SLAC BEAM LINE

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

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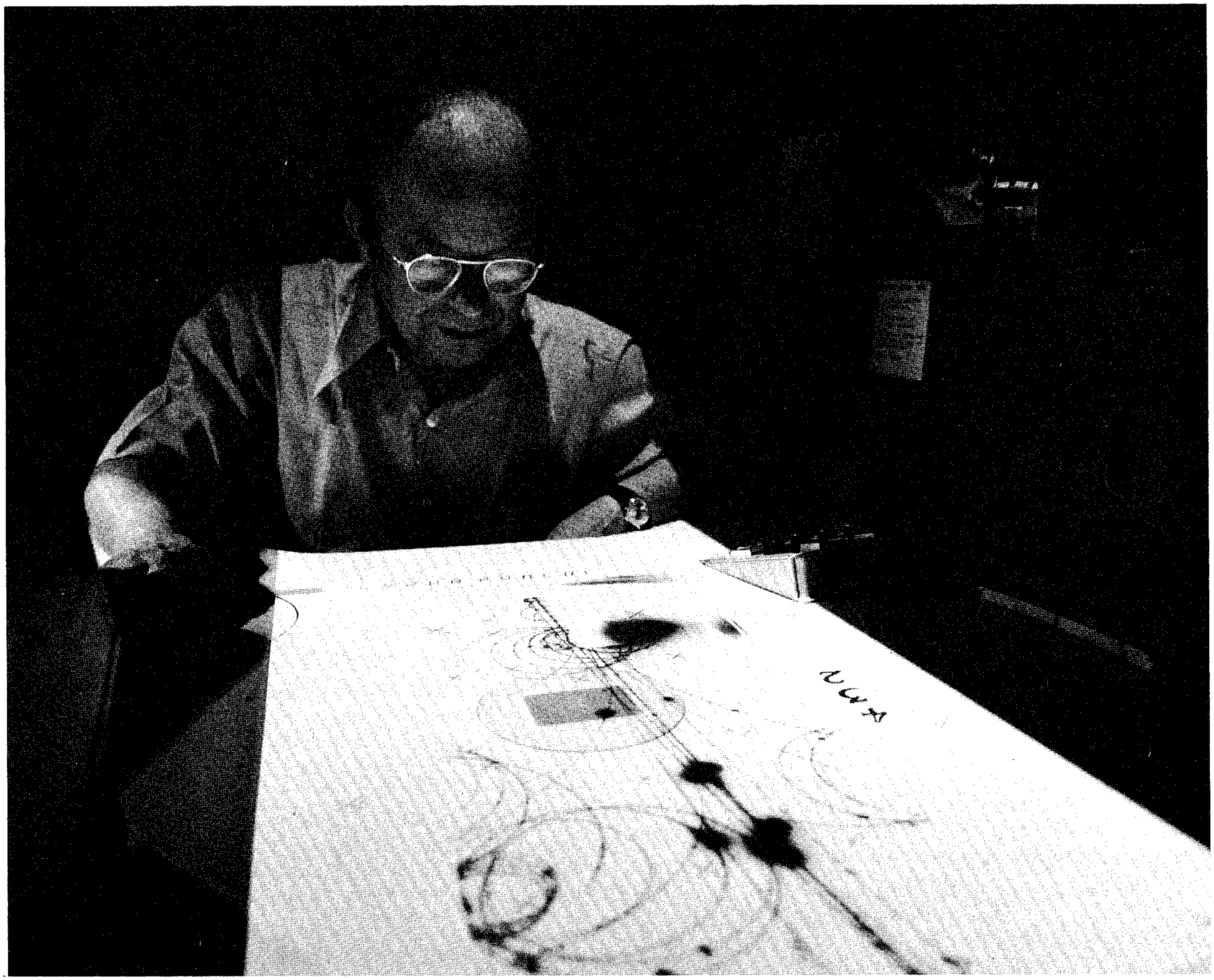


--Photo by Joe Faust

SLAC's Director, W. K. H. Panofsky, is shown here looking over a photograph of particle interactions recorded during an experiment in the large SLAC streamer chamber facility. Panofsky recently gave a talk about the significance of high energy physics research to a group of Journalism Fellows at Stanford. This talk was printed in the February 1976 *Stanford Observer*, but there has been enough additional interest expressed so that we reprint it here, on pages 2-4.

Contents

The frontier of the small in high energy research

[Reprinted, with minor changes, from the February 1976 *Stanford Observer*]

Physicists specializing in high energy research at the Stanford Linear Accelerator Center, as they dig deeper and deeper into the basic structure of all matter, have discovered several particles never before known to exist.

It wasn't too long ago that the atom was thought to be the smallest entity. Now, as its layers have been peeled away, no one knows how small the smallest portion of the atom may be--if and when it is discovered.

Recently Prof. Wolfgang K. H. Panofsky, director of SLAC, was asked by Stanford's Professional Journalism Fellows what value such work, conducted on the multi-million-dollar, two-mile-long accelerator and its periphery of huge targets and machines, has for society.

The following is adapted from his comments, as tape-recorded, to the Journalism Fellows.

Science deals with the frontier of the very large, and with the frontier of the very small.

The frontier of the very large has to do with the universe, with the origin and behavior of such distant matter as stars and galaxies--in other words to find out what really created the world.

The other way round is the frontier of the very small, namely, what we are made of. Everybody knows these days that we are made of atoms and molecules and things like that.

So therefore, you may ask, what are atoms made of? Then you find out that the word "atom" means "indivisible" in Greek. And then we find out that the indivisible atom is divisible.

We learn that the atom consists of what's called the nucleus, which scares us all, and the electrons which go around it.

Then we want to find out what the nucleus is made of, and we learn that the nucleus is made up of neutrons and protons. Then you want to find out what neutrons and protons are made of, and to do that you bombard neutrons and protons with high energy particles, and you learn that, indeed, the neutrons and protons are not the elementary building blocks of matter, either--that they in turn are made up of subconstituents, and so on.

And the question is when or if it will ever stop. You keep peeling an onion down from its outer layers to smaller and smaller inner layers, and at this point nobody can honestly tell you when it will stop.

One of the societal problems that goes with this work is that, if one wishes to explore the frontiers of the very, very small, one gets into the same headaches that one gets into in exploring the frontier of the very large. You need large and complex tools to do it.

To explore the frontier of the very large, you need telescopes and space-borne gadgets to look out uninhibited by the atmosphere.

To look at the very small, you also need very large tools, and that actually is a paradox. One of the questions laymen often ask is "Why in the devil do you need two-mile-long machines to look at very small things?"

This has to do with a very fundamental principle of science which I cannot explain to you here, that goes by the name of "The Uncertainty Principle," which simply states that in order to explore something at very small distances, you have to give it a very high energy kick.

Thus you need particles of very high energy in order to explore what goes on on a very small scale. I won't explain beyond that, other than asserting that it is so.

Therefore, in order to keep peeling down these successive layers of onion, you have to have higher and higher energy in the particles, and thus larger and larger tools with which to do your looking.

It is obviously of strictly fundamental interest to find out what we are all made of. There is a tremendous intellectual challenge and the natural aspiration of man trying to widen his frontiers.

The question is, first, when will it ever stop? Nobody knows the answer to that because, as I've said, so far each time we've looked at smaller and smaller distances, new things have been discovered that no one suspected were there.

The next question is, what does this have to do with mankind? Why should the taxpayer pay for all this exploration of smaller and smaller things? What are the benefits to humanity other than the obvious intellectual ones?

There is no question that these kinds of tools have to be paid for by the federal government, simply because any possible application of the knowledge gained is so remote that it is inconceivable that any one industry would wish to build its own accelerator in its back yard. No one industry could feel that it could recapture, in any way, the long-range developments from this kind of instrument for the benefit of its stockholders.

This kind of research into the extremely fundamental, therefore, must become the responsibility of the nation as a whole.

And one other thing. This work is being carried out completely openly. There are no secrets. Scientific groups doing research at SLAC come from all over the world. We have Russian visitors and Chinese visitors, and one of the benefits of this work is that it forms a kind of link among people doing this sort of work in different parts of the world.

All of these people are united by a common interest in the fundamental nature of matter. And for this reason it is very likely that if a facility very much larger than SLAC were to be built, it might well be an international project. In fact, I am going to a conference this year where a group consisting of Russians, Western Europeans, Japanese and Americans will discuss the possibility of what is known as the "VBA," the Very Big Accelerator.

In the present climate it is certainly doubtful that this idea will get anywhere, but it is at least a beginning.

This international meeting symbolizes two facts--that there is indeed good communication among the scientists of many nations; and also that, just as SLAC serves a national community, so would a substantially larger machine have to serve and be financed by the international community.

When talking about the rationale for our research--just why we are trying to do something as fundamental as understanding the basic building blocks of matter--it is very difficult to give specific answers. By the very definition of basic research we cannot precisely predict what the benefits or impact will turn out to be.

But there are two general arguments that I would like to make.

The first is essentially an expression of faith, and it has to do with one of the major issues that now faces humanity: how to live in harmony with nature and the environment. Since we have to make decisions, the article of faith that I have (and which, I think, is shared with most of the members of the academic community) is that on the average--though not necessarily in any single case--you make more intelligent decisions if you know what you're doing than if you don't. Thus a deeper understanding of the workings of nature may indeed be a useful guide for decision-makers in conducting their affairs more sensibly than in the past.

I repeat that this is simply an expression of faith on my part. I cannot prove that it is correct. Maybe ignorance is bliss.

There is probably no more fundamental inquiry than the attempt to understand the basic building blocks of nature. What we have found out so far, however, is only that the building blocks we once thought were fundamental are in fact composite, complex structures. And so we have continued to push back the frontiers, without really knowing whether we shall ever reach an ultimate goal.

Well, that's one argument. The second argument simply has to do with history. At the turn of the 20th century the frontier was atomic physics, and the work was aimed at demonstrating that there actually were atoms and finding out what they were like.

Then the frontier moved on to the study of the structure of atoms, which led to the discovery of the atomic nucleus surrounded by its cloud of electrons. Next we learned that the nucleus itself was composed of neutrons and protons. And now we are dealing with the substructure of these nuclear particles.

In peeling onions, when will it stop?

This is the historical thrust, which penetrates into what Professor Weisskopf of MIT calls the "intensive" dimension of science. But there also is an "extensive" dimension, which spreads out in an ever-widening wake behind the intensive discoveries, and it is in this extensive realm where the practical applications of basic knowledge make themselves known.

By about 1950, for example, the study of atomic physics had led to the electron microscope, to transistors, and to a vast number of applications in metallurgy and chemistry. Also, during the same period, the study of nuclear physics led to nuclear power and nuclear explosives, and to the development of isotopes for medical and technical uses.

Many of these developments were entirely unforeseen when the fundamental research that led to them was being done. In fact, there is a famous story associated with the name of Ernest Rutherford, the English physicist who first discovered the nuclear nature of the atom. When Rutherford was asked, in the late 1920's, whether he thought the energy locked up in the nuclei of atoms would ever find practical application, his response was that "Anyone who believes that we shall get power from the atom is talking moonshine." From this you can see that scientists, too, have a large chance of being wrong.

At the present time I would have to say that I cannot predict that there will be any specific benefits to society from today's high energy physics research other than a better understanding of nature. There are, however, some tangible benefits from our work that are peripheral rather than direct. In order to build the kinds of accelerators and research devices that we use in high energy physics, we have to solve some very difficult and interesting technical problems. These problems attract some extremely able people to our field, and very often the solutions to the problems transcend the state of the art in a number of different technical fields. Here are a few examples of this kind:

1. The basic element of computers, the element of binary logic, was first developed as a part of particle-detection devices in nuclear physics research.

2. The high-power, high-frequency radio tubes called klystrons, which are now used extensively in radar and in microwave communications, were originally developed as power sources for linear accelerators such as the present SLAC machine.

3. In building the two-mile-long SLAC accelerator, we learned to do surveying more accurately than any surveyor had ever previously achieved. We had to align our machine to within a thousandth of an inch over the two miles.

Examples of this kind could be multiplied. Very often such technical problems lead to solutions that are more expeditious, cheaper and even more elegant by people whose basic motivation is to do scientific research.

Applications of this kind are what is known in the trade as technological "spinoff," and I want to reemphasize the fact that they are a by-product of our work, not a primary objective.

As I stated earlier, the results of our primary work in high energy physics research do not have any obvious predictable applications. As a matter of pure speculation, however, let me say a few words about energy sources.

The more deeply we probe into the basic constituents of matter, the greater is the concentration of energy. Thus more fundamental energy sources would presumably have to come from an understanding of nature on this smaller scale. Whether such hypothetical new sources of energy could, or even should, be tapped eventually is of course a completely open question.

It is instructive to note that most of the developed nations of the world have chosen to invest a fraction of their resources in high energy physics research. We at SLAC were recently visited, in fact, by a committee on Science and Technology from the People's Republic of China. This group informed us that a decision had been taken to set up a high energy physics laboratory and to build a large accelerator in order to enter directly into this field of study. Although they have not yet decided on a specific machine to build, they have already assembled a staff of 600 persons for this work.

We asked them why they had decided on this course of action, since the work would not have any predictable benefits for a people who have a continuing struggle to meet minimum national needs. The answer given by the leader of the delegation was this:

"You have to look further than the end of your nose."

In a nutshell, that is the message that I have been trying to deliver here. The thrust of history has been that, as you gain a more profound understanding of the fundamentals of nature, useful by-products and applications have simply flowed out eventually.

--W. K. H. Panofsky

WALLACE & DARWIN

Alfred Wallace, February 1858: It occurred to me to ask the question, Why do some live and some die? And the answer was clearly, that on the whole the best fitted lived. From the effects of disease the most healthy escaped; from enemies, the strongest, the swiftest, or the most cunning; from famine, the best hunters or those with the best digestion; and so on.

Then I at once saw, that the ever present variability of all living things would furnish the material from which, by the mere weeding out of those less adapted to the actual conditions, the fittest alone would continue the race.

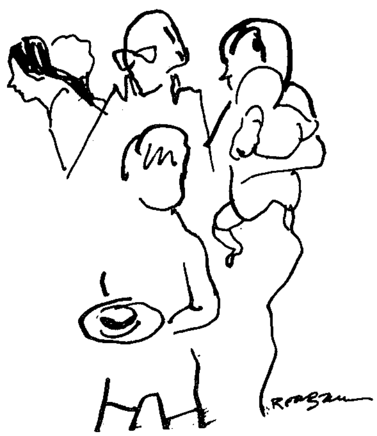
There suddenly flashed upon me the *idea* of the survival of the fittest.

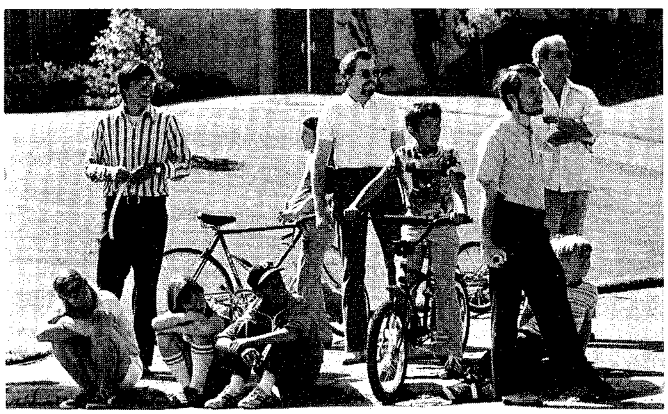
The more I thought over it, the more I became convinced that I had at length found the long-sought-for law of nature that solved the Origin of Species. . . . I waited anxiously for the termination of my fit so that I might at once make notes for a paper on the subject. The same evening I did this pretty fully, and on the next two successive evenings wrote it out carefully in order to send it to Darwin by the next post, which would leave in a day or two.

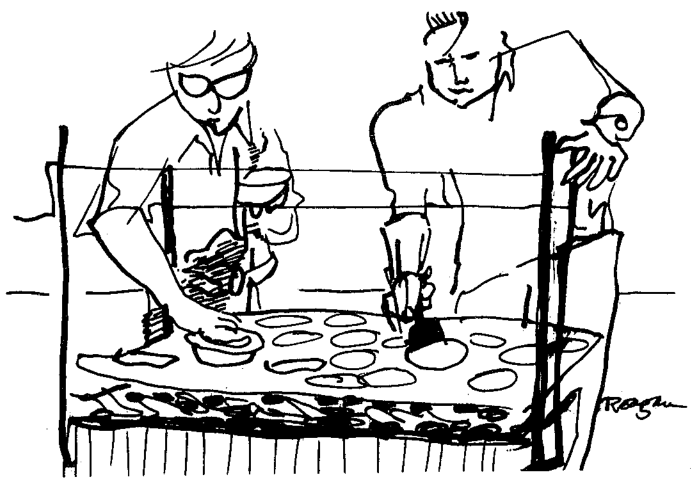
Charles Darwin, June 1958: I never saw a more striking coincidence; if Wallace had my MS. sketch written out in 1842, he could not have made a better short abstract!

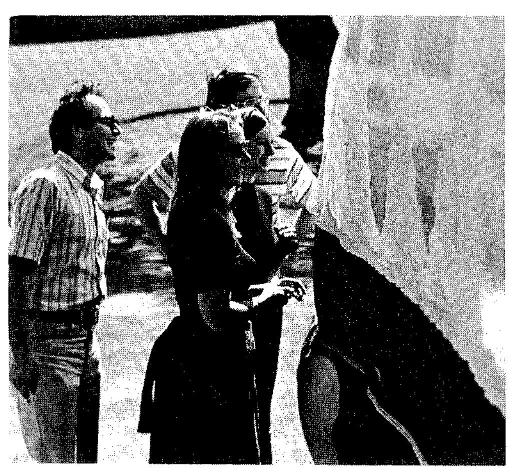
SLAC FAMILY DAY - MAY 1, 1976

Sketches by Gertrude Reagan
Photos by Joe Faust









FAMILY DAY RACE RESULTS

The 1976 Family Day Races attracted over 60 entrants in the various events. Here were the results:

A. 100-YARD DASHES

Girls (12 and under)

Ronnie Decker - 16 seconds
Mary Jean Koontz - 17.5
Dana Ratcliff - 17.6

Boys (12 and under)

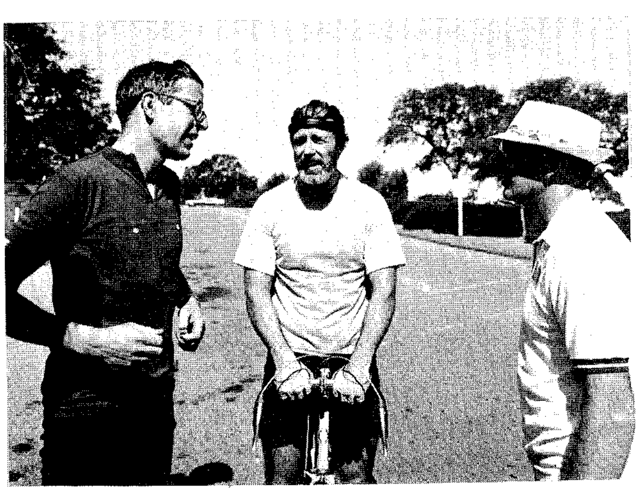
Raphael Roberts - 15 seconds
Taiho Decker - 15.4
Gove Hung - 16.7

Women

Grace Wiegers - 15 seconds
Cynthia Duong-van - 15.7
Muriel Gravina - 16

Men

Frank Collins - 13.2 seconds
Dave Witthaus - 13.4
Dave Thomas - 14



Photos by Joe Faust

B. FOUR-MILE RUN

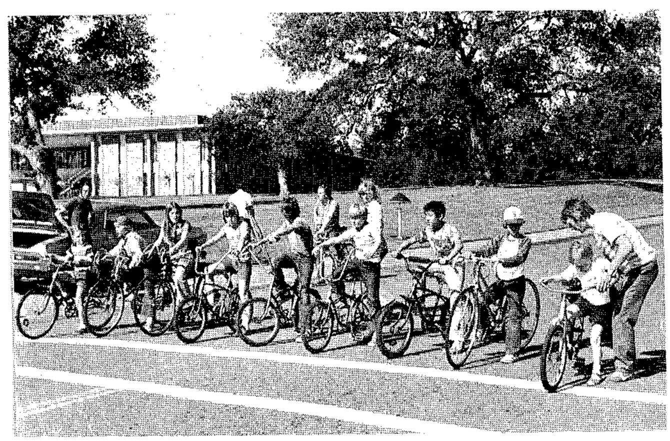
The four-mile run was won by Stanford student Don Flatter in a time of 22:06.

C. SHORT BICYCLE RACE

John Koontz won the 1.6-mile bicycle race in a time of 6:20.

D. LONG BICYCLE RACE

Dave Coward was the winner of the 8-mile bicycle race in a time of 23:29.



STANFORD INTRAMURAL BICYCLE RACE AT SLAC

On the day after Family Day, May 2, the annual Stanford University Intramural Bicycle Race was held at SLAC, with almost 50 riders taking part in this event. The race course measures 10.275 miles, and a new record for this distance was established when Stanford students Dave Voss and Ralph Munson came across the finish line together in a time of 25:34.

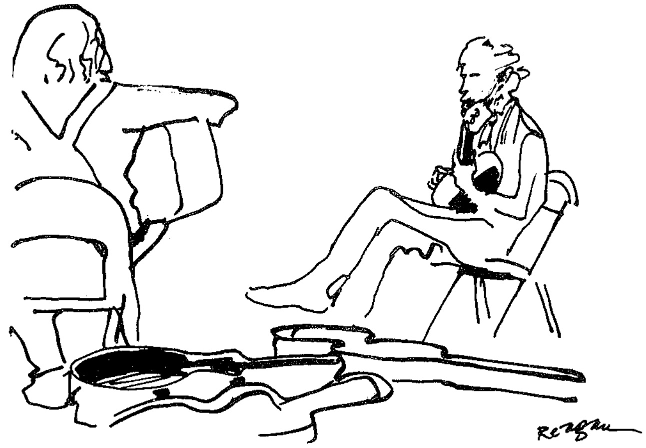
SLAC's own Dave Coward made an excellent showing in this race, finishing 7th in a time of 25:45. Dave's achievement is all the more remarkable in view of the fact that he is about 20 years older than most of the riders with whom he was competing.

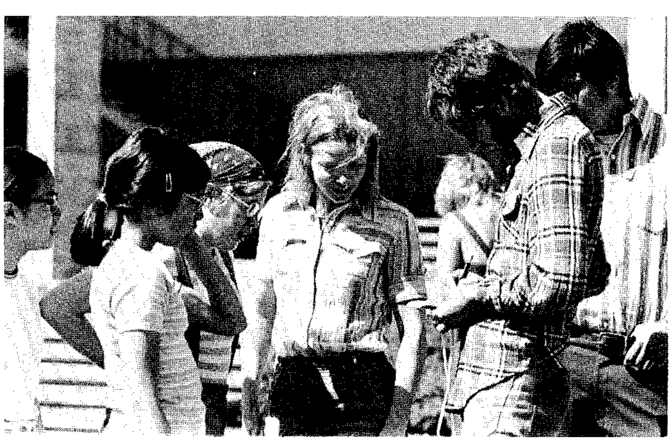
The Head of Stanford's Intramural Sports Program, Dutch Fehring, wishes to express his appreciation for the use of SLAC's facilities for this event.

--Ken Moore

SLAC FAMILY DAY - MAY 1, 1976

Sketches by Gertrude Reagan
Photos by Joe Faust

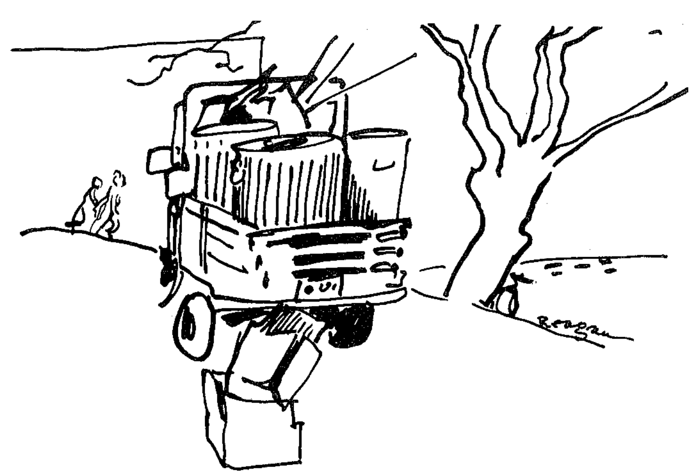


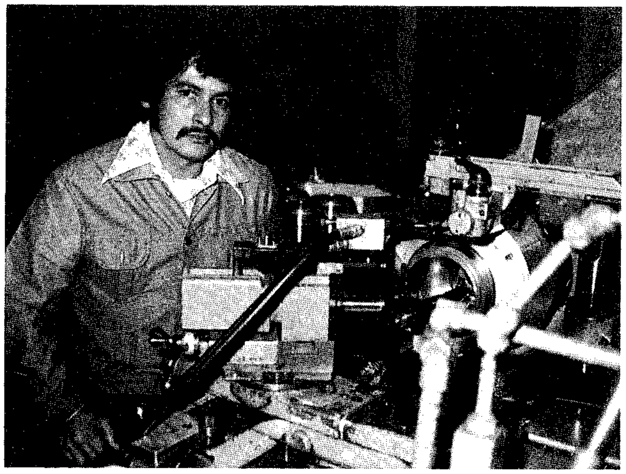


SLAC FAMILY DAY - MAY 1, 1976

Sketches by Gertrude Reagan

Photos by Joe Faust





--Photo by Bob Broeder

FELIX VARGAS: A SUCCESS STORY

Felix Vargas has completed the Mechanical Fabrication Shops Apprentice Machinist Training Program and has filled an opening for a journeyman machinist in the Test Lab machine shop.

Felix, a native of a town close to Morelia, Michoacan, Mexico, came to the Palo Alto area in 1966, and December 1968 started work at SLAC in the Labor Pool. In 1969, Roger Coombes of Experimental Group G needed help in constructing the K^0 Spectrometer, and he managed to persuade Manuel Guttierrez to lend Felix to the group for a couple of months. Felix spent that summer soldering the 80,000 wire ends of the spark chamber and helping Don Clark with the assembly of the Spectrometer. (Don sailed off to Hawaii shortly thereafter--and is still there, as far as we know.) Felix survived this soldering ordeal but never returned to the Labor Pool (sorry about that, Manuel), staying with Group G until early 1971.

Felix spent most of 1971 working with Bud Burns in the Research Division Machine shop, where he also learned welding skills. In September a vacancy occurred in the Machinist Training Program, and Felix joined up.

This program is probably unique in this area. The student spends from six months to one year in each of as many as five different machine shops around the laboratory. Each shop has its own line of work and its own line of machine tools. The student acquires a breadth of knowledge that is not available anywhere else. The four-year program includes classroom work, related math, and the ABC's of the trade. Upon completion of the course, a graduate apprentice can fill an opening at SLAC or, if he so elects, go into the outside world fully qualified as a journeyman.

Congratulations, Felix! It's a pleasure to work with you.

--Bob Broeder

HEY, THAT STICK MOVED!

Chuck Freudenthal found it on Monday beside the wheel of his Alpha Romeo in the Electronics Building parking lot. Wasn't dead, just getting out of the sun. Chuck got it into a waste basket with a stick, but it slithered right out again. Struck at that stick six times fast as lightning. So Chuck and I dumped it into a paper bag and stapled the top closed with about a million staples. Drove it gingerly in the passenger seat to the Wildlife Rescue girl in Santa Clara, who said it was more like a youngster than a baby--all eighteen inches of it. Didn't tell her about the visions of the thing squeezing between those staples and crawling up my leg in traffic. Just felt kind of good about conservation and all that when she told me that they would release the rattler up at the reservoir where people don't go.

Yes, it did my heart good, until . . . about a week and half later, last Friday to be precise, I was walking up the stairs over the BSY and onto the road on top when . . . Hey! That stick moved!

Missed it by less than a shoe width, all eighteen inches of it lyin' in the sun, tongue flicking out. It got away before I could find me a stick and a waste basket.

If anyone sees it, or any of its sisters or brothers, don't step on it. I've seen them move, and let me tell you, they move like lightning! Another problem is that baby rattlesnakes are just as poisonous as their parents, only a lot quieter because they haven't grown anything to shake yet. Be very careful and take care of yourself first. But I have the phone number of the Wildlife Rescue girl, if you want to feel good . . . .

--Ted Jenkins

The College Entrance Examination Board--which administers the Scholastic Aptitude Test (SAT) to a million high school students annually--has appointed a high level panel to investigate why students' scores on the test have been steadily slipping. . . For a decade, SAT scores have gradually declined, but last year they took a dive. In 1963, the average scores were 478 (verbal) and 502 (math); in 1975 the averages were 434 and 472, respectively. The drop in the last year alone was 10 points (verbal) and 8 points (math).

While the Board has refused to speculate publically about the cause of the decline, it has apparently become concerned about the possible significance, since the test scores are widely used by college admissions officials in judging students from different high schools.

HELP, PLEASE

Would you like to help in the fight against cancer in children? I'd like to introduce you to a promising program at the Stanford Children's Hospital. At any given time the Children's Hospital has about 30 young patients and about 400 outpatients. They need your help! Specifically, the help you can offer is some of the circulating white cells from your blood system. The Hospital has a machine that separates out these cells, which are used to confer a temporary measure of protection to some of the children during the course of their treatment (chemotherapy). This special and necessary treatment leaves the young patients without the means to ward off the simple infections that you and I can handle with little difficulty. But for those kids who are affected, the loss of their natural protection can result in serious, and even fatal, infections.

The white blood cells that fight infection are called "granulocytes." These cells have a half-life in the body of 6.7 hours, and they are replaced at a rate of about 100 billion cells each day. A normal healthy person has from 4000 to 8000 of these cells in each cubic millimeter (mm^3) of his blood and since the average person has about 5 million mm^3 of blood, the total number of circulating white cells is about 30 billion. There is also an approximately equal number of white cells that stick to the inner walls of the blood vessels, and that are available if needed. Thus each of us on the average has about 60 billion white cells ready to fight infection.

What is needed from each donor is only 1.5 billion cells, or 5% of the circulating population. Once collected these cells are given to the patient as a single treatment. Many such treatments are usually necessary for a patient, and each requires a matched donor. It is not uncommon for a patient to require 5 or more treatments with cells supplied by an equal number of donors. These donated cells are rapidly replaced in the donor's body; in fact, by the time the donor leaves the medical unit his white cell count is usually back to normal, or even slightly elevated.

I have to point out that there are a couple of problems! The first problem is that it takes about 4 hours of your time to made a white-cell donation. The machine pumps the blood from a vein in one arm and returns it to another vein. The granulocytes are removed from the flowing blood stream inside the machine. All other constituents of the blood are returned intact. During the donation you are free to read, sleep, watch TV, catch up on your technical journals, or even write.

The other major problem is that only about one person in five who volunteers turns out to be a suitable donor. Since the Hospital needs a donor pool of about 200 persons to insure an adequate supply of white cells, a total volunteer group of about 1000 persons must be available from which the 200 can be selected. The medical staff encourages each suitable donor to donate his white cells only twice each year, in order to minimize the inconvenience to these persons.

At any one time there are about 1500 people at SLAC, including visitors. If only 1/3 or so of this large population would volunteer, this would go a very long way toward assuring that these children would get the white blood cells they so desperately need to stay alive and healthy during their cancer therapy. In most cases the therapy is their only hope for survival, and for some the chemotherapy treatment itself is a very serious danger. Your white blood cells could literally help save a young life!

Volunteers are given a thorough physical examination and a complete blood analysis (which will be made available to your personal physician if you wish). One possible benefit that donors derive, although it is not yet a proven fact, is connected with high serum cholesterol levels. There is some evidence that a certain amount of cholesterol is removed from the blood along with the white cells. The reduction in cholesterol level is probably a temporary effect, but is at least beneficial for a brief period.

If you are interested in helping out in this tremendously important cause, please call the following number:

White Cell Unit
Stanford Children's Hospital
327-4800 ext 282

The people there will treat you very well, and you will be giving a gift of life to a young child in serious need.

--Don Busick

IT'S EASY TO LET GOOD INTENTIONS SLIP AWAY. WHY NOT TEAR OFF THE CORNER OF THIS SHEET RIGHT NOW AND CARRY IT OVER TO THE PHONE WITH YOU? CALL:

WHITE CELL UNIT

STANFORD CHILDREN'S HOSPITAL

327-4800

EXT. 282

MEMBERS OF THE BOARD

With this article we offer a glimpse into the little-known world of the SLAC PBX operators.

The concerto for switchboard begins at the console each weekday morning at 7:30 AM. It rises to a crescendo by about 10:30 AM, sustains that level until 2:30 PM, then gradually diminishes to its 6:00 finale. During these hours 170 to 180 outgoing calls may be placed, and an average of 900 to 1000 calls are received. A typical day may bring calls to or from France, Italy, Brazil, Switzerland, Germany, England, Sweden and Japan--as well as Canada and Mexico.

It is not unusual for an incoming call to go as follows:

"Operator, I'm looking for a man named Joe. I don't have a last name. Can you help me?"

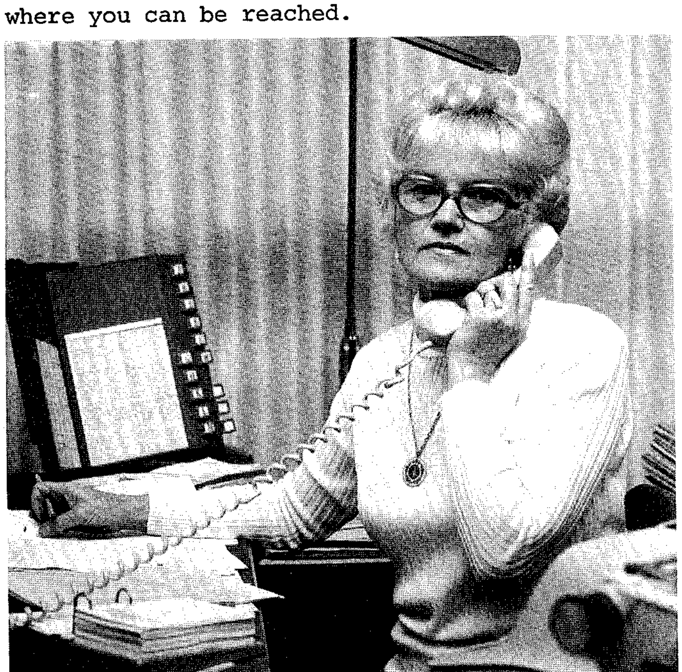
"Operator, there is a visiting physicist from France whose first name is Jean. I met him at the ____________ Conference last year but forgot his last name. Can you help me?"

Then, too, when someone calls in to SLAC he may hear something that sounds like, "Good morning, Celery Center." But don't hang up--you haven't reached Joe Carcione. It's just a busy operator abbreviating "Accelerator Center"!

The SLAC operators offer the following suggestions and comments for a smoother phone operation:

1. Don't leave your phone off the hook.

2. If you place a long-distance call and then find that you have to leave your office before the call is completed, please leave word where you can be reached.



This is SLAC PBX Operator-Supervisor Mary Ann Blackman. *(Photo by Joe Faust.)*

SLAC PBX Operators Johnnie Clarkston (left) and Nada Comstock. *(Photo by Joe Faust.)*

3. When you want to transfer a call to another extension at SLAC, momentarily hold down the release button. This puts an automatic flash on the board, and it saves you the trouble of going to another line to ask the operator to transfer the call. But be patient, please. The operators are often very busy.

4. Try to place Canadian calls before 1:30 PM so that the special FTS system can be used.

5. If at times you wonder why your long-distance call is being delayed, it may be due to busy circuits, the person called not being located, the extension called being busy, a large volume of calls being handled, or last-minute Eastern calls.

Since most SLAC people are familiar with the operators' voices but not the operators themselves, here are some thumbnail sketches of our operators.

PBX Operator-Supervisor Mary Ann Blackman's SLAC career goes all the way back to 1962. She came to the Peninsula from Oakland and began working for the construction firm, Aetron-Blume-Atkinson, that SLAC hired to help build the laboratory. She then began work on the SLAC switchboard in 1963, when it first opened. Mary Ann likes "getting away from it all" to the high country, or to the desert--she says she would make a good "desert rat." Her hobbies include fishing, swimming and gardening, and, most of all, NOT talking on the phone after working hours.

Nada Comstock came to this area from the Thousand Islands region of New York. She worked at the Bank of America in Sunnyvale before joining the SLAC staff in 1969. Nada has a

(Continued)

long list of recreational activities which include bowling in the SLAC league, boating, water skiing, dancing, sewing and gardening.

Johnnie Clarkston moved down to the Peninsula from San Francisco in 1961. She had previously been working with the Mars Metal Corporation, but in 1970 she decided to cast her fate with SLAC. Johnnie's list of recreational activities fits into the pattern of the other SLAC PBX operators: hunting, fishing, gardening, plus a yen to travel.

A fourth, part-time operator is Ann Boesenberg, whose husband Bob is a long-time member of the Klystron Group at SLAC. Ann has been a substitute operator for the past four years, filling in for the others when they are on vacation or out with an illness.

You are invited to stick your head in the door of the PBX room in the A&E Bldg. occasionally to say hello to these efficient and hardworking women. They like to see the people they talk with once in awhile.

--Dorothy Ellison

The modern view of the crust of the earth is that at a certain considerable depth there is a vast accumulation of semi-plastic material, solid and unyielding for all ordinary purposes but yielding slowly like a fluid to long continued forces. In this magma the continents are believed to be floating, solid and stable enough to all appearance and yet liable to slow and regular movements. Some parts might rise; opposite parts might sink; this sort of slow disturbance is known to be going on. Still more extraordinary consequences are suggested as resulting from this floatation theory. For example, a great floating mass of land might break up and a part of it drift away from the rest. The shape of America looks as if it once fitted onto Africa and Europe; the idea is that it once formed part of that great continent.

--*Scientific American*
June 1924

I will allow no man to belittle my soul by making me hate him.

--Booker T. Washington

LEVY'S NINE LAWS OF THE DISILLUSIONMENT OF THE TRUE LIBERAL

1. Large numbers of things are determined, and therefore not subject to change.
2. Anticipated events never live up to expectations.
3. That segment of the community with which one has the greatest sympathy inevitably turns out to be one of the most narrow-minded and bigoted segments of the community. (Marion Stanley Kelley, Jr.'s reformulation: Last guys don't finish nice.)
4. Always pray that your opposition be wicked. In wickedness there is a strong strain toward rationality. Therefore, there is always the possibility, in theory, of handling the wicked by outthinking them.
   Corollary one: Good intentions randomize behavior.
   Subcorollary one: Good intentions are far more difficult to cope with than malicious behavior.
   Corollary two: If good intentions are combined with stupidity, it is impossible to outthink them.
5. In unanimity there is cowardice and uncritical thinking.
6. To have a sense of humor is to be a tragic figure.
7. To know thyself is the ultimate form of aggression.
8. No amount of genius can overcome a preoccupation with detail.
9. Only God can make a random selection.

--Prof. Marion J. Levy
Princeton

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