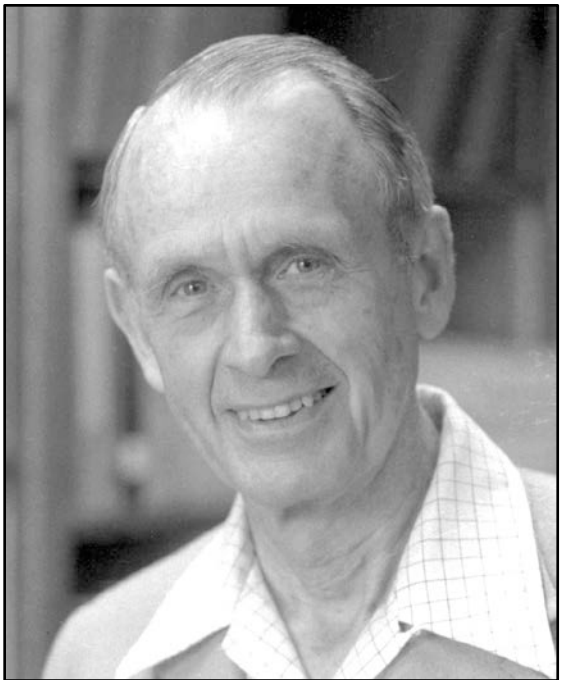

FRANCIS H. CLAUSER
(1913-2013)

INTERVIEWED BY
RACHEL PRUD'HOMME

March 25, 1983

ARCHIVES
CALIFORNIA INSTITUTE OF TECHNOLOGY
Pasadena, California

Subject area

Engineering and applied science

Abstract

An interview in March 1983 with Francis H. Clauser, Clark B. Millikan Professor of Engineering, emeritus, and chairman of the Division of Engineering and Applied Science from 1969 to 1974. He recalls his arrival at Caltech in 1969 to head the engineering division; discusses the broadening of Caltech's engineering option during the 1960s, including a shift toward fundamental research and an increase in the size of the faculty and the graduate program, enabled in part by a generous Ford Foundation grant. Comments on the current state of the division, with numerous retirements coming up and the opportunity for new hires. Recalls the establishment of the Environmental Quality Laboratory and the applied physics option. Discusses the development of computer science at Caltech and his efforts to build up communications science by recruiting John Pierce from Bell Labs. Comments on Caltech's contributions to earthquake engineering. He concludes the interview by discussing his initiation of the Sherman Fairchild Distinguished Scholars Program.

Administrative information

Access

The interview is unrestricted.

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CALIFORNIA INSTITUTE OF TECHNOLOGY ARCHIVES

ORAL HISTORY PROJECT

INTERVIEW WITH FRANCIS H. CLAUSER

BY RACHEL PRUD'HOMME

PASADENA, CALIFORNIA

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CALIFORNIA INSTITUTE OF TECHNOLOGY ARCHIVES
ORAL HISTORY PROJECT

Interview with Francis H. Clauser **by Rachel Prud'homme**
Pasadena, California **March 25, 1983**

Begin Tape 1, Side 1

PRUD'HOMME: Can you tell me when you came to Caltech?

CLAUSER: In 1969, when Lee DuBridge was still president, he asked me to come and take the chairmanship of the Division of Engineering and Applied Science. Fred [Frederick C.] Lindvall, who had been the chairman of that division for more than twenty years, was retiring. Dr. DuBridge asked me if I would serve in that post.

PRUD'HOMME: You came at the same time as Harold Brown [Caltech president 1969-1977].

CLAUSER: I came just a matter of months after Harold Brown had come. Lee DuBridge had gone back to Washington as science advisor, and Harold Brown was just settling into the job of president when I arrived.

PRUD'HOMME: What was the division like at the time you came? What was its emphasis?

CLAUSER: The preceding decade had seen a significant change in the division. The Ford Foundation had granted several million dollars to Caltech, with similar amounts to other schools, for the purpose of improving and strengthening work at the graduate level in engineering. In earlier decades, most of the other divisions had had strong graduate programs with great emphasis on research. The Throop [Polytechnic] Institute, which later, in the post–World War I years, became the California Institute of Technology, had had a traditional emphasis on engineering, and in particular on the practical side of engineering. But during the postwar years of World War II, there was an increasing emphasis on a more fundamental approach to engineering—in particular at Caltech, although this was a common goal of many of the leading

universities. Caltech was certainly one of the foremost in the process of injecting far more science, and far more mathematics, and greater rigor, into what had earlier been a rather empirical engineering profession. A number of the component parts of the engineering division had, in a period since 1930, begun to make the switch to a fundamental approach to engineering. One of the earliest was aeronautics, where I got my training, under [Theodore] von Kármán and Clark Millikan, the son of Robert A. Millikan [chair of Caltech's Executive Council, 1921-1945]. I was very much in sympathy, of course, with this view that the engineer of the future would have to have a far more fundamental training than earlier engineers had had. And the Ford grant made it possible for Caltech to increase the number of its faculty, particularly those with an interest in fundamental research and those prepared to take on graduate students. As a result, during the decade of the sixties, the greatest change, in my view, in engineering at Caltech was a great blossoming of the graduate program and an increase in the faculty who became well known for their research. That program was reaching its fruitful years when I came here in '69. And many of the things that I will talk about later are outgrowths of that change.

PRUD'HOMME: Did you then think that the students were spending enough time in the humanities and social sciences to make an accurate determination of their professional goals?

CLAUSER: That question implies that in order to make a proper choice, you have to be well grounded in the humanities and social sciences.

PRUD'HOMME: Not well grounded, but that you have to have some knowledge of it. I am merely picking up from DuBridge in this.

CLAUSER: Well, dating from the Robert Millikan days, Caltech was one of the leading universities to put great emphasis on humanities and social sciences for its students. There were a number of universities across the country—particularly in engineering and science—that had requirements for humanities and social sciences as little as ten, fifteen percent of the students' study time. Whereas, within my memory, Caltech has always asked for, or had requirements for, something like twenty-five or thirty percent of the students' time. So that the engineers, and scientists as well, would have a very excellent grounding in the humanities and social sciences. I

think it's fair to say that that emphasis existed throughout this whole period—from the thirties clear on through to the present time.

On this question about what the division was like when I came, the faculty had had a great increase in size as a result of the Ford grant. The number of graduate students in engineering and their orientation had changed significantly toward fundamental research. The number of undergraduates in engineering had—over the two preceding decades, perhaps even a longer period of time—gradually decreased. The decrease was not as ominous as one might think at first, because the Engineering and Applied Science Division is one of six, with roughly equal importance in their fields of work. In the early years, the number of undergraduate engineers had been greater than half, which I think, for an institute of technology such as this, was a disproportionate number for one division to have. And it shifted, so that during my term of office [1969-1974] the number of engineering students on the undergraduate level constituted approximately a quarter—which I suppose was more nearly in line with the fact that we were one of six divisions. However, those numbers reflect more a changing attitude of the students toward engineering and their election to a profession rather than anything that the institute itself did. For instance, at the present time the number of engineering undergraduates is again approaching half. And it's through no particular effort of this division to increase the number, other than, of course, that of doing an excellent job in teaching and working with the students. But during these last five or six years, it has become increasingly apparent—first through the engineering profession itself, and then through the media, and then through the students—that prospects for engineering jobs are excellent. At the present time, one of the great problems in engineering is that the salaries are so great that few students are staying on for graduate work, and fewer good students are available to staff engineering-faculty positions around the country. I think one of the greatest needs of our division at the present time is to find young faculty members who are comparable to the quality of what we have now. This is made acute by the fact that a large number of us have retired or are about to retire. It's a marvelous opportunity for the division, because it opens up the opportunity to bring in highly talented young persons—something that during my term of office I was a bit worried about, because our division already had more than eighty percent of the faculty members with tenure. So this opening of many new positions presents an opportunity that didn't exist during my term in office. Every appointment had to be made very carefully, because we had so many tenured faculty members and the retirements were not coming along as

rapidly then as they are now. And because the number of positions opening up was smaller, the selection process had to be made very carefully with the few we had.

PRUD'HOMME: What were the first tasks you wished to do as the new head of the division? What were the first changes?

CLAUSER: Well, the main subjects I'd like to discuss with you on that matter are opportunities that resulted from the previous decade, which I discussed earlier, with the coming of a faculty that had great competence in fundamental research and the ability to carry on graduate work. The first such opportunity that was in the making when I came was this whole question of environmental engineering. Previously, Caltech had had work in sanitary engineering, environmental health engineering, and in hydraulics. These have been brought together in a loose amalgamation within the Keck building [W. M. Keck Engineering Laboratories] here. But when I came, it was clear that the common theme of interest for all those people was this newly blossoming field and interest in the environment. There were men there who were interested in water pollution, in air pollution, in waste management, in nuclear energy problems—in a whole range of things. And as yet there was no formal organization or formal program, although this was beginning to be discussed when I came. I had great interest in it and felt that rapid strides should be taken to capitalize on the possibilities. And I quickly found that Harold Brown was very much in sympathy with this; he encouraged me to move ahead. After considering it carefully, I felt that it was going to take a bit of organizational skill to bring off the larger idea that I had in mind and that was shared by others. This was that instead of a conventional process of forming within the Division of Engineering and Applied Science a group devoted to environmental engineering, that Caltech's contribution could and should be on a much broader front—that it should include work not only in engineering but also in chemistry and chemical engineering as well as in the social sciences. The economic aspects, the legal aspects, and the political aspects of the environment were very important, as well as the engineering and scientific aspects. So what we set about to do was to form an organizational structure, an interdisciplinary unit, that could work within Caltech's administrative framework and cut across all of the various divisional lines.

Now, as to the organization, let me take just a minute to describe what the administrative structure was, so that you can see the problem involved. Harold Brown had decided—as a result of earlier studies that had been made with people like David Morrisroe, who was from outside the university—to assess the administrative hierarchy at Caltech. And Harold Brown followed many of those recommendations and tightened up the administrative structure, so that fewer people reported to him, and those people, in turn, had more direct lines and responsibility themselves. What this resulted in was a central administrative unit called the IAC, the Institute Administrative Council. This group consisted of the president and the vice presidents, the six divisional chairmen, and the director of JPL [Jet Propulsion Laboratory]. Harold Brown was determined to keep that unit small and give it power and effectiveness for all administrative decisions. That group met in full session once a month, or more if required. But this structure, you can see, immediately fanned out into the divisional lines and left unanswered the question of what would happen to a unit that had its roots in several divisions. This question had to be answered before we could go ahead with an environmental engineering group that had this new form.

Well, one of the first things we did was to change the name to environmental engineering science, to convey the idea that it was a more broadly based thing. And secondly, we set up an executive committee and an administrative committee kind of thing within the faculty, with members from geology, geophysics, physics, humanities, social sciences, chemistry, chemical engineering, all represented and all having a voice in the process. This, of course, didn't solve the administrative problems.

So Harold Brown suggested that I wear in effect two hats—one would be division chairman for engineering and applied science and the other was to be the man who would serve as the channel of information and responsibility from this interdivisional group to the administrative council. This wasn't easily done, because many of the original people in environmental engineering science felt that they should be either a seventh division or a seventh organizational unit, and that they should have a man sitting on the administrative council. Harold Brown said no; he was not going to enlarge the administrative council for that. So that group would report to me, at least for a period, until we saw how things worked out. And that's what happened. I think it worked quite well.

These people set themselves up as a regular academic discipline, with an undergraduate program, a graduate program, laboratory research, and so on. But at the same time that this happened, it became clear that that was not enough, that there were interests that transcended the ordinary academic discipline. And here we come to the question of EQL, the Environmental Quality Laboratory. My own background from the University of California had been that the University of California had early seen the wisdom of having extra academic units—that is, outside the academic sphere but still as part of the university—that would permit the faculty to engage in advanced projects. A typical one was the Lawrence Berkeley Laboratory for physics. All of these are attached to the university, but in most cases do not have a student program, don't teach courses. They are capable of undertaking major research projects sponsored from outside, but they do so within the university framework. Caltech was not devoid of such experience. During my own years here at Caltech in aeronautics, I had seen the birth of the Jet Propulsion Laboratory activities, which constituted a unit set up for action—associated with Caltech, carrying on Caltech's high standards, but not engaged in teaching, not engaged in fundamental research. But, as I say, action-oriented. So we had that as a background. That, coupled with the fact that a significant number of the faculty wanted to engage in action on the environmental front. We decided to set up what later became called the Environmental Quality Laboratory. It started off as a series of informal meetings, in which people from outside the environmental engineering science group as well as those within it met to give seminars, to discuss the potential actions that this group might take. It included people from almost all of the divisions here on campus. As this crystallized, a man by the name of Lester Lees [then professor of aeronautics and environmental engineering] emerged as a potential candidate to serve as director of a formal organization. And when the time came, we did in fact set up this Environmental Quality Laboratory [1971], with Lester as its director. At that time, there was no thought that it would be able to appoint tenured professors or anything else. It would have a staff. Members of the faculty could in fact elect to opt out of some of their academic responsibilities and become a part of this organization for whatever period and then come back into the academic stream. Or they could straddle, with a fraction of their time in one place and a fraction of their time in the other place.

PRUD'HOMME: It's remarkably flexible of the institute to do that.

CLAUSER: Yes. Well, that still is a possibility at JPL. For instance, Homer Joe Stewart, in aeronautics, spent part of his time at JPL and part of his time down here. Several people in physics, several people in geology, have done that with JPL. We incorporated that same kind of flexibility in the Environmental Quality Laboratory. There were quite a number of growing pains with the Environmental Quality Laboratory, one of which, of course, was the finding of funds. But the other was facing up to the political and advocacy questions that were very much a matter of concern at that time. Harold Brown appointed a group under [economist] Alain Enthoven's chairmanship, to include Paul Chenea, who was vice president of the General Motors Research Laboratories, [DuPont executive] Sam Lenher, and several faculty members here. It was a distinguished group. Parallel with it was a group of trustees who had become very much interested in this whole question of environment and who were concerned about what this Environmental Quality Laboratory would become.

PRUD'HOMME: A hot potato.

CLAUSER: Yes, that's right.

PRUD'HOMME: Where did you get your money from? Some of it came from industry, didn't it?

CLAUSER: Funds were solicited from and were obtained from quite a number of different sources. I should mention that this had greater background here at Caltech than I've so far led you to believe. [Professor of bio-organic chemistry Arie J.] Haagen-Smit had played a very significant role, first in the fundamental analysis of what constituted smog and what should be done about it. But then he also got into the political arena and served as head of many of the very influential groups, both at the political as well as at the national level, in seeing what could be done, what should be done, and what legally had to be done to clean up the smog. He served as a very useful model for this whole process, and I think that his name helped us to obtain funds—not directly, but just the fact that he had put Caltech on the map in the field of environment.

PRUD'HOMME: And it must have appealed to students, too. I mean, this came at the end of the sixties; this was a kind of culmination of all of the interests of that period.

CLAUSER: Yes, very much so. So, here in the first two or three years of my regime, we set up and managed to solve, I think, the major administrative problems of how to run such organizations within the Caltech framework.

PRUD'HOMME: With very little interdepartmental jealousy?

CLAUSER: That's right. There are occasional voices raised, worries, and so on. But I believe we solved that problem. We also solved a strong apprehension on the part of several of the more conservative trustee members that this was going to be a mess.

PRUD'HOMME: You also enabled the students, in a sense, to flip in and out of various disciplines and to test their wings.

CLAUSER: Yes. So there are those two. Now let's turn to a third topic.

Begin Tape 1, Side 2

CLAUSER: The topic that I would now like to address is the formation of the applied physics option. When I came, it was clear that there was dissatisfaction on the part of a number of excellent students, as follows: They had come to Caltech having heard of its great name in physics. When they got here, they quickly found that physics, as practiced in the physics division, was relatively restricted. The physics people here had an interest, of course, in the fundamental particles, in theoretical physics, and in atomic physics. But there was almost no work at all in the physics division in solid-state physics or in quantum electronics. Quite a number of areas that had proved to be of keen interest in other universities—Harvard, MIT, and so on—just didn't exist in the physics department here at Caltech. Instead, these had grown up within Caltech's department of electrical engineering. We had excellent work in solid-state physics, electronics, quantum optics, quantum electronics—a whole range of things. And the students who were interested in these topics had to enroll in electrical engineering and get a degree in electrical engineering. But they wanted very much to have the word "physics" in the degree that was granted to them. And there seemed to be no reason why they shouldn't.

I discussed the matter at length with Roy Gould, who was in the field of nuclear fusion and plasma physics. In fact, I think he first brought the issue up to me. By that time, we had had some experience with the environmental problem and the fact that it was more broadly based and could be successful. So we set about forming a group in applied physics. We couldn't usurp the name "physics" as such. But the physicists had no desire to claim the name "applied physics." And applied physics would cover, with very little prostitution, quite a number of the activities. But it would include people from geophysics, some people in physics that wanted to change their stripes, and quite a number of people here in engineering and applied science. And so we did, in fact, go through somewhat the same organizational pains to set up and get approval from the faculty for a discipline in applied physics. It included people from other divisions.

PRUD'HOMME: Did they leave their own division to come and work?

CLAUSER: In quite a number of cases, they maintained a foot in both camps. That is, there were quite a number of the faculty who had appointments as professor of something and applied physics. On the other hand, a number of them felt that applied physics was so proper for them that they became wholly professor of applied physics and abandoned their earlier title to electrical engineering or whatnot.

This became very attractive to the students. The appeal that Caltech has to students with a physics orientation has remained.

PRUD'HOMME: The best of both possible worlds.

CLAUSER: Yes. And as a result, this flowered fairly quickly, I think. At that time, Carl Anderson was division chairman for physics [Division of Physics, Mathematics, and Astronomy]. And he was very much in favor of this. He was nearing retirement and did not want to take an active role in administration of it. But Harold Brown, Carl Anderson, and I agreed that it would be best for Carl and for me, jointly, to shepherd this along—and that we would always work together in channeling information to the administrative council. And I found that I could work very closely with Carl Anderson for this purpose, and did so. So, again, I served with Carl as the channel from applied physics to the administrative council.

Fortunately, the group in applied physics was quite vigorous, and they took off on their own; they didn't need very much supervision.

PRUD'HOMME: It must have been a terribly exciting time for them.

CLAUSER: Yes, it was. Now, of course, this has culminated in the building of a building for applied physics as such. And quite a number of the people who made the transition from their earlier discipline to applied physics will now occupy the new Watson building [the Thomas J. Watson Sr. Laboratories of Applied Physics], which is just about ready to open at the present time. So I think that was an activity that essentially has come full flower, with a building of their own and with a very active research program with excellent students.

It's interesting that a good deal of thought now is being given to a rebirth of electrical engineering. The electrical engineering faculty dropped in numbers very significantly when this happened. And quite a number of them no longer taught electrical engineering courses. And yet Caltech still enjoys—perhaps more than it should—an excellent reputation for being a good place to come and get a degree in electrical engineering.

PRUD'HOMME: Why the resurgence of interest? Computer technology?

CLAUSER: In part, but perhaps more important, there are a large number of good jobs for electrical engineers. In a somewhat similar vein, computer work had been growing, with a number of the electrical engineers—principally people like Gilbert McCann, who was a classmate of mine here at Caltech in the thirties—playing a very active role in bringing computing to Caltech. In many cases, they had either built computing devices that had been made available to the rest of the faculty or had played a major role in persuading the administration to buy, lease, or rent a big machine, or served as advisors on such things. And when I came, we had quite a number of people who were interested in computers and in information science. But no formal discipline existed here, even though there were courses listed in the catalog under the title of information science.

PRUD'HOMME: When did the [Earle M.] Jorgensen Laboratory [of Information Science] get built?

CLAUSER: That was built while I was division chairman. It must have been in 1973, approximately [The Jorgenson Laboratory was built in 1971.—ed.]. And the goal there was that it would be a home for grouping information and computer science. It was also a necessary expansion, because by this time computing at Caltech had permeated all nooks and crannies of the campus. We had a major central computing laboratory that served the vast computing needs of the whole campus.

PRUD'HOMME: So you have basically two parts: the needs of the institute and the various departments to perform, as well as an academic discipline.

CLAUSER: As well as an academic discipline, to do research and to teach students. And these were two quite separate activities. It turns out that computing at Caltech became a business. The faculty who wanted to have computing done would pay good money for it and didn't want to be at the whim of academic research on the machine, which invariably had the machine laid up. So we quickly abandoned—really, before I came—the idea that the faculty in information and computer science would run the campus-wide computing. Instead, we set up a formal Computing Center. On the academic side, there were a large number of excellent students who wanted to have careers in information and computer science. And we set about to try and establish such a discipline. All during my term in office, we tried to bring faculty here. As I said, even though we had a set of courses, we never got to a point where we could offer a formal degree in information computer science. We just didn't have what the faculty referred to as a critical mass; we didn't have a large enough core so that the leading people in the field were willing to come here and join an already successful group. We had a small number of excellent people, but they were each in different fields, and they didn't have that coherence.

PRUD'HOMME: It wasn't an entity in and of itself.

CLAUSER: That's right. I made overtures to a number of people. One of the most significant was Ivan Sutherland. My successor, Dr. [Robert] Cannon, later persuaded Ivan Sutherland to come [1976]. And Ivan Sutherland, who was here for a number of years, and other people too, added strength to that. But still, I don't think we have yet solved the problem of a major academic discipline in computing here at Caltech.

PRUD'HOMME: Are there other institutions that have this?

CLAUSER: Oh, yes. Carnegie Mellon has, Stanford has, Berkeley has, MIT has. There are quite a number of places that do. But we've never been able to put together a big enough group. And the day will come when we will, but we haven't done that as yet. But we still have a large number of students who are interested in computing, and they do get, I think, reasonably good courses. Right along this same vein was the question of communication science. But here the background is a bit different. When I came, I immediately reestablished ties with JPL. And my assessment is, or was, that the leading practitioner of fabulously sophisticated communication was JPL. This whole task of communicating with a spacecraft that is out at planetary distances, and doing so reliably, with a worldwide network, isn't matched anyplace else. Now, one of my classmates, John Pierce, had gone back and had become an outstanding man at Bell Labs—which is, of course, I think, the finest telephone laboratory in the world.

PRUD'HOMME: Was Hardy Martel [professor of electrical engineering] also at Bell Labs?

CLAUSER: No, not at that time. Hardy Martel was here. In fact, Hardy Martel very early became Harold Brown's assistant and spent half of his time serving as administrative assistant to Harold Brown—and has continued in that role through successive presidents. But Hardy Martel was very much interested in communications. In fact, in the early days, he was about the only practitioner on the campus. Now, I saw what I thought was a wonderful opportunity. Here we had this magnificent resource at JPL, which practiced, as I said, highly sophisticated communication and had leading geniuses in the field. I arranged, with the help of people like Hardy Martel and others, to have them come down on the campus and teach courses. And a number of them have done that. But there was no central group here on campus that could bring this together as a unified discipline. And it was then that I asked John Pierce to come. He was approaching retirement years at Bell Labs. And he worried, and I worried, about the fact that he was not a young man. He was a vigorous man, a man teeming with ideas, and still full of energy, but he did not have a large number of years ahead before retirement to do this. But, nevertheless, he was such an extraordinarily good man in the field that I persuaded him to come, and he did. He set about to try and bring in people. And I think that we do have a nucleus of a good group.

And I still believe that the idea of being able to capture the talents of JPL is a good one. But this has not yet quite come off. And it's quite possible that in the years ahead it will.

PRUD'HOMME: Satellite communication is such an open-ended field now that perhaps it's hard to interest people in it, because it doesn't have a set pattern of development as yet.

CLAUSER: For instance, one of the most recent challenges that I've heard is that as the space program cuts back, and as the Bell system is broken up, that JPL might become the equivalent of Bell Labs for the whole Pacific Telephone system. I think this would be a marvelous opportunity for both sides—that it would give the Pacific Telephone system extraordinary competence and would be a great opportunity for JPL to move into a challenging field as the space program has decreasing budgets. But that hasn't come off yet, either.

PRUD'HOMME: There was an earthquake in 1971 in L.A. Did this kindle an interest in engineering against earthquake damage?

CLAUSER: Yes. Well, "kindle" is probably the wrong word. It has led to a deepening and strengthening, but I think it's fair to say that even prior to the great Long Beach earthquake back in the early thirties, Caltech has played two parallel, significant roles. One was seismology and the study of earthquakes over in the geology division, and at the same time a study of the effect of earthquakes on structures in the Division of Engineering and Applied Science. I think it's a mark of real achievement that those two groups have been able to work closely and harmoniously together, sharing information and knowledge and friendship, and so on. And to give you a contrast, and yet a similarity, both have established extensive networks of seismology but for quite different purposes. The Seismology Lab, which has the larger network, is interested in detecting very weak signals from earthquakes all around the world—charting and so on. But it turns out that in the very act of getting very sensitive instruments to do that job, those instruments become useless when a great earthquake occurs near or under the instrument itself. Its record just becomes a scramble. For that, you need a quite different network, one that can continue to work right through a strong earthquake that is occurring directly under the instrument itself. And our earthquake engineering group has established just such a monitoring network, which includes not only seismometers mounted on bedrock but also strain gauges in all the big

buildings—high-rise buildings and so on—that have been built here in Southern California. This has proved to be extraordinarily valuable, because it gives us quite complete records of exactly what happens, what motions occur, during strong earthquakes. And we gained more information from 1971's strong motion records than the entire record assembled by the human race in all the preceding years.

PRUD'HOMME: How do you funnel information back to the public on this subject? For example, if I were putting up a high-rise building in industry, could I come to Caltech?

CLAUSER: You bet. Not only that, but Caltech has played a very influential role in this whole field in the following way: Our engineering students now staff most of the state, county, and city offices that are engaged in this activity—the administration of the codes and so on. Our faculty has played a strong role in setting up the very codes that make all these buildings safe. They have played a role in assembling the information, holding conferences to disseminate it, printing publications that carry it out to the engineering profession. Caltech's earthquake engineers have played a major role in making buildings safe. The whole complex system of laws, enforcement, codes, and so on, has been influenced with a scientific and engineering underpinning that stems from Caltech.

PRUD'HOMME: Do you do research in other areas of natural disaster—wind loads or fires or tsunamis or floods?

CLAUSER: There was an early proposal during my term in office as division chairman to bring together expertise from such things as wind loads and other natural disasters. We do have people over in aeronautics—Dr. [Anatol] Roshko is one of the world's experts on wind loads on buildings. There's quite a number of people on the faculty who have this expertise in various aspects of natural disaster. Very frankly, we faced a problem. We faced a problem that all faculties face. And that is that professors are a sternly independent group. And many of them pursue their own activities and so on. And unless there is a closely knit discipline that brings together their common interests, most of them do not like to band together to form an organizational unit; that would, perhaps, more impede than help their progress. What we found was that in each of these different areas, the professor had established a reputation and an

activity, and consulting, and all these things in his field—that an association with others on this disaster front wouldn't help out very much. I think that they certainly exchanged information; they were on very friendly terms. But it never coalesced into a formal organizational structure that might have had some advantage, in that we could have presented to the world an activity of a coordinated or a broad-scale disaster-research institute and might have been a little better able to attract funds, and so on. But, frankly, it didn't come off.

PRUD'HOMME: You can only do so much. You've had an extraordinary influence in establishing closer ties with industry. Tell me about the Industrial Associates program.

CLAUSER: No. I think your words are too strong. The Industrial Associates program was established before I came. Oh, I think I played a role, and so on. But I certainly did not play a significant role in setting up the program or influencing in this direction.

Let me address a quite different topic, one that I think should be on record. This has to do with the establishment of the Sherman Fairchild Distinguished Scholars activities. Just to give you a bit of background, when I was a student here at Caltech [1932-1934], one of my first great experiences was to walk up to the second floor of Norman Bridge Laboratory [of Physics], and there, pacing the floor, was a great white-haired man. And to a young student in physics, the sight of Albert Einstein walking back and forth in the same corridor was an experience of memorable proportions. Not only that: Robert Millikan had made it a major point to have the world's great minds in physics, astronomy, mathematics, chemistry, and so on, come to Caltech for visits. He was personally friendly with many of them. Caltech had become among the first rank in institutions throughout the world in a very short period of time after 1920, when Millikan came to join with [George Ellery] Hale and [Arthur Amos] Noyes and others.

I've never forgotten those experiences. Now, when I came here again in 1969, I surveyed the situation and talked with a number of my faculty colleagues. And a general theme kept reappearing: Wouldn't it be nice if we had the wherewithal to have a major program that would bring, over a long period of time, all of the world's great minds here to Caltech for visits? Now, in my own mind, this had shaped up the following way: We couldn't possibly afford to expand Caltech so as to make these people a permanent part of Caltech. One of the great advantages of Caltech, to me, is the fact that it has an extraordinary collection of people but on a small scale.

So that the concentration of greatness is wonderful. But this would be lost if we simply expanded without control. But, nevertheless, it should be possible to have a flow of people through, so that in the course of one man's lifetime here, most of the world's great minds would have passed through. This meant that they should be here for a period long enough to be significant but not so long as to be permanent.

Now, the question as to amount. At any one time, our faculty consists of several hundred people. This group, this flow, should not be so large that it overwhelms, that it becomes the central theme, a central stream itself. It wouldn't be Caltech if that were to be the case. Nor should it be so small that the impact is trivial. And I envisaged something in between these two things—a group of people at any one time on the order of fifteen, twenty, twenty-five, or thirty people. This would take a significant amount of money. I didn't see where the money was coming from at first.

But then we heard that Sherman Fairchild died [1971] and left an amount of money on the order of $90 million or $100 million, and it was incorporated into a foundation, members of which had announced their intention of dealing this out in fairly big parcels and then they would get out of the foundation business. That is, they didn't want this to be an ongoing thing for themselves. And all of a sudden, these ideas coalesced in my mind. We would ask the Sherman Fairchild Foundation for a grant—and I figured it out, it would take about $15 million to endow this program in perpetuity—and that would permit us to have a steady flow of people here on campus.

We invited the whole board of directors of the Sherman Fairchild Foundation to come here. Harold Brown was persuaded by my eloquence to let me give the presentation. Let me read for you the handwritten document that persuaded them. I said, "We are asking your help in achieving a goal which can be stated quite simply: It is to create a Sherman Mills Fairchild Distinguished Scholars Program, which would be a vital and lasting tribute to Mr. Fairchild and which would make Caltech the intellectual mecca for the world's foremost engineers and scientists. We would seek to make the receipt of a Fairchild Distinguished Scholar Award at Caltech as desirable and prestigious as that of the Guggenheim Fellowships that are in effect today. Every university aspires to be numbered among the very best in the world. The dream of aspiring universities is a meteoric rise to the front ranks. The world's great universities—the Harvards, the Princetons, the Stanfords, the Oxfords, the Cambridges, the Sorbonnes, and so

forth—have all been forced to climb slowly and laboriously up the ladder of fame. All have grown large as well as great—all but one. Fifty years ago, Robert Millikan, George Ellery Hale, and Arthur Amos Noyes built Caltech on the foundations of the little-known Throop Polytechnic Institute. Within ten years, it had been catapulted into the front ranks of the great universities of the world. When I came here in 1932, one of my first experiences was to encounter Einstein pacing the halls of Norman Bridge Laboratory. It was a heady experience for a young man.

"How was it that Caltech was able to make such a meteoric rise? Millikan, Hale, and Noyes insisted that the faculty be small and made up of outstanding scholars. And they insisted upon excellence and research—do a few things, but do them extremely well. During this fifty years, Caltech has been able to maintain its preeminence. But as we look to the next fifty years, we are confronted with a significant problem. We are not content simply to inherit the past; we would like to create a change as great and significant as that which occurred in 1920. But we cannot do this by growing. We treasure our smallness; we believe we have one of the world's highest densities of scientific and engineering talent. Among our faculty and alumni, we have the greatest concentration in existence of Nobel Prize winners, members of the National Academies of Science and Engineering, and great research scholars. What we propose is not to expand our size but to create a distinguished visiting scholars program that would bring to Caltech each year twenty to thirty of the world's best, to interact in an intensive way with the faculty and the students here. Whereas twenty to thirty visitors would get lost in the mammoth campuses of large universities, this same number of annual visitors could engage in intimate and stimulating interaction with Caltech faculty and students, and in turn be deeply stimulated. Also, given an amount of money, one would receive a greater intellectual return and more intellectual interaction per dollar spent with a Sherman Mills Fairchild Distinguished Scholar Program at Caltech than at any corresponding institution in the world. We look forward to a program of such excellence and such stature that no great scholar, scientist, or engineer would consider his career complete unless he had made the pilgrimage to Pasadena as the Sherman Mills Fairchild Distinguished Scholar."

And they bought it. And, as a result, we now have the Sherman Fairchild Distinguished Scholars. And I think it has done just what we hoped it would. And it is a truly distinguished list. It is extraordinary.