PARTICLE HAS "CHARM"

Physicists at SLAC announced the discovery of a new particle last Feb. 5th to a surprised community that had become resigned to the status quo. "Things just don't change that fast," Burton Richter said, shaking his head. Sid Drell commented that it came as a complete surprise to the theorists.

The new particle, described as "relatively large in size for a particle, yet light at the same time," was first detected by physicists working the owl shift on Thursday morning. "We weren't even looking for it," said an amazed Rudy Larsen. "I suppose you might describe it as 'fallout.'"

While they existed long enough to measure, the new particles displayed a relatively short half-life. "I caucused the theorists," Pief said at the briefing, "and it was definitely agreed that the new particles exhibited 'charm.'"

Additional details were furnished by the experimentalists. "We measured spin," Martin Perl noted, but when pressed was unable to state whether this was positive, 1/2, or zero. Dick Taylor added that "Measurements of the form factor failed to show a solid core. It appeared to be uniformly diffuse and, more surprisingly, perhaps, almost completely two-dimensional."

Because of a general lack of agreement, the new particle is being listed as "semi-neutral. Mozley biases it one way, I, another," said Joe Ballam. "Until we come to some agreement, we'll have to leave it at that."

Al Odian of Experimental Group D quickly named it the "O" particle. ("It's about time we had an Omicron.") But Dave Ritson believes it to be a member of the meson family "and therefore definitely a 'W' particle."

In making the announcement, Pief stated that until all complexities and conflicts were resolved (which may take years; conditions for its production have not been duplicated), he would invoke his directorial perogative and considerable ability as an arbitrator in naming the new particle. "It will be called the 'Semi-Neutral Omicron W," he said.

Those inured to acronyms foresee that in the future it will be referred to simply as *SNOW*.

--Ted Jenkins

Gummidge's Law

The amount of expertise varies in inverse proportion to the number of statements understood by the general public.

Fitz-Gibbon's Law

Creativity varies inversely with the number of cooks involved with the broth.

RICHTER AND TING RECEIVE E. O. LAWRENCE AWARDS

Burt Richter of SLAC (photo) and Samuel C. C. Ting of the Massachusetts Institute of Technology were among the five scientists who received, on February 12, the Ernest Orlando Lawrence Memorial Award for 1975. The Lawrence Award is presented by the Energy Research and Development Administration "in recognition of outstanding contributions to the field of atomic energy." Each of the award winners receives a citation and a prize of $5,000. The citations for Professors Richter and Ting were as follows:

DR. BURTON RICHTER

For important contributions to the measurement of photo-induced high-energy reactions; for leadership in the realization of electron-positron storage rings, culminating in the discovery of new particles of matter.

DR. SAMUEL C. C. TING

For powerful new experimental techniques that have extended the validity of quantum electrodynamics, determined the properties of vector mesons, and culminated in the discovery of new particles of matter.

Previous Lawrence Award winners at SLAC include Director W. K. H. Panofsky and Deputy Director Sidney D. Drell.

--Bill Kirk

Dr. Burton Richter

Dr. Burton Richter was born in 1931 in Brooklyn, New York. He received a B.S. degree from the Massachsetts Institute of Technology in 1952 and a Ph.D. from MIT in 1956.

He served as a Research Assistant at the Brookhaven National Laboratory and at the High Energy Physics Laboratory (HEPL) at Stanford University. During his time at HEPL he was a member of the combined HEPL-Princeton University group that constructed the first successful electron-electron colliding-beam storage ring, a machine that produced its first experimental results in 1965. Richter was Assistant Professor in the Stanford Physics Department, then Associate Professor at SLAC. Since 1967 he has been a full Professor at SLAC and has served as the Group Leader of SLAC's Experimental Group C.

Richter is a co-leader of the joint LBL-SLAC (Groups C and E) experimental team that discovered, in November 1974, the new elementary particle of unusual properties that was named "psi." This same particle was also discovered simultaneously at Brookhaven National Laboratory by a joint MIT-BNL group working under Dr. Samuel C. C. Ting, who named it "J". The SLAC-LBL group discovered a second, similar particle within two weeks of the first discovery; and during the past year their continuing studies at the SPEAR storage ring at SLAC have resulted in the discoveries of several additional new particles. These discoveries are regarded as extremely important in the field of high energy physics research.

In addition to his experimental research, Richter was the person who was principally responsible for the conception, design and construction of the SPEAR storage ring at SLAC. Some idea of SPEAR's impact can be got from the following quotation:

> . . . the US machine SPEAR at Stanford, California, which has produced such fundamental and sensational results in the past year (including the new psi particles) and has undoubtedly had the most brilliant debut of any high energy physics facility yet constructed.
>
> --Dr. Wilbur Venus
> *New Scientist*
> May 8, 1975

Richter is presently on sabbatical leave from SLAC and is spending his leave at the European Center for Nuclear Research (CERN) in Geneva, Switzerland.

Feb. 5, 1976

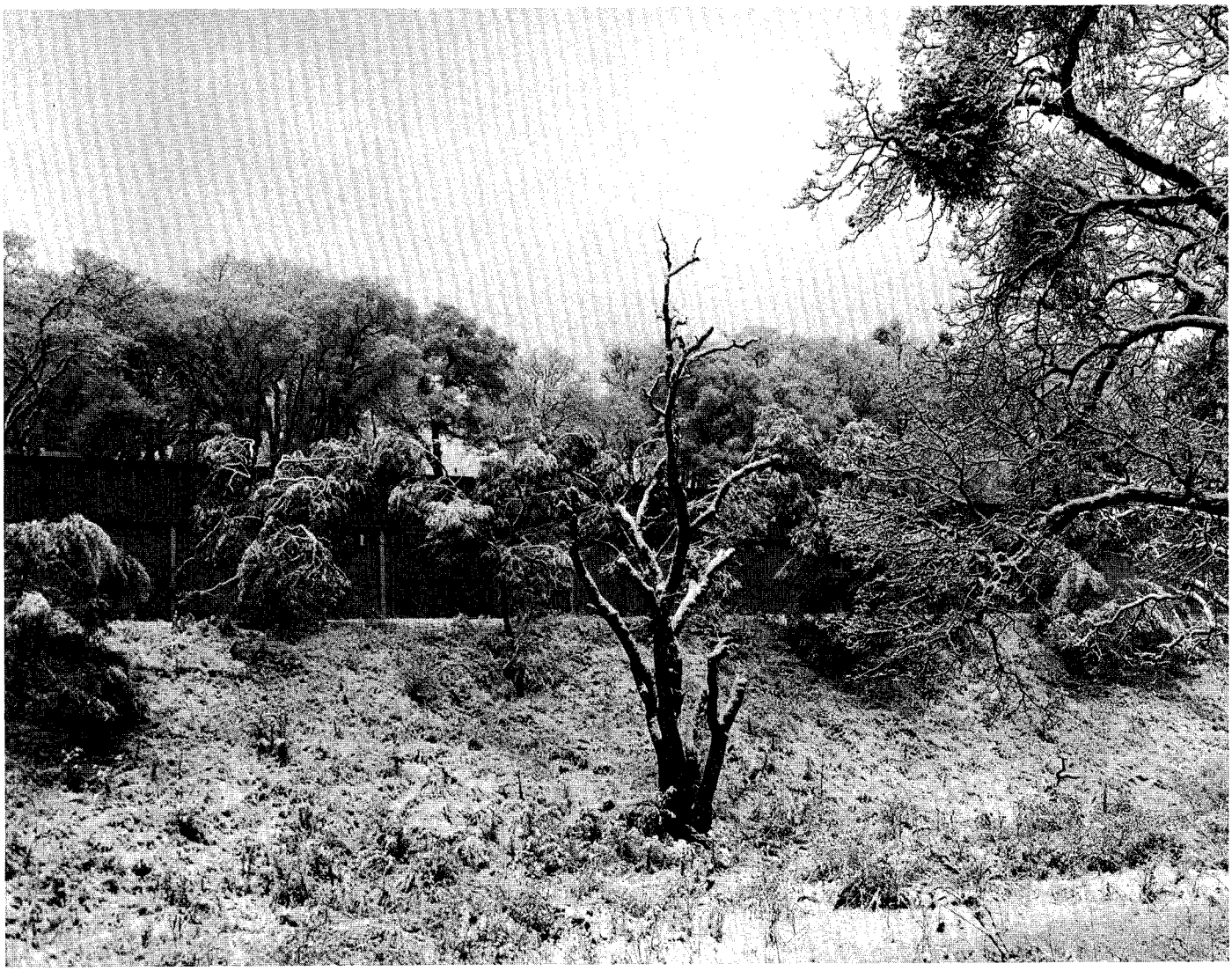
On this historic date, after a waiting period of 13 years, SLAC was again visited by an immense deluge of

SNOW

The blizzard stimulated a great deal of camera activity, some of which is reproduced on the next four pages with the kind permission of the artists. During our time of frigid fibrillation at SLAC we directed many a sympathetic thought toward our colleagues in such favored climes as Toronto and Lund and Helsinki. If these Great Northers continue, we may apply for recognition as NOVOSIBIRSK WEST.

Adele Panofsky

Walter Zawojski



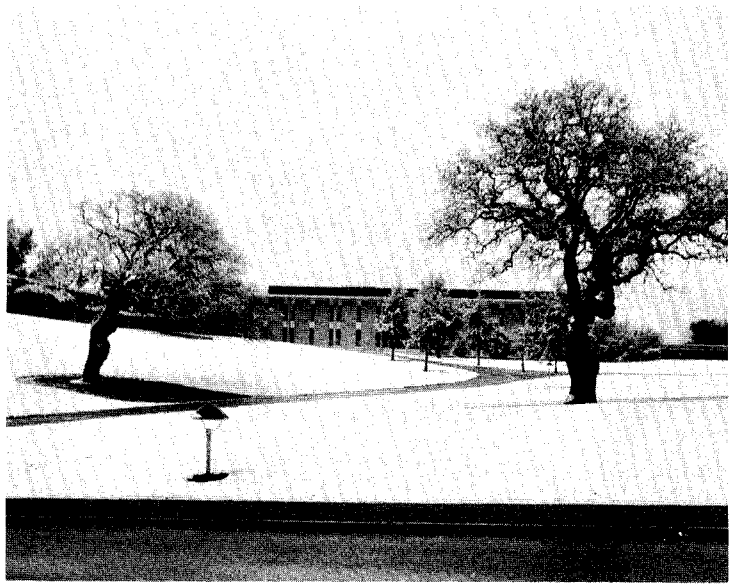
Erasmo Ferreira

Adele Panofsky

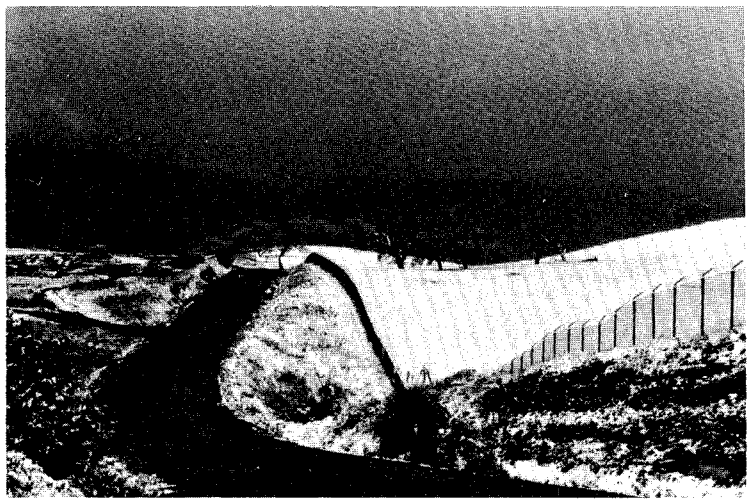
Jack Nicol

John Kieffer

Erasmo Ferriera



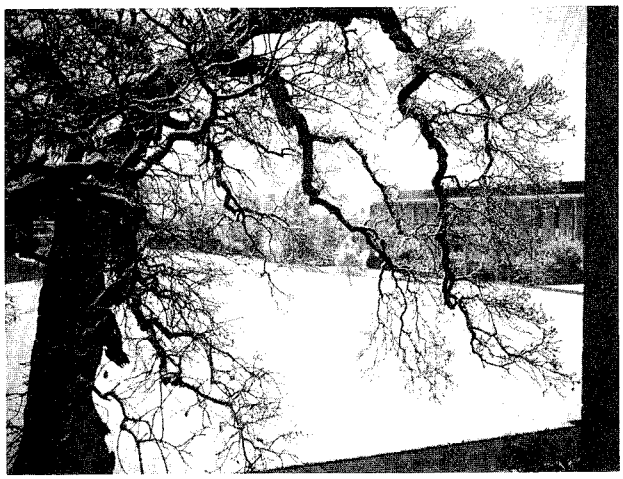
Adele Panofsky



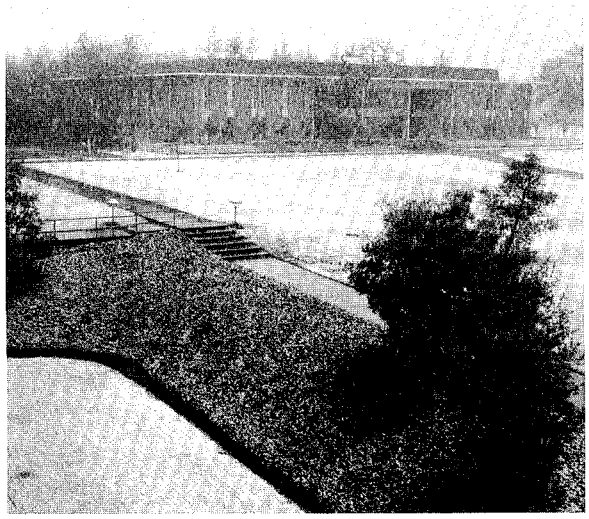
Nancy Kowerski

Nancy Kowerski

Erasmo Ferreira



John Kieffer



EARTHQUAKE SAFETY COMMITTEE

"For want of a nail . . ."

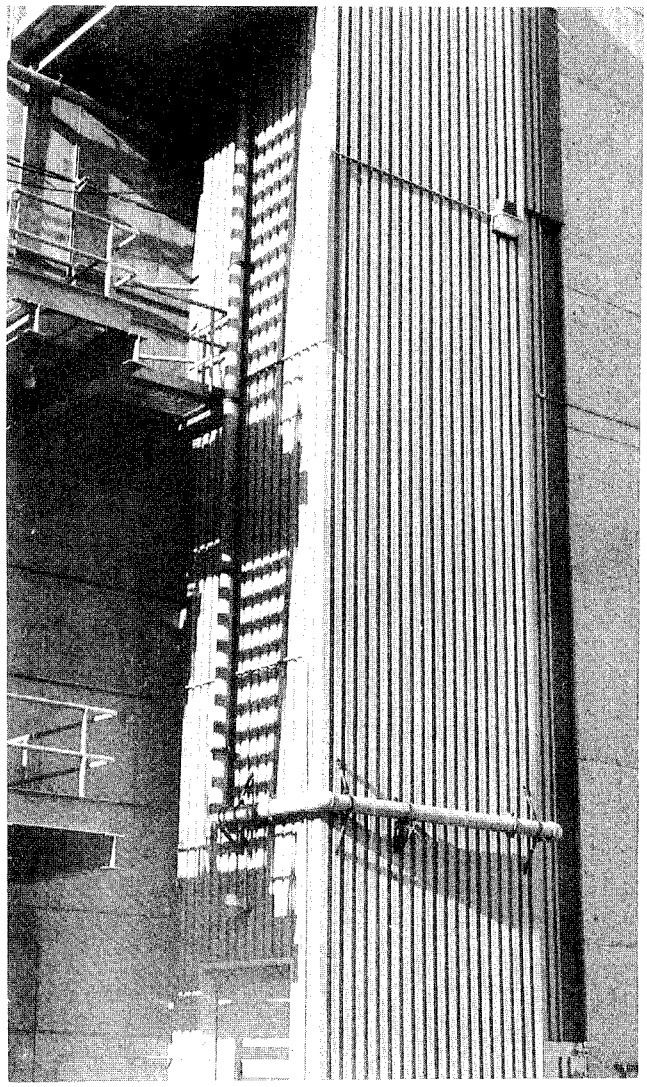
Sooner or later SLAC can probably expect to experience a major earthquake. SLAC has an Earthquake Safety Committee that is charged with the responsibility of identifying potential hazards and requiring responsible parties to take corrective action.

Sometimes the problems are not obvious--the pictures on this page show two items that were recently the subjects of Committee citations.

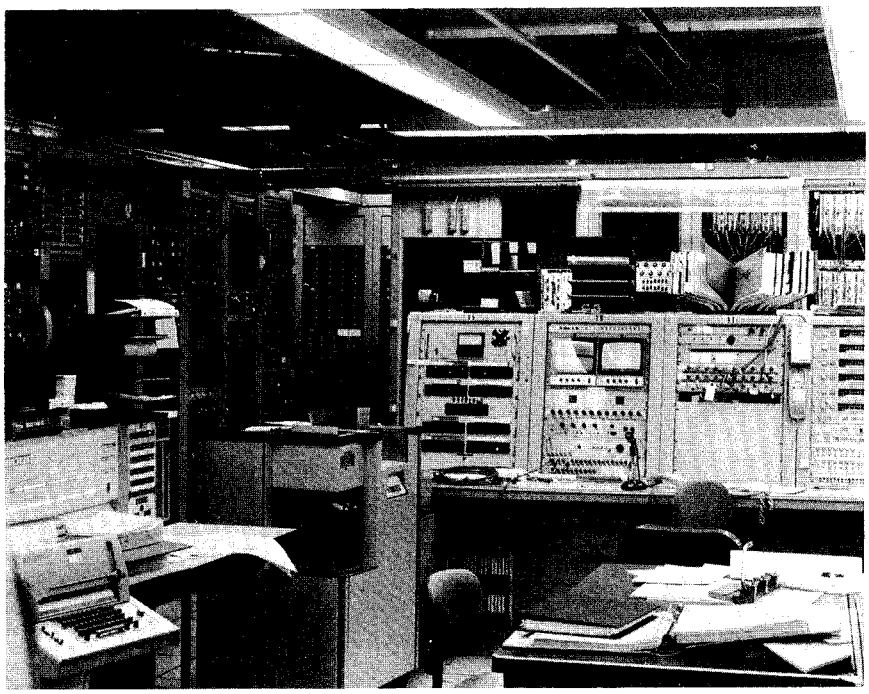
Building Managers and Group Leaders are encouraged to identify potential hazards and to take corrective actions either on their own or in conjunction with the Committee. The Committee will be happy to provide advice and assistance. The following persons are currently members of the Committee:

Dave Coward 2419 John Harris 2767
Finn Halbo 2491 Al Kilert 2437
Bill Savage 2244

--John Harris



The large pipe that can be seen rising vertically up the left side of the elevator shaft is the main supply for the fire sprinkler system. Including the water, it weighs perhaps a couple of tons. It is mounted on rugged brackets with adequate hardware . . . to the sheet metal siding of the shaft which is secured only by sheet metal screws. In a substantial earthquake the piping can be expected to tear off the siding. A pipe joint would then fail, thus disabling the sprinkler system and draining the fire main.



This photo shows a well-ordered experimental control room with a high standard of design and housekeeping. What the picture does not show is that under typical motion in a strong earthquake the electronic racks may be expected to topple over, and that the computer floor may suffer partial collapse, dropping the occupants a couple of feet to the sub-floor. The capital investment here exceeds $1 million; correcting the problems would cost about $1000.

(Both photos by John Harris)

WERNER HEISENBERG
1902-1976

The recent excitement over the discovery of new particles should not obscure the fact that the effort to understand nature is a difficult business. Asked to name the truly profound advances that have been made in this understanding during the 20th century, there are many physicists who would cite only two--both dating back to the early years of the century. One of these is the Theory of Relativity, which dates from the year 1905 and is pre-eminently the work of Albert Einstein. The other is Quantum Theory, which begins with Max Planck in the year 1900, and which culminates in the 1920's with the development of the complete theory that is known as Quantum Mechanics. *Among the many contributors to this great achievement (Bohr, Pauli, Dirac, Schroedinger, Born . . .) the name of Werner Heisenberg ranks high. Last month Heisenberg died at his home in Munich. The following tribute is reprinted from the February 16, 1976 issue of* Newsweek.

THE QUANTUM MECHANIC

"At first I was deeply alarmed. I had the feeling that, through the surface of atomic phenomena, I was looking at a strangely beautiful interior, and felt almost giddy at the thought that I now had to probe this wealth of mathematical structures nature had so generously spread before me. I was far too excited to sleep . . ."

Thus did Werner Heisenberg describe his feelings when he hit upon one of the major insights of twentieth-century physics--the first coherent formulation of quantum mechanics, which explains the structure of the atom. He was only 23 and was recuperating from a severe attack of hay fever on the North Sea island of Helgoland. Heisenberg's subsequent development of this theory won him a Nobel Prize for physics in 1932, and an eminence among physicists of that golden era nearly equal to that of Albert Einstein and Niels Bohr, the Dane who first postulated the modern model of the atom. Though Heisenberg's subsequent career was controversial, his scientific stature was never in doubt. . . He was one of the half-dozen leading physicists of a century rich in great physicists.

Rules: Heisenberg's quantum mechanics, for which he had to develop a new system of mathematics known as matrix mechanics, provided physicists with a detailed and accurate set of rules for computing atomic properties and explained an enormous mass of experimental data. It also allowed them to expand and refine Bohr's picture of the atom--a series of electrons whirling around a nucleus in fixed orbits like planets around a sun.

Two years after his Helgoland holiday, Heisenberg made another profound theoretical advance known as the uncertainty principle. This stated that it is impossible to specify exactly both the momentum and the position of an object, because measuring one of these quantities automatically alters the other. It is a principle with profound applications in philosophy and in the social sciences, indicating as it does that the very act of observing or measuring a phenomenon alters the behavior being studied. In the ultra-small world of atoms, the uncertainty principle helped explain such unexpected events as the discovery in 1932 of the neutron. "This principle indicated that nature could have crazy new properties," explained astrophysicist Hans Peter Dürr, Heisenberg's closest associate during his last years at the Max Planck Institute for Physics and Astrophysics in Munich. "We would not be able to understand atoms without it."

When the Nazis took over Germany in the 1930's, Heisenberg came under great pressure from fellow physicists to emigrate from his native country. This he refused to do, explaining that he hoped to change Nazi ideas from inside the country. "He was never a Nazi or an extreme German nationalist, but he was very patriotic," explained physicist Harry Lehmann of Hamburg University.

When the war came, Heisenberg was picked to head the German effort to produce an atomic bomb. The choice proved a poor one: Heisenberg was a theoretician in an essentially experimental effort and an academic in an enterprise that demanded industrial skills. Quite early in the war he told German Armaments Minister Albert Speer that a bomb was many years away because of technical complexities. Heisenberg, however, always denied that he had held back the German A-bomb effort. In fact, he refused to believe that the Allies had dropped an atom bomb on Hiroshima until he heard the details of the bomb's construction.

View: Heisenberg never fully reestablished himself after the war. He came to believe that there are no new elementary particles to be discovered, and although this view may not prove as outrageous as it may seem . . . some younger physicists thought that Heisenberg was refusing to accept the fact that physics had progressed markedly since the heady days of quantum mechanics and the uncertainty principle.

Heisenberg once likened the role of the scientist to that of Columbus, "who had the courage to leave behind him all inhabited land, in the almost insane hope of finding land again on the other side of the sea." Heisenberg's journey was a long one, and the land he discovered one of the richest in all of science.

--Peter Gwynne with Anthony Collings

CABLE PLANT CLEANUP

(Photos by Joe Faust)

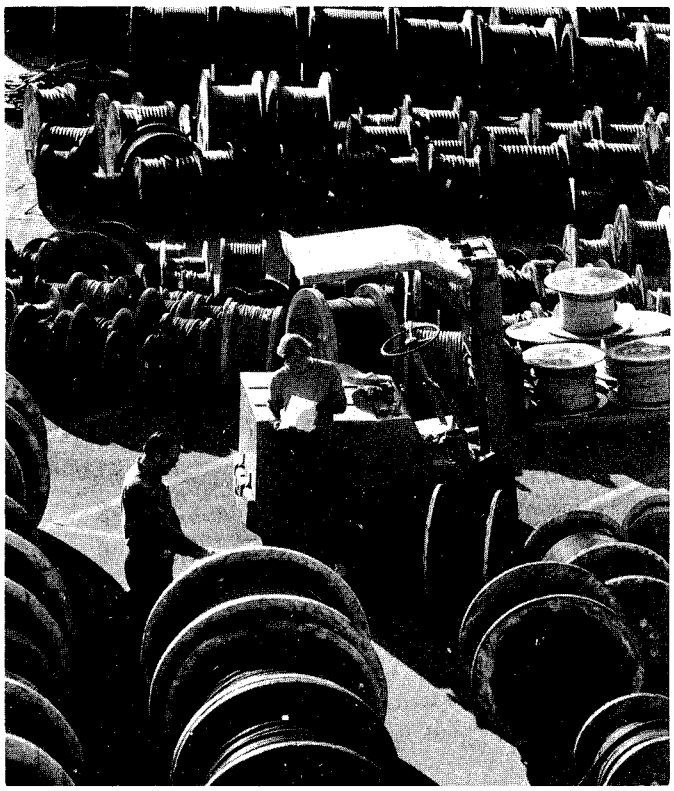
The cable plant cleanup program is a continuing effort to remove cables that were used in now-completed experiments, thus providing space for new cable installations and also improving the general safety aspect of the research area.

The accompanying photographs show some of the activity during the removal of the cable plant that served the 82-inch bubble chamber. This work was done prior to the move of the bubble chamber out of its long-time home in Building 113 and into a well-earned retirement.

Bill Smith, Electronics Technician in SLAC's Experimental Facilities Department (EFD), is responsible for the removal and reclamation effort. With the help of some part-time student workers and other personnel in the EFD Electrical Installation Group, large quantities of valuable cables and connectors are removed, identified, and made available for re-use. Some of the cables have been used in as many as three different experimental set-ups, with a considerable cost saving.

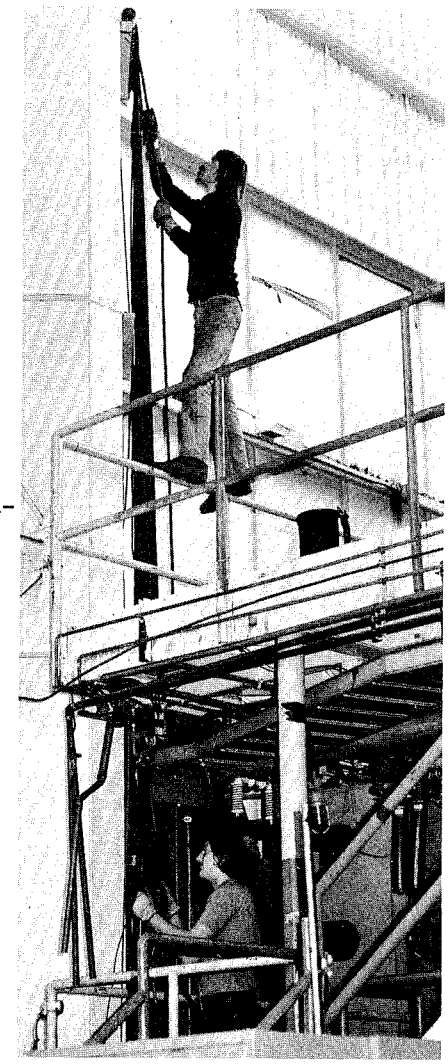
Large-scale cleanup operations in the cable plant are planned for the next two accelerator shutdown periods.

--Ken Johnson



Bill Smith (left) and Steve Kopanski are shown working in the cable yard amid some of the many stored reels of cable--some new, and some reclaimed from completed experiments and other facilities in the research area.

Part-time students Jon Juri (left) and Mel Arterberry, Jr. are shown measuring and reeling cables before labeling and storage.



Ken McLaren (top) and Jeff Colon, both part-time student employees, are shown removing some of the cabling from the 82-inch bubble chamber installation prior to the move of the chamber out of Building 113 in the research area.

> The man who undertakes to solve a scientific question without the help of mathematics undertakes the impossible. We must measure what is measurable and make measurable what cannot be measured.
>
> --Galileo

Fundamental science in the US has been encouraged by President Ford's budget request for 10 per cent rise in funds for fiscal year 1977. The budget clearly favours science, for overall federal spending is to increase by only 5 per cent. . . . Congress has yet to approve the budget.

Beneficiaries would be PEP, the high energy physics colliding electron beam accelerator which should get $25 million; the environmentally controversial Liquid Metal Fast Breeder Reactor which is boosted from $428 million this year to $575 million next; and defense research spending which, with a sidelong glance at the USSR, goes up by $1 billion. The National Science Foundation, if Ford's budget is approved, would also get a massive 20 per cent increase to $625 million in its basic research budget. The National Cancer Institute remains static; it had been accustomed to 25% increases. This holding operation within the National Institutes of Health would benefit many other, less glamorous, aspects of medical and biological research.

--*New Scientist*
5 February 1976

CREF UNIT VALUES

For those who are in the TIAA-CREF retirement plan, here is a summary of how the value of a CREF unit fluctuated during 1975:

Jan.	$30.67	July	$36.81
Feb.	32.80	Aug.	35.86
Mar.	33.77	Sept.	34.31
Apr.	36.12	Oct.	35.89
May	38.07	Nov.	36.61
June	39.88	Dec.	36.44

For January 1976 the value rose to $40.31. Go baby!

CO-OP PROBLEMS? THINK ABOUT QUARKS!

If your Co-op has knotty problems, it may prove to be good therapy if you think a bit about quarks. Here's the situation:

Four quarks are the basic subunits of all heavier particles of matter, providing one of the quarks is a charmed quark. At least, that is the opinion of some U.S. and European physicists. They can't be awfully solid in the opinion, however, because no one has ever observed a quark. They really can't be observed because they exist only when mated with other quarks. There is no clear explanation as to how nothing can mate with nothing to produce a quark, which itself is nothing until it mates with another nothing.

ERC in CNS
Palo Alto Co-op News
Feb. 2, 1976

SLAC Beam Line
Stanford Linear Accelerator Center
Stanford University
P. O. Box 4349, Stanford, CA 94305

Published monthly on about the 15th day of the month. Permission to reprint articles is given with credit to the *SLAC Beam Line*.

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Walter Zawojski, Bin 70, x 2778 } *Photography & Graphic Arts*
Ada Schwartz, Bin 68, x2677 — *Production*
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Bill Kirk, Bin 80, x2605
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	2-*8*	8-*5*	15-*4*	25-*3*	34-*4*	53-*43*	62-*46*	68-*11*	74-*8*	82-*12*	88-*30*	95-*41*
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	5-*3*	11-*18*	22-*15*	30-*48*	50-*25*	56-*13*	65-*25*	71-*53*	79-*86*	85-*28*	91-*7*	99-*3*

To: Krys Ciolkosz, Bin 3

I hereby authorize payroll deductions of $0.50 per month for the SLAC Emergency Relief Association (SERA) until further notice.

Signature_____

Print Name_____

Date_____ Dept._____

WANT TO JOIN SERA?

This sign-up form was accidentally left out of the "History of SERA" article by Charlie Hoard in last month's *Beam Line*. If you'd like to join SERA, please fill out this form, tear it off, and send it to Krys Ciolkosz at Bin 3.