SLAC BEAM LINE

Concepts without factual content are empty;
sense data without concepts are blind.
—*Immanuel Kant*

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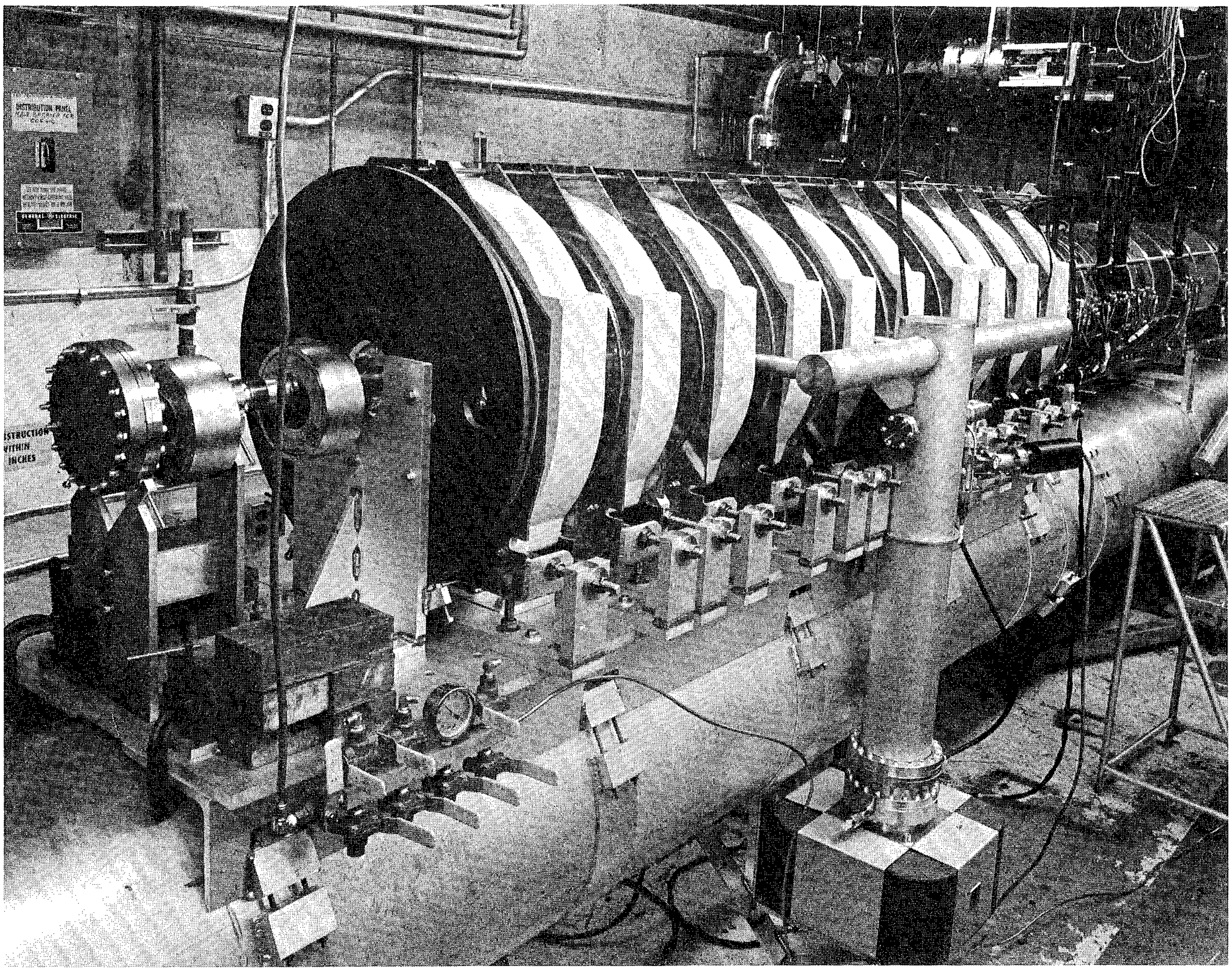


In This Issue

Note: This issue contains the text of the talk on "The State of SLAC" that was given to the staff by SLAC's Director on January 28. The talk deals with funding prospects and with some highlights of SLAC's present and future programs.

PEP REPORT: THE FIRST ONE THOUSAND

PEP is now open for business. The storage ring was completed last April and dedicated in the Fall, but there has been no official ceremony to mark the change from tuning, testing and shakedown to steady running for physics experiments.

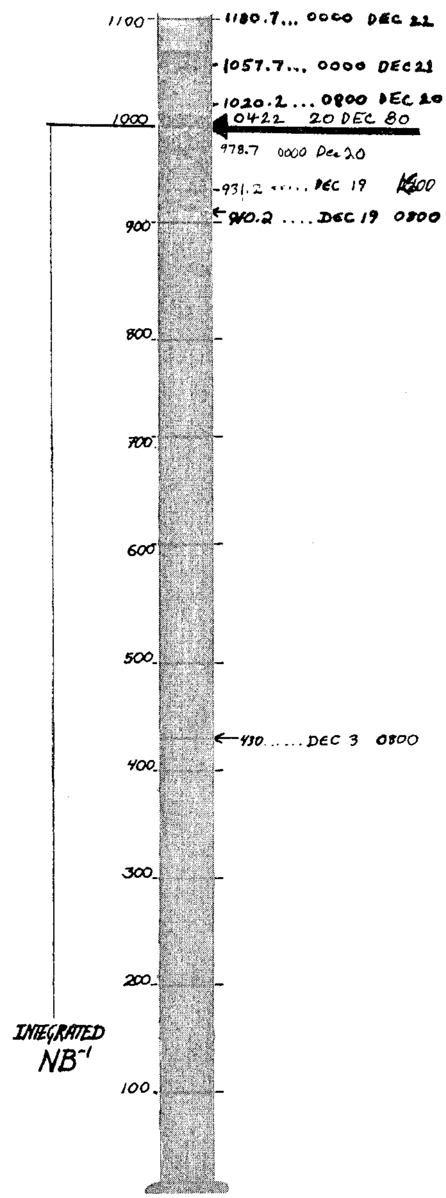
The closest thing to a landmark came in the early morning hours of December 20, when the goal of delivering the first 1000 "units" of beam to the several PEP experiments was met near the end of a two-week run. This event had been anticipated by plotting the amount of colliding-beam time on a bar graph in the PEP control room—just like dollars for United Fund. Above this graph on the PEP main console is a museum of sorts which traces the history of PEP in the form of champagne bottles with labels noting the significance of the particular occasion, such as first injection, circulating beam, etc. Between two of the bottles is a 12-ounce green plastic jar of the antacid Mylanta: apparently some victories were more difficult than others. The last bottle in the row was put up on the 20th, with the label *1000* nb^{-1} ("one thousand inverse nanobarns"). Bottle and chart, it must mean something, and one thousand of anything is a lot. But what, after all, is exciting about a nb^{-1}?

In PEP, three bunches of electrons and three of positrons circulate in opposite directions, passing through each other at six different places around the ring. Only a very small fraction of the particles actually collide with each other at each passing in those interaction areas where the experiments are located. Increasing the numbers of electrons and positrons in the stored beams, and/or reducing the size of the bunches, results in more collisions at each passing, and that is the point of the game. The job of a storage ring, then, is to make this beam-particle density as large as possible, and to keep it that way for many hours as the experiments look at what is happening in the collisions.

The rate of collisions is called luminosity, and high luminosity is the goal of a storage ring. The amount of useful physics data that can be taken is measured by multiplying the luminosity by the time the beams have been kept circulating. This integrated luminosity is measured in units of inverse nanobarns, nb^{-1}, a unit that sounds awkward enough but is quite useful in predicting the number of events that can be expected to occur in an experiment. One thousand inverse nanobarns gives hundreds of interesting events in a typical detector, and it is certainly a significant milestone for a new storage ring. PEP can now pile more on at a rate of about 100 inverse nanobarns per day, which is a quite decent performance.

The primary goal for PEP now is to produce as many inverse nanobarns as possible by the time of the summer shutdown. Mainly, this means running the machine at peak luminosity, but there will also be some shorter periods during which the machine itself will be studied. There are ideas for tuning the ring so that more electrons and positrons can be stored. There is also a scheme being studied that will allow stronger focusing of the beams where they collide. Both will result in higher luminosity but will take time to understand and apply. Meanwhile, PEP has begun its career as a fine scientific instrument with a thousand steps.

—Bill Ash



THE STATE OF SLAC

W. K. H. PANOFSKY

Note: This is the text of the talk given by SLAC's Director to the staff on January 28, 1981.

The proposed budget for Fiscal Year 1982 was submitted to the Congress by the outgoing administration about 10 days ago. Fiscal Year 1982 (FY1982) begins on October 1, 1981. As has now become customary, I would like to discuss with you the implications of this new budget on SLAC's future work. In the latter part of my talk, I will also spent some time describing how SLAC's work, both present and future, fits into the pattern of high energy physics research throughout the world.

This year it is even more necessary than in past years to emphasize that the conclusions I shall draw from the proposed FY1982 budget must be taken with a large grain of salt. The first reason for this is that the new administration has obviously not yet had time to review this budget in detail, and it would not be surprising if they proposed changes in the budget after their own plans are more firmly established. The second reason for caution concerns the Congressional review process, which includes many months of hearings before Congressional budget and appropriations committees, as well as commitees on science and technology and on energy. This process takes time—in fact, so much time that FY1982 may already be upon us before the final form of the budget is actually settled.

We faced a similar situation last year, although of course there was no change in administration at that time. After last year's submission, some Congressional committees made large changes, and there was a great deal of discussion and controversy. After all the dust had settled, however, the final budget ended up rather close to the original submittal, but there were quite a few anxious moments in between. This may or may not happen again this year.

It is my understanding that the new administration has expressed itself very sympathetically to the value of the kind of fundamental research in which this laboratory is engaged, and both the outgoing and incoming administrations have publicly acknowledged that support of this basic research is the responsibility of the Federal Government. Whatever attitude one has about the relative roles of the public and private sectors in supporting research and development, one cannot expect that private industry will significantly support the kind of research, such as that at SLAC, whose payoff on the quality of our lives will not be felt until many decades hence.

1. THE PROPOSED BUDGET FOR FY1982

So much for the preamble. Figure 1 shows the proposed budget for SLAC that is included in the former President's FY1982 submittal for our sponsoring agency, the Department of Energy. The figure also includes the actual funding levels for FY1981, for comparison. As you know, SLAC's funding comes in several different "colors" of money. First, there is the annual operations funding, which covers support of all our ongoing activities with the exception of capital additions to our basic instruments and facilities. These capital items are provided for in three different categories: Capital Equipment not related to construction, Accelerator Improvement Projects (AIP), and General Plant Projects (GPP). Capital Equipment funds are further broken down into those supporting SLAC needs in general and those specifically earmarked for PEP. In addition, in this and the previous year, SLAC is also

Figure 1

SLAC COMPARATIVE FY1981 AND FY1982 BUDGETS

(Dollars in Thousands)

	FY1981 DOE Budget	FY1982 President's Budget
OPERATIONS	56,750	67,000
EQUIPMENT	6,850	6,900
Gen. purpose	*3,000*	*3,500*
PEP[1]	*3,850*	*3,400*
CONSTRUCTION	3,000	4,200
AIP	*1,200*	*1,600*
GPP	*1,000*	*1,100*
PE&D	*800*	*1,500* [2]
TOTAL BUDGET	66,600	78,100
FY1981 BUDGET IN FY1982 DOLLARS:	74,493	

[1]*PEP Equipment funding shown above excludes $3.0 million in FY1981 and $3.3 million in FY1982 assigned to other institutions.*

[2]*Amount requested for FY1982.*

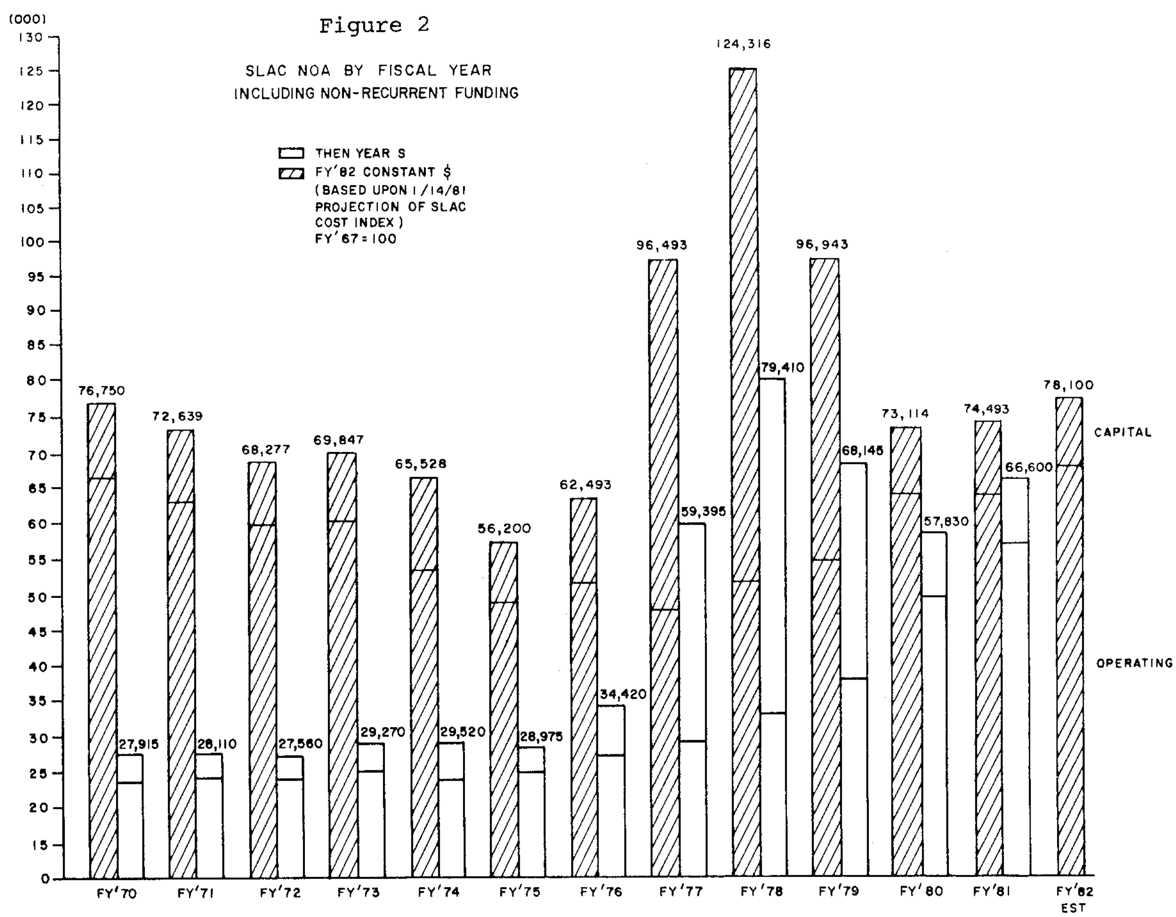
receiving PE&D (Preliminary Engineering and Design) funds. This is money earmarked for advancing design and improving cost estimates for the SLAC Linear Collider (SLC), prior to authorization of construction.

SLAC's long-term funding picture is illustrated in Figure 2, which shows our total resources since FY1970 both corrected and not corrected for the effects of inflation. In making the inflation correction, we have assumed that the average cost of goods, services and salaries for SLAC would increase by 11.2% from FY1981 to FY1982. This figure is of course uncertain, but represents our best estimate.

I would like to make a few observations about the funding pattern shown in Figure 2. First, funding for the construction of the PEP storage ring facility was responsible for the large peak in total funding that is shown for the period FY1977-FY1979. This funding peak did not in itself contribute a great deal to the funds available to pay SLAC people or to provide goods and services for general SLAC use; the reason, of course, is that most of these construction funds were used to pay outside contractors.

The second observation is that, even if we ignore the PEP construction peak, there has still been a small, gradual increase in SLAC's funding during the past few years, as compared with the steady decline that began in the late 1960's. This recent increase was mainly needed to support the PEP operations and equipment programs. Since PEP has now been in steady operation for some time, there is no reason to believe that for other than inflationary reasons PEP operating cost will increase further. Therefore any changes beyond FY1981 will reflect actual changes in program. As you all know only too well, we are operating under an extremely tight budget during the present year. One result of this has been that the linear accelerator itself operates at only a fraction of its potential: we are delivering only about 1/4 of the number of electron pulses that the machine could produce. We have also had to skimp on needed maintenance work at SLAC, and we have informed our physics users that End Station A operations will be suspended during the current fiscal year.

Figure 2



TOTAL SLAC FUNDING, INCLUDING NON-RECURRENT FUNDING EXPRESSED IN BOTH THEN-YEAR AND CONSTANT-FY1982 DOLLARS, AND WITH THE DIVISIONS BETWEEN OPERATING AND CAPITAL FUNDS SHOWN.

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Part of this austerity is a necessity owing to tight funding, and part is a matter of choice. We have decided, in the interests of the future of SLAC and of high energy physics in general, that we must devote a very substantial effort toward developing new devices and instruments that will be used many years from now. The lead time involved in developing, designing and building such things is so long that, unless we plan far ahead, we will not have modern facilities later on. More about this in a moment.

In looking at these budget figures, you will see that the funds for FY1982, as provided for in the proposed budget, but subject to possible future change, do represent a modest but significant increase in funds for operations and also in some of the remaining capital funds. On the other hand, the proposed FY1982 budget does not contain funds for beginning the construction of of the SLAC Linear Collider, which I described to you in outline last year. This is disappointing but not unforeseen. To compensate for this lack of full authorization for the SLC, we have decided to intensify our efforts in research and development on this important new project. Our R&D program has two main purposes: (1) to answer some of the difficult technical questions that have been raised about whether the SLC is too adventuresome a project to be authorized for construction now, and (2) to avoid loss of lead time in the project.

We have given a great deal of thought to the optimum balance between the development effort on the SLC and our ongoing operations and research programs. Since the additional funds for next year are expected to be relatively small once the effects of inflation are taken into account, the work on the SLC has to be carried out at least partially at the expense of our ongoing programs, and we must also largely make use of the same people who are now engaged in the laboratory's regular activities. During FY1981 we devoted about 7% of our operating funds to SLC-related research and development work. For FY 1982 we expect to increase the SLC work to a little more than 10% of our total operating funding. In addition, a substantial fraction of our capital funds will dedicated to the SLC.

All of this implies that during the next fiscal year (provided of course that the proposed FY1982 budget is not significantly modified) the total staff level of SLAC will stay about the same, or perhaps will increase by a few people. I would like to emphasize again that this forecast does not preclude some, hopefully minor, dislocations among different categories of skills. For instance, next year, relative to last year, we'll have less occasion to build large detectors in our shops. We have now accumulated an enormous scientific potential in terms of the recently built detectors for PEP and the new Mark III detector for SPEAR. The time has come to knuckle down and exploit the detectors we now have. On the other hand, the development work on the SLC will result in some major loads on our shops because new instruments, magnets and klystron components, among many other items, need to built in support of the SLC work.

Since our overall staff level will probably remain about constant, this implies both positive and negative consequences. On the positive side it implies stability: there are no prospects, again assuming that the proposed budget stays intact, for any significant reductions in force. On the negative side, what is "stability" to one person may be "lack of mobility" to another. In other words, since the total staff will not change significantly, and since the turnover rate of SLAC personnel continues to be unusually low (about 10% annually), there will not be very many new hires into the laboratory. The number will probably be about 120, with a corresponding number of terminations for reasons of retirement or personal choice. We will make a strong effort to have this limited hiring activity serve both to strengthen the technical power of the laboratory and at the same time to increase the complement of minorities and women who are participating in our work. However, because this total turnover represents such a small fraction of our staff, the actual change in staff composition that will occur is expected to be quite small.

2. SLAC PROGRAM HIGHLIGHTS

Let me turn now to some of the highlights of our present and future programs. Currently, three of the major detectors at PEP (Mark II, MAC and DELCO) are fully operational and are taking data during the present PEP running cycle. The smaller Free Quark Search (FQS) experiment is also in full operation at this time. PEP will stop running in June and start up again in the fall, and by that time the High Resolution Spectrometer (HRS) facility is expected to be ready to begin its experimental work. In addition, work is progressing on the Two Gamma and Time Projection Chamber (TPC) facilities, and these should be ready for full data-taking operation sometime during the next fiscal year. Thus the full arsenal of major PEP detectors will be in place by next year, and we are looking forward eagerly to having their enormous experimental potential bear fruit in terms of important physics results.

We also expect that the new Mark III detector, which is now being assembled at SPEAR, will be fully operational this fall. This means that SPEAR will again have two major detectors operating, the Crystal Ball and Mark III. The energy region accessible to SPEAR continues to be very rich in terms of important physics, and the work of the Crystal Ball during the past year has amply reaffirmed this. It is therefore gratifying that during the next fiscal year both interaction regions at SPEAR will again be occupied by powerful instruments.

We are planning to continue to share the use of SPEAR with the Stanford Synchrotron Radiation Laboratory (SSRL) on the same basis as before. One-half of the running time of SPEAR will be used in single-beam operation fully dedicated to SSRL experimentation. During the other half of the time, SPEAR will run in the colliding-beam mode for high-energy physics work, with the SSRL experimenters taking data parasitically. SSRL continues to be an extraordinarally productive enterprise, and the shared operation of SPEAR has greatly increased the opportunities available to that laboratory. At the same time, since the cost of supporting SPEAR is shared between SSRL and SLAC, this has liberated funds that have been badly needed for other parts of our own program.

During the present year, the powerful LASS facility has resumed data-taking and has logged literally tens of millions of events. The work of LASS will provide definitive data on some of the fundamental interactions of the so-called K mesons with ordinary nuclear matter. During the next fiscal year, LASS will not operate for a large amount of time, since most of the time will be required to analyze the huge amount of data that has been accumulated. Also, the SLAC Hybrid Bubble Chamber facility has been operating this year in a laser backscattered gamma-ray beam, and these runs have been extremely successful. Some of this work is expected to continue into the next fiscal year.

There is also a new class of experiment that is currently being installed and tested which will be ready for data-taking next year. This is a so-called "beam dump" experiment. When an intense beam of high-energy electrons strikes a target, certain classes of new particles whose existence is predicted might be produced, and these new particles may penetrate the entire thickness of earth that encircles the back of the target area behind End Station A. A detector weighing about 20 tons is being installed on the embankment near PEP Interaction Region 2 to register such particles. Like the quark-search experiment I mentioned before, this is one of the "long-shot" experiments in which SLAC is engaged. In general, we try to balance our program between such "long shots" and "sure things," where the experiments serve to exploit phenomena that are already known to exist.

At this time we are not quite sure whether experimentation in End Station A itself will resume next year. As I noted earlier, under financial pressure we suspended End Station A operations last year. The final decision on whether to reactivate End Station A will depend upon what new experimental proposals may be accepted, and upon the financial outlook of the laboratory once the proposed budget has jumped a few more hurdles.

3. THE SLAC LINEAR COLLIDER PROGRAM

The above discussion gives you a rough outline of our planned operations. It is not much different in character from what you are all familiar with, with the exception that we will be doing more data-taking and less apparatus building in the immediate future. Let me now turn to the work on the SLAC Linear Collider (SLC) program.

Figure 3 is a schematic layout of the SLC. I would like to repeat here the main reasons why we are extremely anxious to go forward with this new project. Electron-positron storage rings, toward the creation of which you have all contributed so much, have proved to be enormously productive tools in high energy physics research. We have built SPEAR and PEP here at SLAC; CESR is operating at Cornell; DORIS and PETRA are operating at the DESY laboratory in Germany; and several smaller rings are running elsewhere. In addition, the largest of them all, a machine called LEP, is now getting started at CERN in Switzerland. The final decision to build LEP has not yet been taken, but the conceptual design is complete, geological studies are in progress, and plans for experimentation are already beginning to be formulated. The LEP machine will be about 30 kilometers (18 miles) in circumference and will tunnel under some of the mountains near Geneva. However, the LEP project will probably be the end of the road for the electron-positron storage-ring technique, primarily because the cost of such machines increases with the square of the collision energy. Better ways must be found if we are to go economically to still higher energies.

As I discussed with you last year, one way to push this energy frontier further is to replace storage rings with what are called single-pass colliders. In such machines, electrons and positrons are produced and accelerated, are brought into collision only once, and are then thrown away. If everything else here is equal, then this seemingly wasteful process cannot be competitive with storage-ring devices if the collisions occur only relatively infrequently (say 10 to 100 times per second). If, however, the particle density during collisions is made to be extremely high by focusing such beams into "needles" of a tiny diameter (a small fraction of the diameter of a human hair), then the reaction rate can become respectable. Thus the plan is to accelerate electrons and positrons in concentrated bunches in the SLAC 2-mile linac, then guide the electrons and positrons separately into collision at a single point near the east boundary of our site. A new interaction region near that boundary will be built to accomodate two detectors that can be placed alternately into the beam.

This new project has two objectives. First, it will make possible collisions at energies up to about 100 GeV—essentially as high an energy as that accessible to LEP, but at very much lower cost. At these energies, physics is expected to be extraordinarily rich. This is the energy region at which two of the fundamental interactions (the electromagnetic interaction and the so-called weak interaction which drives ordinary radioactivity) become of comparable strength. It is also the energy region in which the

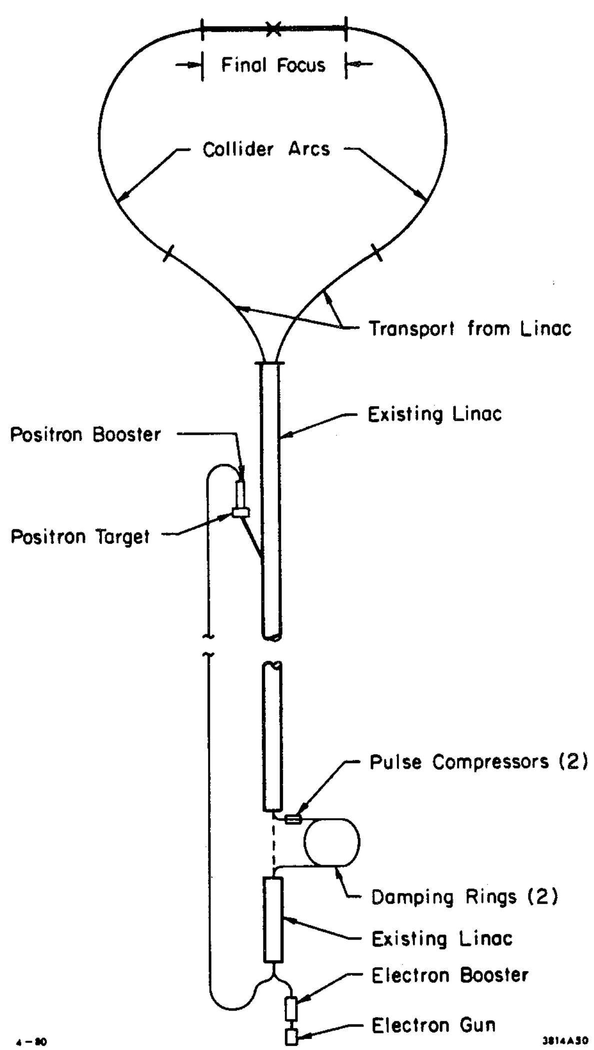


Figure 3. **General layout of the SLAC Linear Collider.**

neutral "carrier" of the weak interaction, the Z^0 intermediate boson, is expected to make its appearance unless there is something terribly wrong with our present theoretical picture. If the SLC performs according to prediction, more than one million events from these new particles can be logged per year.

The second objective of the SLC project is at least equally important, both to the future of SLAC and to the future of high energy physics research throughout the world. This is the role of the SLC as a pioneering program to demonstrate the feasibility of this new class of colliders, and to examine some of its detailed properties. Thus, should the SLC program go forward and be operated successfully, we are looking forward not only to vital experimentation at 100 GeV collision energies but also to the possibility of single-pass devices that could reach collision energies much higher than are conceptually feasible by the now well-established storage-ring technique.

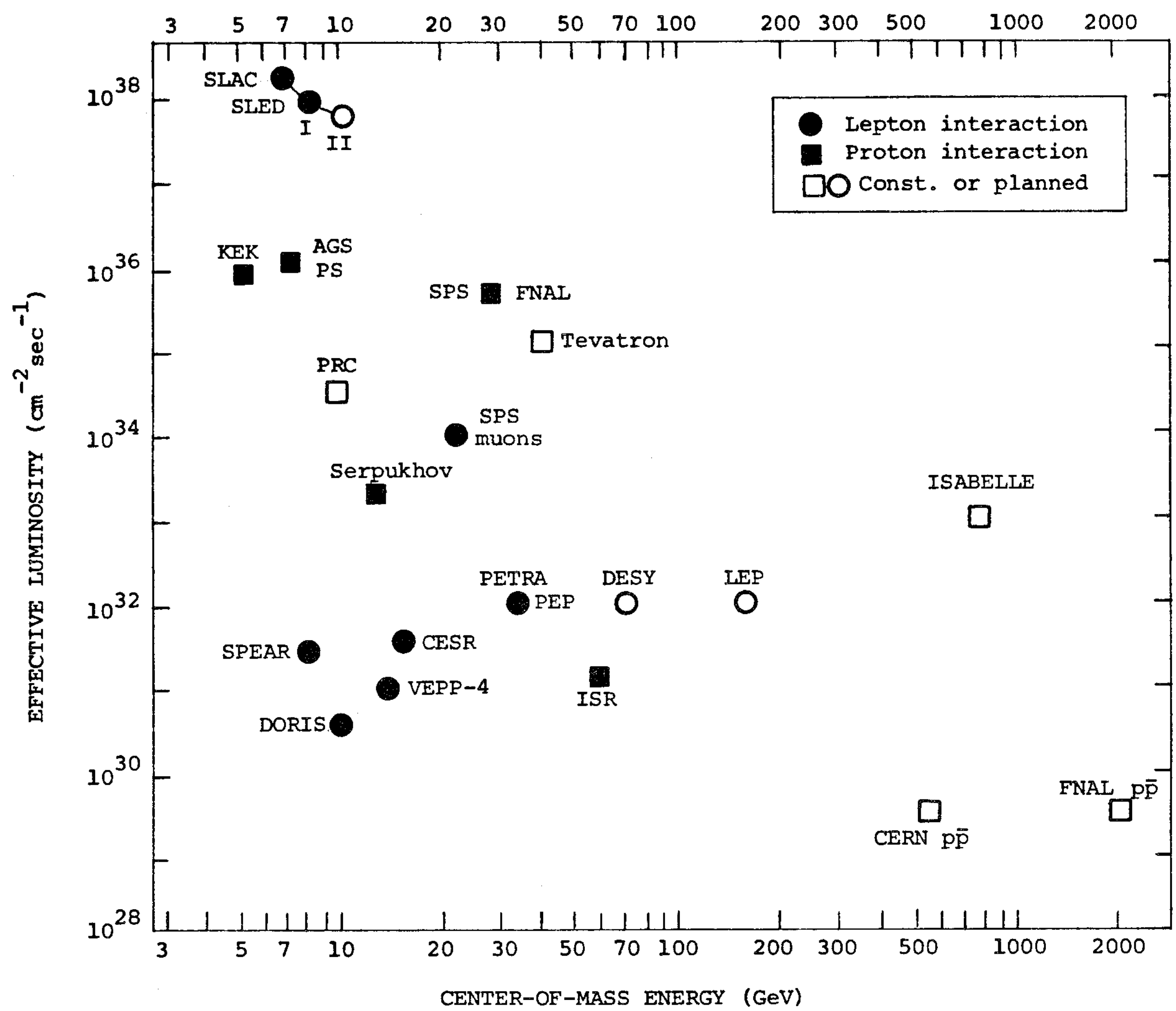
For these reasons, we are now proceeding intensively with development of the SLC technique. We have just completed installation of a new front end in the SLAC linac, including modification of the first 300 feet of the machine, which constitutes the injection end of the SLC. We are also planning to convert the instrumentation of approximately the first one-third of the 2-mile accelerator to make it meet SLC standards. During the coming year, an architectural-engineering firm will be hired to produce the final drawings for the the new tunnels and housing for the machine, and we are also going to do a large amount of engineering development on the other SLC components. All of this is designed to give us a flying start for FY1983 authorization, but it is too early yet to tell whether such authorization can actually be obtained in the prevailing financial climate.

4. SLAC'S ROLE IN HIGH ENERGY PHYSICS RESEARCH

This is a difficult year to talk about the future of high energy physics. In many respects the field is in excellent shape. There has been a steady stream of important new results, and there is a greatly increased understanding of the forces of nature and of the constituents of matter. In particular, the advance in theory for which the Nobel Prize was awarded last year to three theorists appears to unify our concepts of the working of two of the forces in nature, the electromagnetic and weak interactions, and possibly also the third, which is the strong force that holds the components of the nucleus together. In turn, this theory leads to experimentally testable predictions, some of which should be accessible in the next region of energy, and some of which can be put to the test by such esoteric experiments as looking for the possible instability of the proton, which was formerly thought to be a totally stable building block of matter. However, to move ahead on these necessary next steps is a complex undertaking which has given rise to many critical discussions as to "what to do" in both the US and abroad.

Figure 4 is a chart that shows the main characteristics of the largest accelerators and storage rings in the world. Among electron accelerators, you can see that SLAC, as before, continues to lead in terms of both energy and potential data rate ("effective luminosity") for experiments. At the same time, proton machines continue to provide the highest energies for both accelerators and storage rings. For the range of energies now at the frontier, there is no question that colliding-beam devices extend the only hope of reaching higher collision energies, and we hope that CERN will soon demonstrate the feasibility of proton-antiproton collisions as tools for experiments, perhaps late this year. As I discussed earlier, CERN is also planning to push the limit of attainable energies by the now conventional electron-positron storage-ring technique, the same principle employed for PEP.

On our side of the ocean, one of the next big steps is the upgrading of the Fermilab accelerator by adding a ring of superconducting magnets than can eventually reach 1000 GeV to the



Effective luminosity vs. center-of-mass energy for the largest accelerators and storage rings now operating, in construction or planned. For accelerators, the target is assumed to be one meter of liquid hydrogen, except in the case of "SPS muons," where 50 meters of LH_2 is assumed.

Figure 4

already existing main ring, which with conventional magnets has reached 500 GeV and operates routinely at 400 GeV. Construction has also started at Brookhaven on the ambitious ISABELLE project, in which it is planned to bring two circulating beams of 400 GeV protons into collision, and where each of the circulating beams is guided by a ring of superconducting magnets.

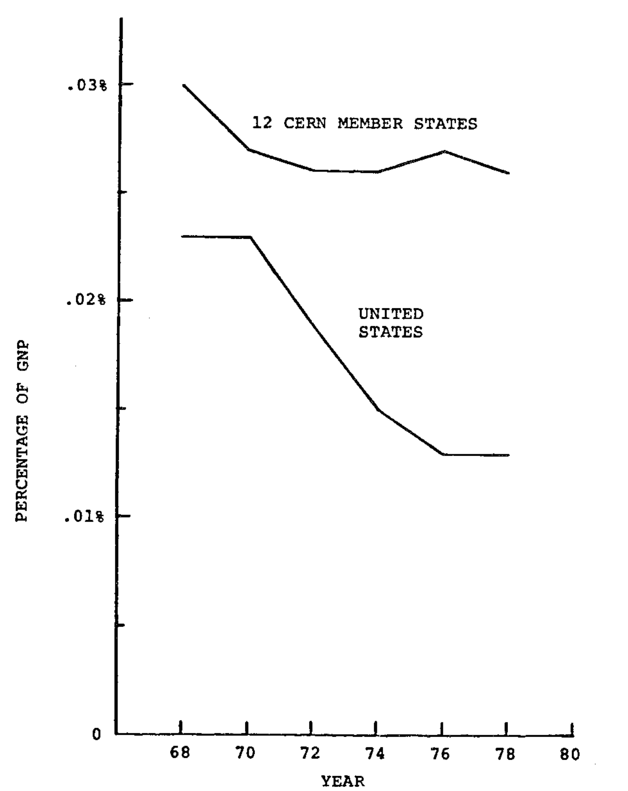
At the same time, the Soviet Union has a plan to build a very large proton accelerator to reach as much as 3000 GeV using superconducting magnets, and they have made good progress in building models of the necessary magnets. In short, high energy physics remains an aggressive enterprise all over the world, and we continue to remain encouraged about the steady stream of both expected and unexpected new results.

This optimistic assessment notwithstanding, there are concerns both in Europe and in the US about the precise directions the enterprise should follow in the future. The Europeans have been technically conservative in the sense that they have not embarked upon the large-scale use of superconducting magnets, but instead have used conventional technology. On the other hand, they have pushed these more conventional techniques to such high limits that their program is now very costly. This in itself has not been a major impediment, since the financial resources the Europeans have been willing to dedicate to high energy physics research have been about twice the amount we have been spending in the United States. This is shown in Figure 5, which indicates the fraction of Gross National Product (GNP) spent on high energy physics in Western Europe in comparison with that spent in the US. However, economic problems are also beginning to appear in Europe, and there is serious concern there that the new, very large construction projects for high energy physics might adversely affect the ongoing research programs of the existing installations. There are about 1800 European experimentalists active in high energy physics, as compared to about 1100 Americans. Thus the experimenters in Europe are concerned about the comparatively few interaction areas that will be available in the distant future at the big storage rings, and some of them are already eyeing possible opportunities in the US for their future experiments. This could potentially aggravate even further the competition for the total amount of running time and accessible facilities that will be available at American accelerators. As I noted earlier, under financial pressures SLAC has already reduced substantially the number of electron pulses we can deliver to our users each year, and the situation is quite similar at Fermilab and at Brookhaven.

On the US side, the new projects that use superconducting magnets are being pursued vigorously, but they are proving to be more difficult technologically than the proponents had originally foreseen. Fermilab seems to have overcome most, if not all, of its problems in building a large superconducting ring, but there is still a long way to go, and costs have been substantially larger than anticipated, thus impacting their own program as well as those of the other laboratories. Brookhaven is having problems with their basic magnet design, and this raises the prospect of delays and possible cost increases. Thus the community of high energy physicists is finding their future research opportunities somewhat unpredictable, and this in turn breeds a certain amount of conservatism into our planning if one wishes to add other new adventuresome projects to the arsenal of instruments.

Quite apart from the as yet uncertain budget actions of the new Administration and the Congress, it is basically for this reason that the exact time and schedule for the possible construction of the Linear Collider is so hard to predict.

Yet innovate we must. The whole progress of this field has been nurtured by a succession of new inventions. As any one invention has run



Total cost of high energy physics as a percentage of GNP in Western Europe and in the United States.

Figure 5

out of steam, a new one has followed, and it is the result of all these inventions that has led high energy physics to the succession of spectaculár discoveries about the nature of matter that you have heard about. Figure 6 traces the history of these innovations. As you can see from this figure, high energy physics remains one of the most dynamic enterprises in all of science and technology, and you can be justly proud of having played a very large role in making it so.

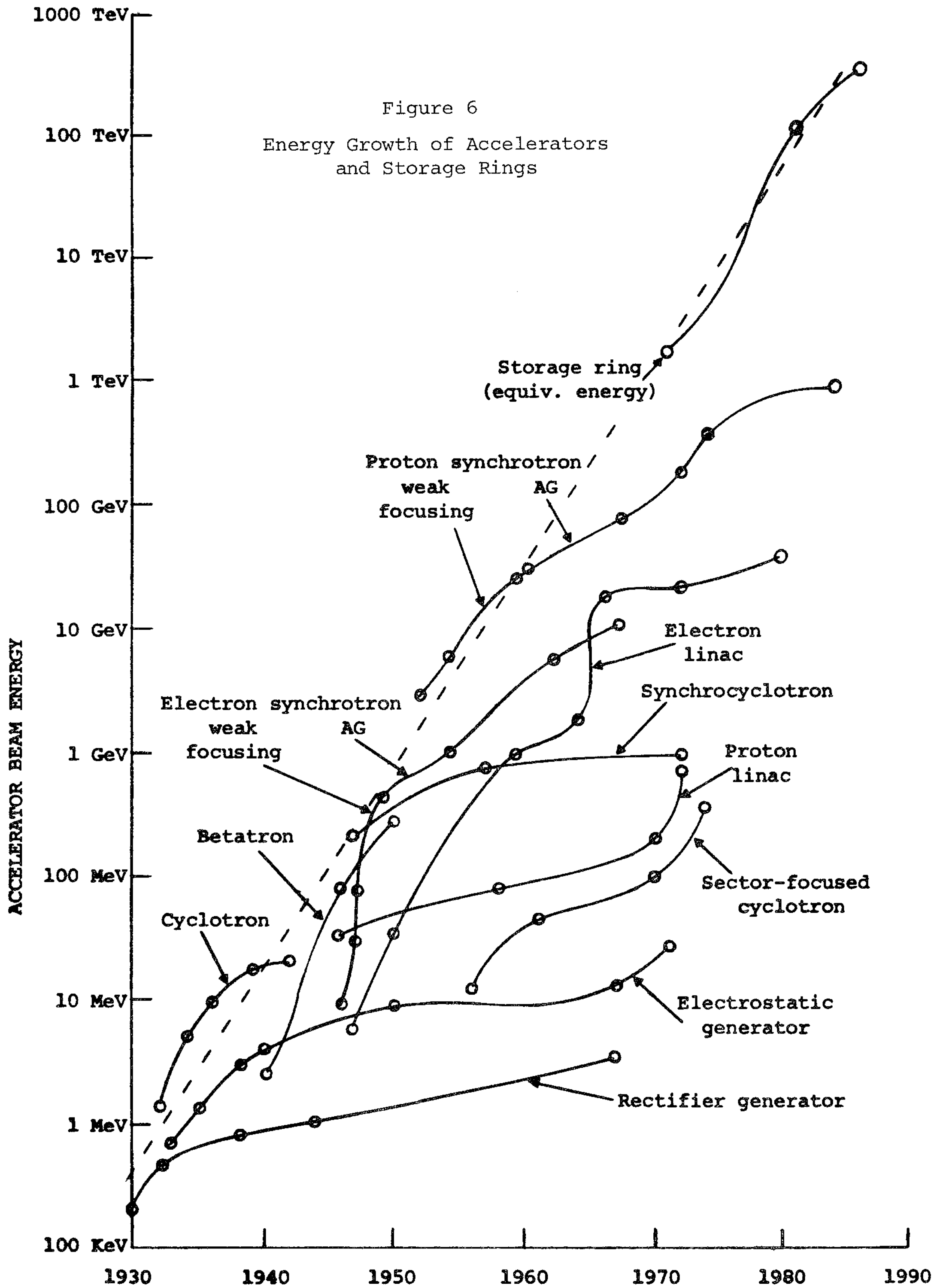


Figure 6

Energy Growth of Accelerators and Storage Rings

STORAGE RING BLUES

(A tribute, in uncertain meter and rhyme,
To the problems of large storage-ring design.)

There are three vicious demons, an ugly crew,
Who are called Eta, Beta, and Delta Nu.

Beta's too big, Delta Nu is too small,
And Eta shouldn't matter at all,
But it does, you see, and all three conspire
To keep luminosity from going much higher.

With PEP's sister, PETRA, things are the same.
The ugly triumvirate's a mutual bane.

John Rees, PEP's aedile, not one to scare,
Has traced these three to their very lair.

When the beams cross, they disrupt one another.
Push it too hard and they never recover.
Delta Nu is the number whose value is set
By the size of the current when this limit is met.
There are hundreds of billions of charges, of course,
And they push on each other with non-linear force.
So no one can figure how big it will be.
You must build the machine before you can see.
Delta Nu, it was hoped, would be point 0 six,
But it's just point 0 two, and there isn't a fix.
As Nature would have it, this factor is paired,
So the luminosity is down by about three squared.

Next we have Beta, from whose value is found
How hard we can focus without losing ground.
The more it decreases, the harder we squeeze.
We's like to make it as small as we please.
But make it small here and it gets bigger there,
So this must be done with very great care.
At present, in PEP, Beta's higher by two
From where it should be when tuning is through.

Momentum changes are very small things,
But distort the orbits in all storage rings.
If Eta is zero, the effect goes away,
And this is the case in all rings today.
A little distortion, though not understood,
Might just, after all, do PEP some good.

These three factors have made a serious dent:
Luminosity is down to just four percent
Of the value for L that everyone felt
Scaling from small rings, like SPEAR, should have spelt.
Playing with Beta and Eta may bring
A doubling or trebling to this storage ring.
But even without this, there is no distress,
For the goal is a guide, not a measure of success.

And PETRA and PEP are running okay,
And nothing is standing in either's way
Of doing the job they set out to do,
Not Eta, not Beta, and not Delta Nu.

—Bill Ash

Cover photo: This photograph shows the subharmonic buncher region of a new injector being constructed at SLAC for studies of the generation and acceleration of single electron bunches of large charge (about 5×10^{10} electrons per bunch). A recently developed high-current photoemission electron gun will be mounted on the vacuum flange shown at the left side of the photo. The beam from this gun will pass through the two small solenoid lenses and then enter a region two 178.5 MHz subharmonic buncher cavities and drift spaces, all contained within the ten large (white) coils shown. After this subharmonic bunching, the beam will then enter a standard SLAC injector section, consisting of an S-band buncher followed by a 3-meter section of linear accelerator. This latter structure is also contained within a solenoidal field, the coils of which can be seen at the right side of the photo. The entire complex of photoemission gun, subharmonic buncher, and injector linac section is currently in the final stages of assembly, and is scheduled for initial injection studies in March. It is anticipated that this system will generate about 5×10^{10} electrons in a single S-band bunch of about 30 picoseconds width, at an energy of 40 MeV, for subsequent acceleration in the main linac. This work is a part of the development program for the SLAC Linear Collider (SLC) project. (Photo by Joe Faust.)

—Charlie Sinclair

The question I would like to raise tonight is whether Congress can deal with the economy and formulate a budget. I address this question amid widespread dissatisfaction with the economy, with economists, with Congress, and with government in general. As a nation, we are luxuriating in a massive national gripe session in which everyone is enjoying telling everyone else that nothing works and that no one is competent, especially those whose misfortune it is to lead the national government. There is general agreement that we need stronger political leaders, smarter advisors, a better class of international enemies, and more predictable volcanoes. . . .

—From "Congress and the Economy," by Alice M. Rivlin, Director of the Congressional Budget Office

The year that Rutherford died (1938) there disappeared forever the happy days of free scientific work which gave us such delight in our youth. Science has lost her freedom. Science has become a productive force. She has become rich but she has become enslaved and part of her is veiled in secrecy. I do not know whether Rutherford would continue to joke and laugh as he used to.

—Peter Kapitsa

[From *The Harvest of a Quiet Eye*, a selection of scientific quotations by Alan L. Mackay.]

Acknowledgment: The unattributed cartoon called "Detectors" that appeared in the previous issue of the *Beam Line* was actually drawn by Per Dahl of Brookhaven. It originally appeared, along with three other Dahl drawings, in the "Proceedings of the 1978 ISABELLE Summer Study" (BNL 50885). Our thanks to Peter Yamin of Brookhaven for supplying this information.

FREMONT-SLAC VANPOOL?

An existing Fremont-SLAC carpool would like to expand to a vanpool. About 6 to 10 more people would be required to form a vanpool. For information, please phone Jim Wahl at SLAC ext. 2001.

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