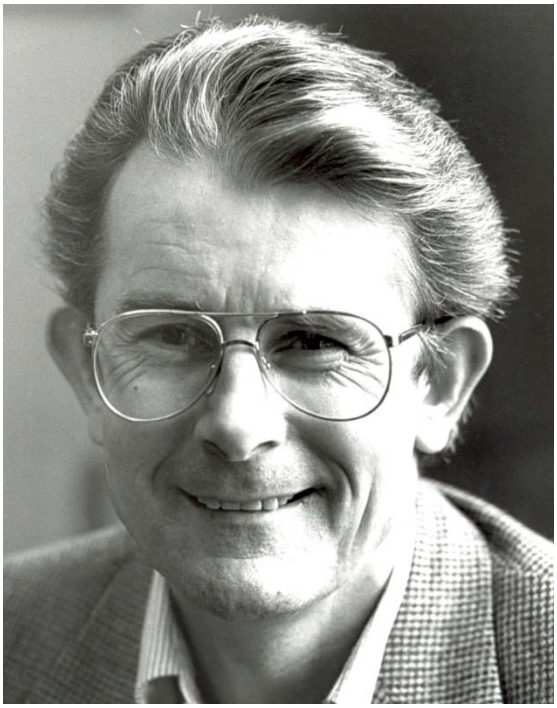

Photo by Bob Paz, 1990

CHRISTOPHER E. BRENNEN
(b. 1941)

INTERVIEWED BY
SHIRLEY K. COHEN

November 19 and 26, and
December 3, 2002

ARCHIVES
CALIFORNIA INSTITUTE OF TECHNOLOGY
Pasadena, California

Subject area

Mechanical engineering, student affairs

Abstract

An interview in three sessions, November-December 2002, with Christopher E. Brennen, Hayman Professor of Mechanical Engineering, emeritus, in the Engineering Division. Dr. Brennen, a native of Northern Ireland who eventually became a U.S. citizen, received his undergraduate and graduate education at Oxford (PhD 1967) and came to Caltech as a postdoc in 1969 with Theodore Y. Wu, after a stint with George Gadd at the U.K.'s National Physical Laboratory. At Caltech, he was a research fellow, senior research fellow, and research associate before being appointed associate professor in 1976. He became a full professor in 1982 and received the Hayman chair in 2005, becoming emeritus in 2010. From 1993 to 1998, he was executive officer for mechanical engineering.

Dr. Brennen discusses his early work with Wu on locomotion of ciliated microorganisms and his later collaborations with Allan Acosta, Milton Plesset,

and Rolf Sabersky, among others. He recalls his early teaching duties and emphasizes his concern with the welfare of Caltech's undergraduates, in his role as master of student houses (1983-1987), dean of students (1988-1992), and vice president for student affairs (1998-2002). Describes atmosphere at Caltech during the Vietnam War and the height of the drug culture. Concludes with an overview of the careers of his own graduate students and expresses his hope that Caltech will continue working to attract top-level undergraduates.

Administrative information

Access

The interview is unrestricted.

Copyright

Preferred citation

Brennen, Christopher E. Interview by Shirley K. Cohen. Pasadena, California, November 19 and 26, and December 3, 2002. Oral History Project, California Institute of Technology Archives. Retrieved [supply date of retrieval] from the World Wide Web: http://resolver.caltech.edu/CaltechOH:OH_Brennen_C

Contact information

Archives, California Institute of Technology
Mail Code 015A-74
Pasadena, CA 91125
Phone: (626)395-2704 Fax: (626)395-4073
Email: archives@caltech.edu

Brennen speaking to incoming freshman class on Caltech campus, 2001

CALIFORNIA INSTITUTE OF TECHNOLOGY

ORAL HISTORY PROJECT

INTERVIEW WITH CHRISTOPHER E. BRENNEN

BY SHIRLEY K. COHEN

PASADENA, CALIFORNIA

http://resolver.caltech.edu/CaltechOH:OH_Brennen_C

TABLE OF CONTENTS

INTERVIEW WITH CHRISTOPHER E. BRENNEN

CALIFORNIA INSTITUTE OF TECHNOLOGY

ORAL HISTORY PROJECT

Interview with Christopher E. Brennen by Shirley K. Cohen

Pasadena, California

Session 1	November 19, 2002
Session 2	November 26, 2002
Session 3	December 3, 2002

Begin Tape 1, Side 1

COHEN: Welcome, Professor Brennen, down here in the Archives. We're delighted that you've agreed to participate in this project.

BRENNEN: Thank you. It's my pleasure.

COHEN: Perhaps we can start by having you talk about your family background.

BRENNEN: My father was born of rather poor parents in the city of Belfast in Northern Ireland. He was obviously a multitalented young man who basically educated himself by earning scholarships. He always said that if he had failed any exam, that would have been the end of his career. He went on to get a medical degree at Queens University in Belfast, where he met my mother. My father graduated in surgery and became a surgeon and was appointed in 1944 to create a country hospital out of nothing in the village of Magherafelt, which is about thirty-five miles due west of Belfast. So my mother and father and brother and I moved there in 1944, and I grew up there. So my home is the village of Magherafelt in County Derry in Northern Ireland. My father really was a self-made man, very determined, very hard-working. To be honest, we didn't see a great deal of him when we were young. I always feel that essentially I was brought up by my mother.

My mother was from a more middle-class family rather than a working-class family. In fact, I think part of my technical heritage—technical gene—derives from her father, who also

came from very poor circumstances but through education rose to become the head of the Belfast College of Technology. It's somewhat ironic. Unfortunately, he died rather young, in 1935, when my mother was just nineteen years old. My mother had the misfortune of losing both her mother and father when she was a teenager. Her mother had died five years previous to that. My mother and her sister Irene, whom I'll return to in just a few minutes, were brought up in their later years by an aunt in Belfast. Both of them attended Queens University, and that's where my mother and father met. So that's a little bit of my background—modest, hardworking, Scotch-Irish.

COHEN: But educated.

BRENNEN: Educated and deeply persuaded of the importance of education. I think one of the characteristics of the Scotch-Irish, the northern Protestant, was that intense belief in the merit of education, and certainly I inherited that belief. Magherafelt was a lovely little village. It probably wouldn't look like much to anyone else, but I thought it was lovely. I still go back to it. My mother still lives in Magherafelt—now in a nursing home. I was the eldest of four children. I have two younger brothers. My brother Michael is a reconstructive surgeon, so he followed in my father's footsteps. I had always been expected to follow in my father's footsteps, and I think it was a little bit of a disappointment to him that I had not, but my brother more than made up for it. He's very successful.

COHEN: Is he in Ireland?

BRENNEN: He stayed in Belfast. He lives just outside Belfast and has done remarkably well. My younger brother, Colin, also a talented young man, became a civil engineer like myself, and he owns his own small company in Northern Ireland. In addition, my parents had a fourth child, my sister Paula, who was a Down's syndrome child. She still lives in the village in which I grew up. It's always hard for me to talk about Paula, because it's a somewhat emotional subject for me. When I used to give graduation speeches here at the banquet the night before graduation, I used to say without too much exaggeration that I probably learned more from my mentally retarded sister than from all of the Nobel Prize winners I have come to know. What I meant by

that is that I learned from her what is truly important to an individual. [Crying] It is hard for me to talk about it. I think we will probably touch on several subjects that are emotional for me, and I think my resistance to emotion has been somewhat worn away by tragedy in my life. But I don't see Paula as a tragedy. I do see her as someone from whom my brothers and I learned an enormous amount and who really was quite selfless.

COHEN: She always lived at home with you?

BRENNEN: Yes. In fact, there was a rather awful time when my father, for reasons that are not really clear to me, decided that maybe he ought to put Paula in a home, because, I think, of concerns about the negative effect she might have on the three of us, the three boys. That was an extraordinarily misguided thought. However, she was sent to a home for a period of about two weeks. My father and mother didn't visit her, because they wanted to somehow make a break. Finally, when my mother gave in and sneaked a telephone call to the place, she found out that Paula had become very ill. So there was a tremendous panic, and my father and mother went, almost in the middle of the night, to this place and brought Paula home. I remember that very vividly in my mind. She recovered, but basically she had not eaten at all. So I think that was a traumatic but important lesson for all of us, and it's one that I've tried to carry through, in a sense.

COHEN: You mean the responsibility to one's own family in some sense?

BRENNEN: And I think to a community in a larger way. So I apologize for seeming emotional.

COHEN: No—that's good.

BRENNEN: It's hard. I haven't thought about all of that for such a long time, though I see Paula every time I go home, of course. Now Paula lives with a family about a hundred yards from the nursing home where my mother is, so it's a very good little setup that we have. She spends the days, basically, with my mother.

COHEN: Is that one of the strengths of villages, in some sense?

BRENNEN: Absolutely. I cannot imagine, in this very kind of impersonal community that we live in here, that my mother and Paula would have been treated quite as well as they are. I mean, they are looked after by the whole village.

COHEN: More of an acceptance of things?

BRENNEN: Absolutely. I have written stories about Paula, and I should give you some of these, because her story isn't just a personal one, her story is a community one. Motivated by the arrival of Paula and the need to provide services and facilities for her, my father and mother campaigned for services for the mentally handicapped in the area in which we grew up and in Northern Ireland as a whole. Both of them did a remarkable job in initiating services for the mentally handicapped that didn't exist before. They really revolutionized not just the services but people's attitude towards the mentally handicapped. It was amazing how many Down's syndrome children came out of the woodwork of the farms in the area when it suddenly became all right to have a mentally handicapped young person. My mother really was the one who did that. Anyway, maybe I'm going into too much detail on that, but it is important, because it is a big part of my philosophy and my attitude towards life.

COHEN: So she was always part of the family, and you were all responsible for looking after her.

BRENNEN: Oh, yes. Absolutely! In fact, perhaps me more than my brothers—not that my mother ever expected me to, but I always felt a certain—

COHEN: How much younger than you is she?

BRENNEN: She is eight years younger. If any of us suffered, it was my youngest brother. He tended to get neglected because of the need to look after Paula, and he suffered a little bit from that. That's the only negative side, I think. But I get along very well with both of my brothers and they with me. We don't see each other all that often, but we talk fairly often. They both

have families.

COHEN: So you grew up and went to school in this community.

BRENNEN: I went to school in this small local village. It was called the Rainey Endowed School, and it was remarkable in a couple of ways that bear mentioning. At the time, it was the only mixed and coeducational school in the whole of Northern Ireland.

COHEN: Now, in Ireland, "mixed" means Catholic and Protestant?

BRENNEN: That's correct. That was also a very important part of my social education. We played on the same teams. I would say that to this day as many of my high school friends are Catholic as they are Protestant. There was no distinction when we were battling the neighboring rugby teams from other villages.

COHEN: These would be people who came from moderate kinds of political households. If not, the children wouldn't have been there.

BRENNEN: Yes, I think that's correct, but it was the only school.

COHEN: It was the only school in that village?

BRENNEN: That was the only school.

COHEN: So it was a state school?

BRENNEN: Oh, yes, all the schools were state schools. The village itself was only about 1,500 people. Kids came on buses from all the surrounding communities, so the total population of the school was probably about 500.

COHEN: In our eyes here, that's a small school.

BRENNEN: So that was one thing—that it was mixed and coeducational. It provided a kind of social education that is important, I think. It had a remarkable math teacher by the name of Dr. [Arthur] Gwilliam. We just called him "the Doc." He had gotten a PhD in mathematics at Cambridge University. I never discovered why he was teaching math at this tiny little Irish rural school.

COHEN: Was he from this area?

BRENNEN: No, he wasn't—he was from Northern England. He was Catholic, however. Now, why he was teaching at this school I don't know, but he really was a brilliant teacher. I have to say that in large measure he is why I am here today. I also had a marvelous physics teacher, James McAteer. Together they provided me with a training in mathematics and physics that—it's hard for me to see how it could have been beaten. It was small, it was personal, and it was really excellent and demanding teaching.

COHEN: Your classes were small?

BRENNEN: Classes were obviously very small. When I got into the last year in this high school, a decision was made jointly by these teachers and my father and mother that I might be able to get a scholarship to go to Oxford University. Now, this was something that happened every twenty years in this village. It was extremely rare. Oxford University was thought of as some very strange place.

COHEN: Why Oxford and not Cambridge?

BRENNEN: I think it was only happenstance. I think the one or two people who had gone before had gone to Oxford.

COHEN: So there was no real distinction [between the two].

BRENNEN: There was no real distinction. I stayed an extra year in this high school to study for the Oxford scholarship exam. It was a great year, because I got personal tutoring advice, and I also had a lot of free time to do other things I liked. I remember it as a great year because I had a certain freedom that I hadn't had before. We worked very hard in high school. If you didn't, you were out.

COHEN: So it wasn't obligatory to go there. You had to earn your keep.

BRENNEN: That's right, absolutely. I think we learned mathematics that Caltech juniors learn today. It was really incredibly demanding. I learned far more in high school than I ever did at Oxford, in terms of the academic subjects.

COHEN: A survival of the fittest, huh?

BRENNEN: It was, I'm afraid. Fortunately, I had the talent for mathematics and physics, so I could do it like a snap. It's not as though I worked awfully hard, it just seemed to come easily. The teaching was excellent. I enjoyed it, and it synchronized with other things I was interested in. But I did a great deal of other things besides.

COHEN: Well, sports were very important in these schools.

BRENNEN: Sports were very important—not like in high schools here, but they were important—and theater was very important. As you know, I've always been a theater person, and I spent a great deal of time in high school on the stage. Every year, we had two big productions, and I was always a part of those productions. We didn't do anything too avant-garde, but we did do Gilbert and Sullivan each year, so I played Koko in *The Mikado* and sang despite my lack of musical talent. [Laughter] I spent a great deal of time on the stage; I enjoyed live theater. Again, I was a little bit of a disappointment to my mother and father, because I didn't have the natural athletic talent they or my brother had. I was determined but somewhat lacking in natural ability.

COHEN: Well, it's good to have a flaw.

BRENNEN: It is good to have a flaw. However I still played for the school on varsity teams in athletics and in rugby. I played with my brother Michael, who's only a year and a half younger than me—that's the one who's a surgeon. Michael has always been my boon companion in life, because he's only a year and a half younger, but he's always been bigger, burlier, and stronger.

COHEN: And a better athlete. [Laughter]

BRENNEN: Yes, a much better athlete. But it was that companionship with Michael, I think, that was a big part of my experience in high school and in my life. So high school was fun—I do remember it with great affection. The school is still there.

COHEN: The troubles in Ireland haven't gone to this village?

BRENNEN: Oh, yes, they've gone there, but fortunately they haven't really changed it drastically. The village in which I grew up is on the border between the predominantly Catholic part of Northern Ireland to the west and the predominantly Protestant part of Northern Ireland to the east. So my village was about fifty-fifty Catholic and Protestant, but the troubles never created much friction within it. Most of the troubles were created by terrorists from the outside, from the poor areas of the cities of Belfast and Derry. I doubt that any of the bombs that went off in my village—and largely destroyed the center of it—

COHEN: So there were bombs?

BRENNEN: Oh, yes. One of my high school friends was blown apart by a bomb. But most of that happened after I left high school. The problems really began in '68, long after I had left my home village.

COHEN: So that wasn't part of your growing up.

BRENNEN: Yes, this high school friend was blown up long after our high school days.

COHEN: So you were studying very hard for this exam, which you did pass.

BRENNEN: Yes, and I did get a scholarship. There's an amusing tale there, because we were given a list on which we had to put down the colleges to which we wanted to apply. No one really knew anything about any of these colleges, so we just put them down in alphabetical order. Balliol was the top one, so I put Balliol down first, and very fortunately it turned out to be the most outstanding in academics of the [Oxford] colleges at that time. I got a mathematics scholarship to Balliol, and going there and adjusting to that—that was really a culture shock of major magnitude.

COHEN: You came from this warm—

BRENNEN: This small, little, warm Irish village with a strong Northern Irish accent—which, given a little effort I can probably reproduce for you—to this strange and somewhat cold [environment].

COHEN: And competitive, I'll bet.

BRENNEN: Yes, and competitive. It took some doing. I have to say, that was not an easy transition. So I have a great deal of sympathy for young people, for freshmen coming to Caltech from some little village in Texas or Iowa to this very cosmopolitan place and trying to make that adjustment, find new friends, and so on. I remember sitting across from a fellow frosh at some dinner early in my time at Oxford, and he couldn't understand a word I said. I guess I was almost forced to change my accent in order to make myself understood.

COHEN: How big a journey was this, going from your town?

BRENNEN: Oh, that was a substantial journey; it was an overnight boat journey followed by a train journey of perhaps four or five hours. It would be like going from here to Europe these

days. It's only 300 miles, but timewise it was almost a twenty-hour journey. Later on I began to fly, but the first few times I had to go by train and boat.

COHEN: So you went by yourself. Your parents didn't come to get you settled or anything?

BRENNEN: I went by myself. I don't know that I would have wanted my parents to go with me.

COHEN: You would have had to take care of them. [Laughter]

BRENNEN: I would have had to take care of them, too. Not that they weren't cosmopolitan; they were certainly the most cosmopolitan among the people in the village in which I grew up. They were very adventurous. When we were very young, my father did something that was quite extraordinary—no one else in the village had ever done anything like it. He took my brothers and me to Switzerland to go skiing on two separate occasions. That's a bit like going from here to Kamchatka today. That was truly regarded as an extraordinary thing to do. We had a great time.

COHEN: I'll bet. [Laughter]

BRENNEN: Of course it was very civilized. It was in the immediate aftermath of the Second World War, and so things were a lot less expensive than they are now.

I'm going to jump back for a minute. I should tell you about a piece of me that we haven't covered. I was born on December 3, 1941, four days before Pearl Harbor, if you can imagine that. We lived briefly in Belfast—briefly because the Germans began to bomb the naval shipyards occasionally. My mother remembers incendiary bombs bouncing off the roof of the house where we were living onto the road. So we were evacuated. She also remembers hiding under a cast-iron table that was issued, because there were no cellars in Belfast. It is built on mud flats, so people were issued these cast-iron tables that you would sit under in the event of an air raid. She remembers sitting under one of these with me. Shortly thereafter, we were evacuated to the countryside. My father stayed in Belfast; he was needed because he was a doctor. That was my departure from Belfast, being evacuated to the countryside to live on a

farm owned by one of my uncles. So that's one piece I wanted to tell you.

The other piece I want to tell you before we go too far in Oxford is that my conviction about the importance of education and the intellect was significantly derived from my mother's sister, Irene, who was a very remarkable woman. I've written her story, and I'll give you a copy of it. Irene was the second woman elected to the Northern Irish Parliament. She was always a pioneer in everything she did. She led a somewhat troubled life in terms of her personal relations but was a woman born way before her time. She would argue with the men. I mean, to us as kids she was a weird alien, because no other woman argued with a man—that was just unheard of in society—but Irene would argue with them.

COHEN: Good for her. [Laughter]

BRENNEN: Oh, yes, absolutely, it was very impressive. In fact, she would win some of these arguments. She would argue with my father, I remember. There would be quite vigorous arguments between my father and Irene over politics or philosophy or whatever. Irene lived with us for some time, because her marriage broke up.

COHEN: One could see how that could happen. [Laughter]

BRENNEN: Yes, that was somehow all connected. But she took an intense interest in us, in the boys, and she taught me the power of logic. She would always question me, "Why do you think that? Why do you think this?" She would also respect my opinion, even as a teenager, when my parents didn't have much time for me. So I learned enormous amounts from Irene. She was a big part of my early life. She just died, about a year and a half ago, in Dublin. She was a truly remarkable person. I've written her story, as well as Paula's story, because in different ways both of them molded my character as much as my parents did.

COHEN: Strong women in your family.

BRENNEN: Very strong women, yes. Since my father was absent so much, it was the women who really brought me up and formed me.

So, back to Oxford. Despite a very difficult beginning, Oxford was just a fun, fun school. It was a whole new society of people, with all these different ideas that I'd never heard of, that no one in Magherafelt would even have dreamt of. I made some great friends there.

COHEN: And language was never a problem?

BRENNEN: Language was never a problem, no. I made some great friends that I still claim to this day. I spent a great deal of time on the stage. I played a lot of sports. I did some learning, but not—

COHEN: It didn't interfere? [Laughter]

BRENNEN: It didn't interfere with the rest of my social life, really, and that was expected. It was a great experience. Balliol was truly a place of supreme intellectual vigor. In the end, I loved every minute of it. I still enjoy going back to Oxford. It's so very nostalgic when I go back to Balliol College and to Oxford.

COHEN: So you stayed there for quite a while?

BRENNEN: I stayed there for a long time. I got my first degree after three years, which was the normal length—I wasn't ahead. As has happened several times in my life, I hadn't given a great deal of thought to what I would do afterwards. I didn't really expect to do quite as well in the final examinations as I did. In fact, I was quite prepared to go to work, to get a job. Doreen and I were actually married at the conclusion of—

COHEN: Was Doreen from the village also?

BRENNEN: No, not quite. We'll come back to that; I'll just finish up. So I did do very well. I got a first-class honors degree. The faculty at Oxford were very keen that I go on and do research, and I thought that was a good idea. The Northern Ireland government was willing to give me a scholarship to do that, because of my first-class honors degree. So it was almost

natural just to drift on and do research and get my PhD, which I did.

COHEN: And they were still paying all your expenses, of course.

BRENNEN: Yes. We were pretty poor, Doreen and I, but we still managed to get by. Doreen and I met the summer before I went to Oxford.

COHEN: So you were just leaving high school.

BRENNEN: We met at a summer resort called Portrush, in Northern Ireland. In those days it was a gathering place where you met other teenagers and hopefully could get a job at one of the ice cream parlors and spend a few weeks there. Doreen was doing that—she got a job at one of the stores in this resort. We met among a big bunch of other kids and we've been together ever since. She went on to Queen's University [Belfast], so we had a long-distance relationship for some time. She got her degree in history. Then we were married. So, let's see, where are we?

COHEN: You're going to do what I would call graduate work now, and you got married at that point.

BRENNEN: Yes. Actually, we got married right after I got my bachelor's degree. We lived together in a little cottage on the outskirts of Oxford. I had the good fortune to have a New Zealander as my supervisor. Before I talk about my graduate work, I should talk about teachers during my undergraduate years, because there were several very excellent teachers I benefited from. Two of them were New Zealanders. One was the engineering tutor at Balliol College, Les Woods. He's still very much alive [d. 2007—ed.]. The other was Don [Donald Lorimer] Schultz , a professor there [at Oriel College] who was a marvelous teacher. He spent a great deal of time with me—much more than he ever had to. Tragically, he died of a heart attack [1987] while hiking in New Zealand, long after I left Oxford. Those were the people to whom I owe my detailed education in physics and engineering. I don't think they're as important in the long term as Dr. Gwilliam and my high school teachers whom I think of—

COHEN: Well, they put you on the track.

BRENNEN: They put me on the track, but they were very important. I did my PhD with Les Woods in fluid mechanics. Fluid mechanics at that time was a very lively subject. It was very attractive mathematically and because of its practical importance. I became very interested in trying to use computers. Computers had only started to be used in solving fluid-mechanical problems. Oxford had only just gotten its first—

COHEN: Are we in the fifties?

BRENNEN: No, we're talking 1963, when I started my graduate work. Oxford had just gotten its first computer. It was a Ferranti Mercury computer. The university was willing to allow some graduate students to use it overnight, if the students would come in and run it themselves. So I learned to run this computer so that I could do these fluid-mechanical calculations. I would do them between roughly midnight and six in the morning. It was truly a computer as most people visualized computers, all lights and switches and so on. Of course, these days computers aren't like that at all. But there were all these lights and switches, and you had to set them all correctly. It would malfunction, oh, maybe once every half hour or so.

COHEN: You had to have patience. [Laughter]

BRENNEN: It ran on ticker tape, so you had to feed this ticker tape into it. You wrote the program on ticker tape, and you fed this ticker tape into the computer to get it to work. So that was my introduction to computers and running computers myself. Once or twice, Doreen even came and computer-sat with me, because to be really efficient I had to go off and type more programs while the thing was running. So I taught Doreen some basic maneuvers on the computer. We would spend one night a week totally alone with this computer, and then the rest of the week we'd try to catch up from our jet lag, as it were—but of course we'd fail, and then we'd go right back to the night schedule. That went on for a couple of years. Then Oxford got a newer computer, an English Electric KDF9, which I also then immediately learned to operate. It was much faster, so I didn't quite need to spend the same length of time to do what I wanted to.

COHEN: So by this time you were on to new independent research projects of your own. That's how it is in England; you go right to a research project.

BRENNEN: Yes, almost right away. My graduate education was.... There were very few courses for graduate students. It wasn't really a very good graduate education, in many ways. Not much was provided for us. It wasn't like a Caltech graduate education. I lacked formal courses in some basic mathematics and advanced mathematics that I had to teach myself; they weren't available as courses. It would have been much better if I had gotten formal courses.

COHEN: That hasn't changed particularly, has it?

BRENNEN: I don't think that's changed. I get the feeling they're still not adequate.

COHEN: English people have three years to get their PhD, and then they're out.

BRENNEN: I know. That was kind of what happened to me. Those years were hard-working years. Doreen and I had our first child there, so we struggled to make ends meet. It was a lot of fun. We still look back on it with great affection.

COHEN: Those good days. [Laughter]

BRENNEN: But it was tough also.

COHEN: Oh, sure.

BRENNEN: I hadn't really given enough thought to what I was going to do after my graduate years. Only at the last minute, when it was clear I was going to get a PhD—and I typed my own thesis; we couldn't even afford to have it typed. Most students had theirs typed, but I typed it on one of these computers that I had learned to operate. I had my thesis on punch-hole tape, believe it or not. For years, I kept those rolls of punch tape that I would feed into the computer and the computer would type out my thesis, because that's the only way I could afford to do it. I still

have a copy of that thesis. For a long time I didn't read it or even look at it, because I thought I would be embarrassed by the quality of the English and the writing. But I looked at it a few years ago, and actually it's quite well written. Technically I knew it was fine, but I didn't expect the quality of the language to be quite as high.

I hadn't given enough thought to what I was going to do afterwards. My supervisor, Professor Les Woods, arranged a postdoc for me at the National Physical Laboratory [in Teddington, England]. It was a very famous government laboratory. It was the place where radar was invented. It was a place that played a significant role in the technical support of the British armed forces during the Second World War. It was beginning to run down a little bit by the time I went there, but I was in the ship division, because I wanted—

COHEN: Now, this was your first job?

BRENNEN: This was my first job. It was really a postdoc, more than a job. I was the only postdoc in this big ship division, which was mostly given over to testing ship models for the shipbuilding industry and testing propellers and water tunnels. They had some wonderful experimental facilities that were almost totally unused—huge facilities.

COHEN: Then you had to move from Oxford to—

BRENNEN: Yes, we moved to London. We moved to Shepperton, where the [film] studios are. We lived right by the Thames River, in a lovely little apartment.

COHEN: So, again, this was a big change for you, although Oxford's not a small town.

BRENNEN: No. It was only sixty miles or so, so we didn't think of it as a big move. Oxford was not a small town, and these were the suburban outskirts of London. It was a different job and intellectual environment than I had experienced, but homewise I don't think it was a big change. We had our second child there; Kathy was born in London. What was good about the National Physical Laboratory was that I was placed under the care of one of the staff members who was a very fine experimentalist. What I had done as a graduate student was essentially understand

computers and numerical solutions of flows and the mathematics of flows, so it was really computational and theoretical. At that point, I hadn't had much experience with experiments. So this year-and-a-half postdoc really taught me how to do experiments, because I had a kind of second PhD, in many ways, under Dr. George Gadd. George was a marvelously talented experimentalist. So I got my theory and my computational training at Oxford and my training in experimental technique under George Gadd.

COHEN: Let me ask you a question about the computer and the fact that you found it a good challenge. Were you rather unique in this, or did many people do this?

BRENNEN: No, there were two or three of us who persuaded them to allow us to use the computer. So I was way ahead of the curve. Why? It wasn't my intention to be at the leading edge of computers, it was more that I wanted to solve these flow problems—free streamline problems—and the only way to do it was to put them on the computer. So I was driven more by wanting to use this new facility than I was by a fascination with the facility itself. The same was true of the experimental part, because I got to use these huge water tunnels and put objects in there and allow them to cavitate, to flow. Both the Oxford and the National Physical Laboratory experiences were in the area of cavitating flows, and those are flows in which the pressure in certain regions of the flow falls below the vapor pressure of the liquid. So you form bubbles, if you like, in the liquid—sometimes *huge* bubbles attached to the object that's creating the low pressure. Those are fascinating and beautiful flows, which I've continued to be interested in ever since. I got to do the experiments on cavitating flows at the National Physical Laboratory and learn experimental techniques. While I was at the National Physical Laboratory and going through this kind of second apprenticeship, a Caltech professor came to visit George Gadd—Ted [Theodore Yao-tsu] Wu. **[Tape ends]**

Begin Tape 1, Side 2

BRENNEN: I think George wanted to show him what the group was doing. Ted and I had a great discussion. I enjoyed very much the opportunity, because I had read some of Ted's work, and I had a number of questions waiting for him when I heard he was going to visit—things that no one other than Ted could have answered. Ted was such a mathematical wizard. We had a great

time, but I didn't think much of it. Then, about three weeks later, much to my enormous amazement, I got a letter from Ted Wu telling me that if I were in any way interested, he would be glad to have me come to Caltech for a year as a postdoc.

COHEN: Out of the blue?

BRENNEN: Absolutely, yes, out of the blue. It was one of the most delightful moments of my life. Let me jump back one more time. This was before I got to Caltech. The reason I was delighted wasn't just the opportunity to work with Ted Wu but also with Allan Acosta and Milton Plesset, all of whose papers I had read.

COHEN: Now, you're not saying Rolf Sabersky. Did that come later?

BRENNEN: That came later, yes. I'm not sure I even knew Rolf's name at that time. But I also loved this country. I want to tell you that bit, because when I was an undergraduate—like my father, I've always been quite adventurous and love to do things and travel places. One summer when I was an undergraduate at Balliol, I applied for a travel scholarship. It's called the Coolidge Atlantic Crossing Trust travel scholarship. This scholarship was a clever idea, because it paid for my way across to the United States, something I couldn't possibly have dreamt of doing during the summer. It gave me some money to tour the United States, and it gave me a long list of names of people in the United States who were willing to put me up for a week or take me to dinner. So I went around the United States for almost two months, starting in Boston with [William Appleton] Coolidge himself, calling up people ahead, going to stay with them, and then imposing myself on their hospitality.

COHEN: That's very interesting. Who established something like that?

BRENNEN: Coolidge himself and the alumni of Balliol College who were in the United States. It had also accumulated other people who had been friends of previous scholarship winners. It was a fantastic experience. I'll give you a little bit of an idea of what I did, because it leads into my eventual transition to becoming a citizen of the United States. I started off in Boston with

Coolidge, who was a somewhat weird old bird.

COHEN: Who had established this scholarship?

BRENNEN: Yes. He had been an alumnus. An American alumnus of Balliol College—William Appleton Coolidge. He had some remote connection with Calvin Coolidge; I forget what. He was a very rich man. When I went to stay with him in Boston, there was a Renoir above my bed. That's the kind of wealth we're talking about—old wealth. There were two of us, and we set off.

COHEN: Somebody else from Balliol who won the award also? Did you know him beforehand?

BRENNEN: Yes, we knew each other, because it was a small college. Tommy [Thomas Richard] Cookson—now headmaster of Winchester College, England. Tommy was a great character, and we had a great time. We are still the best of friends. We went, for example, to Washington. We went down the East Coast, to New York. It was awfully hot in New York—we didn't have a great time in New York. I've never quite liked New York, ever since then. But Washington was incredibly interesting, because we stayed with Nicholas Katzenbach, the deputy attorney general. This was in '63, and we got to go to the civil rights hearings in Washington. I saw Strom Thurmond. It was an incredible experience. From there we traveled south to Atlanta. We stayed with lawyers in Atlanta. We went to New Orleans and then up through Texas. I worked as a cowboy on a ranch in New Mexico for two weeks with people with whom I still have occasional contact. This was a real ranch, so I rode a horse and wrestled cows to the ground and so on. We came across the West, and I was enchanted by the West—the desert and the wide open spaces and the beauty of the place. After that experience, I always said to myself, I've got to come back to the Western United States. I really loved it. Just to finish up, in Los Angeles we stayed with a really crazy, mad commercial sculptor by the name of [Francis] Sedgwick, whose daughter [Edie Sedgwick] actually was a paramour of Andy Warhol. So we saw a little bit of that kind of world.

COHEN: What a fantastic experience!

BRENNEN: It was a crazy, drug-filled society then. We stayed with a big chemical industrialist in Chicago. We stayed with a communist agitator in Detroit. It was an incredible experience.

COHEN: Does this scholarship still exist?

BRENNEN: Yes, and Doreen and I host occasionally. It's been changed significantly. It's been scaled down so that more students can do it. It's not quite as extravagant as when we did it. But it was a great idea. So I had seen the western part of the United States, and I had always said to myself that I'd love to go back there. So when we got this letter from Ted, it was really like manna from heaven. We jumped at the chance. I told Doreen we were only going to go for one year. We came here. People were overwhelmingly kind to us when we arrived.

COHEN: This would have been when?

BRENNEN: We arrived in Pasadena on January 7, 1969. They had already arranged an apartment for us. Cecilia Lin, who still works here but is just about to retire, had stocked the refrigerator of this apartment for us. After coming across from England with two young kids, we were absolutely exhausted and overwhelmed by the kindness that people showed us in providing for our needs. We basically hocked everything we owned to get here.

COHEN: Now, this was going to be just a one-year experience.

BRENNEN: Yes, and it was so generous. It was at least twice as much as what I had gotten as a research fellow in London. I remember it was $10,000 a year, and it just seemed like an enormous amount. We had an old banger of a car when we were in Oxford, which finally gave up the ghost when we got to London, so we hadn't had a car for several years. We were able to buy a secondhand car. We bought a '65 Mustang, which became a classic, but at the time we didn't realize it.

So we arrived in Pasadena, and we had a marvelous time. We thought we would be leaving after a year. I do remember initially being overwhelmed by the intellectual strength at Caltech. Socially, it wasn't a transition for us. The transition from Ireland to Oxford had been

an enormous culture jump, but coming from London to here was not very much of a culture jump for Doreen and me. In fact, I always felt more at home here, because it was more like my Irish society than like English society—it was friendlier, more informal. So we felt very at home here from the very beginning. Intellectually, it was another whole level up, and I felt tremendously challenged. Initially I felt, "I can't make it here; this is overwhelming." I'd say I felt like that probably for two or three months.

COHEN: You immediately went into Ted Wu's laboratory?

BRENNEN: Yes. I started to work with Ted in a number of old areas and a number of new areas. Ted had started to work on microorganism locomotion, and that was a fascinating new subject—trying to figure out how bacteria swim, how a ciliated microorganism swims. I immediately diversified to also work in that area. Ted led a group that did some things for the first time to understand how and why bacteria swim.

COHEN: Now, did you meet other people outside of your—

BRENNEN: Oh, yes, I met lots of people right away, because I was still playing rugby, for example. When they heard I played rugby, I was immediately lured onto the Caltech rugby team, where I played for several years.

COHEN: Would these have been students or faculty?

BRENNEN: Students, postdocs, and a few faculty—very few faculty. I was also still interested in the theater, as you know. So when the students—I forget the year; it probably wasn't the first year, it probably was a little later on, but it fits in with the story better here—somehow the students found out that I acted and that I was Irish. They were putting on this production of *Guys and Dolls*, for which they needed an Irish policeman, Lieutenant Brannigan, and Shirley [Marneus] persuaded me to do it.

COHEN: Without too much trouble.

BRENNEN: Without too much trouble, yes. That was an incredible experience, because there were a number of walk-on faculty parts, but they only showed up at the last minute. There were four of us who were in more substantial roles in *Guys and Dolls*.

COHEN: I remember seeing that. Harry Gray was in that.

BRENNEN: Yes, Harry Gray, Richard Feynman, and Jenijoy La Belle. There were four of us, so I got to know all of them quite well in a completely different context. You know what productions are like; you sit around. Especially if you only have a small part, you sit around for a great deal of the time waiting to go on. So I got to know Harry very well. I happen to know—I probably shouldn't—that when my tenure case came to the IAC [Institute Administrative Council], Harry was particularly supportive, even though he knew nothing about what I actually did. I also got the opportunity to talk a good deal with Feynman, who was participating in his first theatrical production. He played the bongo drums in the Cuban nightclub scene.

COHEN: Was this one of Shirley Marneus's plays?

BRENNEN: Yes, this was one of Shirley Marneus's annual student musicals. Feynman was amazing, because he had never been in this kind of situation before, and he wanted to know why you did this and why you did that. So there were always questions about why. I often had to say to him, "You know, I've never really thought about that. I really don't know why I do that or why we do this."

COHEN: He made an intellectual enterprise out of it.

BRENNEN: He did, absolutely, and I really had never thought of any of these things before. So that's how I got to know Feynman, that's how I got to know Jenijoy, that's how Feynman got to know Jenijoy, and that was the beginning of Feynman's role in the Jenijoy La Belle affair.

COHEN: We'll come to that. Let's get you through this first postdoc. [Laughter]

BRENNEN: Right. The postdoc was—after nine months or so Ted casually said to me, "I hope you're going to stay a second year." I said, "Oh, great."

COHEN: You had nowhere else to go. [Laughter]

BRENNEN: I had nowhere else to go, unfortunately. Somehow it did just kind of stretch on. In those days there was a career progression that they later decided was not very healthy, and they interrupted it. I went from being a research fellow [1969-72] to being a senior research fellow [1972-75] to being a research associate [1975-76]. So I had almost six or seven years of a research career before I ever got onto the teaching line. That was great, because I really had a chance to establish a number of research lines and to focus entirely on research for a long time. Then I was appointed an associate professor [1976].

COHEN: With tenure?

BRENNEN: Did I get tenure? I forget.

COHEN: Evidently it didn't loom over you. [Laughter]

BRENNEN: It didn't loom over me greatly, though we worried about it. I remember very vividly when they finally told me I had tenure. Doreen and the kids were down at the Caltech pool, and I walked down there to tell her. I remember that moment very vividly, so it must have worried us significantly, even though I don't know whether it was a big deal or not. Anyway, it's kind of strange, because I was involved with students even as a postdoc. I taught some classes. I enjoyed teaching. I've always enjoyed teaching, so it's a little odd in some ways that I should have spent so long on the research track without being a professor.

COHEN: Well, you evidently were very good on the project, and Ted Wu must have had the money.

BRENNEN: That's right. That's basically what happened. Now, during that time, Allan Acosta had the office next to me in the Karman building [Karman Laboratory of Fluid Mechanics and Jet Propulsion], and I became very friendly with him and began to do some research with him on the side. Ultimately I probably did more work over my career with Allan than with anyone else. He and I wrote a number of papers that are now thought of as classic papers. We built a number of experimental facilities together that were unique and remain unique.

COHEN: Let me ask you a question, because you said something that really intrigues me. When you came, you felt very comfortable socially, but the intellectual jump was such that.... Because you would think that being at Oxford—or did you not have access to those people at Oxford, because here it's much more democratic, in some sense?

BRENNEN: Let me define it more carefully. I felt that in a broad sense I was better educated than my contemporaries—the other postgraduate students, postdocs—because I was still pretty young. I mean, I knew much more about history and politics and philosophy and drama than almost all of them. So my education at Oxford had been tremendously valuable in a broad sense. But in terms of the specific skills I needed—mathematical skills, knowledge of advanced physics—it was lacking. It was below theirs, and it took me a time to catch up.

COHEN: So they had come out of school much better prepared—from the American system.

BRENNEN: Yes. My remark reflected deficiencies in my graduate education and deficiencies, perhaps, in the quality of the researchers at Oxford. They weren't of the same incredibly high quality.

COHEN: Of course, here you are with the best. Had you gone someplace else, that may not have been the case.

BRENNEN: Exactly. So people like Plesset, Wu, and Acosta were.... I may have encountered one or two people like that briefly elsewhere. To be working with them on a daily basis was extraordinary to me, and very demanding initially. But I think that was fairly transient. I mean, I

think I caught up with them quite quickly. I had to do a little bit of hard work. I sat in on a class of Wu's, and I took some lectures from Plesset, and so on, which helped greatly, but a lot of it was also studying on my own.

COHEN: So you spent those seven years here thinking that this was not permanent.

BRENNEN: Yes, I think so. I was worrying that it might not be permanent. I applied for several jobs back in Oxford, which I failed to get. That always sticks in my craw a little bit, because I know I was the best person for one of the jobs in Oxford that I applied for, but being Northern Irish was something that was not looked on very favorably then.

COHEN: Even at that level?

BRENNEN: Oh, yes. That's an aspect of English society that always.... I try not to be too paranoid about it, but I've always felt some slight finger of suspicion from people in England. Even today, when I tell someone from England that I'm Northern Irish, you can see a little look of concern on their face—I suppose rightly so. I mean, they saw those years of bombings and mutilations and violence, and they associate someone from Northern Ireland with that. Here, I've never felt that.

COHEN: Well, people probably didn't know the difference between Northern and Southern Ireland. It didn't come from fairmindedness; it probably came from ignorance. [Laughter]

BRENNEN: Exactly. So I never felt that here. But when I was in Oxford—this is before the violence—I did experience certain discrimination. I remember one particular friend who wanted me to come to his somewhat palatial home for the weekend, and his mother, when she found out I was Irish, wouldn't have me. You must have experienced this to some degree in this country. There was a level of anti-Irish feeling in England that was hurtful to me and always colored, to some extent, the way I looked at the English and the way I felt about England, even though I had a marvelous time.

COHEN: So you had no pull of conscience when you decided that you were going to be a U.S. citizen?

BRENNEN: No, I didn't. I honestly didn't. I didn't have the slightest doubt that that was the right thing to do, for me and my children and everything else. In fact, I became a citizen as soon as I could. There's such a tradition in that, whether Northern or Southern Irish. I remember when I left for the United States, it was almost like a little playlet. There is a scene in all Irish families where the eldest son, the adventurous one, goes off to seek his fortune and is never seen again. I'm convinced that my mother, despite the fact that she's a very cosmopolitan woman, visualized never seeing me again when I left for the United States.

COHEN: That was the history of the people going.

BRENNEN: Exactly, that was the history of people, when they went. That's basically one of the other reasons I always felt comfortable. While discrimination is certainly not absent from this society, I always felt that there was a better chance here that one would escape it.

COHEN: Maybe this is a good place to stop.

BRENNEN: OK. **[Tape ends]**

CHRISTOPHER E. BRENNEN

SESSION 2

November 26, 2002

Begin Tape 2, Side 1

COHEN: Good morning, Chris. Here we are, in the Rare Book Room again.

BRENNEN: Good morning, Shirley.

COHEN: So we now have you appointed a tenured professor at Caltech.

BRENNEN: That's right. It was a fairly seamless transition from the ranks of senior research fellow and research associate to professor. I don't see any great jump there, because I had already been teaching a number of courses. During those seven years or so when I was on the research line, I was often asked by Allan Acosta, Milton Plesset, Ted Wu, or Rolf Sabersky to teach a class or classes, and occasionally a term's worth of classes, on subjects varying from fluid mechanics to magnetohydrodynamics. I remember Milton Plesset asking me to teach a course on magnetohydrodynamics, and I knew nothing about it when I started.

COHEN: A good way to learn. [Laughter]

BRENNEN: I learned it in a hurry. I remember all of them asking me to teach a term's course on cavitation, which was something I knew something about but they knew much more. That was something of a trial by fire, because it was more of a seminar series, and the audience consisted of the graduate students and the professors—Milton Plesset, Allan Acosta, Ted Wu, and others. I was lecturing to them on a subject they knew more about than I did, so that was quite an effort to bring myself up to speed in all of those subdivisions of the area that I had perhaps paid relatively scant attention to.

COHEN: Now, were these classes big or small? They're big in engineering, aren't they—for Caltech, anyway?

BRENNEN: Undergraduate courses, yes. But these graduate courses of which I just spoke were very small. There probably were fifteen people in the room for those lectures on cavitation. That set of lectures grew over the years, until I finally published it as a book: *Cavitation and Bubble Dynamics*, published by Oxford University Press in 1995. It's my main *large* publication, as it were. I guess it's what I'm best known for around the world.

There were many opportunities for teaching. When I first began to teach undergraduates full time as a professor—I can't remember whether I taught my first undergraduate classes before or after I became a real teacher. I do remember the first undergraduate class I taught in fluid dynamics. I'm teaching that very same class this term [ME 19 Fluid Mechanics and Gasdynamics].

COHEN: Right now? [Laughter]

BRENNEN: Right at this moment. It's a class that I always enjoyed teaching.

COHEN: Well, there's nothing like stability. [Laughter]

BRENNEN: Yes. I've taught many other classes as well, but it just so happens that I'm teaching that one. But that first class was somewhat intimidating, because I remember—

COHEN: Now, what year would we be talking about?

BRENNEN: Somewhere in the middle seventies. I can't remember, but I can look it up, I have the records. I do remember that it was somewhat intimidating, because, first of all, I had not taught undergraduates before, and it's a lot more challenging to teach undergraduates than it is to teach graduate students. They're less invested, they're more skeptical, and sometimes they're less interested, so it's more challenging. But there were two students in that particular class who were challenging. One was Till Liepmann. Hans Liepmann, of course, was one of the local experts on fluid mechanics, and here I was lecturing to his son.

COHEN: He was not in awe of a Caltech professor. [Laughter]

BRENNEN: No, he wasn't, and I could visualize him going home in the evening and telling his father what he had learned in fluid mechanics that day. However, it turned out that Till was a very pleasant young man, and I enjoyed having him in class. Also, one of Al Hibbs's sons was in that class, so I had the same vision of him. That was a little bit of a challenge, I have to tell you. But I always enjoy teaching, and I look back on those early days as an apprenticeship. I think teaching is something that we receive extraordinarily little instruction on.

COHEN: It is just assumed here.

BRENNEN: It's assumed. I don't think it should be, in some ways, because I think a lot of errors are made. I think minimal instruction in how to teach and what kinds of things to look for would be very valuable and not very time-consuming. I'm not sure why we don't do that.

COHEN: Well, I think it's the same thing as I said before respecting professionalism, which is that anybody thinks they can teach.

BRENNEN: Yes, exactly. So I learned, making mistakes along the way. It only took one or two years to learn how to teach undergraduates, because, as I said, it was more challenging. On the other hand, the lessons were more obvious, and you could correct them. I soon became comfortable that I knew what I was doing in teaching undergraduates. I'd have to say it took much longer to learn what I was doing in the much more intimate context of teaching graduate students to do research, because that's a very much deeper process. It's like bringing up children. In fact, I think of my former graduate students as my academic children. I have some thirty of them now, all over the world, which we'll touch upon at some point later. It took quite a while before I realized what I was doing in teaching them how to do research and how to become academically competent and excellent.

COHEN: How big were your undergraduate classes? They were probably big in engineering.

BRENNEN: Yes, they were. In this class of which I spoke, ME19, which is one I've taught quite often through the years, there are usually between thirty and forty-five students. This term there are about forty students.

COHEN: Do they have a lab with that?

BRENNEN: No, that's strictly lectures. We do some lab visits, but there is no lab. It's one of the core courses in mechanical engineering, a junior-level course. Teaching is something that I think I've learned how to do. I don't mean to sound arrogant about it, but I wish I'd had a little more instruction when I was first starting, because there are obvious mistakes that one makes.

COHEN: Well, we know that there is some virtue to learning from your own mistakes.
[Laughter]

BRENNEN: There is, as long as the students don't suffer too much from them.

COHEN: Aside from the teaching element of being a professor, you were suddenly also in the policy-making area, which you're not in as a research fellow.

BRENNEN: That's right. As a research fellow, of course, I had become aware of the process of writing proposals, of getting funding for research, so that was relatively seamless. I continued to collaborate with some marvelous people with whom I enjoyed collaborating. As I said, they were Ted Wu, Allan Acosta, Rolf Sabersky, all of whom I had joint projects with at different times, most fundamentally first with Ted Wu in the early years, and then in the middle and later years with Allan Acosta, with whom I worked very closely for a long time. They were both marvelous colleagues, people for whom I have enormous respect, both intellectually and as people, and they made it very easy for me to make those various transitions. I feel very fortunate having had such great mentors, all four of them. I didn't work with Milton Plesset very much, but he was a substantial figure in my very earliest years. I did work very closely with Ted Wu, Allan Acosta, and Rolf Sabersky. There were a few others. When I counted up recently how many faculty I had written other papers with, it was quite a substantial crew. Some of them I

look back on with a little sadness. Chuck [Charles D.] Babcock was a very fine young professor who helped me a lot. The paper I wrote with him has become something of a minor classic in the area of aeroelasticity.

COHEN: He's no longer here?

BRENNEN: He died of cancer [1988], at quite a young age. He was assistant provost at the time. You probably didn't know him.

COHEN: No.

BRENNEN: He was a very fine man. I worked with Tom [Thomas K.] Caughey quite a bit. I worked reasonably closely with people like Jim [James K.] Knowles, Brad Sturtevant, and Fred Raichlen. I should have mentioned Fred before the others. So I've had a lot—

COHEN: You're very into the engineering school. What was your relationship with the rest of the institute—physics or mathematics? Even the administration.

BRENNEN: We're going to come to the administration a little later. I'm setting that aside for the moment. Academically, I had a fair bit of contact. For example, when Ted and I were working on microorganism locomotion, we worked very closely with Chuck [Charles J.] Brokaw and with Howard Berg in biology on microorganisms, trying to figure out how they managed to swim and why they made the motions they did. That was a very exciting time, and it really did require a combination of engineering expertise and biological expertise. I did a little work on geological problems, on the Earth's mantle and things like isostatic recovery, plate tectonics, and the convection patterns associated with plate tectonics. I had some interaction with geology on that; people like Lee [Leon Theodore] Silver, for example, helped me. In physics, I overlapped a little bit with Tom [Thomas A.] Tombrello's group—not with Tom himself but with Peter Haff, who was a research fellow with Tom Tombrello. That was when Rolf Sabersky and I were working on trying to understand granular flows. I didn't ever work much with anyone in mathematics or chemistry, although I had a lot of overlap with chemical engineering. I worked

quite closely with Gary Leal, who's no longer here, and to some extent with John Brady and Rick [Richard C.] Flagan, all of whom are in areas that overlap mine. That's more engineering. There's a natural overlap at that point, which doesn't depart much from my expertise in engineering. I'm not sure I've covered all of the people.

COHEN: Do you think you had this relationship because it's a small place and they were right here?

BRENNEN: Absolutely, and there were personal friendships involved. Some began as academic and became personal friendships; some were the reverse. That's one of the great advantages of Caltech, the fact that you rub shoulders, whether it be at play readings or at the Athenaeum Round Table with people from all these disciplines. I certainly have gotten to know a lot of people just by sitting around at lunch, talking to Marshall [Cohen] and to all the others that come to the Round Table at the Athenaeum.

COHEN: That's a great strength.

BRENNEN: It's a tremendous strength. I don't think I know of anywhere else where that happens. There are many other places where they think it happens, but it really doesn't.

COHEN: Although there's a lot of moaning now that the young people are so pressured they eat out of their brown bags. That's called the brown-bag syndrome. [Laughter] But they don't come to socialize.

BRENNEN: I think that's a real problem, part of a larger pattern. There's so much pressure on producing research results that it has detracted significantly from the rest of the missions here at Caltech, including the educational mission. It has suffered by an almost excessive focus on research and results. I think we're going too far. I really do think we've made a big mistake. We don't have young people involved with the Y [the way we used to]. I think ultimately the research will suffer from that, because we begin to lose that kind of collegial atmosphere, that collegial tradition.

COHEN: I wonder if that's built in to biology, the way it's practiced now, with these huge groups—

BRENNEN: I think it is. I think biology is probably the worst. They haven't bought into that [collegiality] at all. I don't remember the biologists really being much involved in that at any time, but it's worse now, I think. Maybe I'm just getting old.

COHEN: No, I think if you go into the Athenaeum at lunchtime, you don't see very many young people, and it's too bad.

Well, when did you start getting involved with the administrative part of life here?

BRENNEN: That was also very early, because Allan Acosta had always had a strong interest in teaching ME students and had been involved in a minor way in student affairs, on the UASH [Undergraduate Academic Standards and Honors] Committee and so on. So, early on, when he and I first became friends—he's a sailor, and he used to get me to crew for him. We'd go across in his boat to frosh camp on Catalina Island. So I think the first two or three frosh camps I was at—

COHEN: Your sailing episodes. [Laughter]

BRENNEN: Sailing episodes. But I got to meet students. I remember it was in that way that I first met my very good friend David Wales. I mean, I have a number of very good friends on the faculty, and one with whom I've never done any real work is David Wales. David Wales and I became friends a long, long time ago, at frosh camp on Catalina Island, and we remain great friends to this day. He and I do a lot of hiking together, for example, and he's one of my confidants.

I became involved with students long before I became a professor. So then when I became a professor and started to have advisees, I knew a little bit about student life. I had been to dinner in the student houses many times. I had been in student dramatic productions, such as *Guys and Dolls,* which we spoke of last time, and other productions as well. So I had gotten to

know quite a bit about student life. I think I went to the very first student-faculty conference before I was a faculty member. The first one was held at JPL [Jet Propulsion Laboratory]. I continued to have that interest, obviously, when I was teaching. I had one particular advisee—her name was Barbara Turpin—who came to me one day. She was a nice young woman. She and I talked quite a bit. Some advisees come to see you a lot and some never come to see you. She was one of those who came quite a bit to see me. We had talked casually about problems of student life. She came to me one day with a strong argument that I should think about being master of student houses. So before I knew where I was, I was being interviewed.

COHEN: She was part of this committee looking?

BRENNEN: Yes. She was the president of Dabney House at the time and a member, therefore, of the committee that was looking for a replacement for Sunney Chan as master of student houses. Before I knew where I was, I was being interviewed by—and I remember the interview—there must have been twenty-five people interviewing me.

COHEN: Mostly students?

BRENNEN: Students, but also the faculty committee. I remember there were Andy [Andrew P.] Ingersoll and Jack [John H.] Richards and a number of other faculty—I don't remember exactly who. That was a little startling, to say the least—to find myself suddenly being pressured into taking on this task. I really hadn't thought of that kind of role for myself at all. After some consultation with Doreen, we decided to do it, and we moved from where we currently live, in Sierra Madre, down to 355 South Holliston, the master's house, where we lived for four years [1983-1987].

COHEN: Is that the Steele House? I remember when David Smith lived there.

BRENNEN: David was the first occupant of that house after it was fixed up. I still characterize being master as follows: I think it was both the most demanding task I've ever undertaken, and will ever undertake, and at the same time the most rewarding. Those two things really do go

together, because the challenge and the demand on one's emotional reserves in dealing with the very real problems of young people was something that took a large toll on me. At the time, I realized I was doing something that was really quite meaningful and something that gave me enormous personal satisfaction. I knew that no one else was really going to thank me for it, particularly. They ended up thanking me more than I anticipated, I have to say—I didn't expect that, necessarily. Indeed, I was told very clearly by all of my predecessors, "Don't expect any thanks from anyone, and especially from the administration, for taking on this job." So I had very low expectations in that regard. But I enjoyed the students before that, and I enjoyed them immensely when I was doing the job, and I was able to help some people in a very positive way, I think, and that was very rewarding. I remember—I don't mean to overdramatize, and this might be a little overdramatic—but I remember a couple of students walking up on the platform to get their degree, and I knew they wouldn't be alive if I hadn't been there. That's pretty heavy stuff.

COHEN: So this really took a great deal of time, and not from your teaching or your research life, but rather from your domestic—if I may use that term—your family life.

BRENNEN: I think so, yes, mostly from the family, and a little bit from my academic life. Again, I was blessed by my friendship with Allan Acosta—and with Rolf Sabersky, by that time—because they realized this additional load, and they filled in in a number of respects and helped me to complete reports or finish proposals or whatever when I was maybe overwhelmed by the things I had to do as master. It was an incredible experience being master. What I've written up are just some of the major events. It was almost endless, the individual problems of young people, and I came to have great sympathy for them. If I were to characterize it generally, I think there's an expectation on the part of many of the faculty and administrators here that because the students who arrive as frosh are so competent and accomplished academically, that they are therefore also relatively stable emotionally and psychologically in comparison with their peers, and that's simply not true. That was the biggest shock for me—that so many of them came from broken homes, from very dysfunctional families. Indeed, a really shocking number—and I have to say I mean that, a shocking number—had suffered some kind of abuse as children, whether it was psychological, physical, or sexual. When I began to hear the litany of problems, I was

deeply shocked by the number of students who had suffered in this way, and I remain shocked by that. I think it's a hidden shame in this country. I think it comes about in part because of the fluidity of our society. Things like that would almost be unimaginable in the village life in which I grew up.

COHEN: Well, everybody knew what everybody was doing.

BRENNEN: Exactly—and the extended family knew what was going on. Here you have all these isolated little nuclear families that go wrong much more often than we really like to think.

COHEN: I'm not surprised that you got all of this. I mean, we don't really know what's going on.

BRENNEN: Exactly. So I'd have to say that not only was it a shock to me that these problems exist, but it was also very clear to me that we really weren't addressing those problems. Even today I'm not sure I have an answer, other than that it was important for me to try and convince others in the administration of how important these problems were, of how much responsibility we must have to—

COHEN: Did you get a sympathetic ear from any of them?

BRENNEN: From some. Certainly from Jim [James J.] Morgan, David Wales, and the faculty who served as the vice presidents of student affairs. I thought they were very sympathetic people. They knew enough about it that they certainly understood. However, I don't think any of us quite got the feeling that these problems were regarded as very important by the central administration, and I think that's even more true today, I regret to say. If I were to measure how far we've come, as it were, I think we've got some excellent people on the staff and we have services available. I think people don't really want to think of that seamy underside of the institute, if you like.

COHEN: It's too hard.

BRENNEN: It's too hard, and they don't really know what to do about it, but I wish I felt that they cared more. It took people to care. As you said earlier, this is not an area in which the amateur should meddle, and we have some marvelous professionals. My role as master really was to connect up the people who needed help with those professionals, but at the time there was no one other than the master who cared enough to make those connections. Often they were simple; sometimes they were very hard to make. I saw that as my role, as a facilitator trying to both understand the problems and connect up the professionals with those problems. But the central and most important thing is to care, and you can't make people care.

COHEN: No. Well, they have a huge job and they're doing their job.

BRENNEN: Yes, exactly, absolutely. Doreen thinks I care too much, and she may well be right.

COHEN: That's really possible. [Laughter] I think you need a certain distance to really be effective.

BRENNEN: You do, but that distance can very easily be too great, where you just get to the point where you say, "Well, I'm doing my job."

COHEN: How much of your day actually was involved, or did it vary from time to time?

BRENNEN: During the workday, I'd typically spend two or three hours in the afternoon, and I'd spend many hours at night and on the weekends. These problems tend to come to a head in the middle of the night and after drunken parties on the weekend and times like that. Just about every night that I was master, I would walk a particular route. I set out at the very beginning to do this, to describe a little bit of what I did. I have great respect for Sunney. He really was the first one to tackle the drug problem among our students—not that our students were any different from students elsewhere, but this was a time when there was a major problem. Sunney tried to tackle it. I have great respect for what he did, but Sunney wasn't particularly physically endowed, and he had alienated some of the students by confronting them.

COHEN: Maybe the fact that he wasn't from the same culture didn't help either.

BRENNEN: It could be. I decided right from the get-go that I would walk around the houses at night, and particularly that I'd walk through Dabney House, which had a reputation of being the center of the drug culture.

COHEN: Is that right? OK. Now, we had girls and boys together at this time? It was co-ed?

BRENNEN: It was all co-ed. I didn't have much to do with students at the time that it was becoming co-ed. I decided I'd walk through at a time when most of the students were most active, between eleven o'clock and midnight. I remember the first time I walked through Dabney House, because I could see them watching me, and a brick flew through the air and went crashing on the ground in front of me, not intended to hit me in any way but intended to scare me off so I wouldn't go through there. So I remember that quite well. But I knew a few students, you see. I had the advisee who was president of Dabney at the time, so I knew a few of them, and I soon got to know more.

COHEN: How about the RAs [resident associates]? Weren't they there?

BRENNEN: Yes, they were there, but the RAs are always kind of in a difficult position. The RAs have to live with the students, so they are halfway between being students and being administration. They had to be that way. I wasn't about to change that, because that's the only way they could find out what was going on. There was a marvelous RA in Dabney House with whom I'm still very friendly, a fellow by the name of Andy [Andrew P.] Dowsett, who is now a chairman of biology at one of the Claremont Colleges. He works with Ed [Edward B.] Lewis here quite a bit. Andy was the RA in Dabney House at the time, and he and I worked very closely together. He worked slightly behind the scenes, if you understand what I mean. I *was* the administration walking through there. I would walk down through Fleming, through Dabney, back into Blacker, through Ricketts, and then up around through Ruddock and Lloyd and Page, and that was my route every night.

COHEN: So that took at least an hour?

BRENNEN: Yes, sometimes maybe a little less, but it usually took about an hour. I would stop and talk to students. I often looked the other way; you have to sometimes. I would smell marijuana smoke from time to time, and I didn't go and try to hunt it out, because I was trying to deal with the larger issues and the larger problems. But I got to know the students well, and after a year or two they got to understand. I wanted to establish a presence, which is something I continue to emphasize to this day. I emphasized it particularly when I was vice president of student affairs [1998-2002]—that we had to have a presence in there to avoid the kinds of unacceptable behaviors and unacceptable social events that otherwise can occur. So that's what I did right at the beginning, and it was a bit scary at the beginning. But my upbringing in Northern Ireland—

COHEN: No bombs? [Laughter] Well, I shouldn't say "no bombs."

BRENNEN: No, you shouldn't say "no bombs," because explosives are something that our students have always loved to play with.

COHEN: You remember that I was a chemistry teacher in high school. I know what they like to do. [Laughter]

BRENNEN: Yes, there are always pyrotechnics here. That was another set of issues, and one was concerned with that, but in the beginning it was substance abuse that we were most concerned with.

COHEN: Those were the years when that was going on everywhere; it wasn't unique then.

BRENNEN: As I learned more and my position strengthened, I remember confronting drug dealers. There was one off-campus house—

COHEN: You mean a drug dealer who wasn't part of the Caltech community?

BRENNEN: Well, he was a friend of one of the students at that time and had set up shop in one of the off-campus houses. I confronted him. I physically threw him out, with security waiting around in the background to make sure that things didn't go wrong. I've never been particularly timid, I'll put it that way.

COHEN: It was part of your heritage. [Laughter]

BRENNEN: It was part of my heritage and part of playing rugby when I was young. The presence of people like that and their involvement made me angry enough to do it even if there might have been a danger. It's scary to think back on some of the things I did. I remember a safe, too, for which we couldn't find a key. We were pretty sure it had speed in it. Speed was by far the worst. Marijuana didn't bother much, so I didn't bother that much with marijuana. However, when students were growing it, we did bother. We had to get rid of it, right? They tended to grow it in some of the off-campus residences. Speed was by far the worst, because it induces a kind of neurosis, a paranoia that is almost chemically indistinguishable from paranoid schizophrenia. The trouble is the students would take speed in order to do their exams—

COHEN: So it was part of the pressure of the institute that was making them do this.

BRENNEN: Yes. We had to get rid of the speed. Some of the hallucinogens were a real problem, because students would endanger themselves by taking these hallucinogens. One young man regrettably tried to walk across the 210 Freeway in the middle of the night and got mangled. Maybe I shouldn't talk about this.

COHEN: No, I think you should talk about it. I mean, who else is going to talk about it? This was a bad time, and Caltech was not exempt from it. The fact is that you're saying that perhaps the pressure of the institute—

BRENNEN: Yes, to some extent.

COHEN: But I think it was the times.

BRENNEN: It was the times, yes. I don't know that we've ever quite completely escaped from it. I don't mean to imply that we're lily-white, but I think that the combined efforts of Sunney and myself really made a big difference with the drug abuse.

COHEN: Was the administration—I'm talking about the provost and the president—were they really aware of this?

BRENNEN: No, they didn't want to know about it. Sunney used to tell me that when he became master [1980], [the president] told him, "Go take care of it." He [the president] didn't want to know anything about it.

COHEN: "That's your job."

BRENNEN: "That's your job; you deal with it." In my early times, that was also the attitude, but it also gave me the freedom to do what I thought I had to do. There was some advantage to that—they didn't interfere.

COHEN: Did you ever actually get somebody expelled because of drug use?

BRENNEN: Yes, a number of people. Some had a combination of drug use and psychiatric disturbances. If I found someone dealing, they were out, period.

COHEN: That was it.

BRENNEN: That was it, for good, absolutely. It was very difficult to get definite evidence, very difficult. That was a real challenge, but we did it. So I think that was one area in which I made a major contribution to the institute.

COHEN: It sounds like Doreen was a good helpmate in all of this.

BRENNEN: Oh, absolutely. I never could have dreamt of doing it without her. We had dinners for students every Sunday night for four years. Doreen started off preparing those the first few times, then she realized it was an enormous task. After that she would order in food, so we would have Chinese or Indian or Mexican. She'd order it in and it would arrive. So we had thirty or forty students every Sunday night for four years.

COHEN: Oh, what a job!

BRENNEN: It was kind of fun, and finally kind of easy to do, really, that part of it.

COHEN: But after four years, you'd had quite enough.

BRENNEN: Oh, yes! And Doreen couldn't wait to get back to her own home, up in Sierra Madre. We moved back to Sierra Madre, to the home that we still occupy to this day.

COHEN: What year was this, that you then became just a professor again?

BRENNEN: I became a professor again in '87.

COHEN: You indicate that you were really quite burned out at this point, which is understandable when I listen to what you were doing.

BRENNEN: I was very burned out, absolutely, but amazingly enough, only a year later I agreed to be the dean of students [1988-1992]. That was not a nine-to-five job. It was a halftime job, but it was much more easily partitioned.

COHEN: Well, you weren't looking for eruptions. [Laughter]

BRENNEN: Yes, I wasn't. Although, because I had gained so much experience with all of the

seamier side as master, I was drawn into that side of things more than maybe I would have been otherwise. Since I realized the importance of that kind of social side of student life, maybe as dean I got a little too far over in that direction for my own good, though it seemed essential that I do so at the time. It was an interesting job, being dean. I had much more contact with the faculty and with the administration as dean than I did as master of student houses, of course, frequently dealing with problems in classes and so on.

COHEN: Was this a vice president job yet?

BRENNEN: No, it was dean of students. I worked with some marvelous people. When I began as dean, Jim Morgan was the vice president of student affairs, and Gary Lorden succeeded him. I knew and respected both of those people enormously. I had good bosses as both master and dean in that sense, people who really understood—

COHEN: What does the dean actually do? What was your job? I think that's all changed now.

BRENNEN: The dean hasn't yet changed very much. I was dealing with academic problems of students. Students would come to you for advice, for permission to drop courses. They would come to draw your attention to the fact that there was something going wrong in a class. Perhaps the most important thing was overseeing the honor system and working with the people on the Board of Control. Whenever there was a conviction for an honor system violation, a recommendation would automatically come to the dean. The dean would have to review the case and decide whether to uphold the recommendation of the Board of Control. So the dean is the person who expels people, usually at the recommendation of the Board of Control.

COHEN: Right. So that means you would interview the student again. You'd look at all the stuff again.

BRENNEN: Yes, you would review the case. You had to review each case to make sure there wasn't something wrong. It was part of the appeals process. It worked very well, but it was also time-consuming. You dealt both with the academic problems—honor system violations,

cheating in class, cheating on exams—and also with violations in the social context.

COHEN: But it was strictly students?

BRENNEN: Yes.

COHEN: I mean, the problem has moved in recent years, but we can talk about that later.

BRENNEN: Yes, absolutely. But this was strictly students—strictly undergraduates; there's a dean of graduate studies who deals with the graduate students. There was parents' day, there was frosh camp—we ran frosh camp—those were all things that the dean—

COHEN: So there was still a lot of student involvement.

BRENNEN: There was still a lot of student involvement. But it was more of a partitioned job.

COHEN: Right. So you were still teaching and doing your research?

BRENNEN: I didn't teach every year. I only taught some of the years while I was dean. So by the time those four years were up, I certainly thought I'd had enough…. **[Tape ends]**

Begin Tape 2, Side 2

COHEN: You didn't have to move into a new house for this. You stayed in Sierra Madre.

BRENNEN: Absolutely. We were still in Sierra Madre. Doreen still was quite involved with the students and student events. In 1992, I stepped down as dean. I didn't really anticipate being involved for that long. So then for six years I went back to just being an academic. I was head of mechanical engineering. That wasn't a major job, but it did require some administration. So I was executive officer for mechanical engineering during at least five of those six years [1993-1998].

COHEN: Who would have been the president then?

BRENNEN: That was [Dr. Thomas E.] Everhart. Everhart was president for most of that time. I dealt with him a little bit, but not that much. Mostly I dealt with the division chair, who was Paul Jennings, and then John Seinfeld, so Paul Jennings and John Seinfeld were the people I dealt with mostly. However, mostly I dealt with the faculty. Mechanical engineering was still one of the most popular options. There were many students in mechanical engineering, so I had work to do to keep that option going. Then, a bit to my surprise, when Gary Lorden stepped down as vice president of student affairs, I was asked to become vice president, in 1997. I did wonder about whether I should do that, but [Dr. David] Baltimore came and interviewed me even though he wasn't the president at the time. He had been appointed president, but he hadn't arrived yet.

COHEN: So this was five years ago.

BRENNEN: Yes, right, five or five and a half years ago. He convinced me to take the job, so I did. It was a less rewarding job.

COHEN: Now, this was vice president—

BRENNEN: —of student affairs. So I was in charge of everything. That was managing the staff.

COHEN: Did you have to move into the administration building?

BRENNEN: Yes. I moved into Parsons-Gates [Hall of Administration]. I had an office in Parsons-Gates. I had a large management task. I forget how many people worked for student affairs. If you count all of the coaches, who have very small jobs, I think it could be close to a hundred people who worked at student affairs. So all of the personnel problems essentially are associated with that.

COHEN: You were not teaching then?

BRENNEN: No.

COHEN: This was a full-time administrative position.

BRENNEN: On the books, it was halftime, but it really was much more than halftime, because of all of those—

COHEN: Halftime jobs are always suspect.

BRENNEN: Absolutely. It was much more than halftime, and very much a bureaucratic job and a management job, managing all of these people and then also intersecting with the rest of the administration on a wide range of issues, not just those associated with students. I'd have to say it was a less satisfying job.

COHEN: You probably missed the interaction with the students.

BRENNEN: Yes. I didn't get much of that, and that was the part that I really enjoyed and felt most competent in doing. I did have some interactions with students, but not as much as I'd had earlier. It was much more frustrating to deal with all the personnel problems associated with management and the administration. I say that, but of course you have to take that comment in the context of the fact that by this time I had a lot of experience dealing with students. Caltech students are always so straightforward, so honest, and almost too honest for their own good at times.

COHEN: This has not changed in all the years you've dealt with them?

BRENNEN: No, absolutely not. They have this marvelous tradition of really buying into the honor system. You see it in the alumni as much as you see it in the students. It's almost a naïve honesty, but one that's very attractive and made dealing with them so pleasant, even when it was a tough job, even when you were telling a student, "I'm afraid I have to ask you to leave the

institute." They'd still be honest and tell you what they did, for the most part. So dealing with students was really always a joy, even if the things you dealt with were sometimes extremely difficult.

COHEN: So then you moved into this position, with Baltimore, the present administration. With whom did you have to deal with then?

BRENNEN: With the president. Since the provost oversaw the budget, I would have to deal significantly with the provost. Also with the vice president of business and finance, who was initially—I guess I dealt almost exclusively with Bill [William A.] Jenkins. Paul Jennings was the interim vice president for business and finance [1998-1999] before Bill Jenkins came on board, so those were the people that I dealt with primarily.

COHEN: Fortunately you didn't have to deal with Bill Jenkins leaving [Jenkins served as vice president for business and finance 1999-2002.—ed.]. [Laughter]

BRENNEN: I didn't, that's true. I don't really know anything about that. It was always a bit of a struggle to get people to pay any attention to some of the student problems and issues, and I think that's typical to this day.

COHEN: Now they've hired a professional, so there's been a whole shift in what they're doing.

BRENNEN: Margo Post Marshak, a very pleasant woman. It was, I think, David Baltimore's intention to find a full-time person. I think he somehow was convinced—I wasn't convinced—that it needed a full-time person. I may be persuaded otherwise, but I still think that having faculty involved in that position is really important.

COHEN: But hasn't that been the trend? For instance, and we didn't talk about this at all, the admissions committee used to be faculty driving around interviewing people—

BRENNEN: There are still quite a few faculty involved. The reason they don't go interviewing

people has not so much to do with a decreased faculty involvement, it has to do with a change in our strategy towards admissions, and one that I reluctantly agree with. In the early days, we placed enormous emphasis on judging who should be admitted, and placed almost no effort in trying to get the people we admitted to come to Caltech—recruitment, as it were. We realized at one point—and this was really before I became vice president of student affairs—that that was not our optimal strategy, that we had to put more of our effort into recruiting the people we admitted. So somewhat reluctantly we gave up sending faculty out to interview students. It's not that that process wasn't valuable, but rather it was so—

COHEN: So the faculty played no part in the recruitment? I don't understand why.

BRENNEN: No one paid any attention to recruitment back in the early days.

COHEN: I see. They just went out to see the people that they—

BRENNEN: That had applied.

COHEN: And that was the end of it.

BRENNEN: That was the end of it, or pretty much the end of it. We realized we had to pay much more attention to recruitment. So we necessarily had to give up some of the things we previously did. The faculty are still involved both in admissions and in recruitment, and will continue to be. But that's one little piece of student affairs. I think there have been some marvelous faculty who have been involved with students. There are two or three that come to mind who really have done an incredible amount of work to serve the students: David Wales and Gary Lorden—both of them sacrificed a great deal for the students and for the institute; Jim Morgan as well, and people like Ray Owen and Sunney Chan before him. But it's a small number. There's another group, like Marshall [Cohen], like yourself, who have played important roles down through the years, but that's also a pretty small group.

COHEN: Do you mean like being on the board of the Caltech Y and stuff like that?

BRENNEN: That's right. It's a small group. There are an awful lot of faculty who say to themselves, "I want to focus on my research. The administration encourages that. I've never really paid much attention to other areas."

COHEN: So you would say—maybe putting it too bluntly—that for the administration, the students are sort of way down there someplace?

BRENNEN: Yes, I'm afraid so. I particularly objected to the recent mission statement that was published that says—and I can't quote it verbatim—that the institute is devoted to research at the frontiers, and then the last phrase is, "…while educating students." That "while" really stuck in my craw, I have to tell you. Whereas previous statements of the role of the institute put education and research on the same foundation, that statement seemed to me to make a significant difference, or change in a significant way, the relative importance of those two missions. I continue to believe that the educational mission in the long run is as important, if not more important, than the research effort. I used to say jokingly—I told the trustees when I stepped down as vice president of student affairs—that if you look at it objectively, the students, the alumni of this institute, have won more Nobel prizes than the faculty. So if you're really altruistic and want to advance science, get good students and educate them, and educate them not just for science but also for excellence in other areas, in industry and technology. Look at the return we're going to get from the education we gave Gordon Moore, for example. You can't beat that rate of return.

COHEN: Everhart has established this nice thing where a graduate student wins some award and gives some lectures—

BRENNEN: In fact, one of my students won that.

COHEN: That seems quite nice.

BRENNEN: Yes. I'm sounding a little sour here. I just think that the people who tend to rise to

the top in this institute are obviously those who are best at research, and so that's their focus. That's what they regard as their priority, and that shows up in the administrative decisions as well. I just think that's a little narrow-minded.

COHEN: I can open up another can of worms for you and ask you how you feel about people starting their own businesses and companies. [Laughter]

BRENNEN: Yes, I don't like that at all.

COHEN: Well, I would have guessed that. [Laughter]

BRENNEN: Yes. I don't like that at all. I think that's really a slippery slope.

COHEN: Well, I think they're well on it.

BRENNEN: Yes, they're well on it, absolutely. I've never thought about that. I've never had any interest in doing it. I will admit I've led a remarkably rewarding life here. I should say this, because it balances the criticism that I expressed a few moments ago: I feel enormously fortunate for having had the opportunity to work at Caltech, to work with the students, to work on my research, and for my academic career. I can't imagine any greater gift than to be given that.

COHEN: I want to cover something else. I read your bio here. It seems to me that even though you're doing all these things here, which sounds like more than full time to me, you've gone to an awful lot of meetings, you've accepted an awful lot of honors, you've written an awful lot of papers. When did all that happen, sometime between one and three in the morning?

BRENNEN: Doreen says I never stop, and that's probably true. I was in some sense blessed with a fairly high metabolic rate. I am never doing nothing, and in fact there are many things not listed there that I do, like woodwork—you never see the hours I spend woodworking.

COHEN: I would guess that's a safety valve.

BRENNEN: Exactly, as is the hiking. There's no doubt in my mind that those are things that I do because it balances the other things. I think all the time when I'm hiking. Sometimes I even talk to myself, I realize, when I'm hiking. I imagine what I would say in various circumstances that I am worrying about. I think that's incredibly important to do. There are things I don't do. I never have really watched television. Oh, sure, I watch the news occasionally, or I watch a basketball game or a football game or the World Cup. Compared with most people, I essentially watch no television. I read the newspapers very scantily. Maybe I spend five or ten minutes on the newspaper in the morning. So there are many things I don't do. Doreen has done an awful lot. Like many successful marriages, it truly is a partnership. She does all of those things. She deals with all the finances. She deals with the kids. She deals with *all* the problems. She deals with the house. She does all the grungy jobs.

COHEN: How nice for you. [Laughter]

BRENNEN: It really is. When I think about it, and I do sometimes, I really feel very guilty about it. I don't think we sat down to plan that, but somehow that just is the way it happened. I do feel guilty about it, I will admit. The last thing I want to do is write out all those checks and pay all those bills, or deal with the problems—

COHEN: So are you able to still do the hiking, after the little episode you had a couple of years ago?

BRENNEN: Oh, yes, absolutely. It was almost exactly a year ago that I had a little heart attack, but fortunately I didn't do too much damage to the heart. The doctor's recommendation is that I take as much exercise as I can, and I do.

COHEN: Are you still hiking up in the mountains?

BRENNEN: Hiking, rock climbing, all of the above. I tried to climb the Matterhorn this summer.

I would have gotten to the top, but the snow and the ice were too much for me, so I failed.

COHEN: OK. Is there anything else you wanted to talk about? We skipped some things along the way.

BRENNEN: We did indeed. I think it would be good to talk about some of the specific students. I do feel—and maybe I haven't said enough about it—that that is a very important part of what I've accomplished. One of the things I think about most fondly is a group of marvelous students, almost thirty of them now, who got their PhDs under my direction.

COHEN: You may want to talk a little more about your relations with the administration.

BRENNEN: At some point I'm going to put some of that on paper, because that takes a little more careful thought.

COHEN: OK. Well then, let's talk about students. I also would like to talk about this long list of honors and meetings you've been to, so I think we have to schedule another session.

BRENNEN: Yes, that would be fine. Let's do that.

COHEN: OK. **[Tape ends]**

CHRISTOPHER E. BRENNEN

SESSION 3

December 3, 2002

Begin Tape 3, Side 1

COHEN: We discussed last time that in this interview you wanted to talk about students, life in the dorms, and your own students.

BRENNEN: Yes. Let me start with undergraduates, because although we have made reference to undergraduate life and undergraduate institutions in the previous interviews, I haven't really described my reactions and encounters in a systematic way. Let me say right off the bat that from the beginning I very early on developed a tremendous respect for the undergraduate society that the students have created and maintained here at the institute. Sometimes that was in the face of considerable faculty and alumni criticism—criticism based on what they superficially saw as things that they didn't like about undergraduate life. In particular, the issue of graffiti and painting on the walls in Dabney House, which always seemed to get a small group of alumni highly irritated. I think that's a very superficial and insubstantial criticism.

COHEN: Was this done to be part of a group?

BRENNEN: Yes. It's the tradition in Dabney House that students paint on, or write poetry on, the corridor walls of Dabney House. That developed sometime back in the sixties, probably as a symbol of rebellion against their seniors. Those were difficult times, I might say parenthetically, mostly because of the intergenerational strain created by the Vietnam War in particular. Those were unpleasant times to be a student.

COHEN: Graffiti was going on all over. It was an expression of—maybe due to the fact that you are European, you could see what was going on here.

BRENNEN: Yes, I think so. The Vietnam War, of course, had already been thoroughly engaged by the time I came here in '69. I did have a European attitude to that war. Few Europeans could

understand why the Americans were still in Vietnam. I think I sympathized most with the students for whom there was a very real possibility they would be drafted and sent off to die in the jungles of Vietnam for reasons that none of them really could understand or sympathize with. That created, for many years, a significant feeling of resentment, a feeling of disconnection among young people, and one for which I had considerable sympathy. At the same time, that was also the height of the drug culture. As I have spoken about before, we were not immune from those problems here at the institute, and that added to the stress. I've strayed a long way from my story. I think a remnant of that is the fact that one of the Dabney House traditions is to be able to paint on the walls. Every year they cover up one-third of those writings to leave space for the new students to express themselves, either in painting or in poetry.

COHEN: So it's not a legacy, it's just an expression.

BRENNEN: It's really an expression. It's also true that it's really not graffiti. I've never seen anything truly objectionable on those walls. Some of it is very lovely. Some of the paintings, some of the poetry, some of the memorials to some of their friends who have unfortunately passed away are very touching. However, superficially, many alumni really object to that. They go back to walk through their old house—in this case, Dabney House—and to a certain extent the same sentiment is true in all the houses. They see that and they judge the students by that superficial impression. On the contrary, when you get involved with the undergraduates to any depth whatsoever, you recognize a marvelously strong tradition of community within that group, a tradition of self-governance to a large degree, which is a very important part of the educational mission of any institute. You have to provide young people with freedom to learn while at the same time trying to only impose limitations on what may end up hurting them. There's always a tension there and a compromise. When I was involved as dean or as vice president for student affairs, there was always a tension between those of us who were trying to preserve that freedom and, on the other hand, the lawyers, whose principal objective was to limit the liability of the institute. That's a tension that I think will continue to exist inevitably, and it's a tension that exists in all of us who are parents. We must face the same compromise between providing freedom and providing safety. There's no simple answer to that; it's a judgment call. I just fear that in this increasingly litigious society we veer too far towards endless petty rules and

regulations.

COHEN: When you say there was a tension, did any of it ever erupt into the open?

BRENNEN: Oh, very much so, for those of us whose job it was to look after the students. There were certainly individuals involved in student affairs and the administration whose greater tendency was to introduce rules and regulations. There were others on the other side that wanted to make sure to provide freedom. So that most frequently erupted in the context of things that had very obvious possible dangers, things like lighting bonfires and the conditions under which students could light fires—in the Ricketts [House] pot, for example—and the constraints that ought to be placed on whatever "barbecue" was conducted in the pot to ensure that it didn't represent any danger of the spreading of the fire.

COHEN: You're talking about physical things. How about the sexual revolution that was going on at the same time?

BRENNEN: Absolutely. We often had much discussion about what kinds of sexual harassment issues we should and could address, and what issues the students themselves could resolve without further intrusion. Those are difficult issues. For myself, I always really drew a very solid line in the sand on any issue of harassment or potential physical violence. I had zero tolerance for any kind of physical threat or violence, and zero tolerance for anything that really inflicted emotional or psychological pain on another student.

COHEN: How did you know about this? From walking around, or did people come and tell you?

BRENNEN: I think we strayed, really, from the student society to the safety net that we provided. My objective was always to provide a safety net for the students that was comprehensive. I was always very proud of the safety net that we helped maintain. The students were the primary maintainers, and the administration was the secondary maintainer of that safety net. It consisted of student government and students watching out for each other and recognizing when something was pathological about the behavior of an individual. The resident associates in the house were

the second level. Beyond that were the various resources at the health center in the psychological area or the medical area, and then of course people like the director of resident life, the master, and the deans. That provided a net that I think was fine enough. I'm very proud to say that in all the years that I was directly involved with students I don't think we had any undergraduate suicide. We had several deaths due to accidents, unfortunately, and those were always very, very traumatic, very difficult. However, we had no suicide, which is in marked contrast to the kinds of things that have gone on at MIT in recent years or at some of the other major colleges, even with what I remember happened when I was a student at Oxford University. I have to tell you, we came close on a number of occasions, when that safety net really basically saved students' lives. I recall being directly involved myself in several circumstances.

COHEN: What year are we talking about?

BRENNEN: We're talking anywhere between about '80 and—let's see, when did I start as master? I don't want to get it wrong—I think right from the earliest days when I was master [1983-1987]. So this safety net was very important to all of us.

COHEN: Was this something you set up, or was it in place when you came in?

BRENNEN: I wouldn't take the credit for that at all. I think I helped maintain it. One of the keys to maintaining it was maintaining a relationship with student government, which made the flow of information comfortable and easy. I wanted to be certain that any student who spotted another troubled student wouldn't hesitate to come forward to me or to anyone else to point out the difficulty and to ensure that some proper professional help was provided. That was a marvelous part of our undergraduate community, the extent to which they looked after each other—with our help, of course, and with our services. I'll come to the graduate students in a moment or two, because I want to make a comment about them. There's no doubt in my mind that the glue that held the undergraduate community together was the honor system and the fact that freshmen would buy into that utopian scheme so wholeheartedly every year and would work hard to continue to maintain it. It is a remarkable institution, and I think it doesn't receive enough attention for its remarkable qualities. It is virtually entirely maintained by the students, both by,

if you like, brainwashing the incoming students or at least convincing them of its benefits to the extent that the vast majority of students decide to abide by it, and then they adjudicate it. The Board of Control is an activity that is not seen by any other members of our community except perhaps in some of its results. They spend incredible numbers of hours poring over suspected violations of the honor system and deciding what to do. The recommendations they make to the dean are almost always upheld. The decisions are sometimes very difficult and include, of course, asking students to leave for good.

COHEN: Typically how many infringements would you get in a year?

BRENNEN: It depends on how serious. The number of people that would be asked to leave was one or two, maybe three in a year. The number of convictions was something like fifteen, maybe twenty, but some of those were very minor.

COHEN: This wouldn't be about just sharing homework. This would be for not being honest about a take-home exam or something?

BRENNEN: Yes, exactly. Those were the easy ones. The academic violations were relatively easy. However, the honor system applied to all undergraduate life, and the social ones were sometimes the ones that the Board of Control had the most difficult time with, especially when a lot of students were involved in some incident, like taking someone's couch and damaging it, or doing something without asking, or playing a prank and not properly leaving the right notice that this was a prank to ensure that permanent damage was not done. So that undergraduate community was something that I always had the greatest admiration for. In many ways I felt that my role, whether as dean, master, or vice president, was ensuring that it was maintained.

COHEN: This was a thread that went through all these appointments for you?

BRENNEN: Oh, absolutely, and still to this day. I mentioned Dabney House mostly because I've also separately been the non-resident faculty associate of Dabney House for more than twenty years now, and I go there for dinner regularly.

COHEN: How about this food throwing? [Laughter]

BRENNEN: Well, I'm not all that keen on the food throwing. Fortunately, they don't do that in Dabney House, so that's not a danger, but I have occasionally been in other houses where there was some food thrown. I think that's a rarity. It doesn't happen much anymore.

COHEN: Well, it certainly happened to our president [laughter], but they may have been showing off.

BRENNEN: Yes, that's probably true. Again, that's something that's relatively superficial and in the long run not so important.

COHEN: As an outsider, the thing I've heard criticized and defended has been this rotation system.

BRENNEN: Right. I've always felt it was healthy to criticize it. It's an attempt to find a compromise between which students the seniors want to attract to their house and which house the freshmen want to go to. I persuaded the students to change it when I first became master, because I felt that it was a little too biased in favor of the seniors and the continuing students, and didn't give the freshmen quite as much choice as they should have. Prior to this change, all that a freshman could do was exclude three of the houses, but he or she could be picked into any of the other four. Though it may seem a minor thing, we changed that so that a freshman could express his or her preference. He or she could list four in order of preference: first, second, third, fourth. When I looked at the data after each of the years in which I was involved, more than eighty percent of the students got either their first or second choice, which seemed to me to be a fairly good indication that the freshmen were choosing where they would go. That still left twenty percent, of course. Some of the practices that go on during rotation are not perhaps as constructive as they might be. However, I think on the whole what they're trying to do is appropriate. It is important that someone feel as though they were actively chosen to be with this group of seniors, but it's also equally important that a frosh be given the choice of where to live.

Another test of the system is that very, very few students ever choose to change houses after the first term. After the first term they can go anywhere they want to, but very few ever do. So I think that's one measure that at least the vast majority of the students are happy with the outcome, even if some of the practices during the rotation itself sometimes are unsavory. I think you want to be careful to distinguish between some of the minor stuff that goes on and the fundamental purpose of the system.

I said I'd comment on and go back to safety nets for a minute. I never was all that happy about the safety net they had for graduate students. One of the suicides that occurred during my tenure was among graduate students. I think we failed that student. I think we could have saved that life if we'd had what I would have regarded as—

COHEN: But graduate students are much more independent. I mean, you're not monitoring where they live.

BRENNEN: Yes, that's true, but this particular student was living in institute housing. I think we have a responsibility beyond just saying, "You're free to do what you want." I feel a responsibility to all humanity to do what I can to ensure that they don't get to the desperate situation where they feel they have to take their own life. I believe there's more that we can do to provide a safety net for graduate students which would not be intrusive, not excessively intrusive. I think one of the most difficult things that we do—and I'll talk about my own graduate students in a little bit—we bring graduate students here and then we marry that student to a professor in a very fundamental way, in a way that really will affect that graduate student, for the rest of their career in many instances. I mean, still today I'm writing recommendations for my graduate students of ten, fifteen years ago. It's a very intimate relationship, and I say that word not in any sexual context, of course.

COHEN: Of course.

BRENNEN: This person is connected to you in that you have to teach them how to do research, how to be a teacher, and then guide them by providing them with recommendations and suggestions about their career, and support them then when they go to some other school as a

young faculty member or to some other institution as a young researcher. It's a very, very intimate relationship, and when it starts to go wrong it can be a very traumatic set of circumstances for that student and have very long and telling consequences. So I think it's a tremendous responsibility to take on graduate students, because you're taking on someone who's going to be your academic child for the rest of your life. When I mentioned a safety net, what I said is that we don't really do enough to help when that relationship starts to go wrong. Like all marriages, it happens. It's not always the faculty's fault, and it's not always the student's fault.

COHEN: Shouldn't there be a discussion in the department to say that if you don't get along with this person, why doesn't he go work with someone else?

BRENNEN: It should happen, it probably should happen more, and it doesn't happen much. To be honest, it rarely happens.

COHEN: I think one of the dangers is that when professors have so many postdocs, they give a graduate student to a postdoc.

BRENNEN: Absolutely. There are some departments, like chemistry, where the graduate student really doesn't get a satisfactory experience, I think, because the groups are so large that they get very little interaction with the faculty. I think that's a serious problem—in chemistry in particular and to some extent in biology, too. The other divisions tend to have much smaller groups. I've always felt personally—I've never had more than five or six graduate students at a time, because I couldn't do the job I think I need to do for more than five or six graduate students. You spend a couple of hours a week with each of five or six graduate students—

COHEN: That's a lot.

BRENNEN: That's a lot of time, a lot of effort.

COHEN: That seems like a huge number to me, knowing the astronomy tradition.

BRENNEN: Right. So I do worry about that. I think it's noticeable in most of the places where things go wrong in the way I was describing earlier. I'm afraid that most of the cases I can remember were indeed in chemistry and biology.

COHEN: The professors just didn't realize what they were doing, or what they were up to.

BRENNEN: Yes, that was usually the case. Sometimes it was worse than that.

COHEN: Has anything been done to mitigate this at all?

BRENNEN: There have been some efforts, but it's not an easy problem, because it's such an individualistic problem. More needs to be done. More attention needs to be given to that. More resources need to be provided, and more avenues of counsel need to be provided. I think of Helen Hasenfeld, when she first came here—Helen and the group that she created here continue to do a fine job in trying to resolve—

COHEN: What is she is doing?

BRENNEN: She does the staff counseling center, where she deals with issues of conflict between employees and their supervisors or between graduate students and their supervisors. I think what Helen does is basically talk and provide the kind of counseling that is needed. We need to structure that a little more formally and make it more accepted by the faculty, so that when things start to go wrong, counseling is called upon before the problems become too acute or too severe. Sexual harassment is an issue also, of course. Unfortunately, there have been cases here, which I think is perhaps the worst kind of victimization, especially in an era when we want to encourage women to make a career in science. I've seen too many student sexual harassment cases, and that's particularly insidious, I have to tell you.

COHEN: Well, it's hard to prove. "He said, she said."

BRENNEN: Absolutely. I wish we had a more—and I'll say this quite frankly, because I was

quite angry when in the Faculty Board discussion we adopted the present sexual harassment policy. I think there should be no sexual relationship between any faculty and any student, period. We should feel that it is contrary to any or all of our educational missions. The fact that our policy still allows that is something that irks me, I have to tell you, and something I expressed in no uncertain terms at the Faculty Board meeting in which the current policy was adopted. I don't see *any* circumstances under which it's possible to avoid the kind of unseen stresses that could cause a young woman, for example, to accede to the sexual advances of someone who was senior and much more powerful and likely to be an influence for decades to come. I just find it extraordinary that my colleagues don't accept that that's something that they need to forgo if they're going to be a true teacher in an institution like this that wants to expand the number of women in science and technology.

COHEN: I guess you have expressed this?

BRENNEN: I have expressed this many times. I think my colleagues know where I stand on this.

COHEN: OK. [Laughter]

BRENNEN: When I was dean or master, I took the same attitude to any harassment or any issues involving students on students, especially since we have such a male-dominated student body—though it's less so now, of course. I think it's much better now. Going back to student houses for a moment, I think the student societies and the student houses are better for all concerned because there are thirty-five percent women. It's much more reasonable than the fraction, the few percent that were here when I first became involved—for all concerned. I think it has matured our undergraduate society to a significant degree.

COHEN: So maybe we should get on to your students now.

BRENNEN: Yes, a marvelous group of young people. When I look back I'm immensely proud of what many of them have done and accomplished in the interim. My second student, Sheung-Lip Ng, whose name is now Huang—he changed his name after a while—is now quite a wealthy

man, and a couple of years ago he gave a substantial amount of money to create a graduate student fellowship in mechanical engineering. He's probably financially the most successful of—

COHEN: Does he have his own business?

BRENNEN: He has multiple businesses—airlines, real estate, and so on. Some of them are in industry. Jim [James C.] Pearce, my first student, is now the managing director for a branch of Chevron Oil. Most of the first group went into industry.

COHEN: Now, that would have been what year, the eighties?

BRENNEN: My first student was in 1976. That was Jim Pearce. Then a group started to go into academia. Charlie [Charles S.] Campbell, in 1985, was, I think, the first of my students to become a faculty member. He is now a professor at USC, as well as a visiting associate here at Caltech. Luca d'Agostino is a professor at the University of Pisa [Italy], and I saw him very recently. Hojin Ahn is a professor in Turkey. Steve [Steven L.] Ceccio is a professor at [University of] Michigan. Doug [Douglas P.] Hart is a professor at MIT. Garrett Reisman is a NASA astronaut.

COHEN: Oh, wow!

BRENNEN: I see him fairly frequently, since we both share an interest in the outdoors and still get together to go hiking and climbing. Roberto Zenit is a professor at the University of Mexico, Carl Wassgren is at Purdue University, Yi-Chun Wang is a professor in Taiwan at the National Cheng Kung University, and so on. So there are groups both in industry and in academia. I have to say they've been remarkably successful. I try to keep in contact with all of them, though I've lost contact with one or two.

COHEN: Now, does that mean you send a card at Christmas?

BRENNEN: I get occasional e-mails—e-mail is such a marvelous way of keeping in contact with people—and I see them at conferences or at other gatherings. When I was in Italy this summer Luca d'Agostino and Doreen and I got together. They all know Doreen also, of course, from having been at our house many times. Doreen has her favorites, too. I won't tell you which ones; that probably shouldn't be on the record. My daughters knew them. I'm not sure what else to tell you, other than that when I think of them, I think of them somewhat like a whole big family of children that I and we have formed down through the years, and whose accomplishments I take a great deal of pride and interest in, whether they be accomplishments in academia, in industry or otherwise.

COHEN: Over the years, have you had a lot of foreign students?

BRENNEN: Yes. I'd say a fair number of them were foreign.

COHEN: You mentioned Mexico, Turkey, so actually they're going back; they're not first taking a job here.

BRENNEN: Well, in the case of Hojin Ahn, he came from Korea and he ended up in Turkey; I'm not absolutely sure I can explain why. However, certainly there are students here from Hong Kong, from Indonesia, from Vietnam, from Canada, from Italy, Tunisia, Finland, India, France, China—

COHEN: I think at one point they were saying there were more engineering students from abroad than there were from the United States.

BRENNEN: I think that's been somewhat reversed in the last few years, but there's still a large number of foreign students. I had three women graduate students also. It's a small number. One of the slightly disturbing things about trying to get women more involved is that it's a smaller fraction, at least in the past ten years. Not that many have gone on to graduate school, not as many as their numbers in the undergraduate school would suggest.

COHEN: Anyway, the effort is certainly being made.

BRENNEN: I've always felt—I mean, my daughters never let me forget—that we had to make that effort. Doreen and my daughters always felt that Caltech needed to make more of an effort to bring women into the mainstream of science and technology. I didn't do that just because they pressured me but because I truly believe that bringing that kind of diversity to science and engineering is to everyone's benefit.

COHEN: Maybe you could make some general statements about direction—I think you've actually done that already—now that you're a professor again, which some people think is the best position—

BRENNEN: I must admit it's very nice. I am enjoying being a professor again, I really am. There is nothing quite as rewarding as when you happen to teach a really good class or when some student says to you, "I really thought that was neat" or is sometimes excessively appreciative of something you have done for them or of the time you have taken to explain something to them. There is something so fundamentally rewarding about that, that it's difficult for me to see how to get it from any other possible source.

COHEN: So are you teaching again now?

BRENNEN: Yes, I am. My undergraduate class this term has forty students in it. It's an interesting group. I think the students are better now than they were. There seems to have been a lot of discussion in recent years that maybe we have broadened our net too far, but I think the students are better now academically than they were. I think that they're also less introverted than they used to be. My present class is much more willing to ask questions in class than I can remember, and that's tremendous. I love when they ask questions, because it gives you a way of figuring out how much they're really taking in and how much they're not. It gives you a relationship that goes beyond just writing something on the board. So I think we are doing—it's very important to this institute, since it is so small compared to all of our competitors—to go out of its way to attract the very best minds at the undergraduate level, at the graduate level, and at

the faculty level. I see that as *essential* for the future well-being of this institution.

COHEN: Do you think that is happening?

BRENNEN: I think it has happened. I continue to worry about whether the financial situation will cause us to draw back on that at the student level. I have no doubt they'll continue to try and get the best faculty. I worry that we may start to not provide the kind of financial resources that are needed to get the very best students.

COHEN: I can see that you're really basically very worried about the commitment of the institute to the students.

BRENNEN: That's true. I don't want that to sound too critical, because I think perhaps I have a stronger belief than many others in the value of a very high-quality undergraduate body and a very high-quality graduate body. Graduate is more obvious to the faculty, because they need these extremely intelligent graduate students to conduct most of the research. It's less obvious to everyone why we should attract the very best undergraduates. But I think the SURF [Summer Undergraduate Research Fellowships] program has demonstrated that they, too, can play an enormously important role in research. Our undergraduate alumni are tremendously loyal.

COHEN: Way above the national average on these things.

BRENNEN: Way above, and when you think about that and what those alumni have provided for the institute down through the years, it's very important to continue that, and to continue that at the very highest level. So those would be my concerns. By being concerned about it, I don't mean to be excessively critical of the present administration, just that we need to continue to be aware that these are very important aspects to the future of the institute. I worry about the lawyers becoming too powerful and instituting rules and regulations, because I think freedom for exploration—especially in science—is critical to the educational process and the research process. So I'm a little bit worried that the lawyers are going to ban all laboratories in the future. So those are issues that are certainly of concern to me.

COHEN: But had you been able to pick somewhere else to go—

BRENNEN: Oh, of course not. This is an absolutely marvelous place. I count myself as extraordinarily lucky to have had the opportunity to fulfill my career in research and teaching here at Caltech. This is an incredible place. This is truly a national treasure, as it's been characterized. All of the alums, even those at places like Princeton, MIT, and Michigan, will come and say Caltech really is special, and it's important to maintain that.

COHEN: I think that's a good place to stop.

BRENNEN: I think so.

COHEN: OK. **[Tape ends]**