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)

Volume 5, Number 6 *December 1974*

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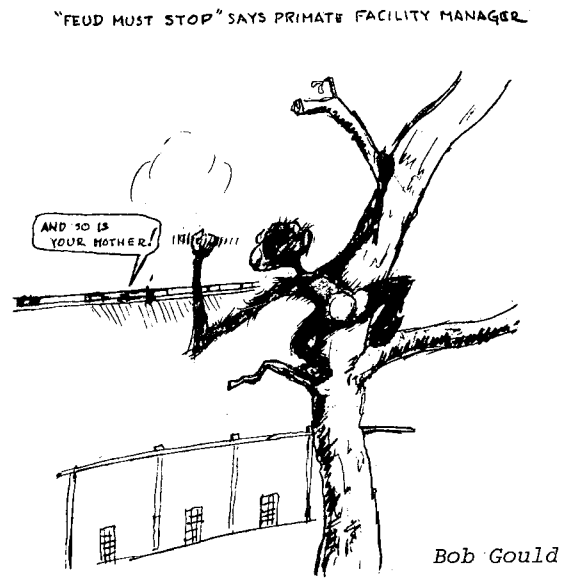
FROM THE EDITOR

Since this regular issue of the *Beam Line* comes hard on the heels of the recent special issue on the new particle discoveries, it gives us a chance to catch up on some people news and to sprinkle in a little technical information in our usual format. We will doubtless have more to say about the new psi particles in the January issue. Already the SLAC Library has started to receive the first of what will assuredly become a flood of preprints of scientific papers that attempt to explain, suggest, extrapolate, predict, etcetera, etcetera, the significance of the new discoveries. There has also already been a special meeting of SLAC's Program Advisory Committee, at which a half dozen proposals for non-SPEAR psi experiments were presented, and one was accepted. This experiment, a collaboration among physicists from the University of Wisconsin, SLAC's Experimental Group F, and the Spectrometer Facilities Group at SLAC, will search for the psi resonances by using a high-energy photon beam with the large magnetic spectrometers in End Station A.

We'd like to take a short paragraph here to give a special vote of thanks to Bob Gould of SLAC's Plant Engineering Dept., whose cartoons have graced several issues, including this one, of the *Beam Line*. We were pleased to learn recently that our opinion of the pith and humor of his work is apparently shared by others: a copy of his TV watcher from the special psi-particle issue (". . . *and it is termed the most exciting event since the discovery of the omega minus*") is now posted prominently in the news room of the *New York Times*. So score one for the home team, and we hope that there will be many more.

--Bill Kirk



Bob Gould

NO MONKEYING WITH THE CHIMPS!

Both the hairy and the not so hairy primates at the Primate Facility would appreciate it if SLAC people would resist the temptation to bug the chimpanzees. The problem is that people driving along the Klystron Gallery road sometimes shout or make other noises in order to attract the chimps' attention, and the chimps sometimes respond by sending off a fast (and very accurate) rock in the direction of the noise. However, they *always* respond by getting upset, which doesn't help the scientific study very much. The idea, you may remember, was to try to learn something about the behavior of chimpanzees in a *natural* environment--which at least in Africa rarely includes a running feud with screaming humanoids or honking pick-up trucks. So what do you say, people? Let's let the chimps have a little peace and quiet. OK?

". . . The reaction to the news was spirited and immediate. Within seven days after the official announcement of the find, at least three other experimental groups in Europe and the U.S. had confirmed the existence of the particle, and four theoretical groups had submitted papers detailing their interpretations of it to Physical Review Letters. . . ."

--*Newsweek*, December 2, 1974

ERDA

As most SLAC people have heard, our present sponsoring government agency, the Atomic Energy Commission, is scheduled to become a part of the Energy Research and Development Administration (ERDA) on February 8, 1975. The authorizing legislation for the creation of ERDA provides that

> *All of the functions, authorities and resources of the Atomic Energy Commission, except the AEC's licensing, regulatory and related environment and safety functions, will be transferred to ERDA. These transferred functions include nuclear materials, production, reactor development, military applications, physical research, biomedical and environmental research, controlled thermonuclear research, nonnuclear energy R&D, and other nonregulatory functions.*

The basic idea of ERDA is to consolidate under one agency the full range of federal energy research and development activities. Thus portions of the R&D work of the Interior Dept., the National Science Foundation, and the Environmental Protection Agency will also be transferred to ERDA, along with the AEC activities just noted. Thus ERDA will play the central role in planning, coordinating, and managing the R&D effort for all energy sources and for all technology of energy use.

ERDA will he headed by an Administrator, a Deputy Administrator, and six Assistant Administrators, with each of the latter responsible for one of ERDA's six major program areas:

1. Fossil energy
2. Nuclear energy
3. Environment and safety
4. Conservation
5. Solar, geothermal & advanced energy systems
6. National security

So far, only the Administrator has been named. He is Mr. Robert Seamans, who was formerly the Deputy Administrator of NASA. The other positions will likely be filled within the next month or so.

What Effect On SLAC?

All indications are that the changeover from AEC sponsorship to ERDA sponsorship will occur smoothly and with a minimum of confusion. Most of the AEC personnel we've been dealing with for years will be continuing their work with ERDA. SLAC's basic research activities will not be affected (we fit under *physical research* in the list of transferred functions above).

Elementary-particle physicists are often asked how their research relates to practical applications--to the energy R&D that is now ERDA's responsibility, for example. There is no simple answer to that question. Obviously the recent discovery of the Psi(3105) and (3695) particles doesn't have much to do with gasifying coal. But the other side of that coin is the longer-term argument, either historical:

> *Anyone who expects a source of power from transformations of these atoms is talking moonshine.*
> --Lord Rutherford (1933)

or else speculation about some physics of the future. For the last 300 years each deeper understanding of nature has had striking practical consequences. And it may (or may not) again. Perhaps the best argument for the "relevance" of particle physics is the historical argumented inverted: *If* striking practical consequences are coming they are almost certain to flow from a deeper understanding of nature.

But now we're going to stop talking "relevance" and possible "payoffs" with the final remark that we'll know the answer, at least as far as SLAC is concerned, in another 5 or 10, or 10 or 20, or 20 or 50, approximately, years.

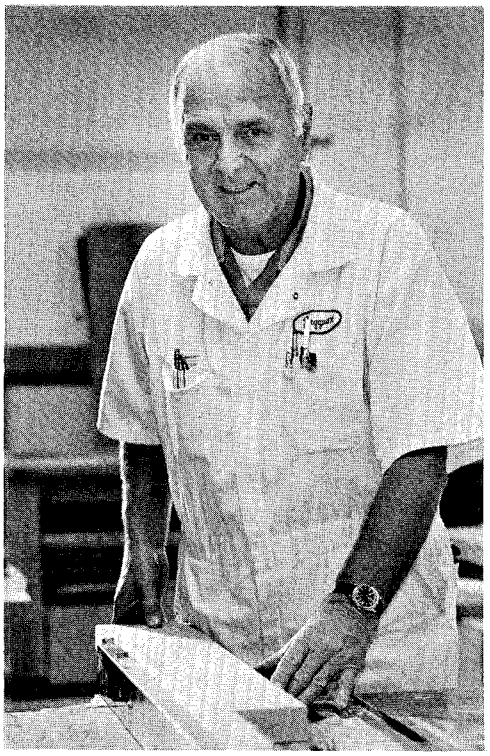
To summarize, SLAC has been and will continue to be an important part of the long-term research effort sponsored by our government's Energy agency. The transition from AEC to ERDA will have no large or immediate effect upon us. To consolidate energy R&D in the way the ERDA creation has done seems a good thing. Starting with a new sign at the front gate and some new letterheads of various kinds, we expect to adapt quickly to ERDA's ways. It should work out just fine.

SLAC'S SAFETY RECORD

Each year since 1967 there has been a gradual decline in the number of reported injuries at SLAC. This fine record has been achieved through the dedicated and cooperative efforts of all laboratory personnel in carrying out the SLAC policy of maintaining safe and healthful working conditions.

An interesting aspect of the reported injury experience at SLAC is that injury-producing accidents have not in general resulted from any unusual conditions such as sources of high energy or certain construction situations. Our experience has been that injuries at SLAC have been typical of those encountered with common equipment in the usual industrial situation.

--Fred Peregoy



SID BERGQUAM TO RETIRE

One of SLAC's outstanding craftsman, Sid Bergquam of the Carpentry Shop, will soon be retiring after more than 10 years of service. Sid was born in Grafton, North Dakota, and was educated in the Grafton schools and at the University of North Dakota, where he obtained a B.A. degree in Social Science and in Physical Education. During the late 1930's, Sid worked in retail sales work and as a County Welfare agent in his home state.

Sid was in the Army during the Second World War. As a member of the 34th Infantry Division from 1941 to 1945, he attained a rating of 1st Sergeant and participated in several of the South Pacific campaigns during the war. Afterward, he tried his hand at real estate work in Milwaukee, then eventually came to California and began work as a carpenter in Redwood City in 1948.

In connection with his forthcoming retirement, Sid was recently interviewed by *Beam Line* reporter Herb Weidner about his work at SLAC and some of his future plans. Here are parts of that interview:

Herb: So you're retiring after 10 years at SLAC.

Sid: Ten years last June. Before that I was a carpenter in the Bay Area for 17 years. For years I worked on jobs from start to finish, but they started to specialize, so I got out. I thought SLAC would be better for me.

Herb: Did it work out that way?

Sid: Yes, very much so. I've enjoyed it here. The work is a lot easier than on the outside. It's more varied--you do different things all the time.

Herb: Have you worked on things you'll remember?

Sid: I worked mostly out of the carpentry shop. I've done almost everything from remodeling the A&E Building three times to a lot of crating when SLAC was shipping things out.

Herb: Has it been mostly inside work?

Sid: No, mostly outside. I like that--better than working in the shop. I spent quite a time on the packaging for that [accelerator] section we sent to Holland. We changed this and changed that. It went by plane; it had to be just so. Cliff Rasmussen went along with it. It was a real interesting job. I enjoyed it. It got there in A-1 condition.

Herb: Are you going to stay in this area?

Sid: Yes. I have a house in this area. My wife and I intend to go places. Like now, we just got back from Mesa, Arizona.

Herb: I've got a note here that you went to the University of North Dakota.

Sid: Yes. I finished there in 1937. At that time you couldn't buy a job.

Herb: Your degree was in Physical Education. Did you specialize in any sport?

Sid: Well, all of them. Everything from ice hockey to baseball. But I had to take a job in a grocery store for about 6 months, then I went to work for the County in Social Welfare. That was interesting. Then, in 1940, I went into the service. I was in for over 5 years, most of the time in the South Pacific. I was on a baseball team for 9 months out there. We played in small towns in Australia for good will. After the war I came out here and decided to go to work as a carpenter. I've been here ever since.

Sid's many friends at SLAC wish him all the best in the years ahead. We'll miss his fine work and the cheerful, easy-going style that has made him so well liked here.

--Don Ewings & Herb Weidner

NOTARY PUBLIC

Al Ashley of Personnel has recently become a Notary Public. If you want to have something notarized, Al will be happy to provide this service at no charge. His phone number is SLAC Ext. 2355.

Photo by Joe Faust

MEL RAY LEAVING STANFORD

Mel Ray, Associate Director of Production Services of the Stanford Center for Information Processing (SCIP) and for seven years associated with computing services at SLAC, left Stanford on December 4 for a new position with RayChem Corporation in Menlo Park. In his new post Mel will be the Director of RayChem's Data Center.

During his seven-year career at Stanford, Mel has been Operations Manager for the Stanford Computation Center at SLAC, Assistant Facility Director at SLAC, and Associate Director of Production Services with SCIP, the latter a position which has brought him into contact with the entire University community. In Mel's words, "SCIP, we think, is one of the few, if not the only, organizations that spans all aspects of the University--the Medical Center, SLAC, the University itself."

In his new position he will be director of operations, as well as of systems development and programming, for the computing facility of RayChem Corporation, a multi-national corporation with activities in 30 states and 22 foreign countries. RayChem is a high-technology corporation with considerable activity in the communications industry and with recent applications of specialized polymers to such diverse uses as protective sealants for the Alaska pipe-line.

The Data Center, which he will direct, is intended to collect and compile data about the company's varied activities in the United States and abroad. The Center presently uses a Burroughs B-4700 computer and is currently installing a B-6700 (to be completed by Christmas) in a new computer facility building. The Menlo Park offices of RayChem serve as its World Operations Headquarters, and the Data Center will be its central computing facility.

Mel came to SLAC almost exactly seven years ago as Operations Manager of the interim IBM 360/75 facility. One of his first organizational activities was to establish the basic classes and schedules of service (Class E for express, B for tape-oriented jobs, M-N-L for production work). This structure has been expanded but remains almost intact at the present time.

In the late summer of 1968, Mel directed the installation of the IBM 360/91 computer which replaced the 360/75. The installation was in a temporary building which tended to leak in the winter rains and over-heat in the summer. As Mel recalls, "We felt that we were putting $10,000,000 worth of computer into a $100,000 pup tent." Ironically, now that Mel is leaving, SLAC is finally constructing a new Computation Building which he won't have a chance to enjoy, even though he played a key role in its design.

SCIP was formed in April of 1973, and in his position as Associate Director of Production Services for SCIP Mel also directed and planned for the coming of the two new IBM 370/168 computers which together with the 360/91 form the present "triplex" system at SLAC. "A 370/168 alone is a complex situation," Mel commented, "but connecting two of them together with the 91 was something that had not, to the best of our knowledge, been done before." Setting up the triplex system had to be done with a minimum of down time for the SLAC community. "We planned for 55 hours of down time, and I think we came up with 53," Mel points out. "To schedule it that closely was an event that all of us who participated are very proud of. There was terrific support from IBM, and the SCIP operations staff at SLAC did an outstanding job."

In his position with SCIP, Mel interacted with and assumed responsibility for the operations problems of the entire Stanford computer community: "When you look at the kind of business I'm in, I'm not aware of any place in the country where there's the wide spectrum of challenges that you find at Stanford. I had the opportunity to deal with almost every kind of user. In almost every area, the users were pressing the state of the art. And that provided some enormous challenges in a business where you're trying to manage a predictable, reliable service."

Through his association with SLAC, Mel participated in the AESOP program (Atomic Energy Systems Operations and Programming). He served first as Speaker, Session Chairman, Program Chairman, then as Executive Council Member. Shortly before his decision to leave Stanford, he was nominated as Chairman of the Executive Council. This association and its achievements he remembers as one of the special opportunities "in working for a place like SLAC."

We'll all miss Mel at SLAC, and we wish him well in his new post.

--Bill Johnson

RECENT ADVANCES IN PARTICLE PHYSICS

The following article was written by Professor Leon Van Hove of the European Center for Nuclear Physics (CERN) in Geneva, Switzerland. It is reprinted here from the October 1974 issue of the CERN COURIER.

Very important results in high energy physics in the last three to four years have profoundly affected our conception of even such basic notions as the internal structure of the proton and neutron, two of the three particles out of which ordinary matter is composed. Our knowledge of the electron, the third of these particles, is much more advanced and has changed little in recents years.

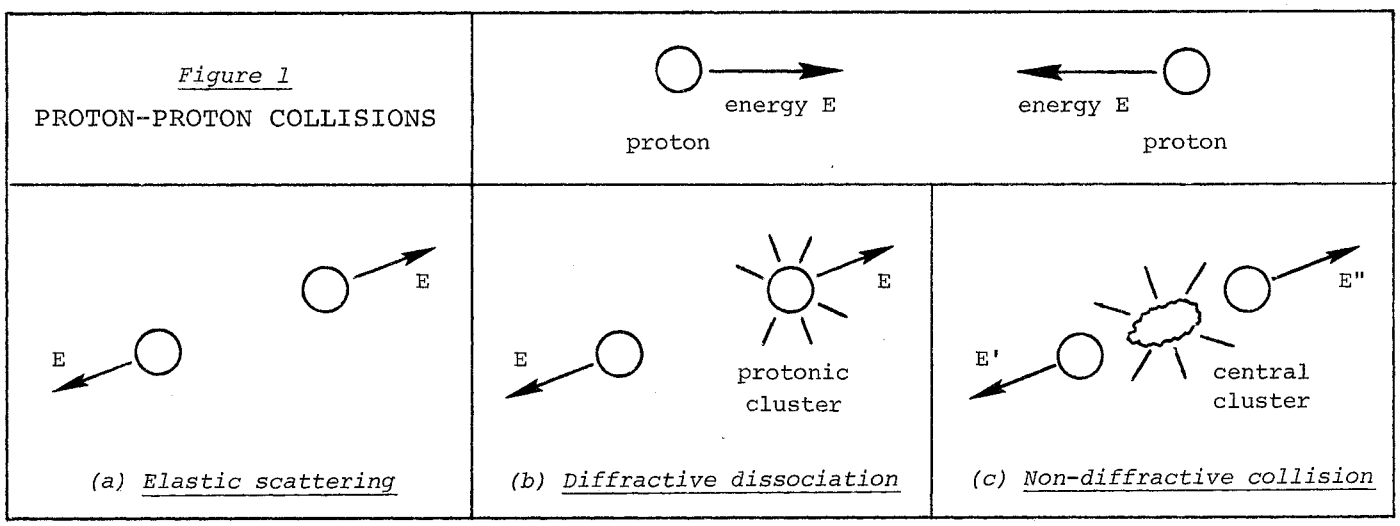
I will attempt to sketch what we have learned from recent experiments carried out on proton-proton collisions (at the Intersecting Storage Rings of CERN and at the American 400 GeV synchrotron at the Fermi National Accelerator Laboratory), on neutrino-proton and neutrino-neutron collisions (mainly Gargamelle heavy liquid bubble chamber experiments at CERN), and on electron-proton and electron-neutron collisions (mainly at the 20 GeV electron accelerator at the Stanford Linear Accelerator Center). It is remarkable that a rather unified picture of proton and neutron structure begins to emerge from all these experiments and, although many aspects are still beyond our understanding, this picture reveals some form of basic simplicity.

Classes Of Proton-Proton Collisions At High Energies

In a proton-proton collision, two protons fly towards each other and interact by the strong interaction, after which one of various things can happen [see Figure 1]. In the simplest case of *elastic scattering*, just two protons fly out after the collision and they have the same energy, E, as the incident protons. In all other cases (inelastic collisions) new particles are created.

At the very high energies available at the Intersecting Storage Rings (ISR) and at the FermiLab, these inelastic collisions reveal striking properties which were not clearly recognizable at lower energies and which lend themselves to simple phenomenological interpretation. The inelastic collisions neatly separate into two main classes. In the first class, called *diffractive dissociation*, either of the two incident protons gets excited into an object composed of a few particles; this group or cluster of particles is usually composed of a nucleon (proton or neutron) and of a few mesons all flying roughly in the same general direction and carrying in total about the amount E. The other proton flies out alone in the opposite direction also carrying about the energy E.

In the second and main class of inelastic collisions, called *non-diffractive*, the protons come out in opposite directions, excited or not, and with strongly reduced amounts of energy, E' and E", which are on average about equal to about half of the energy E of the incident protons. In addition, a considerable number of other particles, mostly mesons of lower energy, come out. They show quite remarkable correlations which suggest that they somehow come out in clusters of threa to four mesons each, and there is evidence that the clusters are frequently neutral (the total



electric charge of a cluster is frequently zero). These clusters, the average number of which may itself be around three or four per collision, are called "central clusters" in order to distinguish them from the "protonic clusters" which occur when one of the incident protons gets excited in a diffractive collision.

Electron-Nucleon And Neutrino-Nucleon Collisions

By studying collisions of high energy electrons on nucleons we can obtain information on the distribution of electric charge within the nucleon. Similarly, collisions of high energy neutrinos on nucleons give information on the distribution inside the nucleon of what can be called the "weak charge" (a quantity controlling how the weak interaction acts on the nucleon, just as the electric charge controls how the electromagnetic interaction, that is, the electric and magnetic forces, act on the nucleon).

Recent electron experiments at SLAC and neutrino experiments with the Gargamelle bubble chamber at CERN have concentrated on deep inelastic collisions, meaning collisions where the nucleon gets very heavily excited. In such collisions, we can measure the texture of the distribution of charges inside the nucleon at short distances (in space-time).

The results of the experiments are quite remarkable. In a first approximation, it appears that the electric and weak charges of the nucleon are concentrated on three small grains. These grains have a radius which is at most about one-tenth of the nucleon radius. Their charges and spin appear to have the same values as those of the celebrated *quarks*. These are the conceptual building blocks of nucleons, mesons, etc., which were postulated in 1964 as a very simple but amazingly successful model for the classification of all hadrons (of all particles which partake in the strong interaction).

The resulting picture of deep inelastic electron and neutrino collisions on nucleons is shown in Figures 2 and 3. In both cases, one and only one quark is hit in the collision, and by its recoil it heavily excites the nucleon. It does not escape, however (this is the big mystery about quarks), and the excited nucleon separates into many particles. We believe these to be in general a nucleon and many mesons, but the very important experimental

Figure 2

INELASTIC ELECTRON-NUCLEON COLLISIONS

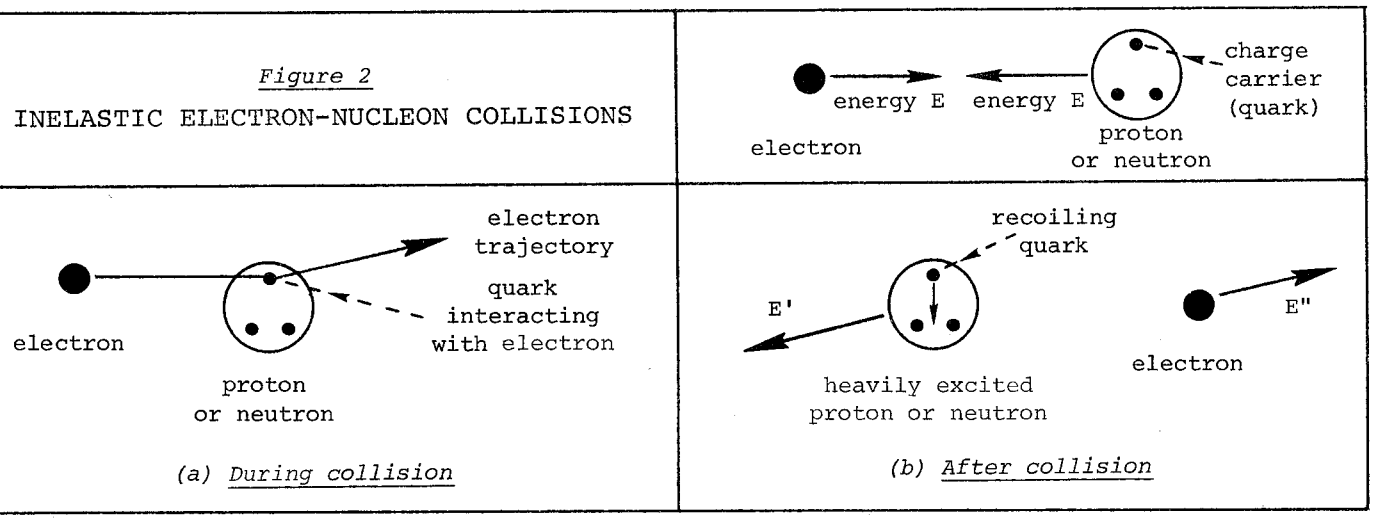
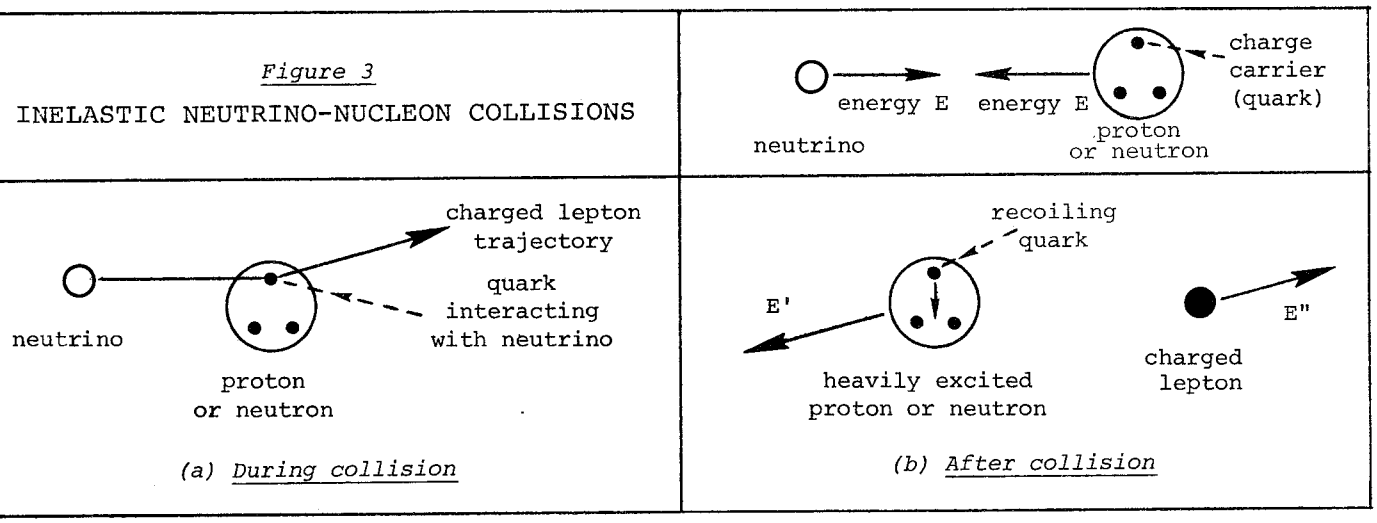


Figure 3

INELASTIC NEUTRINO-NUCLEON COLLISIONS



question of what they are and how they share the recoil energy has hardly been investigated up to now.

In the neutrino case, the collision converts the neutrino into another particle, which is an electrically charged lepton--electron, positron, negative or positive muon--depending on the nature of the incident neutrino. This is the normal case. As is by now well known, good evidence for an abnormal type of neutrino collision has been found in the Gargamelle experiment and, more recently, at the FermiLab and at Argonne National Laboratory [both near Chicago]. In these abnormal collisions, the neutrino does not convert into a charged lepton. It is believed (though not checked experimentally) that it remains a neutrino. In the physicist's terminology, normal neutrino collisions are said to be of the "charged current" type, while the abnormal ones are of the "neutral current" type. The experimental findings about the neutrino collisions of neutral current type, coupled with important developments in quantum field theory, have raised lively hopes for a possible theoretical unification of the electromagnetic and weak interactions. It should be stressed, however, that the discovery of the new type of neutrino interaction is of great scientific importance in itself, irrespective of what its final theoretical interpretation turns out to be.

Nuclear "Glue"

To return to the consequences of the SLAC and CERN experiments for the internal structure of the proton and neutron--not only did they show that the charges are concentrated mainly on three small grains, which can be identified with quarks, but their detailed interpretation leads to a determination of the fraction, x, of the nucleon energy, E, which is carried by a single quark. This quantity is found to have an interesting distribution with a mean value of about 1/6, so that the energy fraction carried by the three quarks is about 1/2 (three times 1/6). This result, which came as a surprise, means that the nucleon contains more than the three quarks, and that the additional stuff which carries the remaining half of the energy must be essentially neutral (without electric or weak charges). The name of "glue" is often used for this additional stuff because it is believed to be associated with the very strong field which would be responsible for binding or "gluing" the quarks together inside the nucleon.

Electron-Positron Annihilation

The surprisingly large amount of glue as neutral component inside the nucleon is probably related to the fact that the quarks are very strongly bound within the nucleon--so strongly that all attempts to extract them have failed so far. It is therefore unlikely that quarks could be similar to ordinary particles. A further and very striking result in this direction has come out of the research program of electron-positron storage rings (Frascati, Cambridge and SLAC). At the higher energies, the cross-section [probability] for annihilation of an electron and a positron with production of strongly interacting particles, mainly mesons, takes values that are much larger than what is calculated if quarks are treated as charged particles without strong interactions. Here also the very strong binding forces which prevent quarks from getting away from each other must deeply affect the physical situation. In these annihilation experiments, as well as in the deep inelastic scattering experiments mentioned earlier, one can look forward with the greatest interest to the detailed study of the multiparticle system coming out of the process.

More About Proton-Proton Collisions

It is natural to ask whether the recently discovered internal structure properties of the proton and neutron have anything to do with the processes taking place when high energy nucleons collide with each other. The answer seems to be positive in the sense that interesting, though still speculative, connections can be established for the main non-diffractive class of inelastic proton-proton collisions. The other classes are then automatically linked also to the structure properties since they can be regarded as "shadow" effects.

In its simplest form, the picture is the following. In a non-diffractive proton-proton collision, the quarks of each incident proton fly through with their own fraction of the incident energy, and they give rise to the outgoing protons (excited or not). The glue contained in the incident protons converts into the central clusters, where it then decays into the particles finally observed (mostly mesons). There are two attractive features of this picture. Firstly, the property of the glue being neutral is reflected in the fact that the total charge of the central clusters seems to be dominantly zero. Secondly, the property that the quarks inside a proton of high energy, E, carry on average about half of its energy is reflected in the fact that the protonic energies, E' and E", are on average about 1/2 of E.

Large Tranverse Momentum Processes

Another phenomenon discovered at the ISR is that, as we go to higher energies, proton-proton collisions produce a small but rapidly increasing number of high energy particles flying off sideways. ("Sideways" means that these particles fly off in directions very different from the direction of flight of the incident protons.) This so-called *large*

transverse momentum phenomenon is one of the most interesting presently under study.

Two types of explanation have been proposed. The phenomenon could result from occasional processes where quarks of the two incident protons collide with each other, or perhaps are interchanged with each other, producing a strong sideways deflection (the latter property could result naturally from the small size of the quarks). Alternatively, the phenomenon could result from occasional production of an exceptionally massive cluster, the decay of which would naturally give rise to energetic particles flying off sideways. Careful study of the large transverse momentum process may well become an important source of progress for better understanding of internal proton structure.

--L. Van Hove, CERN

RATES FOR BLUE CROSS & KAISER HEALTH PLANS TO INCREASE

The rates for both Blue Cross and Kaiser health plans have been increased, starting with the December payroll, for coverage as of January 1. The Kaiser rate increase is 15.3%, and the Blue Cross increase is 16.2%. The United Medical Clinics Plan and the Major medical rates were not changed.

Since Stanford's policy is to contribute the cost of insuring employees under the least expensive base plan, the United Medical Clinics' plan at $19.21 per month (for employee coverage) now becomes the new base. Stanford also contributes an additional $10 per month toward the cost of insuring employees or their dependents. Thus the total Stanford contribution will now be $29.31 per month.

Health Plan	Kaiser	Clinic	Blue Cross	Major Medical
Employee	0	0	0	0
+1 Dependent	13.37	8.78	22.97	5.00
+2 Dependents	31.98	21.84	22.99	5.00
+3 or more	31.98	24.48	22.99	5.00

The rate information given above applies to regular employees who work 75% time or more and are eligible for the Stanford contribution to their health insurance. Major Medical rates are $7.00 per month for dependents who are not covered by a Stanford base plan.

Employees may enroll in one of the plans or change from one plan to another during open enrollment periods. The next such period is from April 10 to May 10, 1975, for coverage starting on June 1, 1975.

--Bernie Lighthouse

ED SHARNEE TO RETIRE

Ed Sharnee has been the head of SLAC's mail room for the last 9 years. As with many places at SLAC, there have been many changes in the mail room since Ed began his work there. People have come and gone, moving on to other kinds of work. Because of budget limitations during recent years, Ed has had to make do with a smaller staff to handle the work load. But through it all Ed has carried on in usual cheerful and reliable way, and somehow the mail has always managed to get through.

When Ed first came to SLAC, he wasn't exactly new to the mail game--he had been in the U.S. Postal Service in Milwaukee for 38 years. During those days his hobby (you'll never guess) was stamp collecting. But apparently that was a little too much of a good thing, because Ed eventually gave away his extensive stamp collection. Before going into the Postal Service, Ed had considered becoming a furrier, which seems a pretty logical profession for Milwaukee, but he changed his mind after he learned of some of the health hazards that are associated with the constant handling of furs.

Ed is planning an active retirement. He and his wife, Gert, enjoy travel. In fact, during the last year or so they have on tours to both the Hawaiian Islands and to the Mediterranean area. They also plan visits with their two married children, and between times they can probably be found catching up on their golf or perhaps just puttering around the house and garden.

Whatever is happening, we know Ed will go after it with his usual energy and enthusiasm. We hope Ed will enjoy his retirement to the fullest. We'll certainly miss him here at SLAC.

--Herb Weidner

PHOTOGRAPHS

Beginning in December, Health Physics will be taking pictures for the new wallet dosimeters (TLD). We will also be taking pictures for the new SLAC Picture Book at the same time. All of this will happen at the Health Physics office in the Electronics Building. Groups and individuals will be notified by letter as to the scheduled date and time. If there are conflicts, individual arrangements can be made by phoning Health Physics at

Extension 2345

The first round of picture-taking will include only those people who are on the SLAC payroll. Visitors will be scheduled at a later time.

We plan to distribute the new wallet TLD's by January 7, 1975, although a more realistic date might be January 22. In any case, the old TLD will be good until January 31.

--Don Busick

THE SWISS RABIES CAPER

This, to the best of my recollection, is how it all began that day in Switzerland. It seems that my wife, Judy, had to go to the supermarket, and she took the kids with her. As is typical of supermarket complexes in Switzerland, there were two stores, with a sort of mall between them, and in that mall on this particular day there was a dog whose leash had been tied to a post. Since dogs are not allowed in stores, it is a common practice to leave them tied up outside.

Our little kids were about 4 and 2 at that time. The boy likes dogs quite a bit, so he went up to the tied-up dog, but the dog snapped at him and bit a hunk of skin out of his hand. Since Judy didn't know whose dog it was, or whether it might have rabies or some such thing, she waited for awhile as people came out of the supermarket. Finally a lady emerged, went to the dog, and untied the leash. Judy went up to the lady and told her what had happened. She explained that she was worried about rabies and asked if the dog had been vaccinated against this disease.

No answer. The lady just turned away and said nothing. Judy said that she wasn't trying to cause any harm to the dog, and she certainly wasn't thinking about suing or any such thing; she just wanted to know about the dog's rabies shots, if any. Still no answer, so when the lady then started to walk away, Judy took hold of the dog's leash. There ensued a tug-of-war, with Judy pulling the leash and the lady pulling the dog. Then the dog's collar popped off, which left Judy holding the leash and empty collar while the woman made a dash for her shopping cart, dog under arm, and started to beat a fast retreat, the cart wobbling along in front of her.

By this time a crowd has started to gather. Trotting after the lady, Judy (who knows the Swiss very well) gets an idea. She grabs one of the grocery bags from the shopping cart, which instantly stops the lady's retreat, and soon the tugging and hauling splits the bag and spills the beans. Furious, the lady grabs Judy's coat and with a quick wrench tears it off her back. A nice new winter coat, all wool, and the lady rips it right off.

The crowd is now quite a bit larger. Judy hollers for someone to call the police, which someone does. The police move Judy and the lady into opposite neutral corners and write down names and opposite versions of what happened. They seem to conclude that it was the lady's fault, and that it could all have been avoided if she had just responded to Judy's questions.

In a few days there comes a letter from the Police Department asking that we write down exactly what happened. We do so, all in French, winding up with a very Official-looking document which we mail back. The lady and her husband are then notified by the police that they are responsible for making proper amends to us, and several evenings later the husband rings our doorbell, shares a glass of wine with us, and states his intention to make up for his wife's poor behavior. That such a thing should happen in his good Swiss family upsets him; it is his wife's irrational fear that her dog will be taken away, or some such thing.

All we want, we assure him, is an affadavit from a veterinarian which certifies that the dog does not have rabies. Of course, there is also the matter of the new and not inexpensive coat. We agree to a price for the coat, which he pays without hesitation. He promises prompt action on the affadavit.

And he is as good as his word. The veterinarian's affadavit attests to the fact that the dog does not have rabies. He also assures us, in a separate note, that Swiss dogs are rather unlikely to be rabid anyhow, since the last case of rabies in Switzerland was reported about 200 years ago. Which seems a fitting anticlimax to the whole peculiar episode.

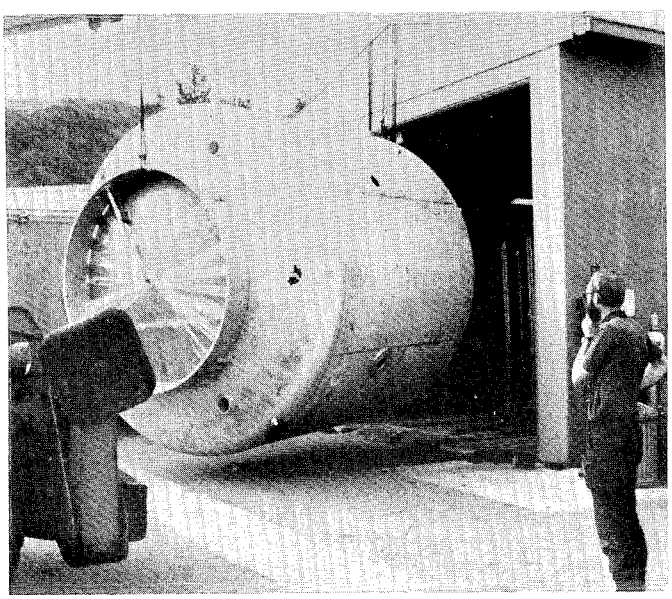
--Bob Bell

CERENKOV COUNTER BEING BUILT FOR NEW HYBRID BUBBLE CHAMBER FACILITY

(Photos by Clive Field and Steve Borjon.)

(Note: The Beam Line *will carry a more complete article on the new "hybrid" 40-inch bubble chamber facility when this project gets a little closer to completion. Some of the background information for this facility was described in the article "Getting the most out of bubble chambers" that appeared in the September 1974 issue of the* Beam Line. *The purpose of this brief sketch is simply to note some recent progress and to give a simple explanation of how a Cerenkov counter works and what its uses are in particle-physics research.)*

The photographs on this and the following page show the pressure vessel or tank that has recently been built to house a special kind of particle detector, a Cerenkov counter, that will be used with the new hybrid bubble chamber facility that is being built by Group BC at SLAC. The photos were taken as the tank was being rigged out of its temporary quarters in the Cryogenic Building to a nearby outdoor site for testing.



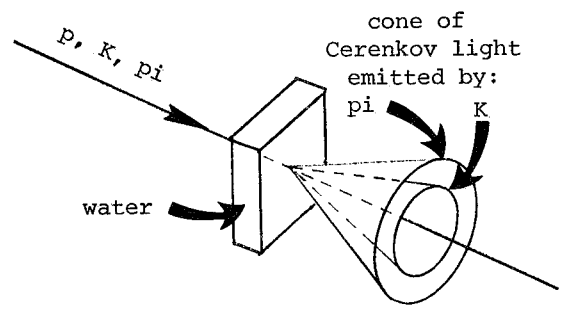
The pressure tank for the Cerenkov counter is moved out of the Cryogenics Building for tests.

The basic idea of a Cerenkov counter (named after the Russian scientist who first studied the effect) is this: As everyone knows, no particle can travel faster than the speed of light. But to make that statement completely accurate we have to say "faster than the speed of light *in vacuum*." The speed of light in water, say, or in any fairly dense medium, is a good deal less than the 186,272 miles per second that light travels in vacuum. In order to calculate just how much less, we divide the vacuum (or "free space") velocity of light by the particular material's *index of refraction*, n. For water, with n = 1.33, the velocity of light is about 140,000 miles per second.

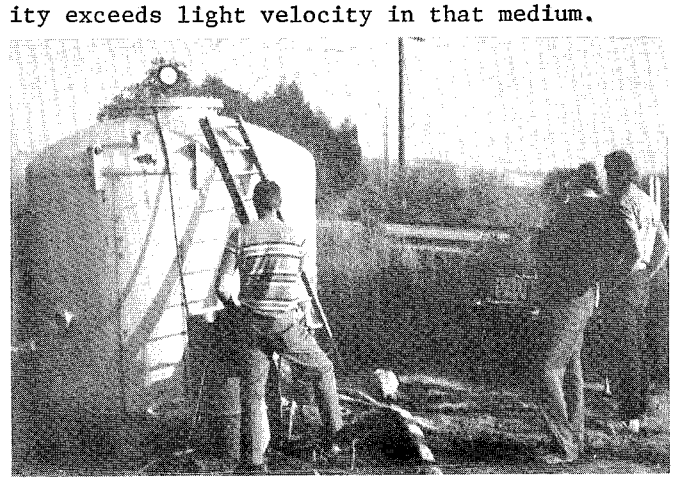
Now let's what happens when we send three different particles, traveling at three different velocities, into a bucket of water. Here are the three particles:

Particle	*Velocity in Miles/Second*
proton	120,000
K-meson	150,000
pi-meson	170,000

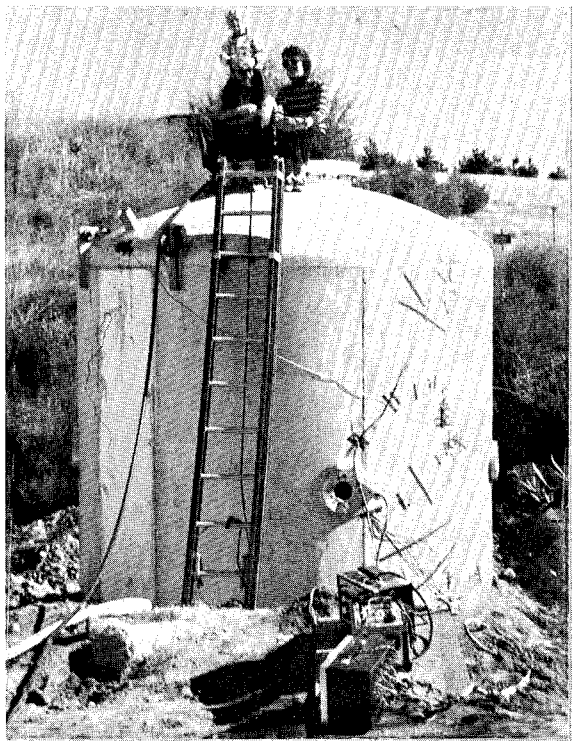
And here is what happens when the particles enter the water:



Both the K- and pi-mesons emit *Cerenkov radiation* or *Cerenkov light* until they have lost enough energy through this process to reduce their velocity to less than 140,000 miles per second. The proton does not emit such radiation because its velocity does not exceed the velocity of light in this particular medium. An important part of the Cerenkov radiation process is the fact that the light is emitted in a cone-shaped pattern--that is, at a specific angle which depends uniquely on how much the particle's velocity exceeds light velocity in that medium.

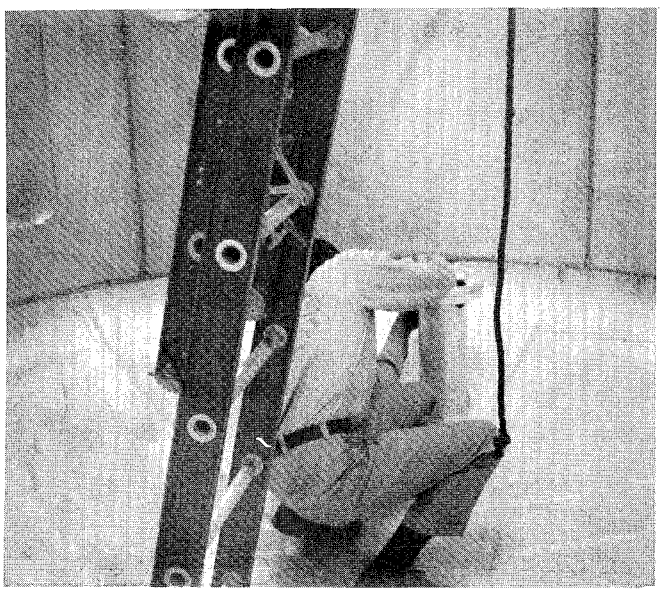


L to R, Knut Skarpaas, Henning Petersen and John Cockroft look over the pressure-vessel test setup.



The Ascent of Mount Cerenkov was accomplished by this hardy band of local Sherpas.

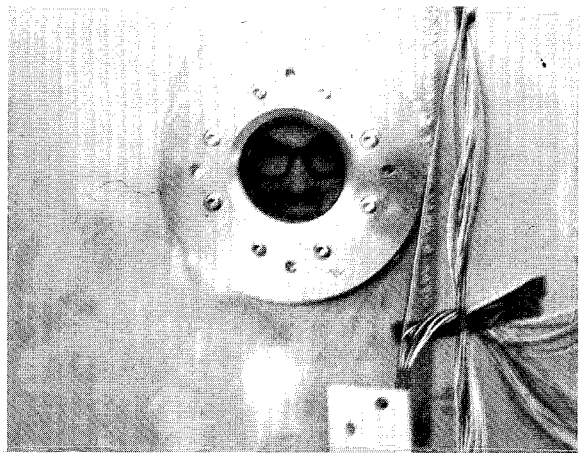
Thus a Cerenkov counter which makes use of this principle can be used to *identify* each of several different kinds of particles that come out of an interaction or that may be mixed together in a beam of particles, even when all the particles have the same momentum. Cerenkov counters are therefore typically placed downstream of a bending magnet, which directs particles of the same momentum into the counter.



I wonder if this gadget is really stuck on here right.

Clive Field takes a (muddy-looking) dip in the tank in preparation for the water-pressure test. The vessel was tested to a pressure of about 4½ atmospheres, as required by the code.

By using a gas instead of water, and by adjusting the pressure or density of the gas, Cerenkov counters can be used for a variety of different particle-identification tasks. Sometimes they are used simply as *threshold* counters (protons do not radiate, but all lighter particles do, for example); and sometimes as *differtial* counters (all incident particles radiate and they are distinguished by the different cone-angles which characterize each type of particle).



Skin-divers will do anything for a quick dip.

"Don't become an expert, because of two reasons: First, you become a virtuoso of formalism and forget about real nature, and second, if you become an expert, you risk that you are not working for anything interesting anymore."

--W. Pauli to V. Weisskopf

> The most incomprehensible fact is the fact that nature is comprehensible.
>
> --*Albert Einstein*

JOE WELLS APPOINTED ACTING ASSISTANT DIRECTOR OF SCIP

Mel Ray of the Stanford Center for Information Processing (SCIP) has recently left Stanford for a position in local industry (see story on page 4). As a result, Joe Wells of SCIP has now become Acting Assistant Director of SCIP for SLAC Computing Services. Joe's new responsibilities will be somewhat changed from those that Mel previously carried out. Whereas Mel was concerned with production services for all three parts of the SCIP enterprise (Medical School, campus facility, and SLAC), Joe will devote himself wholly to the SLAC facility. He will handle SLAC facility operations, improvement planning, and the solving of problems that relate to the "triplex" computer system at SLAC.

Chuck Dickens continues as the Director of the SLAC Facility of SCIP, with overall responsibility for establishing general policies and for long-range planning of the facility's computer needs.

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Contributors

Herb Weidner, Bin 20, x2521: experimental area & facilities; general news.

Dorothy Ellison, Bin 20, x2723: want ads, clubs, sports, people; general news.

Harry Hogg, Bin 33, x2441: accelerator & related information.

Photographer

Joe Faust, Bin 26, x2429

Production

George Owens, Bin 82, x2411

Editor

Bill Kirk, Bin 80, x2605: letters, comments, articles; general news; whatever.

TEN-YEAR SERVICE AWARDS 1964 - 1974

Awards in recognition of ten years of service at SLAC will be presented in the Cafeteria on

Tuesday
December 17
4 to 6 P.M.

Martin Anderson
Leroy P. Andrade
Aaron Baumgarten
Sidney H. Bergquam
Richard L. Blumberg
Willys O. Brunk
Marge Burns
Bill Chandler
Roger W. Coombes
Irby E. Crawford
Philip T. Davies
William Davies-White
Bernard G. Denton
Dominic Deremigio
Mack Dillard
Keith C. Doty
William D. Ewings
Adolph Fiedor
Hoyt H. Fuller
Franco Generali
Boris V. Golceff
Joe D. Good
Warren L. Graves
Ross Hagel
Richard E. Hamman
Terry G. Heaslett
Charles T. Hoard
Harold A. Hogg
Jack G. Hollenbeck
Robert Hom
Harry Houghton
Dick Jeong
Robert A. Johnson
Newman E. Kidd
Albert H. Kilert
Arthur C. Koleszar
Edmund Kolod
George C. Lee
Vernon C. Lee
Robert Vetterlein
Robert H. Leonard
Richard T. Lorentz
Richard C. McCall
Arthur Mainwaring
Lawrence K. Monus
Harold A. Morales
Peter C. Munzell
Roger A. Nelson
Walter A. Nelson
Daniel A. Nevius
John W. Nicol
Frank E. Noga
George W. Petri
Charles A. Poole
Ricardo Ramirez
Antonio Roder
Steven St. Lorant
Tony A. Sanchez
Anthony Sartori
Wayne J. Shetler
Harold E. Smith
Louise B. Shreve
Edwin D. Stephenson
Ronald D. Stickley
Bohdan A. Sukiennicki
Edwin A. Taylor
Edward F. Tillmann
Alexander A. Tseng
Lester K. Uyeda
Reyes Valenzuela
Francesco Villa
John Voss
William Wadley
William J. Walsh
Gary J. Warren
Howard H. Webb
Faye V. Woodford
Charles Xuereb
Herman F. Zaiss
Joe Zink

WANT ADS

Wanted: The use of a ceramic kiln to fire small to medium size sculptured pieces. Gail Stout, X2291.

Wanted: More want ads. Contact Dorothy Ellison, X2723.

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	2-8	8-4	14-4	23-12	30-41	45-7	54-30	62-47	67-12	72-3	79-85	84-20	89-20	95-37
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