SLAC BEAM LINE

There is no excellent beauty that hath not some strangeness in the proportion.—Francis Bacon

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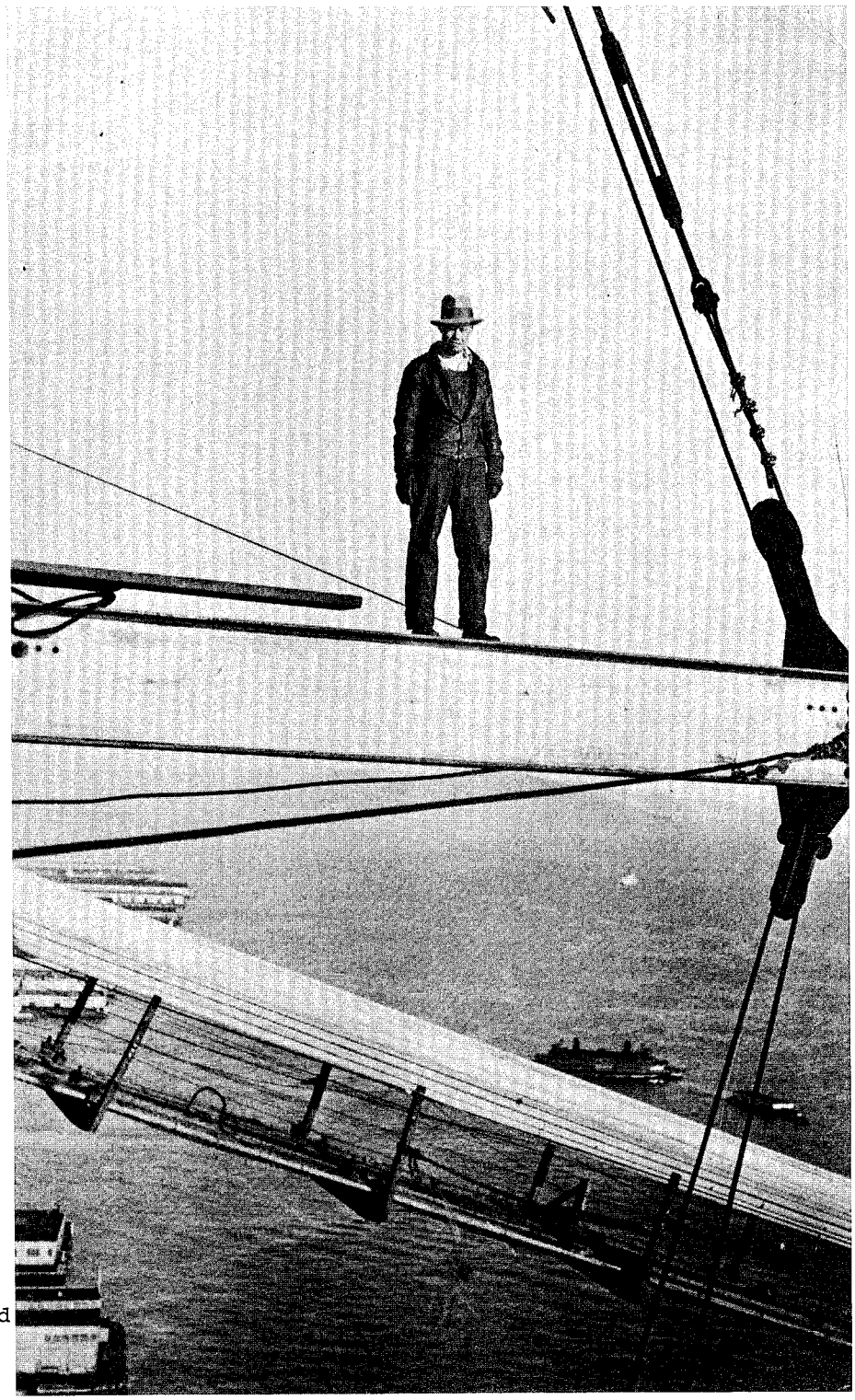


Cover photo: Bob Gould working on the construction of the SF-Oakland Bay Bridge. See story on page 2.

The contents of this issue are shown on page 2.

In This Issue

BOB GOULD RETIRES FROM SLAC

Bob Gould needs little introduction, since most of us know him either directly through work contacts, or indirectly through his many cartoons that have entertained us over the years. He is probably the only person who literally knows the entire SLAC accelerator system, including PEP, from subfoundation to finished siding. After all, he was the Chief Engineer in charge of the design and construction of both the two-mile linac and of PEP.

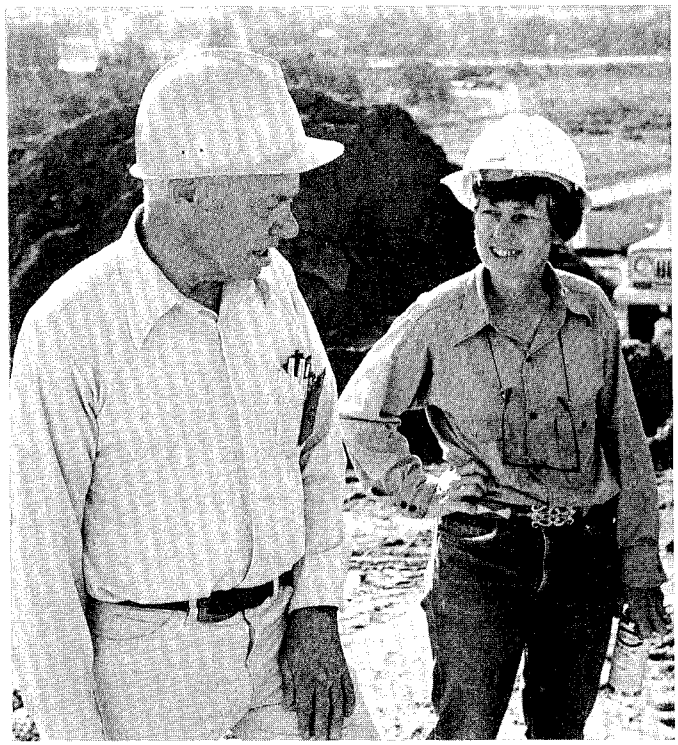
Bob has been at SLAC since 1960, and during this time his keen insight into the life of the laboratory has often been displayed in his widely admired single-frame cartoons. His warm understanding of people combined with his subtle sense of humor have evoked a smile from almost everyone at SLAC at one time or another.

Right To The "Top"

Born and raised in San Francisco, Bob first began to experience the real world soon after he graduated from UC-Berkeley in 1934 with a degree in Civil Engineering. This was at the height of the depression, and not one company came recruiting to the Berkeley campus that year. When Bob walked into a local engineering firm and explained that he had just received a C.E. degree and was looking for a job in that field, the response was "You poor soul—get outta here." Not easily discouraged, Bob finally got a laborer's job working 400 feet above sea level on the Oakland-San Francisco Bay Bridge (even that job required a recommendation from the Berkeley Dean of Engineering). His starting wage was 68-3/4 cents per hour, well above the minimum wage at that time, and the view was free.

But it wasn't long before Bob got his feet back on the ground—into the ground, actually—as he went to work in a gold mine up in the mountains. While living in the company camp, Bob recalls the many interesting people he met, like the simple-minded guy who enjoyed sitting in his tent and whittling on a stick of dynamite.

Mapping The Sierra



Bob Gould and Adele Panofsky are shown at the PEP site. *(Photo by Joe Faust.)*

After a brief turn working for the State Highway Department, Bob eventually found an outdoor niche doing plane-table mapping up in the Sierra Nevada Mountains for the U.S. Geological Survey. Camping out for months at a time, his survey party would occasionally stop into nearby mining or lumber towns to pick up supplies and check out the Saturday night festivities. It was a rugged and healthy way of life, and that outdoor look remains with Bob to this day. After seven years of such mountaineering, Bob was transferred to Tennessee where he met his fun-loving wife Sally, who was recently described as "the force behind the wizardry of R.S. Gould." After a three-year turn in the Navy, Bob returned to the Bay Area with his young family and took charge of authenticating the USGS maps of the area "between San Carlos and

San Quentin" for three more years.

Joining The Laboratories

In 1947 Bob joined the Office of Architects and Engineers at UC-Berkeley, where he was in charge of road and site development for what was then called the UC Radiation Laboratory. He worked on the foundations for Building 90 and the Bevatron and was in charge of "slide control" for Building 47, which had a terrible habit of creeping down the hill. Bob represented the second generation of Goulds in that line of work, since his father had previously been campus architect and had worked directly with E.O. Lawrence in selecting the site for the famous 184-inch cyclotron up on the hill.

Present-day visitors to LBL can thank Bob as they shift into low gear at the end of Hearst Avenue and begin to climb the scenic road that leads up to the Lab's main entrance. Bob designed the superelevated hairpin turn that is cut into the side of the hill and that to this day defies most of the laws of physics.

After eight years at Berkeley, Bob transferred to the Lawrence Livermore Laboratory, where he became head of Plant Engineering. At one point during this time he was handling 15 major contracts and dealing with 5 different A&E firms. Who said life used to be simple? At LLL, Bob carried out much of the development of Site 300, from initial design to final "hand-waving" of construction equipment in the field. Bob takes great satisfaction in handling problems as they arise in the field and tries to avoid inundating his projects in paperwork. He sometimes modestly describes his method of operation as "lacking in administrative procedure." Others would call it getting the job done.

"Anything Going On Down There At Stanford?"

In June 1960, Bob rang up Stanford University to ask if there were any projects starting up that could incorporate one "slightly used civil engineer." The response was, "Sure, come on down." Bob recalls that, after accepting the job, he seriously doubted that there would be enough work to last six months. Little did he know that he would find enough work to keep him busy for the next 19 years. At that time the proposed project that was to become SLAC was known as "project M" (for "monster") for lack of an official name. Bob notes that a contest among project members to name the new laboratory finally had to be abandoned when most of the submitted names turned out to have acronyms that were unprintable in family newspapers.

Bob began his work here by roughing out the location of the accelerator on the Sand Hill site, and he followed its construction every concrete pour of the way during the succeeding years. He was also involved in the construction of the Research Yard, where the first scientific discovery was made not by physicists but by an overzealous bulldozer operator. It seems that the operator overexcavated a certain trench and in the process uncovered the bones of a large extinct animal that was later named *Paleoparadoxia*. (With a name like that, it's no wonder that the poor beast had kept a low profile for the past 15 millions years.)

Since completion of the accelerator, Bob has been the principal "guesstimator" who has transformed the plans for later machines into black and white construction costs. These include SPEAR and PEP and several other possible machines that were contemplated but never actually built. The first question thrown up for these machines was usually, "How much will it cost, Gould?" So Bob would crank up his slide rule and come up with estimated costs for the earthwork and quantities of concrete.

Caution! Rock Slide Area

Over the years, Bob has taken a personal interest in the geology of the SLAC site ever since the first exploratory trenches were dug for the linac. It doesn't take much asking to get him to describe the interweaving of "Eocene and Miocene" (that's sandstone not Shakespeare). With the help of Stanford graduate students, Bob conducted the first geological investigation of the PEP site in 1973. Their findings were essentially confirmed shortly thereafter by a private consulting firm.

Today a visitor to Bob's office is immediately confronted by the collection of rocks that crowds the sloped top of a bookcase from which hangs the makeshift sign *Caution! Rock Slide Area*. The rocks are individually labeled to identify their origins from around the PEP site. Bob's favorite is a petrified clam that was found in the spoils from the mined PEP tunnel.

"Trade In My Calculator For An Abacus?"

Bob's retirement from SLAC is perhaps an inaccurate description. He will continue to assist SLAC as a civil engineering consultant and also, we hope, as a part-time volunteer cartoonist. The subject of China is also in the air, in light of the recent visit of Chinese physicists to the U.S. They are seriously looking into the idea of building their own accelerator and are well aware that Bob's experience would be valuable to them. But Bob and Sally aren't trading in their forks for chopsticks just yet. Bob is also in contact with an engineering firm in San Francisco that is involved in some interesting civil engineering projects. So although Bob has officially retired from SLAC, he is still in pursuit of the kind of engineering challenges that began many years ago atop the Bay Bridge. We at PEP and all of SLAC wish him and Sally the best always.

—Steve Blair

KENNETH B. MALLORY, 1926-1979

SLAC has lost one of its finest microwave engineers, and we in the I&C group have lost a respected colleague and firm friend.

Ken Mallory was a remarkable person. His intellectual accomplishments were well known to all who came into contact with him, and his contributions to accelerator technology and control systems were both original and continuous over a period of more than twenty years. But it was during the last five years, when Ken was undergoing chemotherapy and radiation treatment, sometimes for weeks or months at a time, that his special strengths became most apparent. He never complained nor lost his optimism. He fought his illness every inch of the way, and in so doing he inspired all of us who came into daily contact with him. There was a time, a year or so ago, when the only comfortable position for him was lying down, so for several days he conducted the business of the group from a bed in his office. And during all the years of his illness he managed to convey, time and again, a sense of loyalty and support towards those who worked with him in the group.

We can only hope that he felt our own loyalty, support and admiration towards him. We will miss him dearly. —Ken Crook for the I&C Group

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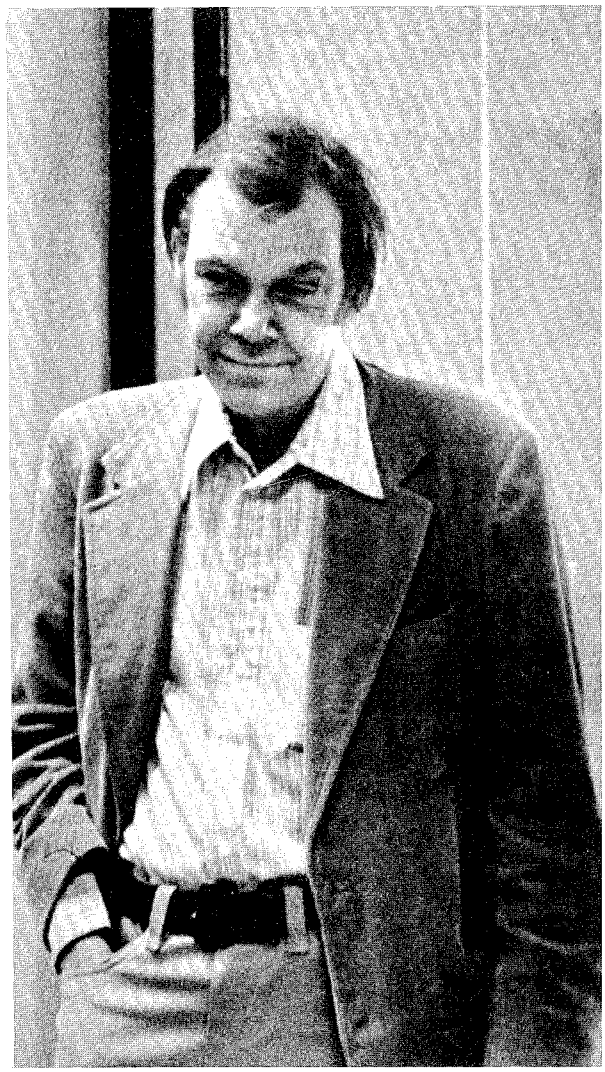


The first time I met Ken Mallory was at the Stanford Microwave Lab in 1958. He had been at the Hansen Labs since 1950, first as a Ph.D. student doing his thesis on the Mark III accelerator, then as a Research Associate. Among various activities, he was working on medical linacs, supervising Ph.D. theses such as that of Roger Miller, and teaching the Microwave Measurements lab course under Ed Ginzton. I had just joined the Project M group, and I needed to solve a problem with microwave impedences and Smith charts. After talking to a few people who were unable to help me, I was told to see Ken Mallory. At the time he was sharing an office with his teaching partner, John Jasberg. From the very first minutes of talking with Ken, I realized that he was a very unusual character. He understood my problem almost instantly, and within a very short time he was giving me all sorts of ideas and advice on how to go about solving it. While standing at the blackboard in front of me, he would nod his head up and down, frequently interrupt his explanations to stare at me with a wide grin, and generally convey the impression that he had all day to talk to me. I should add that I couldn't understand half of what he was telling me, and that he always seemto be several steps ahead of me in his understanding and his explanations.

Subsequent conversations with others at the Microwave Lab made it clear that my experience with Ken was by no means unique; and that sometimes it would prove useful, after an arduous conversation with him, to have his ideas reinterpreted by his office-mate, John.

The last time I saw Ken Mallory, it was 21 years later and just a few weeks ago, at the Stanford Hospital. He was very ill then, but his mind had not changed at all. We talked about solar energy, SLAC computers and 12 beam lines for our Control Room, teaching science to young children, and his family. On all of these subjects he was as sharp and as unpredictable as ever.

During the first part of his career, Ken was predominantly a microwave specialist. At one point he told me that he wanted to write a book entitled *Eighty Ways Around The Smith Chart*. Unfortunately, he never found the time to complete

(Continued on next page)

that project. As he began work at SLAC and assumed leadership of the I&C Group in Accelerator Physics, he gradually became more and more involved with computers. I have often thought that this was not merely a coincidence, for Ken's insight into computers and how to use them elegantly was a natural reflection of the remarkable computer he carried in his own head. Somehow, his brain seemed to make connections unlike everyone else's. He had an incredible intuition. He loved to speak in enigmas and could often get upset if one did not understand him. But it was almost impossible to hold that against him because what he criticized was the intellectual content with which he disagreed and never you as a person. In all the years I knew Ken, I cannot remember him making a derogatory comment about anyone behind his back.

Those who did not know Ken were occasionally turned off by his reactions. But those of us who worked with him knew that behind his enigmatic responses there was invariably a wealth of information and insight. He had an amazing technical discipline and made it apparent in his everyday design decisions. He retained these characteristics throughout his illness. Until almost the very end, he never seemed to give up hope nor to show signs of feeling sorry for himself. With the same sharp judgment, he participated with interest in discussions of SLAC plans that would only materialize two or three years hence. Few people could have done that.

Not long ago, I ran into Ken limping painfully in the rain between two buildings at SLAC. When I offered him a ride, he smiled and said, "No thanks, my mother made me waterproof." Those who knew and learned from Ken will miss him for a long time.

—Greg Loew

SUMMER RENTALS?

Going on vacation? Would you like to have a SLAC visitor as a renter/house-sitter? Summer listings are urgently needed for summer visitors to SLAC: rooms, apartments and houses, for long or short periods of time, and at varying prices. If you have any such accomodations that you are interested in renting, please contact Gwen Bowen or Carolyn O'Brien at SLAC extensions 2859 or 2351

Reminder: The open meetings sponsored by Alcoholics Anonymous are held every Thursday, from noon to 12:30 PM, in the Conference Room (Room 126) of the Electronics Building. Anyone interested in the recognition and treatment of alcoholism is cordially invited to attend.

DON McMAHON IS LEAVING SLAC

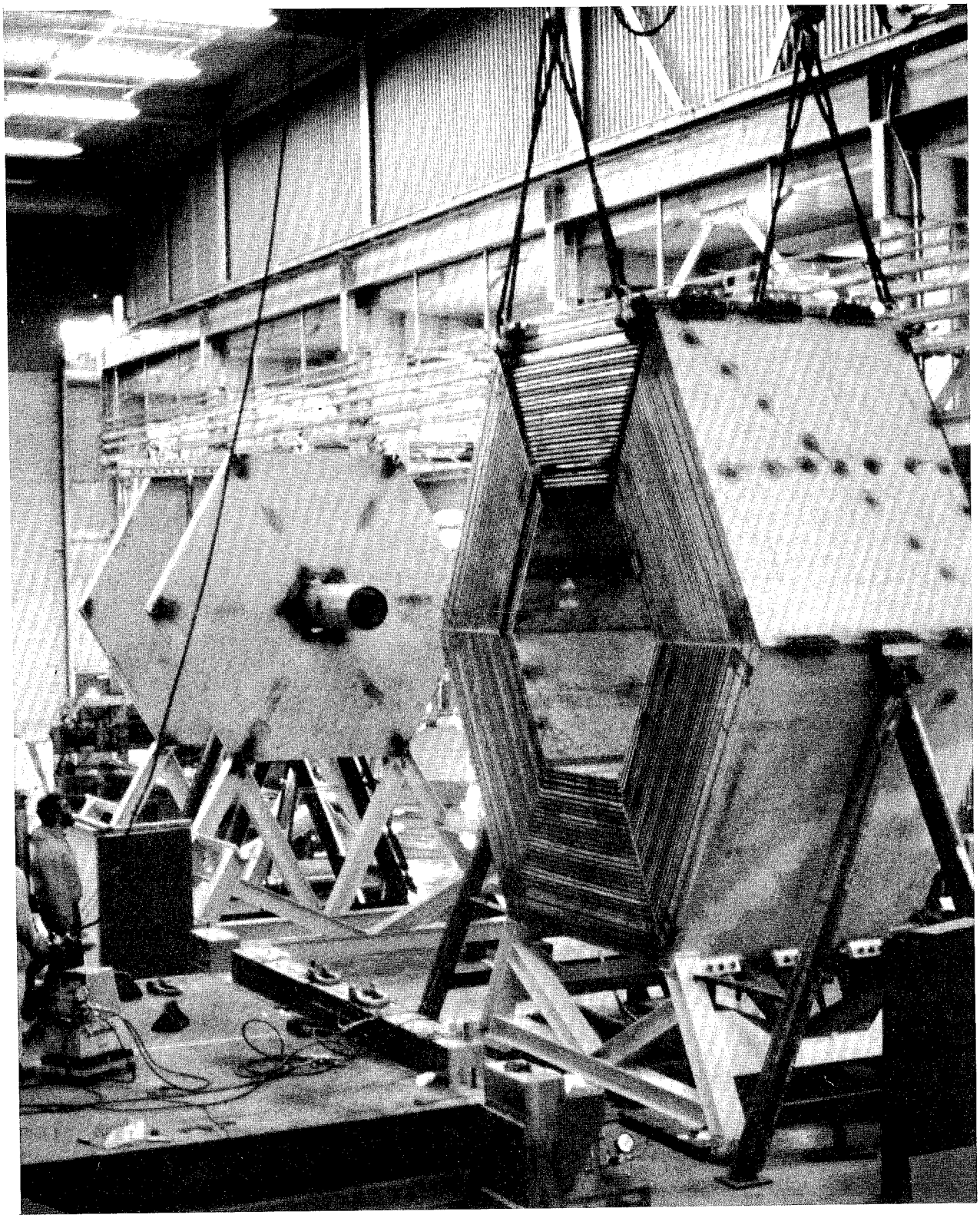
Don "Mac" McMahon, Foreman of the SLAC Carpentry Shop for the past 10 years, will soon be leaving SLAC to move to Clear Lake, California, where he and his wife, Rosemary, plan to build a home. Before starting this project, however, the McMahons are planning to take a three-month cross country trip in their new fifth-wheel trailer. They will travel first to Oregon, where they have many relatives; then to Nebraska, visiting Mac's home town of Red Cloud; then eastward to Chicago, which is Rose's home town. From there they will travel on to New York and down the east coast before turning back to California.

Mac and Rose have a large and close-knit family of eight children, most of whom are now grown and have left the nest. Mac originally came to California from Nebraska in 1949 and began work as a carpenter's apprentice. He went on to the shingler's trade and then, in the early 1950's, began working for United Air Lines at the San Francisco airport as an A&E mechanic. After a short time in the plant maintenance shop at UAL, Mac left to start his own Formica business in Mt. View, where he remained until he joined SLAC about ten years ago.

Mac has many hobbies. In his early days he was a boxer, and he has always enjoyed bowling and fishing. More recently, he and his family have taken up scuba diving, and he and Rose also enjoy dancing.

Mac has made many good friends during his time at SLAC. All of us now join in wishing him and his family a good life at Clear Lake.

—Don Ewings



The main pieces of the MAC detector, PEP-6, are shown in this photo by project engineer Roger Coombes. BIG MAC is described in the article by Bill Ash on the next page.

WHAT'S IN A NAME?

PEP will be running before the year is out. A large part of SLAC is working on it. There should be some articles on all the things that are going on, including the big detectors now being built. Why not start with MAC (PEP-6)? And don't make it just another technical description.

These were all fine suggestions from the *Beam Line*, but the last point is a bit tricky. A non-technical article on PEP is like talking about current events without mentioning gasoline.

MAC has been growing out of the floor of the Heavy Assembly Bldg. for about a year now, starting with 300 tons of iron plate delivered last Spring. Now it is nearly all together—big, yellow and impressive. The photograph shows the three main pieces: the six-sided central section, and two end caps. Sometime this June these pieces will be taken down to interaction Region #4 at PEP on a very large, and very slow, truck.

There are many more than just these three pieces to the MAC puzzle, however. From the University of Colorado will come a drift chamber for the center of MAC. It weighs only a few hundred pounds, but some of that weight will come from about 10,000 hair-sized wires. Moving this may prove to be more difficult than moving the 300 tons of iron.

Northeastern University in Boston will supply hundreds of 20-foot-long, 4-inch-diameter aluminum tubes to surround the iron. The University of Utah is sending long plastic scintillation counters, and the University of Wisconsin will ship out 700 big, flat chambers to slide between the iron plates of the end caps. SLAC will provide 1500 aluminum, tray-shaped chambers to fit into the slots in the central iron, 6 heavy shower chambers, and a magnet coil.

This potluck affair is presided over by our project engineer, Roger Coombes, who will have the job of assembling all this stuff into an engineering version of a sphere.

The small PEP beam pipe will pass through MAC, but otherwise there is no way for anything at the center (where the two beams collide) to get out through all that iron—which is pretty much the whole idea of the MAC detector. The product of electron-positron collisions in PEP is typically the creations of lots of new particles of different kinds, having different energies, and heading in different directions.

One way of studying this particle-creation explosion is to measure where all the energy carried by the particles ends up. MAC does this by leaving lots of open spaces in the iron and filling those spaces with small detectors that measure just how much energy is deposited here and there throughout the system. Such energy-measurement is called "calorimetry," a name that goes back to earlier days when the energy being measured was in the form of heat. One of the first, in fact, was a block of ice: put in a sample and measure how much ice is melted.

Techniques have changed a bit since those days. MAC is enormous, but not because the amount of energy being measured is very large. In fact, it would take some thousands of years of PEP operation to produce enough energy in particles to melt a penny-sized piece of ice. MAC is so large because this energy, although small, is not easy to contain, and once contained is not easy to measure.

So, MAC is a calorimeter. But there is a bit more. In spite of the size, it is fairly easy to magnetize all the iron, and we can learn still more from the way in which the magnetic field affects the charged particles that are produced in the PEP collisions.

And now back to the name. What else would you call a BIG MAgnetic Calorimeter if not BIG MAC? There were at least a half dozen suggestions, in fact, but something about the detector made our final choice seem inevitable. The decision was clinched by the artwork shown here, which came from a friend of one of the MAC collaborators.

Welcome, MAC. We'll do it all for you.

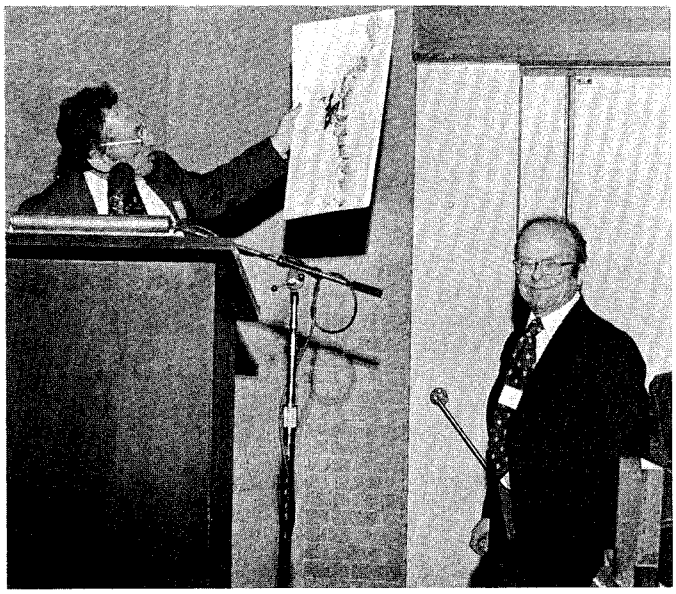
—Bill Ash

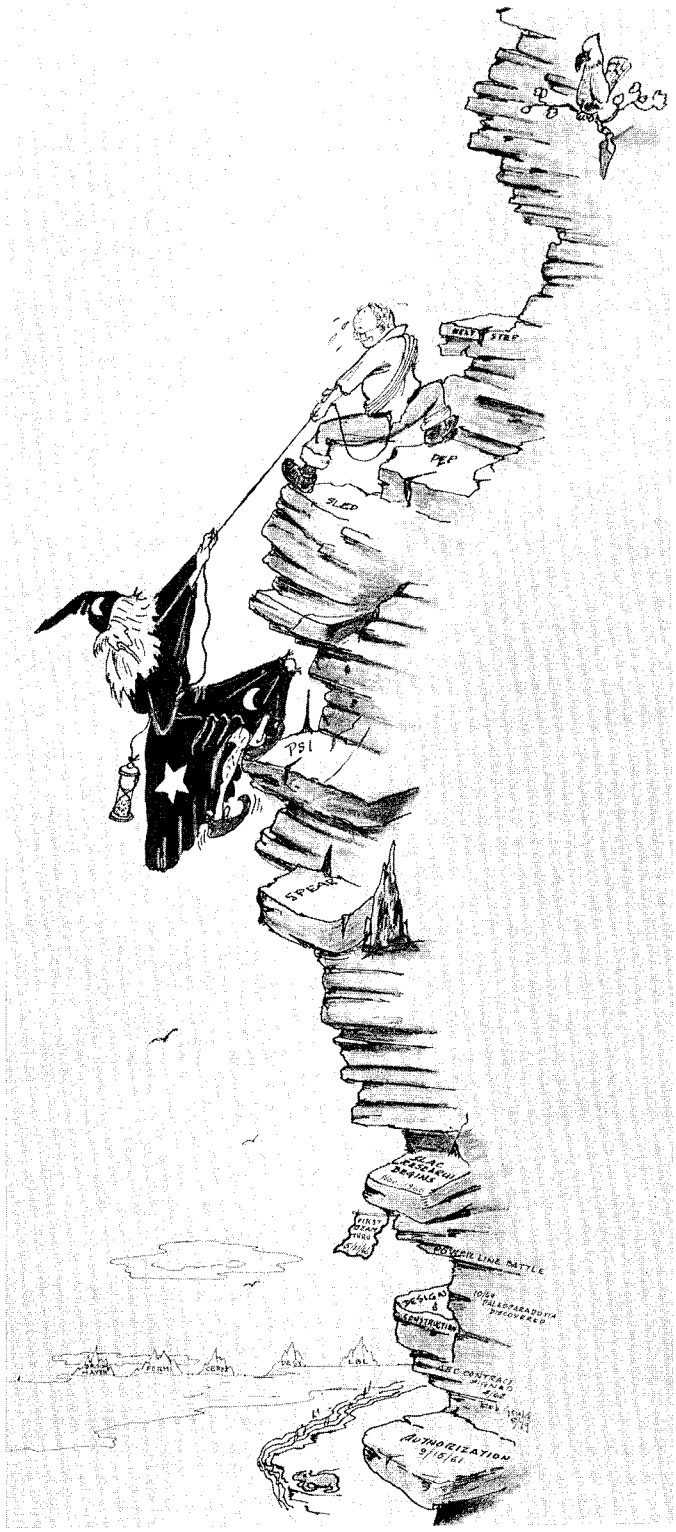
AT S.L.A.C.
ee DO IT ALL FOR μμ

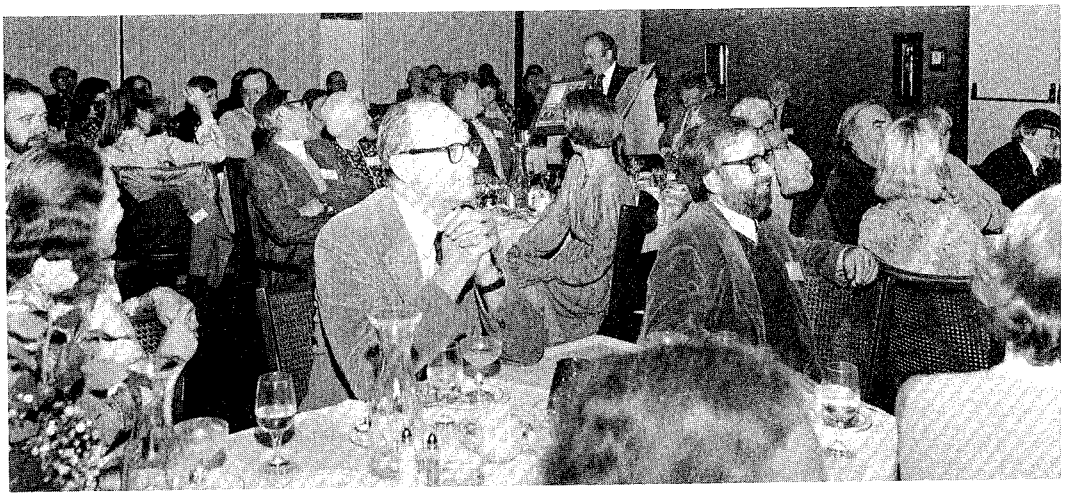
PIEF'S 60TH BIRTHDAY

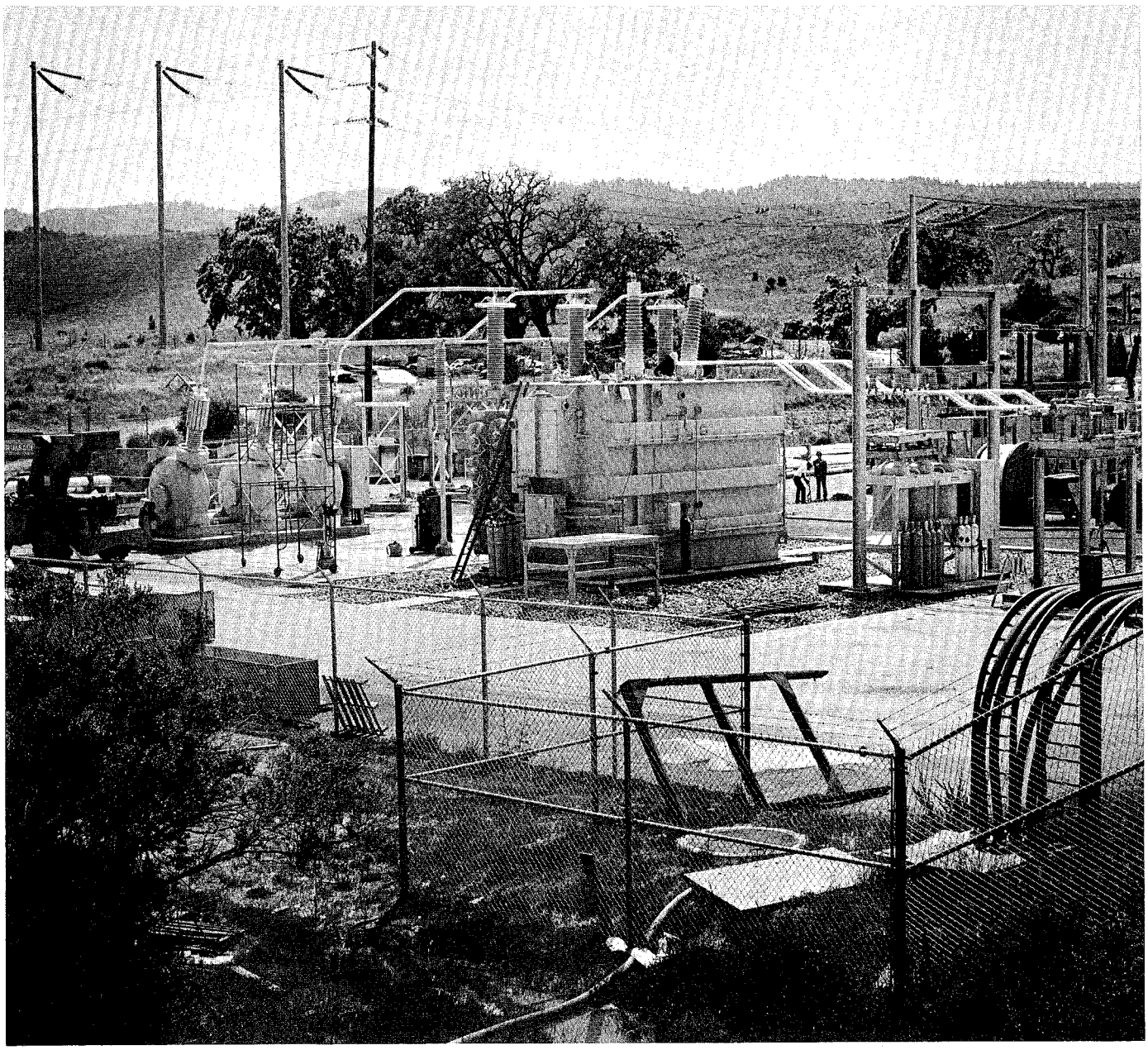
On May 4, a large number of Pief Panofsky's friends and co-workers got together to mark the occasion of his 60th birthday. The party was held at the Stanford Faculty Club. After dinner, brief talks were given by President Richard Lyman of Stanford; Edwin McMillan, former Director of the Lawrence Berkeley Laboratory; and Dick Neal, Burt Richter and Joe Ballam of SLAC. Pief was also given half a dozen presents that marked various stages of his career in physics and accelerator building.

Joe Faust took the photographs that are shown on this and the next page. The cartoon showing the SLAC "Wizard" being hauled up the mountainside by Pief was drawn by Bob Gould. This cartoon was a part of a large birthday card that was signed by everyone who attended the celebration.









NEW POWER TRANSFORMER INSTALLED

Since 1963, SLAC's electrical power has been supplied by a single main transformer rated at 50 MVA, 230 kV/12.47 kV. Because major repairs to equipment of this kind may take as long as 18 months, and also because SLAC's electrical load will increase significantly when the PEP storage ring comes into operation, it was decided to increase both the reliability and capacity of the electrical plant by adding a second 50 MVA transformer.

In order to install this new transformer near the added PEP load, a special bus filled with sulfur hexaflouride (SF_6) was used so that it could be extended below the existing 60 kV line without building any new superstructure and thus minimizing its aesthetic impact. The SF_6 bus and circuit breaker offer the highest reliability and require the minimum space. This will be the first SF_6, 230 kV bus on the Pacific Coast. It is expected that there will be many visitors from West Coast utilities, EPRI and large research labs to follow this new trend in compact electrical substations.

The photograph of the new installation was taken by Joe Faust.

--Alex Tseng

SLAC'S HEART DISEASE GUINEA PIGS

Stanford's Heart Disease Prevention Program has recently launched a new year-long project to investigate the effects of regular vigorous physical activity upon components of cholesterol in the bloodstream. Secondary benefits of this study will be information about heart function and behavioral changes induced by exercise.

Thirty of the eighty people involved are from SLAC. Of the 80, 48 are labeled "exercisers," while the balance form a control group that will not begin exercising until next year. All of the "guinea pigs" in the study are men between the ages of 30 and 55 who are currently in good health but who were not engaged in vigorous physical activity on a regular basis prior to the start of the study. Many of the volunteers had participated in an earlier heart disease risk survey that was conducted by the Stanford Heart Disease Prevention Program in 1973-75. The present study is an outgrowth of the earlier one.

The importance of cholesterol, the focus of this new study, has been debated for years in the medical community. New findings from the Framingham (Massachusetts) Heart Study and from the Stanford work now appear to resolving some of the issues in the debate. In discussions at Stanford with Ping Ho, Program Coordinator, and Dr. Peter Wood, Project Director, I learned the following information. When viewed under an electron microscope, cholesterol appears like tiny drops of oil in vinegar. These drops are carried through the bloodstream by a group of molecules called lipoproteins, of which there are three kinds: high-density lipoprotein (HDL), low-density lipoprotein (LDL), and very low-density lipoprotein (VLDL). The three types are markedly different in size. The HDL's are small, the LDL's about 100 times larger, and the VLDL's about 100 times larger than the LDL's.

It is presently thought that the medium-sized LDL's are the "bad guys" in heart disease. It is the LDL cholesterol packed in the walls of arteries that reduces blood flow and in the end may actually prevent it. Note that a certain amount of cholesterol is required for normal human metabolism. The LDL's pick up the necessary cholesterol from the food we eat or from the liver (where some is manufactured) and transport it to the cells for processing. If there is more cholesterol available than needed for normal metabolic purposes, then some of the LDL's appear to deposit this excess on the inner walls of the arteries.

Perhaps the most interesting information coming out of the new studies is that the build-up of fat in the arteries does not seem to occur if the *ratio* of HDL to LDL cholesterol is high enough. The tiny HDL drops may have a scouring action on the walls of the arteries, like a sandblasting tool, thus cleaning off the LDL molecules. The fatty material that is chipped away is then carried back to the liver and subsequently excreted from the body.

Some people seem to be naturally protected from cholesterol build-up because they have inherited a high ratio of HDL to LDL. Such people are able to eat high cholesterol foods without any sign of cardio-vascular disease. In addition, women seem to have a higher HDL/LDL ratio than men at comparable ages and thus to have less heart trouble in general. (This is why the present Stanford study is concentrating on men.)

However, if you are not one of the lucky few naturally protected individuals, is there anything you can do to produce a more favorable HDL/LDL ratio? At Stanford, Drs. Peter Wood and William Haskel have now collected enough data to convince themselves that vigorous exercise combined with a prudent diet will do just that. These doctors observed that joggers have very high HDL/LDL ratios compared with the national average. With the better diets than joggers seem to use, the quantity of LDL cholesterol is reduced, thus making the ratio higher than it otherwise might be.

With this background, the present study was initiated to observe in a controlled manner any changes in the ratio of HDL to LDL that occur in the Stanford volunteers. All 80 people were carefully weighed, measured and analyzed at the start of the project. The conditioning for the "exercisers" is supervised in a progressive, individualized program of walking, jogging and running. Eating habits and certain psychological characteristics have been noted and will be monitored for any change during the year.

It will be interesting to report the results of this study during the coming year. If each of us can be assured of healthier living as a result of exercise, there are probably many people who would want to jog or take other forms of exercise on a regular basis.

It is perhaps needless to say that anyone who plans to begin a program of regular vigorous physical activity should first have a thorough checkup at SLAC or through his or her own doctor.

—Vernon Price

Nobody before the Pythagoreans had thought that mathematical relations held the secret of the universe. Twenty-five centuries later, Europe is still blessed and cursed with their heritage. To non-European civilizations, the idea that numbers are the key to both wisdom and power, seems never to have occurred.

—Arthur Koestler
The Sleepwalkers

It has been shown by Rutherford that the atomic nucleus deflects an alpha particle as if the force between them were one of electrical repulsion between two charges. Thus by counting the number of collisions occurring when a group of alpha particles passes through a known number of atoms we can determine the charge on the nucleus. Measurements of this kind have shown that the nucleus of the hydrogen atom has a positive charge equal to that of one electron, helium that of two electrons, lithium three, and so on down the list of chemical elements to uranium. This suggests that the nucleus of the atom may be built up of units carrying a positive charge equal to the negative charge of the electron. Such a unit we find in the nucleus of the hydrogen atom. It is perhaps surprising that the positive unit of electric charge should be associated with a mass almost 2,000 times greater than that associated with the negative unit. Rutherford has, however, performed a series of experiments that gives us good reason to believe our guess is correct. These experiments consist in shooting alpha rays from radium through various substances. It is found that particles having the same charge and mass as the hydrogen nucleus can be knocked out of some of the lighter elements. An event of this kind is shown in a remarkable photograph taken by Mr. Blackett. The evidence seems very strong that the nuclei of the various atoms are indeed built up of an aggregate of hydrogen nuclei, which are now called protons.

--*Scientific American*
February 1929

The tangible objects with which we are familiar are constituted of molecules. These in turn are composed of atoms, and these of the positively charged and massive protons and the negatively charged and mobile electrons. The light that makes plants grow and that gives us warmth has the double characteristics of waves and particles and is found to consist ultimately of photons. Having carried the analysis of the universe as far as we are able, there thus remains the proton, the electron and the photon—only these three. We sometimes think of standardization as being the distinctive keynote of modern industry. But even a Ford car has hundreds of parts that differ from one another. What then shall we say of the Workman who by using only three different parts, protons, electrons and photons, has made a universe with its infinite variety of beauty and life?

--*Scientific American*
March 1929

SLAC AMATEUR RADIO CLUB IS ON THE AIR!

WA6NUP

The SLAC Amateur Radio Club, which was organized in 1970, is looking for interested people who work at SLAC. The only qualification is an interest in amateur radio. If you have a CB or amateur radio background, so much the better. We have an operational station and code practice facilities on the middle floor of the Central Control Room. At a recent meeting, over 20 people participated in various planning and organizing activities. Code and theory classes are currently going. Come on down and learn. The Club is running a code class every working day at noon in the station. We are also in the process of constructing a new antenna system so that worldwide contacts can be made more easily.

Amateur radio field day activities will be held at SLAC on the weekend of June 23-24, 1979. Why not plan to come out then and see what amateur radio is all about?

For more details and date of the next meeting, please contact

Roger Gearhart, ext. 2709
Dick Collins, ext. 2588
Dave Ficklin, ext. 2160

We hope to see you at our next meeting.

—Dave Ficklin

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3-7	10-2	20-65	26-21	48-7	56-11	64-17	70-2	78-36	84-8	91-4	98-32
4-17	11-18	21-4	30-47	50-20	57-14	65-32	71-26	79-86	85-27	92-2	
6-17	12-117	22-19	33-24	51-60	60-19	66-10	72-3	80-8	86-6	94-19	