SLAC BEAM LINE

Pluralitas non est ponenda sine necessitate. [Do not invent more hypotheses than are necessary.] --William of Occam

Volume 7, Number 10 *October 1976*

--*Photo by Joe Faust*

This photograph includes many of the women from SLAC who participated in the recent Conference on Options for Women at the Labs (OWL), held in Berkeley on October 1. In the front row, left to right, are Betty Bowker, Phyllis Jairl, Harriet Canfield, Ruth Parker and Marsha Langston. Back row, L to R, Mary Lou Arnold, Sharon Jensen, Anna Maria Pacheco, Gloria Hoganauer, Faye Woodford, Suzanne Young, Rhea Price, Shirley Livengood and Eileen Long. The OWL Conference is described in a special article starting on page 7 of this issue.

In This Issue

A SCIENCE QUIZ

[This quiz is reprinted here from the August 2, 1976 edition of *The New York Times*, where it appeared under the title, "Do You Have a Fine 14th- or 20th Century Mind?" The quiz was prepared by physics teachers Grace Marmor Spruch and Larry Spruch, who introduce the questions by noting, in part, that "We have put together a test . . . primarily on physics and astronomy, for an educated layman in an atomic, technological space age. Some of the questions require having had a course in science somewhere along the line. Many can be answered simply from having read the press."]

1. The ratio of the kilometer to the mile is roughly (A) 1 to 10 (B) 5 to 8 (C) 8 to 5 (D) 2 to 1.

2. Water freezes at (A) zero degrees Fahrenheit (B) 32 degrees Fahrenheit (C) 100 degrees Celsius (D) absolute zero.

3. A lunar eclipse can occur only when (A) the Earth is between the sun and the moon (B) the moon is between the Earth and the sun (C) the sun is between the Earth and the moon (D) there is a new moon.

4. The conservation-of-energy principle refers to the fact that (A) it is essential not to waste natural gas and oil for these are limited in supply (B) solar heating makes use of the sun's energy, which otherwise would be wasted (C) energy can be neither created nor destroyed (D) nuclear power plants recycle spent fuel.

5. The splitting of an atomic nucleus into two large parts and several smaller ones is known as (A) fusion (B) alpha energy (C) fission (D) thermonuclear energy.

6. Atoms are believed to be composed of (A) protons, neutrons and electrons (B) protons and electrons (C) positrons, neutrinos and electrons (D) protons and antiprotons.

7. The period of revolution of the moon about the Earth is approximately (A) one hour (B) one day (C) one month (D) one year.

8. Identify the nonastronomical objects: (A) white giants and red dwarfs (B) white dwarfs and black holes (C) quasars and supernovas (D) neutron stars and galaxies.

9. An outstanding Soviet dissident who is a physicist is (A) Rostropovitch (B) Sakharov (C) Mendeleev (D) Baryshnikov.

10. The Pythagorean Theorem states that (A) in any triangle the square of the longest side equals the sum of the squares of the other sides (B) in any triangle the square of the longest side equals the square of the sum of the other sides (C) in a right triangle the square of the hypotenuse equals the sum of the squares of the other sides (D) in an isosceles triangle the third side equals the sum of the two equal sides.

11. One type of radioactivity involves (A) gamma rays (B) sunspots (C) pulsars (D) magnetic fields.

12. Thirteen billion years corresponds most closely to the presumed (A) age of the universe (B) age of the Earth (C) time since the dinosaurs were on Earth (D) time man has been on Earth.

13. Helium was first discovered (A) in mines (B) in the depths of the ocean (C) on the moon (D) on the sun.

14. A planet that is never visible to the naked eye is (A) Mercury (B) Venus (C) Mars (D) Neptune.

15. The chain reaction that forms the basis of the atomic bomb was first achieved by a group directed by (A) Albert Einstein (B) Neils Bohr (C) Edward Teller (D) Enrico Fermi.

16. The gravitational force between two spherical objects is known to be inversely proportional to the square of the distance between their centers. If that distance is made three times larger, the gravitational force will be (A) 3 times smaller (B) 9 times smaller (C) 2 times smaller (D) 3 times larger.

17. Who did not make fundamental contributions to the science of electricity? (A) Charles Coulomb (B) Michael Faraday (C) Benjamin Franklin (D) Isaac Newton.

18. The Big Bang is related to (A) the hydrogen bomb (B) the maximum noise level in an amplifier (C) a theory of the origin of the universe (D) supersonic aircraft.

19. Nuclear physics does not deal with (A) alpha particles (B) beta rays (C) deuterons (D) desoxyribonucleic acid.

20. Identify the incorrect statement: Transmutation of the elements (A) was a goal of the alchemists (B) occurs in ordinary chemical reactions (C) was first achieved by Ernest Rutherford (D) occurs in some nuclear reactions.

21. Radiocarbon dating is a technique by which (A) persons who might get along well are identified by a computer (B) the fading of carbon copies is used to tell the age of a document (C) the age of art objects is measured (D) the length of time a patient has had cancer is determined.

22. A laser is not (A) a source of light that can be focused to a tiny area (B) a device conceived by Jules Verne for propelling a man to the moon (C) employed in some delicate eye operations (D) a device that was used to measure the distance to the moon.

23. Light (A) can travel in a vacuum (B) can travel at infinite speed (C) always travels in

perfectly straight lines (D) cannot travel through solid objects.

24. A rocket moves because (A) its shape permits air to support it (B) it has exceptionally powerful propellers (C) it weighs less than the air it displaces (D) there is a reaction to the gases it exhausts.

25. The speed of sound is most nearly (A) 10 feet per second (B) 1,000 feet per second (C) 10,000 feet per second (D) 186,000 miles per second.

26. Acceleration (A) is the change in velocity (B) is the rate of change of velocity (C) always increases (D) is the force on an object.

27. Newton's three laws relate to (A) electricity (B) atomic physics (C) heat (D) motion.

28. There is no conservation of (A) angular momentum (B) momentum (C) force (D) charge.

29. A hologram is (A) a rapid means of communication (B) a slide that can be used to produce three-dimensional images (C) an atom smasher (D) a future mode of transportation.

30. The "Red Planet" is (A) Saturn (B) Venus (C) Sputnik (D) Mars.

31. An ancient Greek scientist one associates with an atomic theory is (A) Archimedes (B) Pythagoras (C) Eureka (D) Democritus.

32. A half-life is (A) a molecule that cannot definitely be classed as organic or definitely inorganic (B) half the average life expectancy of a group of people (C) the time for half of a given amount of radioactive material to decay (D) the radiation dose that will be lethal to half the subjects in an experiment.

33. Give the proper order of the names Archimedes, Copernicus, Einstein and Galileo so that they correspond to these statements:
--The first to view the moons of Jupiter through a telescope.
--Showed the equivalence of mass and energy.
--Stated that a floating body displaces a volume of water the weight of which equals the weight of the body.
--Stated that the sun, rather than the Earth, is at the center of the solar system.
(A) Archimedes, Einstein, Galileo, Copernicus
(B) Copernicus, Einstein, Archimedes, Galileo
(C) Copernicus, Archimedes, Galileo, Einstein
(D) Galileo, Einstein, Archimedes, Copernicus

34. A topic not likely to arise in SALT talks is (A) NaCl (B) ICBM (C) MIRV (D) U-235.

Answers to the Science Quiz questions are given on the last page on this issue of the Beam Line.

1911: FAREWELL TO THE RAISIN-BUN ATOM

It is well known that α and β particles suffer deflexions from their rectilinear paths by encounters with atoms of matter. The scattering is far more marked for the β [electron] than for the α particle [two protons and two neutrons bound together] on account of the much smaller momentum and energy of the former particle. There seems to be no doubt that such swiftly moving particles pass through the atoms in their path, and that the deflexions observed are due to the strong electric field traversed within the atomic system. It has generally been supposed that the scattering of . . . α or β rays in passing through a thin plate of matter is the result of a multitude of small scatterings by the atoms of the matter traversed. The observations, however, of Geiger and Marsden on the scattering of α rays indicate that some of the α particles must suffer a deflexion of more than a right angle at a single encounter. They found, for example, that a small fraction of the incident α particles, about 1 in 20,000, were turned through an average angle of 90° in passing through a layer of gold-foil about .00004 cm. thick . . . . Geiger showed later that the most probable angle of deflexion for a [narrow beam] of α particles traversing a gold-foil of this thickness was about 0.87°. A simple calculation based on the theory of probability shows that the chance of an α particle being deflected through 90° is vanishingly small. . . the distribution of the α particles for various angles of large deflexion does not follow the probability law to be expected if such large deflexions are made up of a large number of small deviations. It seems reasonable to suppose that the deflexion through a large angle is due to a single atomic encounter. . . . A simple calculation shows that the atom must be the seat of an intense electric field in order to produce such a large deflexion at a single encounter. . . .

Since the α and β particles traverse the atom, it should be possible from a close study of the nature of the deflexion to form some idea of the constitution of the atom to produce the effects observed. In fact, the scattering of high-speed charged particles by the atoms of matter is one of the most promising methods of attack upon this problem.

Considering the evidence as a whole, it seems simplest to suppose that the atom contains a central charge distributed throughout a very small volume, and that the large single deflexions are due to the central charge as a whole, and not to its constituents.

--E. Rutherford, *The London, Edinburgh and Dublin Philosophical Magazine and Journal of Science, 6th series, 21,* 669 (1911).

THE LONGEST DAY

When my little girl spent a day with me at SLAC, she listened to conversations and covered my blackboard with roguish squirrels, rabbits and foxes. Going home she asked, "But Daddy, what do you do?" Thus this longest day, wasted on lofty engineering problems instead of sailing or skiing, is dedicated to my daughter Qali. (The name? Oh, that's another story.)

The Lead Glass Wall, or SP-26, is to be assembled with a computer's help in an air-conditioned room. My job is to get the carriage, weighing a ton, into that room, and then, when it weighs 13 tons, get it out, pick it up, and carry it down to SPEAR. So it seemed like a good idea to test all the steel beams and straps and hangers that I would use to carry it before it added up to half a megabuck.

Why not stack lead bricks? Let's see, 12 tons of 26 1/4 pounds each is...*900 bricks*! And it was going to be one of those over-100-degree days, too. Now I'm not crazy enough to stack 900 lead bricks in that sun and I don't believe in asking anyone to do a job I'd refuse. (Besides, there's always the chance I'd end up picking lead out of my teeth.)

A call to stores determined that lead bricks come in rickety wooden boxes, 100 to a box, and yes, they had nine boxes. But there was a catch: "No, we don't *loan* anybody anything. You *sign* for 'em and *then* if you don't lose 'em you can put 'em back in the yard the same day and we'll tear up the card... What? Sure you can lose 'em easy. Just leave 'em out on a dock someplace and watch everybody pick up a sample or two... How the hell would I know? Fishing sinkers, maybe."

That was more like it, all I needed was a forklift to stack the boxes three high in three piles in the carriage. The Riggers? No. They showed up right away with the Pettibone and moved the carriage to the edge of the dock, but no forklift until the afternoon. Sorry, busy. Labor Pool? "Yeah, we got a little one but it's kinda busy. Want me to put you down for next week?" So I ended up borrowing my old favorite with the admonition, "Gotta have it back by eleven." It was a little dingier than the last time I'd driven it and the gas gauge was busted. Also, with its capacity of 4000 pounds, it would carry only one box at a time -- that meant nine trips.

I signed the card; Dick Lorentz opened the yard and I hauled the boxes outside the gate. While Charlie McManus and Jeff Richard got the carriage ready I made my nine trips. The first few were sort of fun, bouncing along, hoisting a box to the dock and backing out, but the sun kept climbing and every time I turned downwind, a cloud of thick blue exhaust wrapped around me and I had to stand up to breathe. I finished just in time to return Old Blue Smoke. If I could find another forklift I could load the carriage now.

No luck. I watched a few go by, unloaded, and considered piracy. After lunch I spotted one parked, unloaded. It was a Brand X, one I had never driven before, and had only one wheel in the back. A nearby welder answered my question. "No, we're not using it, but we borrowed it from Cryo. It has to be back by three." "You're in luck," I said,"I'll take it back for you." Great, but all the levers were different and they weren't marked. The welder helped. "One of them is fast and slow. The other one's forward and back" and "One side is tilt and the other is lift, but I forget which." After backing into the building once and prying up a plank I was an expert.

The first row of boxes was easy -- the little yellow forklift had heart -- but the second row was level with my head and the forklift developed a rock and roll rhythm. The third row would be way over my head. I thought about that awhile and sadly drove my little friend over to Cryo one hour early.

By and by the Riggers came with Pettibone and huge forklift and finished the job. The load test was an anticlimax, happily; nothing bent, nothing broke. Now to return 900 bricks. The Riggers' forklift could carry three boxes at a time and they would be happy to stack them by the yard gate for me. After putting away the handling hardware I went to borrow Old Blue Smoke again. Everyone was gone. I could see Blue Smoke through a window, all locked up. A lot of phone calls later a Guard appeared with a key. Good Old Blue Smoke rolled again!

I called Dick Lorentz to open the gate -- and he had gone home. More frantic phone calls. Ah, John Barreiro had not yet left and he had a key. I explained about the nine boxes stacked by the gate, "It'll only take a minute." I would meet him there with Blue Smoke.

When I got down to the yard, there was only one stack of three boxes. I was exhausted, dripping with sweat, and the sun was going down. My mind snapped. "Somebody stole six boxes of lead! And it's charged to *me!*" Slowly, reason returned. Six boxes were eight tons. Not even one of those vans that clutter our parking lots could cart away eight tons. I spun the wheel and roared back up the hill. There came Barreiro; I shouted something hysterical and roared on to the loading dock. Pheew! Six boxes, neatly stacked, full of bricks.

I hoisted a box and raced back to John and through the now open gate. I apologized for the six unexpected trips and took off up the hill again. The end of The Longest Day was in sight. Downhill, though, I drove the whole way without standing up. The wind must have changed: no more blue smoke. At the bottom of the hill, approaching the gate, I realized -- the throttle was dead! Desperately I tried to coast through the gate but Blue Smoke stopped right between the posts. Furthermore, the gas cap sported a padlock.

John was laughing; I was swearing through my tears. "It's your gate it's stuck in!" I yelled. John doubled up. I would have kicked Blue Smoke, but something about the compact five tons of steel deterred me. An ERDA truck appeared. I ran out in front and waved my arms. Ron Koontz was driving. "This forklift's out of gas and it's blocking the gate. Would you push it in for me, please?" I begged. Ron looked at the tinny little truck and then at the five tons. "It doesn't have a bumper," he protested gently. I raised an imperious finger and glared at my former friend, Blue Smoke, who had betrayed me. "*Push* the damn thing!" I ordered. Ron shrugged, the truck engine raced, and finally the ugly five tons lurched ignominiously into the yard.

John locked the gate and said goodnight with a grin. I went off to find Terry Halliday on second shift to keep an eye on *my* 400 bricks. In spite of all my high-level engineering, the Longest Day wasn't over yet.

--Charlie Hoard

--Photo by John Harris

PALMY DAYS AT SPEAR

During May and June, SPEAR was full of friendly competition as well as charmed particles. Some modifications to the beam-transport and injection system permitted an improved method of injecting electrons and positrons into the storage ring. The old method was to fill the ring, then run for several hours, during which time the circulating beams gradually dwindled away to lower levels. This meant that SPEAR's average luminosity (or number of e^+e^- collisions occuring each minute) was significantly lower than the value achieved just after the ring had been filled.

The new scheme makes it possible to inject fresh bunches of electrons and positrons much more frequently, so that every 10 or 15 minutes or so the ring is "topped off" with additional particles. Although this method cannot be used at all SPEAR energies, the result when it can be used is an increase in average luminosity of about 50% or even more.

Since higher luminosity means more physics, a friendly competition soon developed among the operating crews (one SPEAR operator and two physicists manning the Mark I detector) to see who could turn out the most productive 8-hour operating shift. The criterion chosen was the total number of recorded e^+e^- interactions that resulted in the creation of multiple strongly interacting particles ("multihadronic events").

Many operational improvements were made in such procedures as magnetic-tape changing and checking out counters, as well as in the new injection process itself. New records were set almost daily. Physicists would swear when a typing error would cause them to lose a few minutes in reloading computer programs and thus cost the team a chance at a new record.

The eventual winners turned out to be the crew of operator Bill Graham and physicists Ida Peruzzi and Petros Rapidis. Graham is shown on the left in the photo above, along with operations coordinator Tom Taylor who is admiring the *PERPETUAL MEMORIAL PALM FROND "MOST HADRON SHIFT" AWARD* that was presented in recognition of the 807 hadrons chalked up during the winners shift of July 8.

--Ewan Paterson

NEW RECORDS SET IN SLAC RACES

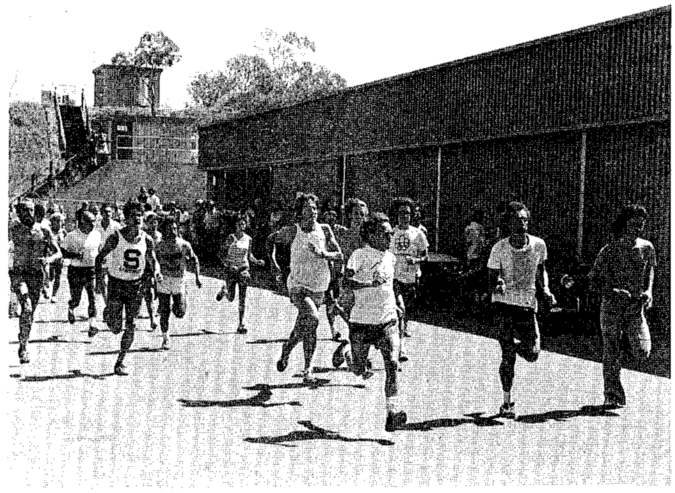
(Story by Ken Moore; photos by Joe Faust)

This year SLAC's annual "Sports Spectacular" was held on Thursday, September 2, and it drew the largest group of participants and spectators since the event was first held in 1972.

The 100-yard dash was won by SLAC summer student Malcom Dixon (center) in 10.9, followed closely by Clyde Barker (right) in 11.1 and Ted Ragland (left) in 11.2.

Records fell all over the place in the 7.8-mile bike race, in which the first six finishers all bettered Dave Uggla's 1973 time of 19 minutes and 35 seconds. In fact, these six all finished with 6 seconds of each other, with Phil Harsch hanging in there for the win.

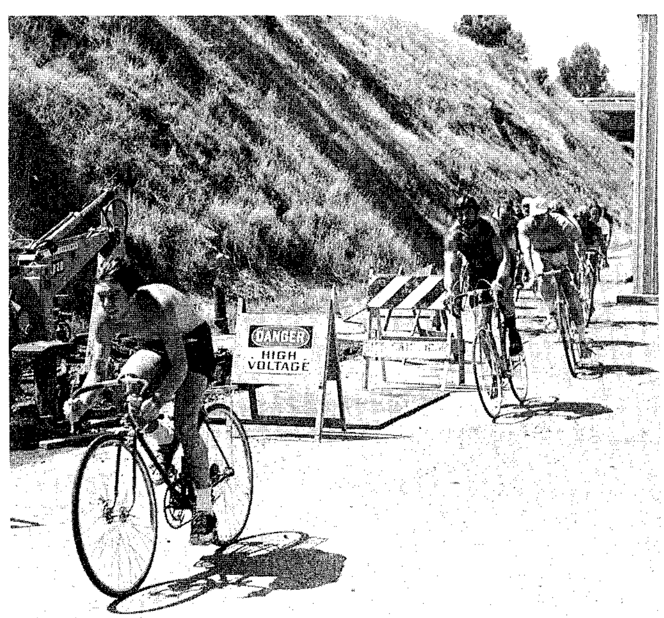
Phil Harsh	19:06	Jeff Hook	19:10
Mark Bratt	19:08	Bob Young	19:12
Don Burwell	19:09	Skip Stritter	19:55
Roger Bratt	19:10	Martin Berndt	20:20



Although a strong contingent of runners from the Stanford campus were entered in the 3.8-mile run (once around the Klystron Gallery), it was graduate student Alan Homna from East Lansing, Michigan, who breezed in to win in the record-setting time of 20 minutes and 53 seconds. His time clipped 26 seconds off the previous record of 21:19 set by Dave Catthiel in 1972.

This is the way the field finished:

Alan Homna	20:53	Becky Schmidt	24:31
Doug McLean	21:30	Paul Ilacqua	25:16
Larry Washington	21:36	Dennis Brunc	27:01
Rick Hill	21:49	Audrey Bettencourt	27:27
Alex Gallegos	22:07	Dennis Sivers	29:43
Diarmuid McGuire	22:15	Charlie Hoard	31:45
Rich Divita	22:22	Chris Graham	34:59
Tom Knight	22:30	Gerard Putallaz	35:05
Dennis Milligan	23:03	Bill Divita	35:05
Ken Moore	23:45	Lydia Campbell	38:30
Lou Kouvacs	24:30	Herb Tiedemann	38:32



THE OWL CONFERENCE

OPTIONS FOR WOMEN AT THE LABS

On Friday, October 1, about 200 women employed under ERDA contracts in the Bay Area attended the Options for Women at the Labs (OWL) Conference in Berkeley. This meeting was the first of its kind and, judging from the very enthusiatic response, will not be the last. The Women's Associations of Lawrence Berkeley Laboratory and Lawrence Livermore Laboratory sponsored the Conference, which was organized by representatives from LBL, LLL, SLAC, Sandia Laboratory in Livermore, and ERDA's San Francisco Operations Office (ERDA-SAN).

Robert Thorne, Manager of ERDA-SAN, and Andrew Sessler, Director of LBL, opened the day-long Conference with expressions of support for the meeting and for its theme, which stressed the importance of women helping themselves and each other in setting and attaining career goals.

The keynote speaker was Aileen Hernandez, who is perhaps most well-known as one of the founders of the National Organization for Women (NOW). She presently heads Hernandez Associates, Urban Consultants, in San Francisco. Ms. Hernandez provided a summary of the problems faced by women who wish to enter traditionally male-dominated fields, as well as the difficulties of achieving recognition and fair wages in their more traditional jobs. She noted that the meaning of "radical" is "root," and that changing the root causes of discrimination thus requires a kind of radical action. She reminded the participants that society was not terribly concerned with root causes when only a minority was involved; however, when women organize to define societal changes for themselves, society must be concerned because women are a majority. She spoke of the double and sometimes triple discrimination experienced by minority women, and also stressed the overriding importance of full employment in the battle against sex and race discrimination.*

Louise Addis represented SLAC on a panel which described the functions of the different laboratories, the ranges of skills and professions utilized under each of the contracts, and discussed the growing disparity between the average wages of women and men. At each of the labs, women are employed in the largest numbers in clerical jobs, which pay less than any other category. One of the most interesting slides displayed the results of a poll of SLAC women which indicated that, like men, women are in favor of interesting, well-paid jobs! (This was the only case where the statistics for men and women were virtually identical.)

The afternoon of the Conference was devoted to parallel-session Workshops designed to help women achieve those goals. Reviews of the various Workshops are given in the following sections of this report.

Despite a miserable morning rain, a long commute for most of us, and wet shoes most of the morning, the OWL Conference was very much a success. Discovering that work has been undertaken by professionals both in analyzing the problems of working women and in formulating remedies was an exhilarating experience. Learning and talking about ways in which women can help themselves and take advantage of the options available in the labs made us aware of the work to be done. There was, and is, a spirit of rededication to professionalism in our jobs. The members of the Women's Ad Hoc Council at SLAC, who served on the Steering Committee of the OWL Conference, feel that the months of planning and organizing were well-spent.

--Martha C. Zipf

*The full text of Ms. Hernandez' talk will appear in the Proceedings of the OWL Conference.

SLAC PARTICIPANTS

Adams, Deloris	Kelley, Blanchie
Addis, Louise	Langston, Marsha
Andrews, Marjolaine	Livengood, Shirley
Arnold, Mary Lou	Long, Eileen
Bowen, Gwen	Minor, Joan
Bowker, Betty	Nelson, Ruth
Canfield, Harriet	Pacheco, Anna Maria
Ellison, Dorothy	Parker, Ruth
Fabian, Elizabeth	Price, Rhea
Ferrari, Chris	Spencer, Sherrill
Fisherkeller, Mary Anne	Woodford, Faye
Heineman, Carol	Youmans, Katreina
Hogenauer, Gloria	Young, Suzanne
Jairl, Phyllis	Zipf, Martha
Jensen, Sharon	

(The small photos appearing in this article were taken at the OWL Conference by Martha Zipf.)

WORKSHOP #1: A NEW LOOK AT THE EQUAL PAY FOR EQUAL WORK LAW

The Workshop leader was Marjorie Gelb, who is an Attorney with the Employment Law Center. She reviewed the statistical data related to women's salaries and discussed methods used to determine wages, stressing the effects of the law of supply and demand, but noting that inequities exist that cannot be explained by anything other than discrimination based on sex. For example, she presented Labor Department statistics which showed that women constitute 77% of all clerical workers nationally, but that these women receive salaries that average only 61% of men's average salaries in the same category.

One method of overcoming built-in biases in wage-setting is a job-worth determination based on a factor-point system. (Such a system is presently being used by the state of Washington.) Jobs are evaluated in the following four areas:

1. Knowledge and skills: Length of time of necessary education or training, skills required, interpersonal skills.

2. Mental demands: Use of independent judgement, decision-making, problem-solving.

3. Accountability: Freedom to act, nature of impact of action.

4. Working conditions: Physical hazards, discomfort.

Ms. Gelb noted that even such a factor-point system can be subject to abuse, and that employers who may be interested in using this system should contract with an appropriate management consultant firm to survey and evaluate jobs within their organizations.

--Reviewed by Martha Zipf

SLAC's Ruth Thor Nelson, right, is shown here talking with one of the Conference participants from another lab.

Participant Delores Adams of SLAC.

WORKSHOP #2: CONFIDENT COMMUNICATION

This Workshop was led by Educational Consultant M. Elteen Kirschbaum, and its purpose was to increase the effectiveness of expression. Communications training is important to everyone. This Workshop concentrated on three specific areas: on-the-job communications, consumer situations, and personal relationships. The Workshop stressed the importance of developing the ability to be assertive without being aggressive by communicating in a clear way without violating the rights of others. Communicating clearly also allows women to avoid being manipulated unless they are aware of it and choose to allow it. There were short practice sessions in exercises designed to help women develop various techniques; however, the time allowed was felt to be too limited to explore fully the possibilities inherent in such training. This topic is one that deserves further attention by women.

--Reviewed by Chris Ferrari

* * * * * * * * * *

WORKSHOP #3: SECRETARIAL AND CLERICAL PROFESSIONALISM

The Workshop leader was Wilma McGurn, Professional Secretary at Lawrence Livermore Lab, who was assisted by Joan Feeney and Bea Robinson, also of LLL. While some of the other Workshops focused on options for women outside the secretarial field, the discussion in this Workshop centered on recognition and education for professionalism within the secretarial field.

What is a professional secretary? First and foremost, it is a person skilled in communications, especially in the use of the English language. A person who has a highly developed set of basic office skills, such as use of equipment, procedures and references. A person who is a master of diplomacy on the telephone. A person who knows the workings of the organization, administratively, functionally and politically. A person who decisive, responsible, intuitive, accountable, creative, flexible, and one who has "attitude." It is the mental attitude that sets an excellent secretary apart from one who is merely adequate. Intelligence and attention to detail are important, but so are eagerness, initiative and good humor.

Being more than adequate means being intuitive by doing complete staff work, following through on assignments, and keeping your boss informed; it means being flexible, adjusting to managerial styles, and making the most of changes; it means being accountable, making the most of mistakes, and profiting from criticism; it means being creative, seeking out hidden challenges, and exceeding established work standards.

In preparing this Workshop, top business and government executives were solicited for

This photograph shows members of the Women's Ad Hoc Council at SLAC who served on the Steering Committee for the OWL Conference. Front row, L to R: Dorothy Ellison, Mary Anne Fisherkeller and Louise Stanley. Back row, L to R: Chris Ferrari, Louise Addis, Frankie McLaughlin and Katreina Youmans. Committee member Martha Zipf is not shown here. *(Photo by Joe Faust.)*

their opinions on what constitutes a professional secretary. Copies of the letters they wrote were distributed to the Workshop participants.

In summation, you can be a professional if you are skilled, knowledgeable, and work at being more than "merely adequate."

--Reviewed by Faye Woodford

* * * * * * * * * *

WORKSHOP #4: NON-TRADITIONAL JOBS FOR WOMEN

This Workshop was led by Christie Nebel of San Francisco-based Advocates for Women, who is a full-time counselor for women who are interested in entering one of California's 350 apprenticible crafts.

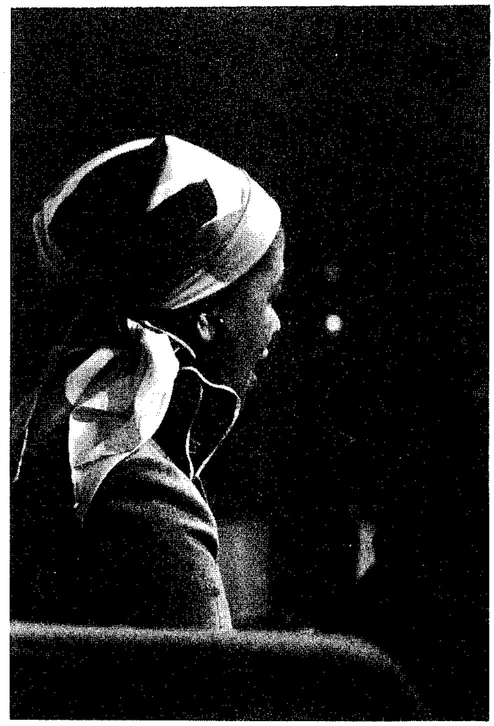
The presence of women in apprenticeship programs (outside of bookbinding) has been made possible only in the last two years by changes in State and Federal law which require women to be included. Apprenticeship programs are established on an employer-by-employer basis in a three-way negotiation involving union, employer and state. To become an apprentice, a person need have no experience in a craft, though it is wise to get as much training and experience as possible through community college courses. The first step is to get on the "list" of a particular craft union. "Lists" are opened for a short time at intervals of as much as two years, and written and oral exams for aptitude, attitude, etc., must be passed before the applicant can be added to a list of those waiting for apprenticeship openings.

In the past, nepotism has been strong in some unions, and oral exams were used to exclude those, such as minority men, who didn't have the right connections. Legal controls have now made such exclusions more difficult.

Christie emphasized that entering a craft should be regarded very much like entering a profession and may take an equivalent number of years, perhaps two or three years to get on a list and to get an apprenticeship position, plus three or four years of actual apprenticeship. The period of apprenticeship is one of hard and demanding labor.

Wages for the apprentice are very good, i.e. perhaps $7/hour with regular raises, as compared to $3-3.50/hour for beginning clerical work. Apprenticeship now represents a real alternative for working women with crafts aptitudes and with the will and wish to escape the typist's chair.

--Reviewed by Louise Addis



Conference keynote speaker Aileen Hernandez is shown here. Among her memorable remarks were these: "Society has decided that some are more equal than others. . . ." "A pedestal is a very narrow base from which to operate. . . ."

WORKSHOP #5: SELF-ESTEEM AND THE WORKING WOMAN

Dr. James Carothers, Associate Director for Human Relations at LLL, and Ms. Ruth Gasten, Adult Educator and Consultant, worked as a team during this Workshop in demonstrating techniques for developing feelings of self-esteem. This was a condensed version of the full-length workshops in which they deal with this topic in greater depth than was possible in the time available. They discussed the ways in which everyone in our society is bombarded with information about things that are wrong with them but seldom hear very much about what is right. Women are the targets for much of this negative information, as advertisements attempt to convince them to purchase cosmetics and personal-care items designed to make them more attractive, more fragrant, and even to have more fun (do blonds *always* have more fun?). In addition, women are traditionally trained to be humble, modest, and "unassuming" about their accomplishments.

This was an especially popular Workshop for women who work in clerical positions, who often find it difficult to maintain self-esteem under the added burden of the implied message of low pay. Carothers and Gasten demonstrated two ways in which people can begin to increase their feelings of self-esteem. The first exercise required the participants to think about an event or accomplishment of which they were proud and to describe it to another person. The second exercise was to list positive personal qualities and to tell about one of them.

Increasing one's awareness of self-esteem, even in such a superficial way, felt good and made one wish that the Workshop could have been presented in full. Bringing about basic changes in feelings about ourselves is a lot of work and is certainly deserving of more time than was available during the Workshop.

--Reviewed by Martha Zipf

Participant Carol Heineman of SLAC.

Two of the Panelists from other labs.

WORKSHOP #6: EMPLOYMENT PROBLEMS OF MINORITY WOMEN

This Workshop was led by Yolanda George, M.S., who is a biologist at Lawrence Livermore Laboratory. The Workshop was designed to give the minority woman an idea of the options available to her in choosing a new career and/or in expanding within the present work areas. This was a panel presentation, with representatives from each of the laboratories participating.

Katreina Youmans from SLAC presented a statistical picture of the placement of minority women in the work force compared to both white women and men and also to minority men. Minority women, it was shown, hold mostly clerical, service and factory-type positions, and are among the lowest paid of all persons presently in the labor force.

With these facts in mind, minority women were encouraged to do as much as they could in achieving new careers and/or developing their present jobs in order to lessen the financial and professional gaps between themselves and other groups.

Frances M. Mann of LBL presented techniques of time management that can help minority women and others to organize their work schedules better and to get assignments done more rapidly and efficiently. She stressed establishing priorities in determining the best times of the day to do your most difficult tasks, and making a list of tasks to improve production. She suggested using good judgement in problem-solving by getting to the root of the problem and then making the best decision. She also emphasized being responsive to organizational needs by displaying creativity, accepting responsibility, and using good follow-through and the determination to do a good job.

Yolanda George talked about the importance of sound goal-setting for the minority woman, since it can help her decide if she is spending her time energy effectively and efficiently. Some of the things she felt were important to remember were: (a) goals should be written down so that they are specific and clear, and (b) goals should be based on work experience, education, and a knowledge of available job opportunities. She then asked the women to fill out a questionnaire that could help them to set realistic goals, and that provided many good examples of the kinds of questions they should be asking themselves.

Joanne Williams of LLL talked to the group about career planning, stating that the norms of society have historically dictated the career directions of minority women. In particular, minority women have been directed towards occupations in the so-called "helping" professions of sales, service, secretarial, nursing and teaching. Minority women have made career choices within the narrow framework of skills that have traditionally been allowed them. Today, however, minority women are beginning to question the paths that have led them to their currect occupational skills, and many are now realizing that they have taken a path that leads to an unforeseen occupational obsolescence. Ms. Williams stressed that good career planning was for everyone and that it can define the steps you need to take to reach your career goals, with the first and foremost step being to seek counseling within your own organization.

--Reviewed by Katreina Youmans

More of the OWL Conference participants, left to right: Martha Zipf, Gwen Bowen, Ruth Thor Nelson, Elizabeth Fabian, Marjolaine Andrews, Delores Adams and Joan Minor. *(Photo by Joe Faust.)*

WORKSHOP #7: OCCUPATIONAL SEGREGATION

Women's lib is not "taking power to put others down," but is "equal rights, equal pay, and equal jobs." With this as her theme, Delaine A. Eastin, Instructor at De Anza and Cañada Colleges, presented her Workshop on Occupational Segregation. Its purpose was to help working women understand the female job-ghetto situation and to help them to find practical ways to end occupational segregation.

Occupational segregation can be observed through a look at some of the statistics of employment. Women constitute about 1/3 of the US work force. Of these women, fully 78% are presently in dead-end jobs in factories or in clerical or service work, while only about 15% are in non-traditional professional or technical jobs (this excludes nurses and teachers). About 2/3 of all working women fit into one of the following categories: (a) single, (b) divorced, (c) widowed, or (d) married to men whose income is less than $5000/year. This makes it quite clear that these women are working for economic reasons and not just to earn a little "pin money."

In the clerical field, the average yearly pay for women in $5551, while for men it is $8671. In the technical and professional fields, the average yearly pay for women is $7780, while for men it is $11,800. Another example of the disparity: 17% of all working men earn more than $15,000/year, but only 1.3% of all working women earn that much. And the income gap between men and women continues to grow. In 1955 the wages of working women averaged 64% of men's. In 1976 this average is down to 57%.

Louise Addis represented SLAC on a Panel which described the functions of the different laboratories, and the ranges of skills and professions that each employ.

SLAC participant Harriet Canfield.

Here are some of the problems that women run into: (a) Differences in title and in pay for men and women who do the same job. (b) Same job, same title, but different pay. (c) Higher qualifications required of women than of men applying for the same job. (d) Disproportionate appointment or promotion of men to college faculty or senior staff positions even though equally or better qualified women are available.

To help end occupational segregation, Ms. Eastin recommended several things:

1. That women develop long-term goals and plans, and strategies to achieve these goals.

2. That women learn to boast about themselves in interviews. Men have long had this skill, but women have not yet learned it.

3. That women seek out work that will give them needed experience and for which they will get proper credit if they do it well.

Ms. Eastin concluded the Workshop by recommending several books for women, and for men, who would like to learn more about this subject:

Everything A Woman Needs to Know To Get Paid What She's Worth, by C. Bird.

And Jill Came Tumbling After: Sexism In American Education, by J. Stacey & B. J. Daniels.

Sex And Temperament, by Margaret Meade.

--Reviewed by Louise Addis
from notes by L. Gloff, LBL

SLAC'S TECH DATA LIBRARY

SLAC's Tech Data Library has been operated by Shirley Livengood since 1964. She came here with an extensive background in engineering, having started her career as an ink-tracer on linen, a field that was entirely staffed by men. It took many courses, on-the-job training and persistence for Shirley to become a senior draftsman in the engine drawing room of a large shipbuilding company. She became interested in materials, and after a time she transferred to the Material Control Department, another totally male-oriented field.

In Shirley's words, "My position as a material control analyst required attending meetings with Navy Officers, engineers and designers, and sometimes the men would wonder why I wasn't taking notes or serving coffee until I was called upon to give a technical opinion. It took patience, tact and determination to be accepted. Some of my co-workers' idea of a compliment was to tell me, 'You have a pretty good brain, for a woman.'"

When Shirley started here at SLAC the Trade Catalog Library was a small collection of company catalogs, standards and specifications located in the A & E Building. She organized it from an engineer's point of view--"The way I would have wanted it as a user." She also expanded the collection. Today it has more than doubled in size.

Shirley's background in many different phases of engineering (mechanical, cryogenic, electronic) has proved to be very useful in finding answers to the startling array of questions that come in to the Tech Data Library. Here are a few examples.

Who makes and where can we buy a machine that will embed small tablet-like items into aluminum packages? (It's called a "pouching" machine, she learned.)

Where can we find printed certification that proper ventilation will alleviate the hazard of inhaling an alloy containing 2% beryllium?

Find a manufacturer who makes a film-reader that will, when connected to a computer, read a radiation dosimeter that has been modified with punched holes or magnetic tape, for the purpose of controlling access to a radiation area.

We have a leak detector with *JFC, Model 210* stamped on it. *JFC* is not the name of the company, only the initials. How can we locate the manufacturer in order to replace it?

Where can I find a solid-state starter for a three-phase motor that is subject to strong vibrations?

Who makes aluminum honeycomb panels with one-inch cells and a highly reflective surface?

Who makes *TETRAMETHYLSILANE???*

Do you have a Sears, Roebuck or Montgomery Ward catalog?

For the benefit of those who prefer to use the Tech Data Library unassisted, the specifications and standards are arranged alphabetically according to the acronym or nickname they usually go by: ANSI, ASTM, ASME, Mil, NEMA, SAE, to mention a few. The company catalogs are shelved alphabetically by company name. Shirley maintains a card catalog by name of company with cross-references to untangle knotty conglomerates. The card lists the home address of the company, local source when available, what kind of catalog (leaflet, brochure, registered), and what kind of items are included in the literature. In the same file cabinet is a card catalog of specifications and standards, listing letter code, number and title.

The Tech Data Library boasts one of the largest collections around of telephone books, exceeded only by certain libraries and by the telephone company itself. Perhaps best of all, Shirley recognizes how difficult it can be to find minor suburbs of major cities and has made a card file by city that will refer you to the correct phone directory. This listing also appears in our own computer information retrieval system, *SPIRES 3*, identified as "Phonebooks."

Buyer's Guides, DATA books and other valuable directories are kept in a cabinet that is locked (because of their tendency to disappear) when the Tech Data Library is unattended. The current edition of *THOMAS REGISTER* is readily accessible, however, listing manufacturers by products and by company name.

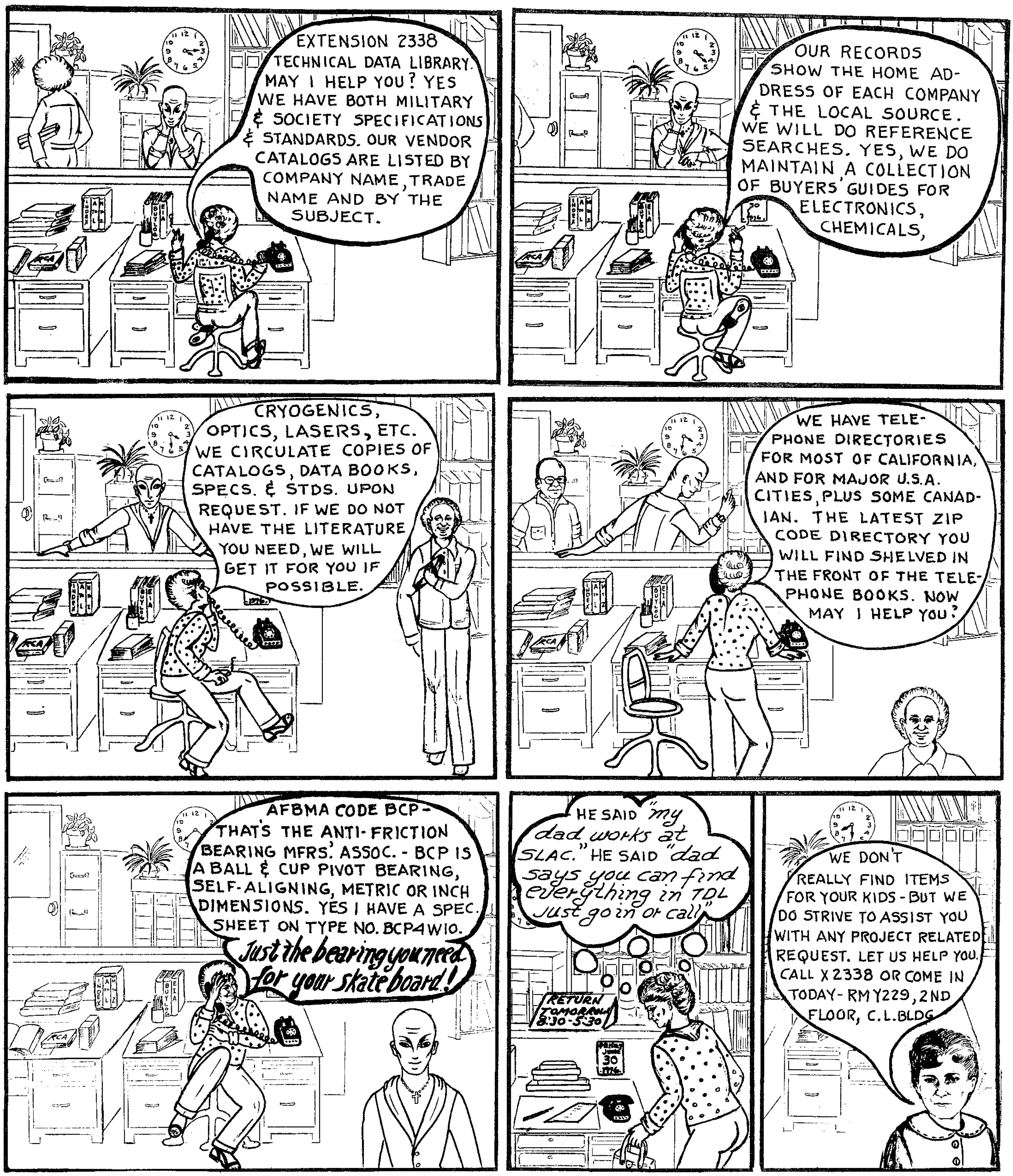
Every other month Shirley publishes *TDL News*, which lists new items received and cataloged. Copies can be picked up in the Tech Data Library, or let her know if you want to be added to her mailing list by contacting her at ext. 2338 or mail bin #82.

--Arsella Raman

No. 40, or
"On The Next Time Around"

My reincarnated soul
will return to haunt
all those predators
in the asphalt jungles
as a cunning snake
just grazing in the grass--

Or will I fly like a dove
sharing love in the
heavens above?
--Ken Stewart



THIS IS AN ADVERTISEMENT FOR THE TECHNICAL DATA LIBRARY

(Not Syndicated) By Shirley Livengood

SLAC'S TINY UNIVERSE

[Editor's note: In spite of our best efforts to report the exciting discoveries being made in high energy physics research in a simple and lucid manner, we occasionally receive comments that the articles in the *Beam Line* are too technical. Some readers, especially new employees, tend to feel overwhelmed by the scientific jargon and the sometimes difficult new ideas. For the benefit of those particular readers, and for any others who may feel like a refresher course, we have dug out and updated two old articles that were written by Doug Dupen while the SLAC two-mile accelerator was being built. The first of these articles is presented below. It originally appeared in the November-December 1964 issue of *Stanford Magazine*. The article answers many of the questions that were being asked in those days, and that are still worth asking today. Doug's other article will be reprinted in a future issue of the *Beam Line*. --Herb Weidner]

Over the years since its inception, SLAC has engendered a great deal of public interest. And, I might add, public puzzlement. From the time the first shovel was turned, one of my ancillary assignments has been to act, so to speak, as "outside man." In meeting and talking with people curious about what is going on, I have found the same questions appearing again and again. To dispel some of the bewilderment, I should like to set down these popular questions and their answers.

What is an accelerator?

This is perhaps the most basic of all questions. To answer it most succinctly: an accelerator is a device used to generate a beam of elementary particles, in our case electrons, and to accelerate them to as high an energy as possible. The higher the energy of the beam, the more useful it is in performing physics research.

What is the beam used for?

Just as newer, more gigantic telescopes are needed to permit exploration further and further out into the most distant reaches of our universe, so are newer, more gigantic instruments required to permit exploration in the opposite direction. The world of the incomprehensibly small, where sizes are measured in millionths of a billionth of an inch and where strange nuclear particles have lives of only billionths of a second, is almost beyond our reach. The only tool fine enough to be useful in exploring things so utterly small is a beam of high energy particles.

You can think of the beam as being a microscopic light whose resolving power is proportional to its energy. Or alternatively you can look upon the beam as being a surgeon's exploratory scalpel, the sharpness and precision of which is proportional to the energy of the beam.

Using high energy beams from accelerators all over the world, considerable knowledge of the universe inside the atom's nucleus has been acquired. What has been discovered shows that there exists a whole new "sub-universe" explorable only at these higher energies. It has also taught us a great deal about the most basic forces that hold the parts of the atom together. However, there is still much to learn about this world and how its particles relate to the rest of nature.

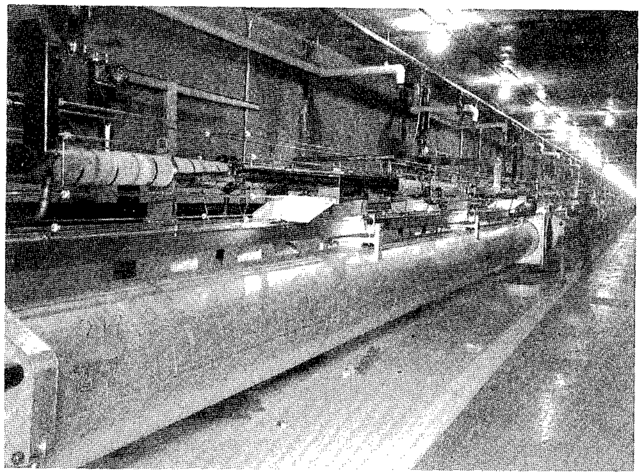
It takes machines like this 20-billion-electron-volt accelerator to generate sufficiently energetic beams to permit the piecing together of the puzzle.

How is this high energy beam developed?

Electrons are first gathered from a rather conventional source, a standard hot wire and cathode arrangement much like the ordinary one in the neck of the picture tube in your TV set. The electrons are then injected into a 4-inch-diameter copper pipe for acceleration. This small copper pipe is two miles long. The electrons travel along this pipe by riding on the crests of a powerful radio wave. This unique principle of electron acceleration was developed at Stanford during the 1930's by the late Professor W. W. Hansen. The sources of the high power radio waves are amplifier tubes called klystrons. As the electrons gain energy from the radio wave, the wave is constantly reinforced from successive klystron tubes. At each ten-foot interval along the pipe six millions watts of pulsed radio energy is introduced. There are 240 klystrons spaced along the 10,000 foot length of the accelerator.

How is the beam used?

When the electrons have traveled the full distance and have reached maximum energy, they are ready to be used as a probe into the unknown. At the output end of the accelerator, the beam is directed into a target area where physicists have set up experiments. The beam is allowed to impinge upon a target made up of a material whose structure is under investigation. Sophisticated detecting and analyzing equipment (bubble chambers, spark chambers, particle counters, etc.) then determine what interactions take place between the beam electrons and the target nuclei. The results of these observations of what happens during the interactions will answer vital questions about the basic laws of the universe.



The accelerator housing, buried 25 feet below the surface. The accelerating structure is the banded cylinder near the middle of the photo. It is supported by girders which rest on the vacuum pipe which houses the laser alignment system.

What does the accelerator look like?

Physically, the accelerator is housed in two separate two-mile-long buildings. The 4-inch copper pipe in which beam acceleration actually takes place is located in a concrete tunnel 25 feet below the surface of the earth. The klystrons and associated equipment which provide the power for acceleration are located in a second, lightly framed structure that is on the surface directly above the underground accelerator tunnel. These two parallel, linear structures are interconnected at regular intervals via 25-foot-long vertical pipes which extend down from the klystron "gallery" on the surface to the accelerator housing below.

This configuration makes it easy to operate and maintain all of the equipment in the klystron gallery while the accelerator is running. To the extent possible, only very rugged equipment, requiring little or no maintenance, has been located in the underground accelerator tunnel, where potentially hazardous radiation is present whenever the machine is operating.

Why was two miles chosen for the length?

The two-mile length of the accelerator was arrived at as a result of other considerations. The first consideration was to choose a maximum beam energy of about 20 GeV as being well-suited to the kinds of physics experiments that could be undertaken. The second consideration was to determine the optimum combination of accelerator length and accelerating power that should be selected to achieve a beam energy of 20 GeV. The power-generating capabilities of the klystrons used on the SLAC accelerator represented a rather conservative extension of those used with earlier machines, and this fact led to the decision to feed power into the accelerator at 960 separate feed points separated by 10-foot intervals. Thus the 9600 feet of active accelerating structure determined in this way, plus an allowance for space for certain other control functions, resulted in the eventual total length of approximately two miles.

Why was the machine built by Stanford?

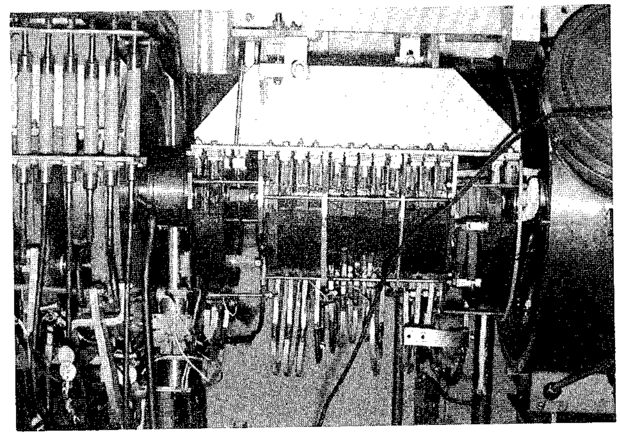
Stanford University scientists and engineers have carried out much of the pioneering work in developing linear electron accelerators and in using these machines for high energy physics research. This work extends all the way back to the 1930's. The experience gained in building and operating earlier machines--the largest of which was the 1 GeV Mark accelerator at the High Energy Physics Laboratory on the Stanford campus--was a necessary ingredient in designing the SLAC two-mile machine. For these reasons, the linear electron accelerator group at Stanford had been widely recognized as the most experienced and competent in this particular field, as therefore as the group most qualified to carry out a construction project of this kind.

Why was the accelerator built at Stanford?

SLAC has the dual objectives of contributing significantly both to research and to education. Its location on the campus carries great advantages for these objectives by making it easier to attract and retain scientists and students of the highest caliber; both prefer to live and work in the atmosphere of a total academic community.

This historic photo, taken in about 1946, shows (left to right) Stan Kaisel, Clair Carlson, Bill Kennedy and W.W. (Bill) Hansen carrying one of the first linear electron accelerator sections ever built at Stanford. (We are indebted to Karl Brown for preserving this photograph.)

Furthermore, SLAC needs and uses the many capacities typically available at a major university, such as computers, mathematicians, theoretical physicists, technological laboratories, and medical experts and facilities. SLAC's collaboration with these existing Stanford groups benefits both SLAC and the rest of the Stanford community. If the laboratory had been remotely located, these special capacities would sooner or later have had to be provided at the remote site. To avoid having to build these costly duplicate facilities, which might not be efficiently utilized by the requirements of SLAC alone, the accelerator was located at Stanford where such capacities are already available.



This simple gadgetry is at the upbeam end of the positron source, the device which supplies the "other" particles accelerated in the two-mile machine. The target is in the vacuum housing at the left. The tapered field solenoid is in the center. A small part of the fixed field solenoid is visible at the right. There is a fast-acting vacuum valve between the two solenoids.

Who uses the accelerator?

The linear accelerator is operated by Stanford University. However, the entire cost of the machine is borne by ERDA. The contract between ERDA and the Stanford Board of Trustees calls for the accelerator to be operated as a "national facility" much like the Brookhaven National Laboratory and Argonne National Laboratory. This means that the use of the machine is open to physicists from all over the nation and from other countries.

Who decides who will use it?

The "programming of beam time", that is, scheduling the experiments to be done, is determined by SLAC's director with the aid of a Program Advisory Committee. This scheduling as well as all activities of the Center are under regular review of a Scientific Policy Committee. This committee is comprised of 14 experienced high energy physicists from all over the country.

Can the accelerator accelerate other particles besides electrons?

There are generally two classes of particles in the beams of accelerators. One class is made up of heavy particles such as protons and alpha particles. The other class is made up of very light particles such as electrons and their anti-particles, positrons. Any one accelerator must be designed for only one of these two classes. The Stanford machine falls in the latter class and is able to accelerate only electrons (which have a negative charge) and positrons (positively charged electrons).

How does this machine differ from, say, a cyclotron?

There are a great many kinds of accelerators in the world: cyclotrons, synchrocyclotrons, betatrons, synchrotrons, linear accelerators, etc. All but the last above are round machines. That is to say, they accelerate their beam particles by constraining the particles to move in circular paths in magnetic fields. There are in the world both linear and circular heavy particle accelerators as well as both linear and circular light particle accelerators.

There is a need for every type of accelerator. It is much like the old story of several blind men touching an elephant at a different particular spot and then comparing notes to determine what an elephant is really like. Each accelerator in the world gives a slightly different view of our elephant, the sub-nuclear universe. With enough different accelerators operated in as many different ways as possible, someday we will be able to patch together a clearer understanding of the elementary laws of nature.

What are the reasons for building straight accelerators?

It is true that most accelerators are round. But every kind of accelerator has its own peculiar advantages and disadvantages. Each type of accelerator complements every other kind. Two advantages to linear accelerators in general are that they can accelerate a greater number of particles at one time and that the beam exits normally from the machine in a very clean configuration. Accelerating very many particles at once in round machines is extremely difficult and extracting the beam from its circular path is an unwieldy process and not too satisfactory a one.

Another advantage of linear accelerators applies only to electron acceleration. Due to the nature of an electron particularly, really very high energies are just not achievable in practical circular machines. Protons and other heavy particles do not suffer from this problem and can be accelerated as high in energy as desired in round accelerators. In fact, there are several round accelerators in existence which accelerate protons to energies much higher than we are able to achieve with the electrons in our machine.

Is the accelerator a source of radiation?

Yes. There are two types of radiation to be considered. First, the accelerator produces direct radiation only when it is turned on. Then and only then is there radiation in the underground housing, and only there. The 25-foot-thick earth shield around the accelerator is designed to keep external radiation down to less than one-half of one percent of the guide level maximums recommended by the National Committee on Radiation Protection, ERDA, and the Federal Radiation Council. During a lifetime the average person receives more than a hundred times more radiation from other sources, such as medical and dental x-rays and cosmic rays, than he or she would receive from living adjacent to the two-mile accelerator.

The second type of radiation is that from the materials made radioactive by the accelerator. This radioactivity persists after the accelerator is turned off. The radioactive materials are contained within the heavily shielded accelerator, switchyard, and research area buildings, or in protected storage areas.

Can anyone visit SLAC?

Yes. There is nothing at all secret about this project. Everybody is welcome. Tours of the entire site for organized groups can be arranged.

What is the taxpayer getting for his money?

This is the 64-dollar question which never fails to appear. The best answer I have seen appeared in an editorial in the Weaverville Trinity Journal.

"The man from Stanford had been telling the Rotary Club about the linear accelerator being built on the campus. The question period came, and with it a very natural question:

"'But just what is all this going to accomplish for us taxpayers?'

"The answer was just as inevitable:

"'We can't really tell. We can only say that we think the benefits to mankind will be tremendous.'

"The speaker was right; he didn't know. No one in pure research ever knows just what he's getting at; and it's only natural that the taxpayer should wonder what he's paying for.

"Marie Curie didn't know what she was doing when she was fussing around with a shovel of pitchblende ore which seemed somehow to cause photographic plates to fog. She could not know that her shovel would lead to the discovery of radium; but it did.

"Heinrich Rudolph Hertz was a professor at Bonn, seemingly frittering away his time with experiments--but they led to the development of wireless telegraphy, radio and television. 'He studied to be an engineer', says a biography, 'but at 20 he turned to physics because he was more interested in learning the laws of nature than in applying them.' As an engineer, he might have 'done something for the taxpayers' like building a bridge; as a theoretical scientist he led the way for one of mankind's greatest advances in communications.

"Albert Einstein was a clerk in a patent office in Berne, with spare time on his hands and a brilliant mind . . . Einstein's doodlings in the patent office proved him one of the greatest figures in physics, and his simple equation led us into the atomic age.

"The list is a thousand names long. Discoveries like those of penicillin and gravitation, and the existence of a solar system often come by accident, achieved by men and women who are, in the usual term, nonproductive. The inventor of the wheel was not out to build an automobile, or even an ox cart, and man harnassed fire not by design but as a result of a natural phenomenon.

"Of course there was no expense to the taxpayers (except those of Switzerland) while the young Einstein doodled, and Hertz did not bankrupt the treasury at Bonn. But more complex research on the modern scale costs millions; and if western civilization is not to stand still, these multimillion dollar microscopes will have to be built. The lesson of history in science is that research pays unimaginable dividends."

SLAC's Director, Professor W. K. H. Panofsky, has said it even more succinctly: "When spending money on an applied device, you do have to question the need for it. But when spending money on fundamental research that may change our whole way of looking at nature, the question of the need is premature. We cannot afford to be ignorant of the most fundamental type of structure on which everything else depends. What the nation is investing in this accelerator and the contribution which Stanford is making in terms of its land are used to buy knowledge and fundamental understanding of nature."

At a visit to Stanford ten years ago, AEC Chairman Glenn T. Seaborg commented on SLAC's field of endeavor: "High energy physics is one of the leading intellectual developments of our age. It is not only very exciting, but experimentation in the field will probably lead to some of the most important theoretical and perhaps then the most practical developments of our age."

SCIENCE QUIZ ANSWERS

1.B	6.A	11.A	16.B	21.C	26.B	31.D
2.B	7.C	12.A	17.D	22.B	27.D	32.C
3.A	8.A	13.D	18.C	23.A	28.C	33.D
4.C	9.B	14.D	19.D	24.D	29.B	34.A
5.C	10.C	15.D	20.D	25.B	30.D	

RECORDING FOR THE BLIND

There are thousands of students in the United States who would not get an education except for a vital "fourth R." These are the blind and the handicapped students who depend upon a non-profit organization called Recording For The Blind.

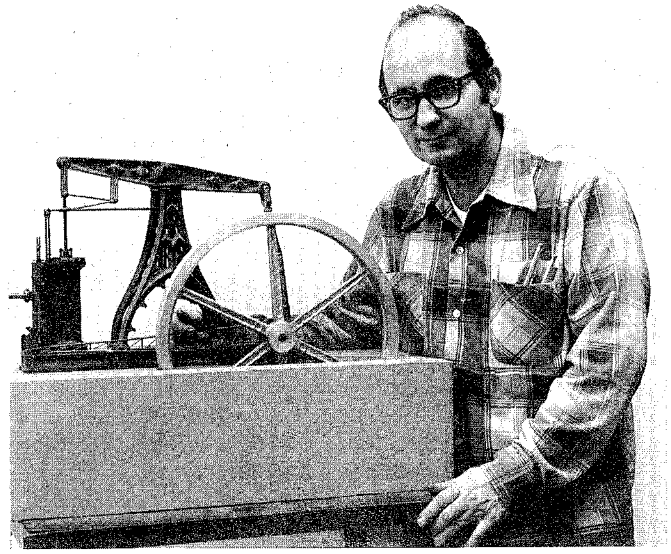
The San Francisco Peninsula unit of Recording For The Blind is now in need of people who can read math, computer science and other technical subjects.

Most of the classic literature and a great deal of history have already been recorded over the years that RFB has been serving blind students nationally, but the requests coming in now are often for highly technical science and engineering texts.

Volunteer readers must pass a reading test, but dramatic talent is not a requirement, just the ability to read intelligibly. Most readers come in once a week to record at a 90-minute session, and the time chosen is set at the convenience of the volunteer, either day or evening.

The RFB studio is located at 488 Charleston Road, Palo Alto. For further information, please call Recording For The Blind at 493-3717.

Isabelle S. Stone (for RFB)



LIVE STEAM SHOW: OCTOBER 22 AT SLAC

"It isn't the boys that grow up, it's just their toys." Especially if the toy is a steam engine. The great stationary engines with their walking beams and car-sized pistons are all gone now, replaced by turbines and electric motors. But here's your chance to see several dozen working models of these classic engines, built or collected by members of the West Valley Live Steamers. The club's Fifth Annual Stationary Engine Show will be held in the SLAC Cafeteria on October 22 at 8:00 PM.

John Grant (shown above in Joe Faust's photo), SLAC's leading live steamer, will display a 1/12-scale working model of an 1840 French walking-beam engine (photo). He built it from a description and a picture in an old book in the Stanford Library. The original engine was made of cast iron, which John also intended for the model. He made up all the casting patterns himself, only to learn that the local iron foundries would not even attempt to cast such fine detail. A brass foundry finally came to his rescue.

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*.

Joe Faust, Bin 26, x2429 Walter Zawojski, Bin 70, x2778	*Photography & Graphic Arts*
Ada Schwartz, Bin 68, x2677	*Production*
Dorothy Ellison, Bin 20, x2723	*Articles*
Bill Kirk, Bin 80, x2605 Herb Weidner, Bin 20, x2521	*Editors*

Beam Line Distribution at SLAC											
0-*3*	6-*17*	12-*56*	23-*15*	31-*11*	51-*31*	60-*20*	66-*28*	72-*4*	80-*9*	86-*6*	92-*3*
1-*15*	7-*2*	14-*4*	24-*13*	33-*19*	52-*6*	61-*26*	67-*11*	73-*13*	81-*51*	87-*8*	94-*14*
2-*9*	8-*4*	15-*4*	25-*3*	34-*5*	53-*41*	62-*43*	68-*12*	74-*9*	82-*15*	88-*23*	95-*47*
3-*7*	9-*3*	20-*29*	26-*26*	40-*108*	54-*29*	63-*14*	69-*20*	75-*12*	83-*6*	89-*16*	96-*20*
4-*9*	10-*3*	21-*4*	27-*1*	45-*6*	55-*36*	64-*16*	70-*2*	78-*30*	84-*18*	90-*4*	97-*108*
5-*3*	11-*23*	22-*15*	30-*44*	50-*23*	56-*12*	65-*24*	71-*40*	79-*83*	85-*29*	91-*6*	98-*20*

Total: 1456

Note to readers at SLAC: Please return any extra copies to B. Kirk (Bin 80) or H. Weidner (Bin 20).