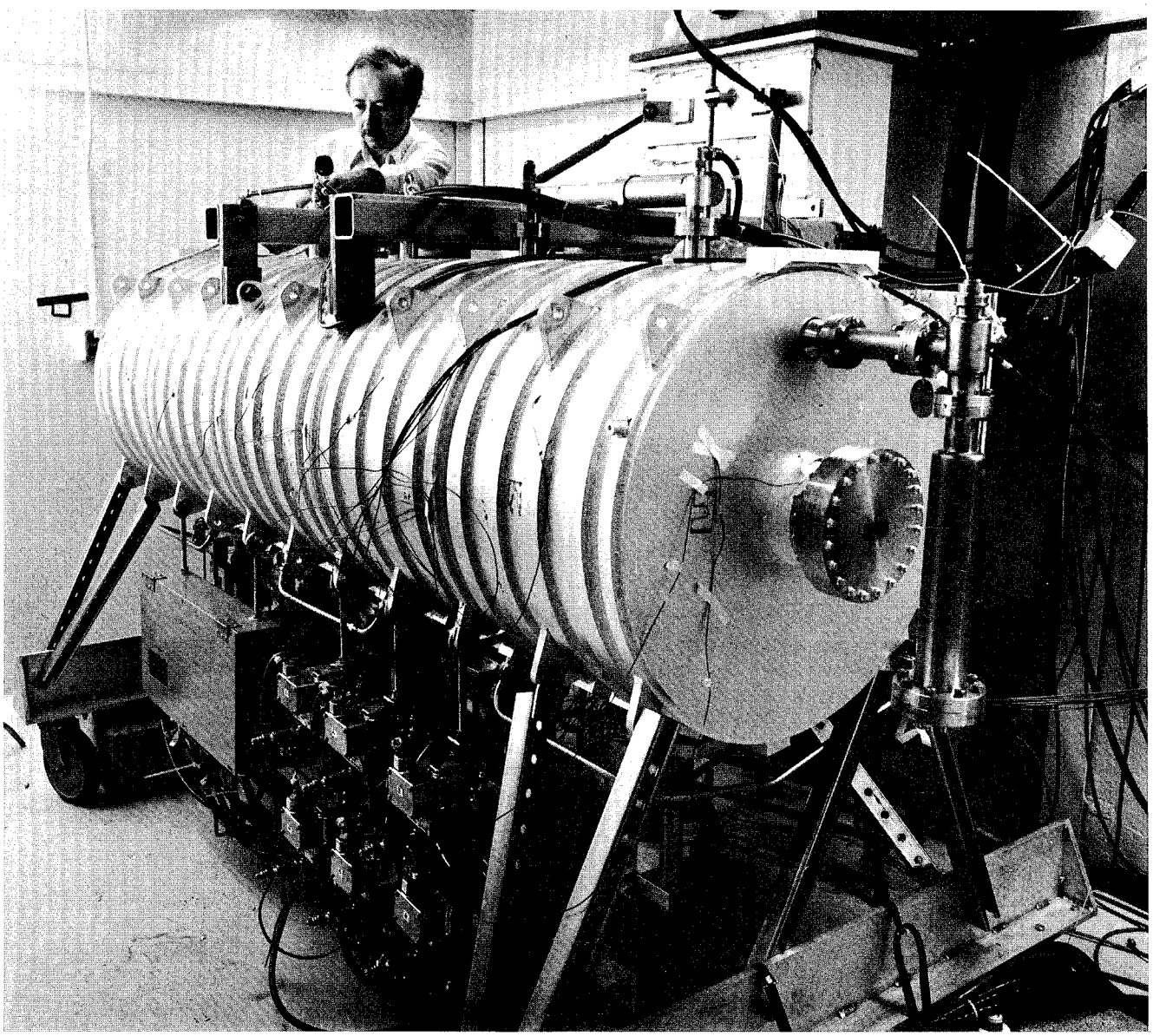
SLAC BEAM LINE

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

Volume 9, Number 3 *March 1978*



Matt Allen of the PEP group is shown in Joe Faust's photo above of the first production RF accelerating structure (cavity) for PEP. This cavity has been tested at power levels up to 300 kilowatts, 20% higher than the PEP requirement. The vacuum achieved was 5×10^{-9} torr and is expected to improve with processing. A total of 24 such cavities will constitute the initial accelerating structure at PEP, capable of "holding" beam energies up to 18 GeV. Production of the remaining 23 cavities is well along.

In This Issue

Stanford lab site yields treasure

Campus once domain of sea creatures

STANFORD--Fourteen million years ago, ancient whales, porpoises, sea lions and at least six different kinds of sharks swam in what is now the Stanford University campus.

Workers excavating for the new Positron Electron Project storage ring at the Stanford Linear Accelerator Center (SLAC) have found the fossil remains of the underwater world.

The fossils were not unexpected. An environmental impact report for the $78 million project predicted that fossils might be found in the area.

U.S. Geological Survey paleontologists have been on hand to monitor the digging and help recover any specimens that might turn up.

In 1964, when excavations were under way for the original linear accelerator, workmen uncovered "Paleoparadoxia," the remains of an extinct sea mammal about the size and shape of a hippopotamus.

The name is Greek for "ancient paradox," to describe an animal that had feet like flippers and paddled about in the shallow waters of the Pacific Coast.

Dr. Charles A. Repenning, in charge of the USGS studies on the site, and Mrs. Adele Panofsky, an amateur paleontologist and wife of SLAC director Wolfgang Panofsky, worked together to reconstruct the skeleton.

They had fossil bones comprising both hind legs, a foreleg, spinal column, 14 pairs of ribs and left lower jaw.

Mrs. Panofsky reconstructed the missing skull using a partial skull from the Santa Barbara Museum of Natural History and other specimens from the Natural Sciences Museum of Japan, which then possessed the only skeleton of Paleoparadoxia in existence.

These days the SLAC Paleoparadoxia resides at UC-Berkeley's Museum of Paleontology.

Mrs. Panofsky is assembling plaster casts of the parts to exhibit permanently at SLAC.

Paleontologists remain unsure about Paleoparadoxia's ancestry but speculate that the obscure mammal was a distant cousin of sea cows and mastodons, weighed more than a ton, and may have looked like a cross between a sea lion and a sea cow.

Repenning said that recent information suggests the mammal may have been related to land animals with hoofs, such as the pig family.

Spurred on by the exciting find, Dr. Bruce Lander and Dale Russell of USGS are working in the now mud-filled site alongside Mrs. Panofsky.

"One's enthusiasm for fossil hunting diminishes as one sinks slowly into the mud," Mrs. Panofsky admits.

--*San Jose Mercury*, January 4, 1978

THE CONVERSION OF CANUTE

Physicists from the University of Cambridge in England have been at SLAC recently preparing for an experiment that will make use of the hybrid bubble chamber facility. One major part of this facility is the large Cerenkov counter that sits downstream from the 40-inch bubble chamber. The Cerenkov radiation (light) that is produced in Canute is presently collected by 10 phototubes, but it was recently decided that Canute should be converted to 12 phototubes for the Cambridge experiment.

In connection with this decision, one of the Cambridge physicists who was at SLAC sent off a telex to his colleague, Dr. White, back at Cambridge. The telex contained references to SLAC, to the intended conversion of Canute, and also to the fact that a group of students would soon be returning to Cambridge.

At Cambridge, the telex machine printed out a part of the message, then left a gap on the paper, then printed the rest of the message. In the gap it printed the label:

PAGE 2/50

Seeing the gap, the machine attendant cut the telex in half and sent the first part to Dr. White. The second part was sent to a certain Dr. Page, who happens to be the Librarian for the Cambridge College called Corpus Christi. When the second half of the telex finally found its way back to Dr. White, it was accompanied by the following note:

From
THE LIBRARIAN, CORPUS CHRISTI COLLEGE,
CAMBRIDGE, CB2 1RH

I am moved by the thought that a group of students should come and help me with my Study of Languages and Antique Customs (SLAC) in the fields of Old Norse and Old English. However, it is just possible that this telex has got to the wrong Dr. Page. My reason for suspecting this is the second message which speaks of help with the 'Canute conversion.' According to all sources Canute was converted in the early eleventh century, and if there is any residual uncertainty in his mind, only the Almighty can help him now. Alternatively, the message may have confused Canute with his father, Swein Forkbeard, who, according to some, reneged to paganism and would need more conversion. Though how we can help him is more than I can say.

RMPage

A VISIT FROM LAS LOMITAS

Friday, January 13, was a lucky day for the students in Mrs. Dorothy Dary's third grade class at the Las Lomitas School in West Menlo Park. The students were guests at a party held for them at SLAC Stores, and they were also taken on a tour of SLAC. How all this happened is a story in itself.

In late October, Mrs. Dary's class launched 36 helium-filled balloons, each one bearing a tag that requested that the finder please contact the students. One of the balloons landed in a tree near Bldg. 17 at SLAC and was retrieved by Ruthie Boyd, who works in Stores. She wrote a letter to Mrs. Dary and her students, inviting them to visit SLAC. The visit consisted of a party held at Stores, with root beer and cookies, followed by a tour of SLAC that was led by SLAC Tour Guide Gene Robinson.

The students seemed to have a very good time. Mrs. Dary was full of praise for the friendly folks at SLAC. Ruthie Boyd thought that having 40 elementary-school students partying at Stores was enjoyable albiet a little disruptive. (She remarked later that "Next time if a hundred balloons land in that tree, I'm leaving them there!")

After the visit, the students wrote thank-you letters, some of which are reprinted below. A smaller group of these students plans a return visit on March 1 to see the reconstruction of the *Paleoparadoxia* fossil remains that Mrs. Panofsky has been working on at SLAC.

--Jane Marcus
Public Information

To Gene:

How ya doing bud? I am fine. I liked our tour around Slac. And tell the people in Room 17 that we liked the root beer and cookies. I know that you don't lie, but I don't think anything can go around the world 7 times in 1 second but maybe. I knew that an accelerator can be long but 2 miles! I know that 2 acres is big but 400 acres! That's bigger than 100 of my front yards. See ya around bud, bye!

Sincerely,
David Finkel

Dear Gene,

Thank you for showing us S.L.A.C. It was really fun. On a hill, when the bus was driving, I think I saw the tailbone of a fossil, sticking out from behind a bush. It is fun at S.L.A.C.

Thanks again,
Amy Jervis

Dear Gene:

Thank you for the nice tour at Slac and for showing us the movie. Tell the people "thank you" for the root beer and cookies. Gene you do such a good job at telling things. The Klystrom Gallery is really two miles long. That is really big. How do you get around in the Klystrom Gallery? I hope you get the bones of the paleo-paradoxia together and make your own museum.

p.s. See you soon!

Your friend,
Linda Fuensten

Dear Gene:

Thank you for showing us around Stanford Linear Accelerator Center.

Sincerely,
David Boles

P.S. I really dig the Klystron Gallery.

SANTA CLARA VALLEY SCIENCE & ENGINEERING FAIR

A special invitation is extended to all SLAC employees and their families to visit the 18th Annual Santa Clara Valley Science and Engineering Fair. The Fair will be open to the public April 6, 7 and 8 (Thursday-Saturday) from 10 AM to 5 PM in Gateway Hall at the Santa Clara County Fairgrounds, located on Tully Road, San Jose. Admission is free.

Each year several hundred students from public, private and parochial schools, grades six through twelve, exhibit projects chosen because of their scientific interest. The research, attention to detail, and documenting of data offer evidence that American students are still "turned on" to science.

The Fair is judged by scientists from the various fields of the physical and biological sciences. In many instances, these volunteer judges are associated with companies and organizations that sponsor the Science Fair.

The Awards Ceremony, held on Saturday, April 8 at 1:30 PM at Fiesta Hall on the Fairgrounds, honor the winners of each category at each grade level. In addition, many prizes from local and national organizations are awarded to outstanding exhibitors, including several $600 Work-Fellowships. Grand prizes for the best biological and physical science projects entitle the winners to compete in the International Science and Engineering Fair held this year in Anaheim, California. The public is also invited to the Awards Ceremonies.

NOTE TO MAGNETIC-CARD HOLDERS

Bob Sukiennicki reports that the large LASS magnet has erased the magnetic markings on his Alpha Beta check-cashing card. So users of such cards (Alpha Beta, Crocker, etc.) should beware.

Photo by Joe Faust

DAN DANIELSON RETIRES

Gentleman, scholar, sportsman, raconteur--these words alone cannot do justice to the man. After spending a good part of his working life at SLAC, Dan Danielson is leaving us to go into active retirement in Montana. Although one of the best designers at SLAC, Dan labored solely to finance his real loves--fishing, hunting, traveling, and story-telling. (I still don't believe he caught a six-pound rainbow trout in the cooling tower.)

Dan is a man of many talents:

1. Gunsmith: He designed the Danielson blunderbuss which was noted for downing three mosquitos and a 747 in one blast.

2. Photographer: Many of his pastoral scenes became legend when the National Park Service threatened to sue him for destroying public property.

3. Machinist: Dan was the first to combine a lathe, a mill, a bandsaw and a drill press into one unit. (Ford bought the patent and later marketed it under the trade name "Edsel.")

4. Poet: Dan is the only poet with three words that rhyme with orange.

5. Wilderness guide: One story has it that in Dan's youth, while leading the pioneers, he circled the wagons OK but forgot to point the guns outside.

6. Dog trainer: Dan is such a good dog trainer that his current side-kick, Heather, trains people. Dan is her star pupil.

7. Undercover man: I never understood this claim since he never carries a badge.

Jokes aside, Dan is an exceptional man who has gained the respect and affection of all of us. He has actually been, at one time or another, a designer, a gunsmith, a machinist, a photographer, a recreational vehicle manufacturer, and a small businessman. If he desired, he could make a comfortable living in any of these professions but, rascal that he is, he has decided to concentrate on finding out how big the trout and deer grow in the Yellowstone country of Montana. I envy him, and I'll miss him when I'm not up there with my sleeping bag and fishing rod.

--Tom Jones

A NOTE FROM DAN

I'm sure that for every person there is a time and a place they remember as favorite. A time when there were things to do and a place of many friends. SLAC will hold this place in my memory. Although I am leaving my friends at SLAC, I will have the privilege of taking their friendship with me--and for that I am most grateful. Your friend,

--Dan Danielson

There is no plea which will justify the use of high-tension and alternating currents, either in a scientific or a commercial sense. They are employed solely to reduce investment in copper wire and real estate.

My personal desire would be to prohibit entirely the use of alternating currents. They are unnecessary as they are dangerous. . . . I can therefore see no justification for the introduction of a system which has no element of permanency and every element of danger to life and property.

I have always consistently opposed high-tension and alternating systems of electric lighting, not only on account of danger but because of their general unreliability and unsuitability for any general system of distribution.

--Thomas A. Edison (1889)

I have been told of an incident in the life of H.A. Rowland which I cannot certify but which is consistent with other reports of his personality. It seems he was called on to testify as a science expert in some kind of court case. In exploring his competence an attorney asked him who was the foremost American physicist. Rowland answered, "I am." Later a friend reproached him gently for his immodesty. Rowland's response was, "Well, you have to remember I was under oath."

--Paul Kirkpatrick

PHYSICS IS AN ABSTRACT ART

[Reprinted from *Science News*, February 4, 1978]

The physics of subatomic particles today is like a jigsaw puzzle in which not only is the appearance of the total picture unknown, it is not even known whether all the pieces are present. Physicists keep discovering new particles, some of which have new properties. The properties, which tend to get whimsical names, can be followed consistently through all the interactions and changes that the various particles undergo. But although Nobel prizes are given for the discovery of new particle properties (for example, the discovery of charm, which got the 1976 prize), the essential significance and interrelationships of the various properties is quite unclear. At last week's meeting of the American Physical Society in San Francisco, physicist Martin Perl of the Stanford Linear Accelerator Center suggested that what physics needs is a new Einstein to make sense of it all. Perhaps not a literal Einstein, since the actual Einstein strongly disliked the kind of physics involved in the particle game, but a mind as synthesizing and generalizing as his.

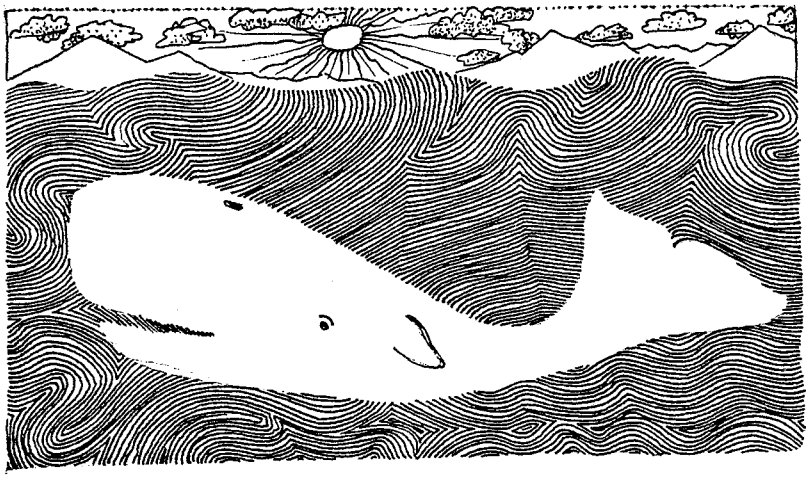
The actual Einstein to the contrary, God continues to throw dice, and the dice continue to land with new faces up. Vincent Vuillemin of the Lawrence Berkeley Laboratory and Stanley G. Wojcicki of Stanford University reported that two experiments running at SLAC's SPEAR storage ring, the one called the SLAC-LBL collaboration and the other called DELCO, have discovered what is being called a D meson factory, a point at which the collisions of electrons and positrons that take place in the storage ring produce copious amounts of the new D mesons in a particularly clear and easy-to-study way. The significance of this discovery to the over-all understanding of the particle physics puzzle is that the D mesons are particularly pure manifestations of the newly discovered property, charm.

The D's, which come in electrically charged and neutral versions, are believed to consist of a charmed quark and a [regular antiquark, or vice-versa]. According to the theoretical models most widely applied at the moment, quarks are the fundamental entities out of which most of the known particles are built. Quarks are the ultimate carriers of the basic particle properties: old one like electric charge and strangeness, new ones like charm. How the quarks combine with each other to make a given particle determines the properties that particle will manifest. At first three quarks were enough. The discovery of charm provided a fourth, and a discovery made in the middle of 1977 seems to require a fifth.

The D mesons, or charmed mesons . . . appear as products of the radioactive decay of the particles that first manifested charm, the psi particles. To the original psi, which was discovered in November 1974 at both SLAC and the Brookhaven National Laboratory and which won the 1976 Nobel Prize for the leaders of the discovery teams, continuing work at SLAC has added the psi-prime and the psi-double-prime. The masses of the three are 3.1 billion electron-volts (3.1 GeV), 3.68 GeV and 3.77 GeV, respectively. It is the mass of the latter, 3.772 GeV, to add another significant figure, that is the "threshold" of the D meson factory. D mesons are produced at other energies, but along with a lot of other particles that complicate the interpretations of the data. At 3.772 there happens to be just enough energy to make a pair of D's, a D and an anti-D, so nothing else comes along to complicate the picture. Thus the masses of the D's can be determined, and the particles into which they decay can be studied. The mass of the electrically neutral D comes out to 1.863 GeV and that of the electrically charged D comes to 1.868 GeV. Study of the ways D's can decay and the probability of each mode of decay will help elucidate the detailed behavior of charm.

DELCO has also added, or confirmed the addition of, another important new piece to the puzzle, a heavy lepton. The particles made up of quarks, of which there are more than 100, constitute a class called hadrons. In addition, there is another class called leptons. Leptons are not made of quarks, but seem to be as fundamental as quarks. Leptons and hadrons represent what physicists often refer to as two different kinds of matter. For reasons that rapidly get more profound than simple esthetics, theorists would like a symmetry between quarks and leptons, as many of one as there are of the other.

Although experimental evidence now shows up to five quarks, and some theorists postulate six, the number of known, confirmed and accepted leptons was only four -- the electron, the muon, the electron neutrino and the muon neutrino. About two years ago an experimental group led by Perl reported the discovery of a new particle that they believed was a new lepton, one heavier than any of the other known leptons. But the mass of that particle was somewhere between 1.800 and 1.900 GeV. This was somewhat suspicious, because the masses of the D mesons lie in that range, and it was possible that the discovery of Perl and company was really one of them. Wojcicki reports that studies by the DELCO experiment indicate that the new particle of Perl and co-workers appears when the storage ring is run at an energy of 1.860 GeV, just below the threshold for D pair production. Furthermore, its behavior shows that it has nothing to do with charm but is a heavy lepton. It is being called tau, comes in electrically positive and negative varieties and has a mass of 1.825 GeV.



--Chris Schmierer

The following communication was received by Universities Research Association, which is the consortium of Universities that operates the Fermi National Accelerator Laboratory near Chicago:

Department of the Treasury
Internal Revenue
Service Center
Philadelphia, PA. 19155
KO 7649

UNIVERSITIES RESEARCH ASSOCIATION INC
2100 PENNA AVE NW
WASHINGTON, DC 20037

Date of This Notice N122
Dec. 20, 1976
Taxpayer Identifying Number
52-0816670 KO
Document Locator Number
52141-311-19773-6
Form Number Tax Period
941 Sep. 30, 1976

FEDERAL EMPLOYMENT TAXES

NOTICE TO TAXPAYER

In checking the arithmetic on your tax return identified above, we had to make corrections. You may want to check your figures against the corrected ones shown below.

Adjusted total of income tax withheld...	$904,179.81
FICA tax at applicable rate.....	559,315.85
Adjusted total of FICA taxes.....	559,266.00
Total taxes.....	1,463,445.81
Total tax deposits for the quarter.....	1,463,445.82-
Overpayments from previous quarter.....	.00
Other credits.....	.00
Less credit to next quarter.....	.00
Overpayment.....	.01-
Penalty.....	.00
Interest.....	.00
Net overpayment.....	$.01-

We made the corrections because:
An error was made in computing your total tax.

This notice is for your information only. When the overpayment or total balance due is less than $1, as it is here, it is our policy to disregard it. However, if you overpaid less than $1, we will refund it if you request.

NOTE--If you have any questions about this notice, please see the message on the back. If penalty or interest charges have been added, see these code numbers on the back for an explanation_____→

A penny saved is a penny earned.

SUMMER INSTITUTE ON PARTICLE PHYSICS
JULY 10-18, 1978

The sixth annual SLAC Summer Institute offers both experimental and theoretical physicists the opportunity to study and review critically recent progress in high energy physics. responding to the observation of neutral currents, the continuing elucidation of the structure of the weak interactions and the prospects for the observation of carriers of the weak force at accelerators, the post-doctoral research community is invited to participate in an examination of

WEAK INTERACTIONS--PRESENT AND FUTURE

The format for the Institute will be two separate sessions--a 7-day school of a generally pedagogic nature followed by a 3-day topical conference. The school will consist of lectures each morning with early afternoon study and informal discussion, followed by organized discussion in the late afternoon during which participants will meet with the lecturers to raise questions and discuss problems. The conference format will be rather intense, with 5-6 invited talks each day. The program of the Institute is designed primarily, but not exclusively, for post-doctoral experimental physicists.

OUTLINE OF TOPICS

July 10-18 Summer School

Gauge theories of the weak and electromagnetic interactions will be reviewed as the basis for understanding the weak interactions and for predicting the results of future experiments. Production of the intermediate bosons and other particles at future accelerators will be discussed. The present status of high energy neutrino experiments and the information obtained from weak decays of hadrons and leptons will be reviewed.

July 19-21 Topical Conference

Invited talks will be presented on the most recent results on selected topics of current interest....

Participants must obtain their own travel and subsistence funds. Low-cost dormitory-style housing on the Stanford campus is available for 50-75 selected applicants from outside the Stanford community. Transportation between SLAC and the campus will be provided.

Those interested in attending the Summer Institute on Particle Physics at SLAC should apply in writing before April 30, 1978 to Martha C. Zipf, Coordinator of Summer Institute, Stanford Linear Accelerator Center, P.O. Box 4349, Bin 62, Stanford, California 94305.

ROBERT R. WILSON RESIGNS IN PROTEST

For years the United States budget for basic science has been relatively static or even in decline. Exactly how one assesses the raw amounts depends on how one defines basic research and how one values a dollar (how one allows for inflation, etc.). But it is clear that the days of regular and generous increases are over.

The budgetary crunch has been hardest in astronomy and physics; the life sciences tend to benefit from the pains of cancer and heart disease and the pitiful pictures of sick children on posters. In scientific terms the budgets have meant a slowing of research; in human terms they have meant many career disappointments. Now there has been a resignation in protest of this situation by one of the leaders of the country's physics establishment, Robert R. Wilson, director of the Fermi National Accelerator Laboratory.

Wilson is resigning, because, he says, his laboratory is underfunded. To quote Wilson's letter to Norman F. Ramsey, president of the Universities Research Association, which operates Fermilab for the Department of Energy, ". . . the future viability of Fermilab has been threatened because the funding is below that necessary to operate the existing facilities responsibly; presently we are operating at about half of our capacity to do physics experiments . . . ." Another discontent is the slowness of the funding of the Tevatron, the project to double the energy of Fermilab's proton synchrotron, which at 500 billion electron-volts, is now the world's most energetic, and the cool governmental response to the laboratory's proposal to build colliding beams of ultrahigh-energy protons. Wilson points out that the financial resources of Fermilab's European counterpart, the international CERN laboratory in Geneva, "are considerably more than double our own . . . . Such considerations led me, in desperation, to the conclusion . . . that I should not continue to give the impression that I could responsibly direct Fermilab without a substantial increase in funding."

The only public response to the resignation so far is Ramsey's, who says, ". . . science at Fermilab, in America, and throughout the world will suffer a great loss." It seems too late in the budgetary process for Wilson's resignation to have much effect on Fermilab's funds for fiscal 1979, but it is possible that Congress might increase the laboratory's funds without a request to do so from the administration.

--*Science News*
February 18, 1978

CERN COURIER'S CRYSTAL BALL

A new simulation computer program, OMEN (On-going Multiparticle Event Number-cruncher) is being developed to aid the long-term planning of particle physics experiments. Although the program is not yet available for general release, we were fortunate enough to obtain a prototype version, and used input data culled from the pages of the 1977 COURIER to obtain this unique glimpse of what could be in store for 1978.

JANUARY. Twenty new high mass particles discovered in lepton pair experiments. Theorists propose periodic table of quarks. Copies printed and distributed to schools. IBM announces a new computer to handle the world's neutrino data.

FEBRUARY. Fractional electronic charges detected on a television screen in Memphis, Tennessee. Five muons seen coming from a neutrino interaction. Weinberg-Salam angle remains unchanged. US Supreme Court rules that jets must no longer be produced in hadronic reactions.

MARCH. Leptons get heavier and heavier. Very high energy cosmic ray event recorded in South America. Government overthrown. The A_1 meson disappears from view. Medical applications of charmed quarks demonstrated. Six muons seen coming from neutrino interaction.

APRIL. Analysis of cosmic ray event reveals ten free quarks, a tachyon, four Higgs particles, two magnetic monopoles, three superheavy nuclei and an intermediate vector boson (the charged kind). Weinberg-Salam angle remains unchanged but accelerator building stops throughout the world.

MAY. Particle Data Group publishes special quark souvenir issue. Land prices in the Andes soar as USA physicists rush to install particle detectors. European physicists hold Workshops to decide which cosmic rays to observe. Muon production in neutrino interactions included as event in Olympic games.

JUNE. The Big Shut Down starts. Accelerator sites used as car parks. BEBC is resited for cosmic ray experiments on the summit of Mont-Blanc. g-2 experiment reconstructed to measure Weinberg-Salam angle to one part per million. South American governments introduce import tariffs on multiwire proportional chambers.

JULY. Photograph of cosmic ray event hung in Louvre. IBM (South America) reanalyzes world's neutrino data. World record of 256 muons seen coming from a neutrino interaction is not ratified because of following wind and physicists taking anabolic steroids. Weinberg-Salam angle unchanged. Physicists read *Finnegan's Wake* to learn significance of quarks.

AUGUST. CERN COURIER reports naked bottom seen on Copacabana beach. International high energy physics conference hurriedly convened in Rio de Janeiro. High energy physics football team wins final of World Cup in Argentina.

SEPTEMBER. South American cosmic ray event shown to be a hoax. Land prices in Andes plummet as physicists return to machines. Owners reluctant to remove their cars from accelerator sites. Parity experiment discovers violation of atomic physics. IBM analyzes *Finnegan's Wake*.

OCTOBER. IPFCA (Inter Planetary Committee for Future Accelerators) holds first meeting. Although next generation of machines envisaged to be built on a regional basis, plans to construct a Cosmic Ray Storage Ring in ten years' time as a World Machine are put forward. The A_1 reappears. Five million physicists now using synchrotron radiation facilities.

NOVEMBER. IBM computer wins Nobel prizes for physics and literature. IPFCA proposes Energy Doubler for the Cosmic Ray Storage Ring. Mohammed Ali says "I can knock muons out of anything!" Accelerator building stops again.

DECEMBER. Bug found in OMEN.

Oh well.

--CERN COURIER
December 1977

SLAC Beam Line
Stanford Linear Accelerator Center
Stanford University
Stanford, CA 94305

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Beam Line Distribution at SLAC	0-5	7-2	13-60	23-20	34-4	52-8	61-22	67-10	73-13	81-60	87-12	94-18
	1-21	8-5	14-2	24-19	40-123	53-44	62-42	68-11	74-9	82-12	88-22	95-42
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	4-16	11-19	21-4	30-50	50-22	57-16	65-22	71-35	79-82	85-25	91-3	98-24
Total: 1625	6-19	12-112	22-17	33-25	51-55	60-22	66-20	72-3	80-8	86-7	92-3	