



An Interview with Marvin Goldberger

President Marvin Goldberger has been at Caltech for almost three years. What problems has he found here, and what changes has he promoted? What does the future hold for Caltech? What does being president of the Institute entail, and how does he like it? These are some of the questions Caltech faculty and students keep asking, so E&S invited a representative group to interview the president and get his answers.

The interviewers: Tim Brazy, president of ASCIT; Eric Davidson, professor of biology; Norman Davidson, professor of chemistry; David Goodstein, professor of physics and applied physics and chairman of the faculty; Dan Kevles, professor of history and executive officer for the humanities; Albert Lin, chairman of the Graduate Student Council; John List, professor of and executive officer for environmental engineering science; Bruce Sams, writer for The California Tech; Gerald Wasserburg, professor of geology and geophysics; and James Workman (BS '57, MS '58), president of the Alumni Association.

DAVID GOODSTEIN: When Harold Brown was interviewed in a situation similar to this in 1972, he was asked what had been done since the beginning of his administration.

Some of the accomplishments that he listed sound a bit strange now. Just to take one example, one of his accomplishments — of many — was splitting Physics 2 into two pieces. One of our accomplishments recently has been repairing the split. In view of that, what has been accomplished during the time you have been here and how will those things look ten years from now?

MARVIN GOLDBERGER: It's hard for me to separate what I can legitimately claim to have accomplished from things that already had a certain momentum before I arrived — and would have happened whether I was here or someone else. Coeducation was a fact when I came here; a concern about the addition of women to the faculty existed; quality of teaching has always been a concern; quality of student life has been a concern; and the extent to which I have made contributions in any of those areas is hard for me to judge.

I'm pleased by the fact that there are now two tenured women faculty members, and five or six non-tenured women, and that offers have been made to many other women. I'm also pleased that the percentage of women in the freshman class for the past few years has risen to 17 percent, and this year applications from women are up

15 percent, whereas applications from men are up only 9 percent.

Another area that I've devoted a good deal of attention to is an effort to strengthen the humanities program, and I'm pleased that we have made one senior appointment of a Dreyfuss Professor in humanities and we have an offer out to another senior humanities professor. So I feel that we have made some significant progress in that area.

Martin Ridge, who is a senior historian at the Huntington Library, now has a joint appointment with Caltech, and that has served along with several other appointments to greatly strengthen the traditional bonds of friendship between Caltech and the Huntington Library.

I sense a renewed interest and attention to issues of undergraduate teaching. The conference that was held last year involving students, faculty, and alumni was a very positive event, one we should probably repeat sometime in the future to see whether the customers feel that there has been progress.

JOHN LIST: Since I came here 18 years ago, there are 13 new buildings on campus. The number of faculty in that period of time has grown a relatively minuscule amount, which means that the faculty has to bring in an ever-increasing amount of research money. Do you anticipate there are going to be another 13 new buildings in the next 18 years?

GOLDBERGER: For the immediate future, there are only a very small number of building projects that we are even beginning to talk about. I believe that we are now more careful than in the past to make sure that when buildings are built a suitable endowment is provided for their maintenance. Otherwise, new buildings — marvelous gifts though they may be — eat you alive.

As far as future building plans are concerned, there are three or four conceivable building operations that I can see on the horizon. The first, though not necessarily the first to be completed, is going to be an athletic facility. We are going to do something about the athletic facilities, somehow.

GERALD WASSERBURG: Why? Building athletic facilities hardly seems that important.

GOLDBERGER: I think it is very important. A growing number of students, faculty, and people in this community are extraordinarily interested in fitness, in physical well-being. At Caltech there is a severe shortage of facilities for women. Our swimming pool is so crowded that if you want to go swimming at noon, you have to wait 45 minutes to force your way into the pool. We need another swimming pool, and there isn't a single squash court on this campus.

Now another area of concern is a truly adequate student union facility to house a whole flock of activities that are now largely unavailable on this campus. The student unions at places like Illinois and Wisconsin, for example,

are a real focus for student life. In Pasadena, which is not really a college town, I think we have an obligation to provide better facilities for improving the quality of student life than those we currently have.

Another possible building project has to do with more housing for graduate students in the immediate area. These might conceivably be combined with housing for young faculty. Making it possible for faculty to have houses in the immediate neighborhood of Caltech is one of the most important things we can strive for. The atmosphere at a campus where people frequently walk over to their offices in the evening and have contact with their students is quite a different atmosphere from that of an urban campus, where by 5 o'clock in the afternoon everybody is gone. So I am eager for people to live as close as possible and for a genuine community.

We are also going to do our very best to renovate and modernize existing facilities, because that can be done at a cost which is about a half or a third of the current cost of building new structures.

WASSERBURG: The historical circumstances that led to Harold Brown's efforts to maintain some form of solvency within the Institute have resulted in a retrenchment in the staff of maintenance and technical personnel on campus. The effects have been next to disastrous — both in terms of number and variety of skilled people necessary to maintain the facilities and in the ability to pay them so they stay. Have you considered how to keep physical plant facilities staff at a level of adequate competence and dedication to maintain those buildings we have and those which some would have us have?

GOLDBERGER: The dramatic cuts in the size of the staff that Harold Brown had to institute as a result of financial stringency have stretched the staff practically to the breaking point and maybe a little bit beyond. In a number of areas the staff support is inadequate, and I would foresee a certain growth in the size of staff. A level of salaries that will compete successfully with local firms and keep the kind of dedicated people we now have is one of our highest priorities. Last year we got a variance from the Council on Wages and Prices so that we could give an anomalously large salary increase. Attracting and keeping a competent staff is something we take extremely seriously.

NORMAN DAVIDSON: How do you foresee the overall financial situation of the Institute and what opportunities for growth and improvement do we have?

GOLDBERGER: Right now is one of the most difficult times to project the financial situation for the future. One important factor is the continued vitality of JPL and the level of activity that can be expected there over the next few years. The fee from the operation of that laboratory feeds directly into our general funds and is a very important component of our income, but the outlook for the continued support of the deep space program — which is

the cornerstone of JPL activity — is certainly cloudy. The support for the lab's energy work is also quite uncertain at this time. Fortunately, we have over the years built up a "rainy day fund" to compensate for a catastrophic loss of JPL. That, of course, wouldn't happen overnight but over a period of years.

As you all know, there are certain areas, primarily in the behavioral and social sciences, that are now being seriously cut back, at least in the projections of the National Science Foundation budget. Those cuts are going to have an impact on us. The physical sciences budgets seem to be holding up fairly well. If there is a general cutback on direct federal support of research, all universities will suffer, but I think we may suffer a bit less than most of them. One development somewhat on the bright side is a renewed interest on the part of a number of industries to become seriously involved in the support of research at universities in general and at Caltech in particular. We're trying to be as receptive as we can to those approaches, recognizing that just as there have been fears and concerns about becoming too heavily involved with the federal government there are fears and concerns about becoming too beholden to industry in ways that might torque our research interests and our fundamental purposes.

I'm very pleased by the fact that the trustees have become much more seriously involved and concerned about the financial state and outlook for the Institute and are throwing themselves into our development plans for the future.

ERIC DAVIDSON: Among the specific proposals of the administration in Washington is severe reduction of the funds to support graduate education. Our sources in the National Institutes of Health tell us that training grants are liable to be very adversely affected as well as postdoctoral fellowships, which provide support for many of the people doing research in biology and chemistry. The last time anything like this happened, during the Nixon era, the Caltech administration advised the divisions to find ways of paying for more student and postdocs on their already-stretched research grants. When push came to shove in our division, we just decided we weren't going to take as many graduate students and then things relaxed. I wonder whether you've given any thought to the possibility of helping with both the graduate education costs and postdoctoral support that would otherwise have come from funding agencies in Washington.

GOLDBERGER: I don't think we've really addressed the full magnitude of that problem yet. For a long time the number of graduate and postdoctoral fellowships associated with the NSF has been so negligible in the physical sciences that there's never been any source except research contracts. The situation in the biological sciences is certainly somewhat different. We're fortunate at the present time in having some new funds available from a very generous gift from Myron Bantrell for a program of post-



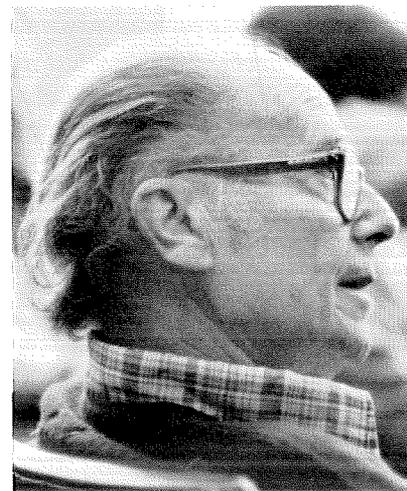
Gerald Wasserburg and Tim Brazy



Albert Lin



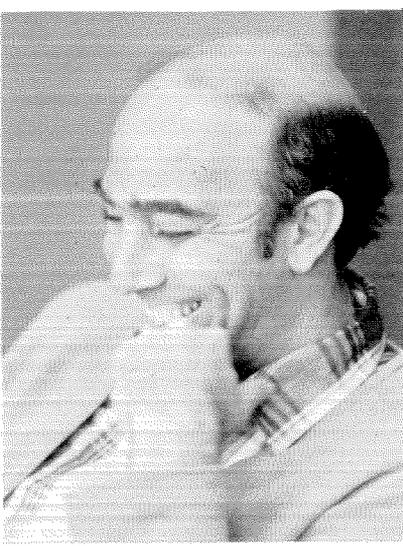
John List



Norman Davidson

doctoral fellowships. But we're going to have to scurry very hard to try to make up for the shortfall in the biological and life sciences if the worst happens. I don't know how we are going to do that because the amounts of money involved are rather horrendous.

There's a similar threat, of course, for undergraduates in the cutting off of the student loan program, and we're taking unilateral action to try to provide funds for a loan pool. We hope to be able to loan students money at a reasonable interest rate so that students, particularly from middle-income families, have a fighting chance of coming to Cal-



Dan Kevles



David Goodstein and James Workman



Eric Davidson and Bruce Sams

tech. But student aid, both undergraduate and graduate, poses an incredible problem to us. We face a loan shortage next fall for undergraduate students somewhere in the neighborhood of \$400,000, which is a lot of money.

ERIC DAVIDSON: Supposing the training grants really are more or less cut, would your recommendation to the various divisions be just to take the graduate students that they can afford from other sources, or would you expect that the central administration would be able to step in with aid?

GOLDBERGER: I hesitate to make a flat statement about it. The question of how many graduate students one should have is always a very difficult one. Any study that I have ever seen comes up with the same answer: The right number is exactly the number that you have at the moment. I would be very unhappy to see the size of the graduate body here shrink appreciably at this time. We do a good job with the size of the graduate body that we have, and conceivably if we had the funds it might be larger. But I would prefer not to shoot from the hip as to what we might have to do.

ERIC DAVIDSON: If the administration in Washington is successful in blocking funds for some of JPL's deep space explorations, energy research, and other applied research, it will be very hard on the technological machine that exists at the lab. What are your thoughts on alternative uses for that machine?

GOLDBERGER: Well, one could imagine JPL becoming a laboratory with a number of specialties that would attract the research interests of various industries. These industries might be able to capitalize on both JPL's talent and its facilities rather than setting up their own independent research operations. A program was designed to set up generic research facilities that would be of interest to a whole class of industries. I think this program is targeted for budgetary extinction, but it could rise again. And maybe we can re-invent it. You know, we have an example of such an activity here on the campus in the form of the Silicon Structures Project. And that idea may be cloneable. In fact, we're now considering trying to clone it in some other areas.

JAMES WORKMAN: Terms like "independent" and "private" institutions are used to describe Caltech, yet you rely very heavily on government funding for your annual operating budget. Are you terribly concerned about that and the influence the government may have because of the funding?

GOLDBERGER: I am terribly concerned about it, but not so much because I fear evil influence. One of the fears, of course, is the capriciousness of government funding, as we're witnessing particularly this year. The failure of government to support universities, in spite of all the evidence of the importance of continuity and commitment, the failure to recognize that you can't turn things on and off, disturbs me mightily. If you include our income from JPL, approximately 60 percent of our budget is dependent upon the federal government. It's not clear how we can reduce that significantly, but we can make some reductions, and I am very anxious that we do so because it makes us less subject to the vagaries of Washington budgets.

LIST: In that connection, I get the feeling that we don't spend a lot of money in raising money. Is that really the case?

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John
Todd



cian. During the war he was a scientific officer with the British Admiralty. In 1945 he was instrumental in preventing the dissolution of the Research Institute at Oberwolfach, an organization that has since made unique contributions to the mathematical sciences. In 1947 he was invited to work on high-speed computing at the National Bureau of Standards in Washington, D.C., and California. Except for some time with John Von Neumann's group at Princeton's Institute for Advanced Study, and a brief return to London, Todd remained at the Bureau for ten years, first as chief of its Computation Laboratory (one of the first such to be equipped with an electronic computer, the SEAC) and then as chief of Numerical Analysis. In 1957 he became professor of mathematics at Caltech.

Robert
Walker



Todd was also a Fulbright Professor at the University of Vienna in 1965. He has been active in various professional societies, in particular the Mathematical Association of America, of which he is at present a governor.

Robert L. Walker
Professor of Physics

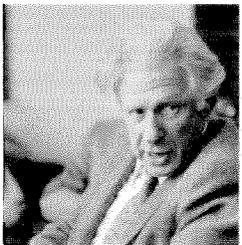
Robert L. Walker, who has also been executive officer for physics since 1976, will become professor emeritus this July. He has elected early retirement and plans to move to New Mexico.

Walker earned his BS at the University of Chicago in 1941 and during the war worked on the Manhattan Project at both the University of Chicago and Los Ala-

mos. After a year as research associate at Cornell University, where he earned his PhD in 1948, he came to Caltech as an assistant professor. He became associate professor in 1953, spent a year in Italy on a Fulbright Fellowship in 1955-56, and has been full professor since 1959.

Experimental high energy physics is Walker's field, and he has been particularly concerned with the design of detectors for high energy physics. During his early years at Caltech he was involved in the construction and operation of the billion-volt electron synchrotron, which at the time was the most powerful machine of its type. Much of his research was devoted to the experimental study of pion photoproduction reactions and to the theoretical interpretation of photoproduction data. After 1970 he worked on pion charge exchange and related reactions at the Fermi National Accelerator Laboratory.

His book, *Mathematical Methods of Physics*, written with Jon Mathews, was published in 1964. Walker is a fellow of the American Physical Society and a member of the American Association for the Advancement of Science. □



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GOLDBERGER: That is the case, and that is being changed by a program now in its formative stages. We expect to emphasize in our fund-raising activities over the next three or four years those things that will contribute heavily to our unrestricted funds. The mechanism for doing that is to try to greatly increase the number of endowed professorships, which will serve the purpose of giving appropriate recognition to professors on the campus. It will also relieve the general budget effectively and therefore turn even highly restricted

grants instantly into unrestricted funds. And it gives us an excellent lever for attracting outstanding people from the outside.

TIM BRAZY: Tuition has been raised by \$1,000 for next year. Do you see this kind of increase continuing for the next few years?

GOLDBERGER: Well, the tuition is going up very rapidly all over the country. We're still \$1,000 or so behind the Ivy League schools. I think our tuition will continue to climb. I worry about this seriously, of course, because when tuition climbs, we have to find adequate funds for student aid. You know we don't deny people entrance on financial grounds. So you sort of get caught coming and going.

WASSERBURG: What is your view about faculty salaries, in particular for junior faculty? A small study has shown that these people are suffering some substantial economic jeopardy, and that means that the institutions are in danger of not being able to attract really outstanding young people on which the future of their institutions must clearly depend.

DANIEL KEVLES: Particularly in very high demand fields like engineering.

GOLDBERGER: Well the problem in engineering is really acute in all of the fashionable fields — computer science, electrical engineering, solid state physics. With current industrial engineering salaries, students in those fields have little incentive to take a job at half the salary at a university. But there are only a certain number of things that one can do to alleviate this situation. One thing we're trying to interest donors in is making prize junior appointments — like the Noyes instructorship in chemistry — jobs that have some perks such as certain amounts of funds available for research, for travel, or we might even want to allow a half year off during the first three or six years appointment for a sabbatical. As far as competing directly with salaries, I don't see how we can ever do that.

LIST: How do medical and dental schools do it, and law schools? They have exactly the same kind of problem — competing with a professional income that may run into six figures. Yet they seem to be able to find very good people to teach.

GOLDBERGER: If I'm not mistaken, in these medical, dental, and law schools, professors are allowed very generous moonlight privileges. We have, of course, a somewhat restrictive policy about outside consulting, and at least for us I think by and large it's a good policy because of the opportunities for abuses under a liberal consulting policy.

ALBERT LIN: Do you think that Caltech will start doing classified research if it becomes apparent that fiscally it is necessary to do so?

GOLDBERGER: I doubt it. I would be strongly opposed to doing classified research at Caltech unless it met two conditions: first, that it was clearly perceived by all of us here as being absolutely necessary in the national interest and, second, that we had some truly unique capability to do so. I certainly would not flee to the classified research coffers just to keep going with business as usual.

It is necessary to distinguish classified research from research with Department of Defense funding. There was a time when a tremendous amount of basic research without any strings whatsoever was supported by the DOD. Recently, there has been a desire on the part of DOD to get back into the support of basic research in universities, but in two successive years Congress cut the funds. Now it may be with the current enthusiasm for DOD spending — and these being trivial amounts of money by comparison with most of their outlays — that basic research money might come through. I have no objections whatsoever to taking money from DOD under those circumstances, but it wouldn't be for classified research.

KEVLES: Would you say the same for proprietary research in regard to industry as well?

GOLDBERGER: Yes. I think that setting foot on that particular slippery slope can completely distort the whole Institute, and I would be strongly opposed to it. The recent Harvard farrago of trying to set up a private corporation in the university provides a very stern lesson.

WASSERBURG: What do you envision the role of Caltech should be over the next decade, in particular with regard to the function and role, first, of private institutions and, second, of those whose dominant effort is directed toward excellence in science, engineering, and technology —

as distinct from humanities, economics, or any other field?

GOLDBERGER: I think the continuing role of the Institute is to train excellent students and to produce excellent research. The fact that the preponderance of effort at Caltech has historically been in the physical and biological sciences doesn't in my mind preclude our having a selective and excellent humanities and social sciences activity.

I'm not concerned that the Institute will lose its leadership position in the physical and biological sciences if it should acquire excellence in humanities and social science. In other words, it's not a zero-sum game, and there is no need to dilute the historic strengths of the Institute.

WASSERBURG: You mean that it is still the major goal of the institution to maintain absolute excellence in science, engineering, and technology as the primary goal and these other things as ancillary features of the education program, or are you saying that the balance of the educational goals should shift? The facts are that historically the California Institute of Technology has always had an extremely strong training for undergraduates in the humanities, and that training has much distinguished its scientific and engineering product. I did not intend to demean these other fields but to ask what is your sense of the balance and primary goal of the institution.

GOLDBERGER: I don't like saying that one thing is primary and another thing is secondary. I want us to be the best in everything that we choose to do. Of course, 80 percent of the activity here is in the physical and biological sciences, so that excellence in those fields by definition becomes a primary goal. I won't compromise with any of those, I won't dilute those, and I won't in any way deflect us from trying to be the very best in the world in all of those subjects, while at the same time doing the absolute best job I can in the humanities and social sciences.

KEVLES: When you came here to discuss the possibility of becoming president of Caltech, you said that you had ambitions for the improvement of undergraduate education. How do you feel about the issue of undergraduate education at this point?

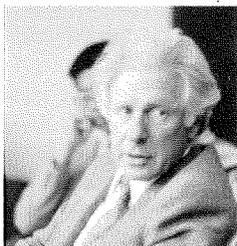
GOLDBERGER: Well, I feel a great deal better about it than I did, largely as a re-

sult of the efforts of David Goodstein in his reorganization of the physics program. I think the fact that the core physics curriculum has as instructors senior professors from all over the Institute is a very positive sign and clearly one that the students have noticed and appreciated. I don't know whether it's because I want to see it, but I find a little bit less of a sort of Marine Corps boot camp attitude on the part of some of the faculty with respect to the students, and I think that's positive.

One thing that has happened the past two summers that I think has had a very therapeutic effect on undergraduate education and the attitude of the students is the Summer Undergraduate Research Fellowship (SURF) program. So far it has touched only a minority of the students, but it will be expanding. This program provides an opportunity for students to spend a really meaningful period at an early stage in their lives learning that science is not just working a set of problems at the end of a chapter, with answers that all come out to be rational fractions.

LIST: An aspect of this that I'd really like to follow up on is that 50 percent of the undergraduates are now opting as upperclassmen to become engineers. Along the same lines, my friends on the freshman admissions committee tell me that the high school students they see are all computer mad. They all want to come here because they see a future associated with computers. What's the Institute's position going to be if it gets to the point where 65 percent or 70 percent of our undergraduate students want to do engineering, and of those, half or more want to do computer science? As it now stands, for the last 10 or 15 years the relative contribution to the engineering division's budget for instruction and research has actually gone down although the number of students has gone up, and it seems to me that the problem is only going to get worse as more and more students become enraptured with the whole business of chasing binary digits.

NORMAN DAVIDSON: To put the question more charitably — supposing you can see that one particular field is a very valuable intellectual enterprise and also one which is pretty marketable right now, so we have quite a few of our students choosing this particular option, but maybe ten years from now they'll all be going into recombinant DNA. How do you reconcile this with the general Institute goal of maintaining excellence in a number of



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fields irrespective of student enthusiasms at a particular time?

GOLDBERGER: That's a very important consideration. We can't afford to overreact to whatever is the current interest of the student body, but I think John has touched on a very important point. The engineering and applied science enterprise here is in the process of rebuilding now. The rate at which it rebuilds is necessarily slow because what's happening here is not an isolated phenomenon; it's happening all over the country. MIT is experiencing the same shift from the pure sciences to engineering — in fact, maybe by an even greater percentage than we have experienced. We're pushing forward in engineering and applied science from two standpoints: one, from the standpoint of encouraging additional faculty appointments, and second, designating funds to provide the appropriate facilities, the start-up costs, for the people who will come.

LIST: That's one aspect of it; the other aspect of it is how to control what the undergraduates want to do.

GOLDBERGER: I don't think that's controllable. You know, undergraduates come in with particular interests that we respond to as best we can. We try to present them with the very best shopping list that we have available, knowing that a lot of their interests will change over a period of a couple of years. It's also true, however, that these same computer interests are going to play a more and more important role across the board in all of the sciences. I don't think you can undo that particular fascination.

LIST: I'm not particularly wanting to undo it; I'm just wondering how the Institute is going to respond to it.

GOLDBERGER: We have to respond.

We have to have people to teach courses, obviously. At the same time we have to be careful not to unbalance the size of the faculty in response to it. It's a delicate line that we have to draw.

BRUCE SAMS: You said you were interested in improving some of the humanities, and I want to ask why it is virtually impossible to get credit for the performing arts. Is that making art any less valuable than studying about it? What is your position on that?

GOLDBERGER: Course credit is a faculty decision, and every time the issue arises, as far as I can tell from studying the faculty minutes, there is an intense and passionate discussion. The comparison with credit for Phys Ed is raised, invidious comparisons are made . . .

WASSERBURG: Fly-casting 1? Ping Pong 2?

GOLDBERGER: Right. All kinds of problems arise, but I'm quite open to a recommendation from the faculty on this.

WORKMAN: I'd like to pursue this one a little further. I think Caltech has a history — its administration — of listening to what students have to say. The meeting among students, faculty, and alumni a year ago was a recent example of that. I have the impression as an alumnus that the vocal students claim to have a very important role in the decision-making process both academically and administratively. Do you see a growth in student influence on campus?

GOLDBERGER: It's my feeling that although students have access to the decision-making process in the form of potential membership on a variety of committees, they don't really take advantage of it, but this is something David may be in a better position to comment on than I am.

GOODSTEIN: Students are duly appointed to all committees; whether they exercise influence on the committees or not, one would have to ask the students.

WASSERBURG: This question goes together with the other discussion of changes in the undergraduate curriculum. There are specific items like course changes which are very positive and I applaud them. On the other hand, I think there's danger in citing these items as a reflection of actual improvement of circumstances in undergraduate and graduate education. There's a problem of student

participation in these things, and I think there really has to be some sort of reassessment of what should happen in this general area, taking into account the very small size of Caltech. Where do you think revitalization of the total undergraduate endeavor might come, with an increase in student vigor and participation?

WORKMAN: It's really a question of administrative attitude relative to the students.

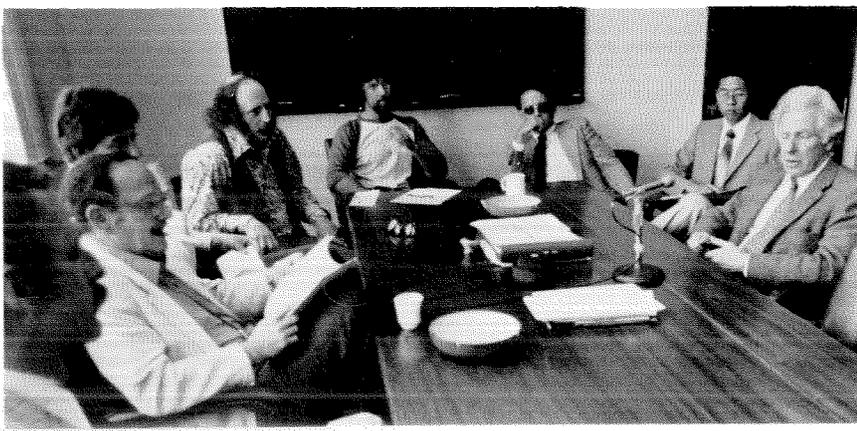
GOLDBERGER: Well, I think it's more than administrative attitude. The differences that I see in undergraduate education here as compared to that in other institutions are not anything terribly concrete — not course content or structure or anything like that. It is a question of attitudes. And changing the minds and hearts of the people, as we have learned from sorry experience, is sometimes a very slow process. But I have a feeling that it is changing, albeit slower than one would like to see. Whether it could be enhanced by improvement of communication between students and faculty and students and administration I don't know. I'm quite open to any mechanisms that might be suggested to speed up the process.

KEVLES: In the old days, before you came here, there was intermittent but persistent talk about changing attitudes by changing the environment for undergraduate education. The idea was to try to bring to the Institute a different kind of student; that is, to diversify the undergraduate body somewhat. Do you have any such notions in your mind?

GOLDBERGER: I think probably one would like ideally that the students not only be as incredibly bright as they are but that they be socially adept and mature and so on. But we are an unusual, special institution, and I don't think that without dramatically changing the character of the place we could have an impact by evolutionary changes in the admissions procedure.

BRAZY: There's been a lot of talk about attrition in the past. A report was made at the faculty-student conference last year that attrition was primarily due to innate characteristics of the students, not characteristics of the Institute. How do you feel about that?

GOLDBERGER: I think there's some truth and some falseness to it. The best we



can do is to make sure if students drop out of Caltech that it's not because we are turning them off or that we're presenting them with a social structure which is so hostile that they can't make an appropriate adjustment to the situation.

I was very concerned about the drop-out rate when I first came here, but the more I thought about it, the less worried I became. When students first come here, they're often almost monomaniacal about their interests, and then they suddenly discover a lot of different things are available in the world that they didn't appreciate before. So they may not be as configured for a dedicated life of binary digits as at first they thought. But there is very little room to move laterally within Caltech, in contrast to major liberal arts colleges. And so they go elsewhere, and we just don't have very much control over that.

WASSERBURG: Don't you think something like a senior thesis would be a major step in alleviating some of the interaction problems between the students and the faculty? It might decrease the dropouts and transfers and increase the level, frequency, and quality of interaction between students and faculty and between the students themselves.

GOLDBERGER: Well, I think it would increase the quality of interaction appreciably, but unfortunately a senior thesis carries the word senior, so the students could well have dropped out before they had this wonderful enriching experience. But I think the SURF program has the capability of having a very therapeutic effect on students, increasing their interaction with the faculty.

NORMAN DAVIDSON: Are you thinking that that could become large enough to really include a significant fraction of the students? If so, it would be marvelous.

GOLDBERGER: It would obviously have to be enlarged because it would require an enormous commitment on the part of the faculty. You know, it's not easy to think

up things for these students to do in a two-month period — things that will really attract their attention and not be totally mechanical. One of our Associates who was a major contributor last year to the SURF program has undertaken, almost as a personal crusade, to greatly increase the funds that will be made available for that program in the future.

ERIC DAVIDSON: When I was in college, for better or worse I spent a lot of time — all four years, not just summer — doing research in the laboratory. And I find that surprisingly uncommon here, at least in biology. A relatively small number of the undergraduates take advantage of the existing opportunities, mostly because of the course pressure. I wonder if something like the SURF program, which is for 2 months out of the 12, could actually substitute for more serious encouragement to regard research as part of an education in the sciences.

GOLDBERGER: I don't know, Eric. It's a hard question. Reducing the course load to a certain extent, so that people would feel freer to become involved earlier on in the laboratories, would require a serious change in attitude on the part of the faculty, who are very intense about the material that they want to transmit in a given period of time. When you have very bright students, the temptation to teach them absolutely everything is almost irresistible. You get so caught up in that that you don't really give the students enough free time to think. Now people learn in different ways; some people probably flourish in this kind of intense pressure of course work. Others learn more slowly and have to have time to contemplate. There probably is no ideal system.

WASSERBURG: To what extent do you think this high-pressure environment is really a reflection of the quarter system rather than the semester system?

GOLDBERGER: Well, I know from my own experience that there is a dangerous

tendency to regard quarters as semesters and to become compulsive about covering a certain amount of material. I think we may be trying to teach too much to undergraduates.

WORKMAN: Is there something you personally can do to change the attitude of the faculty to include more things like SURF?

GOLDBERGER: I don't know what I can do except to implore, . . . I mean, I don't have any powerful tools.

KEVLES: Command?

GOLDBERGER: Commanding doesn't get very far on this campus. Maybe certain kinds of blandishments . . .

KEVLES: Apropos command and blandishments, would you compare your expectations of being president of Caltech and the actual experience? And, also, would you care to comment on what it's like to be a university president these days?

GOLDBERGER: Before I became president, I didn't have much idea of what the job entailed. When I came here to be interviewed, the first person I saw was Bob Christy, who was acting president, and I asked him two questions. The first thing I said to him, because he is a very old friend, was, "Bob, am I really nuts to think about this at all?" And he said, "No, you're not nuts to think about it." And then my second question was, "What do you do when you come in your office in the morning?" He just laughed hysterically, and at that time I didn't know why. Now I know.

I had talked with some elder statesmen before I came, and they informed me that one of the problems is that you have very many bosses — students, faculty, trustees, staff. And I sort of understood that, but I guess the thing that I was least prepared for was how hard you have to work by comparison with being a professor. It's a more high pressure job, in which your time is really not your own. Someone once likened the position of department chairman to being a half-time job; it's five minutes off and five minutes on. And that's what makes the pressure. It's a continuing series of interruptions of any kind of coherent thought.

Usually, by the time people come to see me, they have something fairly serious on their minds. So I have to think very hard about something for half an hour, and



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then I have to turn that off somehow and think very hard about something else. And that is so different from what you do when you are actually doing research, when you think very hard about something for three hours, three days, three weeks, and you don't think about anything else. It's physically tiring too.

Of course there are certain kinds of mandatory social activities, to which I had never been exposed. They are different and in many cases a tremendous amount of fun. I've enjoyed a great deal of that side of the job. I like to talk to people, and that's what I do most of the day, but sometimes when I come home, all I want to do is pick up the newspaper and read it. I don't want to talk then because I've been talking for eight continuous hours, and what I would like more than anything else is just to keep quiet for a few minutes. I generally recover from that.

KEVLES: You regard this as a pretty doable job, not personally doable only, but institutionally and structurally, despite all the constraints, even the many bosses? (Incidentally, you left out the federal government, which is a very important boss.) One finds presidents of other institutions saying after some years that the job is not doable . . .

NORMAN DAVIDSON: But the institutions are functioning.

GOLDBERGER: Institutions, of course, have a tremendous amount of inertia, and if there were no one in this office, much the same thing would go on, I'm afraid. Sometimes my influence is much less than I would like it to be. At least the response time is much slower. I feel it's manageable, Dan. I don't think I could realistically be president of an institution that didn't have such a large component of scientific activity which, if I don't understand in detail, I'm at least not terrified by.

WASSERBURG: Do you think you receive enough support in terms of carrying out your functions as president of Caltech — enough support from the students, the faculty, your administrative associates?

GOLDBERGER: I feel the support from my administrative associates is superb. I think I probably don't go to the faculty with as many requests for support as I might. And that isn't because I don't trust them, but I somehow haven't reached out to them in the way that I think I could. Under circumstances in which I have asked for help, I have found total support. As far as support from the students is concerned, I don't quite see how that fits into the scheme of things, but I try to be as responsive and open to the students as I possibly can.

GOODSTEIN: We have not had a Nobel Prize at Caltech since 1969. Ought we to be worried about that?

GOLDBERGER: I worry about it every October.

GOODSTEIN: I don't mean to be facetious. A place like Caltech either improves or gets worse; it doesn't stay the same.

GOLDBERGER: I agree. I think we must continue to work very hard to bring to Caltech absolute top, first-rate people, but a Nobel Prize is a very capricious measure of success. It has a profound effect on institutions. It gives them a visibility to students that is off-scale. It offers an almost irrational attractiveness to students, who somehow equate the presence of Nobel laureates with excellence in graduate education. But there are a few people around here who I feel are logical potential recipients of the Nobel Prize, and I always grieve when they don't get it. I'm sure that they do too.

There's a question I would like to ask if I may. Are there areas of science or knowledge more generally, including the humanities and social sciences, that Caltech is not now doing that it ought to be doing? Are we overlooking some opportunity that we might seize on? I want to put a boundary condition on this question, namely that I don't want to play catch-up. I don't want to start doing something just because other places are doing it. What I really want to do is the equivalent of hiring Thomas Hunt Morgan and starting biology. That's what I would like to do. It's not easy to think of such things.

LIST: Well, there are two paths which are obviously converging in the future — biology and computer science, the whole business of memory storage. Nobody seems to have approached the biological memory aspect of it, which is orders of magnitude higher than the things that people in the solid state area do. It's clear that somewhere out there they are going to converge.

GOLDBERGER: If I had to pick a particular area, that generalized information-system area is one that I would like to try to emphasize. That's the most obvious one.

LIN: Dr. Goldberger, you are in a very interesting position because you are regarded as an authority in science and technology by virtue of your personal credentials and by your position as president of Caltech. Furthermore, you have a personal interest in some of the applications of technology as evidenced by your current series of talks here at Caltech regarding war and arms control. You have also spoken to other groups in Los Angeles about this and other topics. What do you see as the effect of such talks in areas where you are an authority and where you are trying to influence people to do something?

GOLDBERGER: As for the effect, I believe we are beginning to see a growing sophistication among people about the real implications and dangers associated with the arms race and with nuclear war. How much of an effect this will have on national policy depends upon how much this grass roots movement continues to grow.

I'm concerned somewhat about my going around giving these speeches because although I always try to emphasize that I'm speaking as an individual and not necessarily representing the views of the institution, it's hard for me to divorce myself from the institution. And I suppose that people come to hear me at least in part because I am the president of Caltech. But I feel strongly about the international security situation and that it's important for those people who have experience in it to speak out. I can at least tell the facts and make it more reasonable for people to be in a position to advise their representatives in the government what to do — or to throw out those representatives who seem to be insensitive to what they feel are important issues. So I've got to do it. □