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

Programmer Mary Anne Fisherkeller has been principally responsible for the development of "GIF"—the Graphics Interpretation Facility at SLAC. Her work is described by Charlie Hoard in an article beginning on page 3 of this issue. (Photo by Joe Faust.)

The University of Oxford has made an appropriation of the sum of $2,500 for the purpose of equipping an expedition for scientific investigation in Palestine. Cambridge University will probably contribute a like amount.

—Scientific American, Aug. 1917

[Our apologies to anyone we may have inadvertently overlooked in writing down this list of service awards.]
WERNER SCHULZ RETIRES EARLY

Actually, Werner retires rather late and is an early riser, which schedule he will probably continue after leaving SLAC to devote full-time to medical instrumentation, consultation, and prosthesis development.

If you hadn't guessed it already, Werner was born "Ein Berliner" two months before the W.W. I armistice. Herr Schulz's technical education and career began in the mid-thirties at Telefunken School of Engineering and Berlin-Charlottenberg's Technische Hochschule. At Telefunken, Werner worked on electron tubes and television development.

Following W.W. II, Werner was employed by the U.S. government in Germany, and in 1947 he was smuggled into the the U.S. to work on underwater problems and ultrasonics in Washington, D.C. It was later arranged for Werner and his family to enter the country legally through Canada. From 1948 to 1956, he was Chief Engineer with the Advanced Research Laboratory at Wright-Patterson Air Force Base in Dayton, Ohio, where among his many accomplishments he developed micro-spacer techniques for probing individual human brain cells (diameter about 8000 Å). He used the same techniques to design and build field-controlled semiconductor devices (Fieldistor) in the period around 1950.

In 1956, the Schulz family moved all the way west, where Werner was to apply his talents to problems at Eitel-McCullough and later Litton Industries. In 1962 Werner came to SLAC at the invitation of W.K.H. Panofsky, SLAC's Director. Werner's accomplishments at SLAC are too varied and complex to enumerate fully. One piece of work of great significance was the development of a sputtering technique that is used to coat klytaron windows and thus permit very high power operation. Werner has 15 patents granted and another dozen pending. He is the author or co-author of 30 technical and medical reports, and also of seven medical books. He is a consultant to many medical schools in California, and also to a number of companies in the electronics and medical instrumentation fields.

Werner's special use of the English language is a source of amazement, amusement and respect to many of his friends. He often starts a discussion with "nevertheless." Some other examples are the following. Once after the arrival of a new secretary at SLAC I asked Werner if he had seen her yet, to which he replied, "Yes, I googled her as I passed her office." He also speaks of the "Nebraska cornsuckers," about those guys from "Jail University," and his "Presactly" is better in many contexts than either of its roots.

One of the reasons that we are fortunate that Werner is not completely severing his connection with SLAC is the fact that he is beyond doubt the greatest cumshaw artist of all time. He never visits another company or laboratory without talking them out of a sample of their product or some hardware that will eventually be useful to him. Recently he was in the hospital with a sinus infection and was being treated with a malfunctioning vaporizer. He talked the hospital into ordering a new unit for his bedside and giving him the old unit. He took this gadget home, made a few adjustments and modifications, and produced a device for detergent cleaning and ultrasonic degreasing of his micro-equipment. Werner is on good terms with the management of many firms in the area, and he has frequently saved SLAC time and money by being able to cumshaw parts and services pronto.

Werner is an incurable optimist. He is always positive and looks for solutions rather than scapegoats. He is very much like the little boy who, after getting a large box of horse manure for Christmas, was later found happily sifting through the box and shouting, "There must be a pony in here someplace!"

(continued)
The extent of Werner's tool-making and tool-using is legendary. The only thing that one needs on a camping trip is Werner Schulz. He has made everything one could need, including instant campfire starter using a modified propane torch, fluorescent lights in his trailer, special soap dispensers, etc. I think he even carries an embalming kit, just in case. One occasion Werner and I were fishing with worms but not having much luck. I commented to him that the worms looked a little anemic. "I can fix that," he said, and dug into his tackle box and brought forth a syringe, hypodermic needle and a small jar of cod liver oil. After suitable injections we tried the worms again, and suddenly all the fish started biting.

Some at SLAC may not be aware of Werner's outstanding work in the medical field. He is a pioneer in the development of tools and techniques for use in microsurgery, such as nerve and capillary repair. One of his more recent innovations, the BIOPTOME, permits samples to be taken from a transplanted heart simply through an artery. The older method of checking on transplant rejection involved the traumatic procedure of opening the chest wall. Werner is now busy supplying his new instrument to hospitals and to cardiac surgeons all over the world.

Another of Werner's successes is the development of artificial organs for transexuals (170 at latest count), an outgrowth of his compassion and understanding of those who would rather switch than fight.

Good luck, Werner. We hope to be hearing much more about you and from you in the future. NEVERTHELESS . . .

--Earl Hoyt

The number of theoretical papers purporting to explain the new particles has outweighed the number of definitive experimental results to the extent that the height of the theoretical paper pile was the subject of a cartoon not very long ago. Now, says [Prof. Sheldon] Glashow, "The only thing left is charm itself." James D. Bjorken, at Stanford, who also played a part in the early postulation of charm, is more conservative about the powers of the charm theory (and more conservative than most theoretical physicists, by his own description). Bjorken thinks that charm is probably the best theory around but says, "I don't have much confidence that the physics will turn out to be exactly the way the theoretical consensus would have it be." There are many variations possible on the charm theme, says Bjorken, and "it wouldn't take many twists in the theory to completely change the nature of the search."

--William D. Metz

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Mary Anne Fisherkeller is shown here using a light pen with the Graphics Interpretation Facility at SLAC. She is the principal architect of this system, which is finding increasing use for physics data analysis. (Photo by Joe Faust.)
into the new Computation Building she did have to set it up all over again.

GIF uses the SLAC triplex computer for whatever calculations the problem requires but has its own Varian 620/i computer to handle keyboards, scope, light pen, typewriter and communications with the triplex. There are 32 keys (at Mary Anne's left in the photo) assigned various functions. To take just one as an example, press it and the picture displayed on the scope will rotate around its Y axis; keep pressing and the picture turns faster and faster. What the computer does, of course, is to draw a new picture from a slightly different angle 20 times a second.

A movie camera can be attached to the scope to make a permanent record, and a still camera can also be used for copying single displays. What kind of movies could be made? Well, the US Geological Survey rented GIF to make a movie showing all the earthquakes in the Bay Area. This followed a research project by Steve Levine who found that three-dimensional plots (location plus depth below ground level) indicated the positions of fault planes when geologic time was speeded up to about one century per minute.

There is a spinning disk that can be placed in front of the display that lets you see out of each eye alternately. Since it synchronizes your eyes with the scope, the result is 3-D! Several 3-D movies have been filmed with GIF. One of the programs that GIF uses is named PRIM 9 (for Picture Rotation, Isolation, and Masking up to 9 dimensions). However, for ease of communication with the operator, PRIM 9 displays only three dimensions at a time. (None of that Sci-Fi stuff here!)

The light pen that Mary Anne is shown using has a tracking ability not found on the 2250's. On the 2250's you can point the pen to a spot of light--a dot, a cross, part of a line--and by pressing a button say "Erase this spot," or whatever you want to do with it. GIF can also do this, but in addition you can point the pen to a blank area and say "Put a spot here." You can actually make a freehand sketch on GIF but not on a 2250.

This ability is used to move the small cross shown at the bottom of the drawing to any point within the three squares. Pointing the light pen at the cross is like blowing in its ear. The squares represent three wire chambers that actually are stacked when they record particles from an experiment. The wires running one way are slightly above the wires running at right angles, and when a particle ionizes a path through the gas, a spark jumps between one wire in the upper level and one wire in the lower. GIF displays a line at the position of each wire that was triggered. Let's say there were three particles (marked just for this drawing by the circles). Now you can see the problem: with all these intersections, which ones are the particles? When there are only a few particles, a computer can solve the problem right away. But with lots of wires plus a little noise, how do you write the program? Using GIF, the programmer can study the complexity of the events and design programs to handle them. The operator moves the small cross to an intersection in one of the squares, and GIF instantly shows a cross where such a particle would have passed through the other spaces. If these other crosses are on top of intersections, you've found your particle!

Anyone with a graphic problem a little too tough for the 2250's should really try Mary Anne Fisherkeller's docile monster.

--Charlie Hoard
AN UPDATE ON SSRP
DEDICATED SPEAR OPERATION A GREAT SUCCESS
SECOND BEAM LINE UNDERWAY - PLANS FOR THE FUTURE

Double, double, toil and trouble;
Fire burn and cauldron bubble.
Fillet of a fenny snake,
In the cauldron boil and bake;
Eye of newt and toe of frog,
Wool of bat and tongue of dog,
Adder's fork and blindworm's sting,
Lizard's leg and howlet's wing,
For the charm of powerful trouble,
Like the hell-broth boil and bubble.
Macbeth, Act IV

The preparations at the Stanford Synchrotron Radiation Project (SSRP) for the first block of "dedicated" operation (i.e., running SPEAR for synchrotron radiation research only) included the arrival of specimens such as frogs, garfish, cows' eyes, and bacterial enzymes. It was reminiscent of the Witches' scene in Macbeth, according to SPEAR operator Larry Feathers. Most of the rather exotic samples that were studied during the 2½ days of high-current, single-beam SPEAR operation were used in a series of experiments carried out by a group of CalTech biologists. They were interested in following the changes in structure that occurred as a result of electrically stimulating the leg muscle and sciatic nerve of a frog, and the olfactory nerve of a garfish. For the bovine retinal tissue, the structure changes were stimulated by a pulse of light. To follow changes of this kind, x-ray diffraction patterns must be recorded on a millisecond time scale; and this requires very intense, monochromatic x-rays of the sort that are produced in the powerful synchrotron radiation that is given off by the circulating SPEAR electron beam.

The previous experiments at SSRP, beginning in May 1974, have been carried out in the "symbiotic" mode—that is, using the synchrotron radiation from SPEAR while high energy physics experiments are also being done with electron-positron colliding beams.* The SSRP-dedicated runs at the end of December were special in the sense that the working conditions were chosen to optimize the production of synchrotron radiation, rather than the "luminosity" (rate of collision) of the electron and positron beams. Thus SPEAR was operated in a multiple-bunch, single (electron) beam mode in which a beam current of 60 milliamps was stored at an energy of 3.7 GeV. These beam conditions produced 78 kilowatts of synchrotron radiation, which is about twice the value that had previously been achieved under the best symbiotic conditions. This higher stored beam current, together with the smaller beam cross section and the short filling time combined to yield a factor of 10 or more improvement in the data-taking rate for the SSRP experiments compared with the typical symbiotic operation. The cost of operating SPEAR for this dedicated SSRP running was covered by special funds that had been made available by the National Science Foundation. This NSF funding is sufficient to provide for a total of 21 eight-hour shifts of dedicated SSRP operation of SPEAR, 7 of which have so far been used.

A major problem in planning the special running was deciding which of the 41 active experimental proposals (representing about 100 scientists) would be assigned running time under these very favorable conditions. Fortunately, the SSRP beam line is split into 5 separate parts so that 5 experiments can take data simultaneously. (A second main beam line now under construction will accommodate an additional 5 simultaneous users.) With advice from the SSRP Review Panel—which consists of experts in the fields of biochemistry, surface physics, atomic physics, solid state physics, chemistry and biology—10 different experiments were selected for operation during this first dedicated research period.

A recent photo of the SPEAR storage ring facility at SLAC. SSRP is the rather large building at the ring side of the ring. (Photo by Walter Zawojski.)

*The January 1975 Beam Line contains an article that describes SSRP and its experimental program.
to maximize the scientific output of the facility. Recently a suggestion was made—but rejected—that this review process might perhaps be short-circuited in order to give rapid approval to a proposal for the study of the contraction mechanism in invertebrate muscle. The fact that substantial quantities of lobster meat would likely have been available at the end of the run was not judged to be sufficient justification for eliminating the peer-review process.)

The Dedicated Run

People began to arrive from CalTech, Berkeley, New Jersey and Seattle several days before the start of the special run. A refrigerated aquarium was hauled in to keep the three garfish happy at 10–15°C. The garfish also enjoyed the 15, 14, 13... smaller fish that were served up to them for snacks. The frogs camped in a sink with a trickle of running water, and room was created in the refrigerator for the cows' eyes and for the hemoglobin and nitrogenase samples by displacing a wayward six-pack. The beryllium window that isolates SSRP from the SPEAR vacuum system—would it stand up under the higher radiation power levels that it was slated to receive?

The window had recently begun to exhibit signs of oxidation and corrosion, so a new beryllium window assembly was rapidly fabricated with excellent support from John Mohun and others in Ray Pickup's shop. As it happened, no window failure occurred during the run, which meant that the spare window could be installed during a shutdown period and thus avoid the loss of precious time.

The run began on Saturday, December 20, at 10 PM. A midnight start had originally been scheduled, but the earlier beginning was arranged through the cooperation of the high energy experimental groups. The technique of pulsing the electron gun of the SLAC accelerator 9 times during the normal gun-pulse period (which had been worked out by Roger Miller and Ewan Paterson) made it possible to fill SPEAR to a level of 60 milliamps of stored electrons in a very rapid manner. On several occasions the fill was so fast that the stored beam rose above 60 mA before the SPEAR injection kicker magnets could be turned off. In these case the stored beam of up to 90 mA had to be dumped and the fill started over again because Joe Jurow had commissioned the beryllium window only for duty at currents up to 60 mA at the 3.7 GeV beam energy. Future windows will probably be able to handle the higher currents that SPEAR is clearly capable of delivering.

Typically, it took about one minute to fill the SPEAR ring with electrons, and another several minutes to "ramp" the beam energy up to 3.7 GeV. The synchrotron radiation experiments then used the beam for about 4 or 5 hours, during which time the stored current would decay from 60 to about 30 mA. At that point the remaining beam was dumped and the fill, ramp and run cycle was begun all over again. Every 8 to 12 hours SPEAR was shut down briefly and the beryllium window was inspected visually to ascertain that the corrosion was not getting significantly worse.

Everything went smoothly during the 2½ day run, except for some radiofrequency (rf) power problems near the beginning. To attain a single-beam energy of 3.7 GeV all four SPEAR rf transmitters have to be operating properly. Roger McConnell succeeded in exorcising the rf gremlin after a time, and during most of the run the beam was on so steadily that the experimenters hardly had a chance to rest.

Some Other Experiments

In addition to the biological experiments mentioned earlier, a number of other studies were carried out—some of which would have been difficult or impossible to do except on the
EXCERPTS FROM THE STATEMENT BY DR. H. GUYFORD STEVER, DIRECTOR, NATIONAL SCIENCE FOUNDATION, BEFORE THE SUBCOMMITTEE ON SCIENCE, RESEARCH AND TECHNOLOGY, HOUSE OF REPRESENTATIVES, DEC. 10, 1975

... I believe that we are now in a period of great scientific discovery. We must extend our vision and quicken our stride if science and technology are to aid in the timely solution of societal problems and if we are to find answers to an array of unanswered and important scientific questions.

Now let me turn to the substance of science today. Our quest for knowledge of the universe and man ranges from the underlying fundamental laws of nature, to the complexities of materials and living systems, to the environment in which we live and to the cosmos beyond.

The "charmed quark"

Physicists have been working for 40 years to understand the properties and interactions of neutrons and protons and electrons which we know to be the principal constituents of atoms and their nuclei. Such investigations in the 1930's led to the later development of nuclear energy and lasers. In recent years physicists found a large catalogue of additional particles or excitations with interesting familial similarities and differences. The picture exhibits enough regularities that there must be a deeper and simpler underlying structure, and that is the object of our search. The past year has seen major discoveries that indicate that we may be crossing a new threshold in fundamental knowledge.

A promising hypothesis in the 1960's was that all strongly interacting particles such as protons and neutrons might be built up of various combinations of three more fundamental constituents called "quarks," but existing experiments were unable to show that quarks existed. [Experiments in the early 1970's] caused theorists to speculate that a fourth property should be added, a new attribute called "charm."...

In late 1974 a key discovery was made simultaneously by researchers working at the 30 GeV proton accelerator at Brookhaven and at the electron-positron colliding beam facility at SLAC. A new excitation called the "J/psi particle" was identified... This particle was unusually heavy and unusually stable. Experiments were rapidly mounted in several nations to see if this particle stood alone or was one of a whole new family.

At about the same time, physicists working at CERN in Geneva and at our National Accelerator Laboratory have been discovering unexpected ways in which neutrinos interact with other particles that also support the "charm" hypothesis and have opened the possibility of a new unifying theory of fundamental forces.

Several quite different lines of experiments seem to be converging upon an improved picture of nature and pointing to a new and probably very fundamental attribute of matter. ...

Synchrotron Radiation

Probing the fundamental laws of nature often leads to unexpected scientific spin-offs. An important recent example is the use of synchrotron radiation in biology and materials science. 

... in recent years metallurgists, chemists, biologists, solid state physicists, and others have learned to use this synchrotron radiation as a unique and powerful source of ultraviolet light and x-rays for all kinds of scientific studies having nothing to do with elementary particle physics. It is as though we had found a way to use the proverbial squeal of the pig. Studies presently underway are probing the properties of proteins, enzymes, metals and gasses.

The synchrotron radiation itself had previously been very thoroughly studied and characterized, partly because it was a nuisance in accelerators [such as SPEAR], and partly because of its importance to astrophysicists and plasma scientists interested in fusion power. It is interesting to note how all these concerns are linked together. Synchrotron radiation is nicely polarized and provides a smooth continuous spectrum all the way from visible light to x-rays. In addition, physicists have developed clever techniques to sort out these wavelengths, providing a new and powerful searchlight on the structure of matter. Altogether, then, the case of synchrotron radiation illustrates nicely how a single new technique, sometimes, can quickly change the look for well-worn and extremely recalcitrant problems in several different fields of science.

Nitrogen Fixation

Surprisingly enough, synchrotron radiation may ultimately help us understand the life processes of plants and thus prove important for agriculture. ...

During the past 18 months discoveries from several levels are beginning to fit together and provide a comprehensive understanding of the total process of nitrogen fixation. One aspect involves the enzyme nitrogenase... physical chemists using fine structure data obtained with synchrotron radiation appear to have identified the coordination state of molybdenum in the "resting" enzyme. Further, it appears as if two atoms of molybdenum work together in the functioning enzyme...
dedicated-time basis. Two experiments were
done, by groups from Stanford and UC-Berkeley,
on the yield and energy distribution of elec-
trons ejected by photons from the surfaces of
various materials, including copper, gold and
gallium arsenide. The high radiation flux
available during the dedicated run facilitated
the study of these weak photo-emitters and made
it possible to observe the rapid changes that
occur in surface properties when such gasses as
oxygen settle (or are chemisorbed) on the sur-
face. Basic information of this kind is likely
to have important applications in the develop-
ment of semiconductor devices, and may lead to
an improved understanding and control of the
processes of corrosion, oxidation and catalysis.

Another study of catalysts was aimed at deter-
mining the arrangement of copper and ruthen-
um atoms in cluster systems. Physicists and
chemists from Boeing Company in Seattle and the
Exxon Company in New Jersey used the technique
called "extended x-ray absorption fine structure"
(EXAFS) to understand how the precise arrange-
ment of atoms in catalysts enables them to speed
up many chemical reactions involved in petrol-
eum refining, pollution control, and so on.
These studies require a high flux of x-rays
with energies above the "K-absorption edge" in
ruthenium (22 keV). Such x-ray energies are
only available with adequate fluxes when SPEAR
is run near its highest energies.

Several additional EXAFS experiments were
run by groups from Stanford and from UC-Berkeley
on studies of the proteins hemoglobin and hemo-
cyanin. Another study by these groups is re-
lated to fertilizer production. Commercial fer-
tilizer is now manufactured largely by the
Haber-Bosch process, a cumbersome technique for
fixing atmospheric nitrogen into ammonia com-
pounds which involves temperatures of 550 °C and
pressures of 200 atmospheres. The cost of fer-
tilizers produced by this process has just about
tripled since the fuel crisis, with drastic con-
sequences on world food supplies—particularly
in the poorer countries. By contrast, certain bacteria are able to produce ammonia compounds
at normal temperatures and pressures through the
use of an enzyme (a biological catalyst) called
nitrogenase. EXAFS studies of nitrogenase could
hasten the development of much needed alternat-
tives to the Haber-Bosch process. The potential
importance of these studies was recently empha-
sized by the Director of the National Science
Foundation, H. Guyford Stever, in testimony to
the Congress (excerpts from this testimony are
given on a separate page in this article).

Second Beam Line - Plans For The Future

The SSRP program has evolved significantly
since its inception barely 18 months ago. Oper-
ation in the symbiotic mode at SPEAR has demon-
strated the great potential of synchrotron radia-
tion from a multi-GeV storage ring. The demand

One advantage of high intensities is that
is that researchers can accumulate high-quality
experimental data very quickly, in some cases
with very simple instrumentation. For example,
Keith Hodgson of Stanford University reports
that, in x-ray absorption experiments with
metalloproteins (enzyme proteins that contain
metallic elements as parts of their essential
structure), his group can obtain much higher
quality data from SPEAR and about 50,000 times
faster than it can with the use of the contin-
uous background radiation from a conventional
x-ray tube. Other researchers have a rule of
thumb that 1 hour at SSRP is equivalent to 1
week in the laboratory. . . .

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being given to the possibility of adding several more ports of this kind, which are simpler and less expensive than the long tangential "fingers" that are needed for the higher energy radiation. Such modest facilities would provide useful research opportunities for work with radiation in the visible and ultraviolet portions of the spectrum.

The SSRP experience with SPEAR has shown the very substantial potential for high energy, high intensity synchrotron radiation research. It is becoming quite clear to everyone, including the sponsoring agencies (see separate box), that the needs of a rapidly expanding user community may require the construction of additional new major facilities. With increased exploitation of SPEAR, and perhaps eventual dedicated use of SPEAR for SSRP work, it seems likely that Stanford, SLAC and SSRP can continue at the forefront of this exciting research for many years.

--Herm Winick

NSF, ERDA express interest

The National Science Foundation and the Energy Research and Development Administration are seeking to identify persons interested in and capable of the design and construction of an electron storage ring to be used as a dedicated source of synchrotron radiation. They are requesting preliminary information, rather than proposals, for the purpose of defining project scope and format.

Designs for the facility should provide for optimum production of synchrotron radiation as an intense x-ray source at wavelengths of 1 A˚ or less (as well as the longer wavelength regions) and should take into account the minimum wavelength for useful photon fluxes, electron beam current, radiation source brightness, beam stability in space and time, and the pulsed nature of the radiation. Those providing information are also asked to consider experimental instrumentation (for example, photon and photoelectron detectors, monochromators, and equipment for x-ray diffraction and data-handling). All studies should include cost estimates for the source, auxiliary apparatus, and buildings.

Interested parties are invited to contact Howard Etzel or William Oosterhuis of NSF's Division of Materials Research, 1800 G Street, N.W., Washington, D.C. 20550... or Mark Wittels of the Materials Sciences Program in ERDA's Division of Physical Research, Washington, D.C. 20545... Because the information obtained through this request may later be used to prepare a solicitation, proprietary information is not to be supplied at present.

--Physics Today, December 1975

CAFETERIA SOLAR HEATING

SLAC is now using solar energy to help preheat the ventilation air for the Cafeteria. The south wall of the Cafeteria has been made into a solar-heat collector. The work began with Frank Guidi (shown in the photo) painting the wall black so that it would absorb the solar energy. Then John Beckett and John Trotter installed a clear polyethylene film to provide an air gap and thus trap the heat. To measure the temperature rise of the air, Joe Green installed thermocouples and a temperature recorder. The initial tests indicated a temperature rise of 3°F of the 6000 CFM ventilation air. Since part of the solar energy was being absorbed by the concrete wall, an expanded-metal mesh was then installed by Ray Robello and John Trotter in the air space in order to make the collector a more efficient air heater. As a result, the measured temperature rise increased to 12°F.

This type of solar collector is a "passive" system, since it has no mechanical components. The advantage of passive solar systems is the obvious one of simplicity and low cost. The one unusual problem encountered with this particular solar collector is the fact that it is partially shaded by three young redwood trees on the slope below the Cafeteria south wall. It may eventually prove to be desirable to replace these redwoods with deciduous trees in order to let in the winter sun.

--Gordon Ratliff

The Peter Principle

In every hierarchy, whether it be government or business, each employee tends to rise to his level of incompetence; every post tends to be filled by an employee incompetent to execute its duties.
SOME HOLIDAY FACES

Ed Sharnee is enjoying an active retirement. He is shown here during a recent visit to his old bailiwick in the Mail Room. (Photo by Faye Williams.)

Although now retired, Win Field still manages to put in a few hours a week as SLAC's Legal Eagle at his old stand in the A&E Bldg. (Photo by Wendy Wheaton.)

A hirsute Luther Lucas visits his friends and former coworkers in SLAC's Mechanical Engineering Department. (Photo by Bill Brunk.)

Fred Johnson unretires for awhile to solve a problem at SPEAR. (Photo by Dave Bostic.)

Recent retiree Casey Jones is shown on a visit to his former colleagues in SLAC's Plant Engineering Department. (Photo by Harvey Hukari.)
Anna Laura Berg dropped in to join the festivities at the annual EFD Christmas Party. (Photo by Finn Halbo.)

Former SLACer Mel Ray was recently back visiting in his old haunts. He is shown here enjoying the comfortable seating in the lounge of the new Computation Building at SLAC—which he played a large role in planning. Mel is now an Assistant Vice President at the Univ. of Nebraska. (Photo by Elizabeth Arends.)

Retiree Walt Basinger returns to help out with an SSRP project. (Photo by Axel Golde.)

Another old friend who showed up for the EFD Christmas Party was Ed Dally, who is now at the Naval Postgraduate School in Monterey. (Photo by Finn Halbo.)

Former SLACer Ed Seppi, now with Varian Associates, brought his dapper presence back recently to take part in the EFD Christmas Party. (Photo by Finn Halbo.)

Ray Robbers (left) and Ned Lee, both recent retirees from SLAC, joined the luncheon held by the Plant Engineering Drafting Group in mid-December. (Photo by Harvey Hukari.)
INTERDISCIPLINARY CAREER DEVELOPMENT EXAMINATION

[Author Unknown]

Instructions: Read each question carefully. Answer all questions. Time limit--4 hours. Be brief, concise, and specific.

HISTORY. Describe the history of the papacy from its origins to the present day, concentrating especially, but not exclusively, on its social, political, economic, religious, and philosophical impact on Europe, Asia, America, and Africa. Be brief, concise, and specific.

MEDICINE. You have been provided with a razor blade, a piece of gauze, and a bottle of Scotch. Remove your appendix. Do not suture until your blade, a piece of gauze, and a bottle of Scotch. Printed in Swahili. In ten minutes a hungry Bengal tiger will be admitted to the room. Take whatever action you feel appropriate. Be prepared to justify your decision.

ECONOMICS. Develop a realistic plan for refinancing the national debt. Trace the possible effects of your plan in the following areas: Cubism, the Donatist controversy, the wave theory of light. Outline a method for preventing these effects. Criticize this method from all possible points of view. Point out the deficiencies in your point of view, as demonstrated in your answer to the last question.

POLITICAL SCIENCE. There is a red telephone on the desk beside you. Start World War III. Report at length on its socio-political effects, if any.

PHILOSOPHY. Take a position for or against the truth. Prove the validity of your position.

EPISTEMOLOGY. Take a position for or against the truth. Prove the validity of your position.

ELECTRICAL ENGINEERING. The disassembled parts of a high-powered rifle have been placed in a box on your desk. You will also find an instruction manual, printed in Swahili. In ten minutes a hungry Bengal tiger will be admitted to the room. Take whatever action you feel appropriate. Be prepared to justify your decision.

PHYSICS. Explain the nature of matter. Include in your answer an evaluation of the impact of the development of mathematics on science.

GENERAL KNOWLEDGE. Describe in detail. Be objective and specific.

EXTRA CREDIT. Define the Universe; give three examples.