DONALD E. HUDSON
(1916-1999)

INTERVIEWED BY
SHIRLEY K. COHEN

November 12, December 10 and 17, 1997

ARCHIVES
CALIFORNIA INSTITUTE OF TECHNOLOGY
Pasadena, California

Subject area

Engineering, earthquake engineering

Abstract

Interview in 1997 with Donald Ellis Hudson, professor of mechanical engineering and applied mechanics, emeritus, and a pioneer in the field of earthquake engineering. Hudson received his BS (1938), master's (1939), and PhD (1942, mechanical engineering) from Caltech and then joined the faculty of its Division of Engineering and Applied Science. After retiring from Caltech in 1981 with emeritus status, he moved to the USC School of Engineering, where he chaired the Department of Civil Engineering from 1981 to 1985. He was also president of the International Association for Earthquake Engineering (IAEE) from 1980 to 1984. In this interview, Hudson comments on the development of earthquake engineering at Caltech; his collaboration with Caltech colleagues Frederick Lindvall, Romeo Martel, and George Housner; and his consulting work with General Petroleum Corporation in the late 1930s and early 1940s. He recalls his close association with the University of Roorkee, in India; the founding of the IAEE and the establishment of its periodic international conferences on earthquake engineering; his travels to Japan and to technical schools in South America; his consultation on the Bhakra Dam in India; and the development of civil engineering at USC. He also discusses the eccentric Caltech alumnus

Edward Simmons, inventor of the strain gauge, and Simmons's legal battle with Caltech over the patent.

Administrative information

Access

The interview is unrestricted.

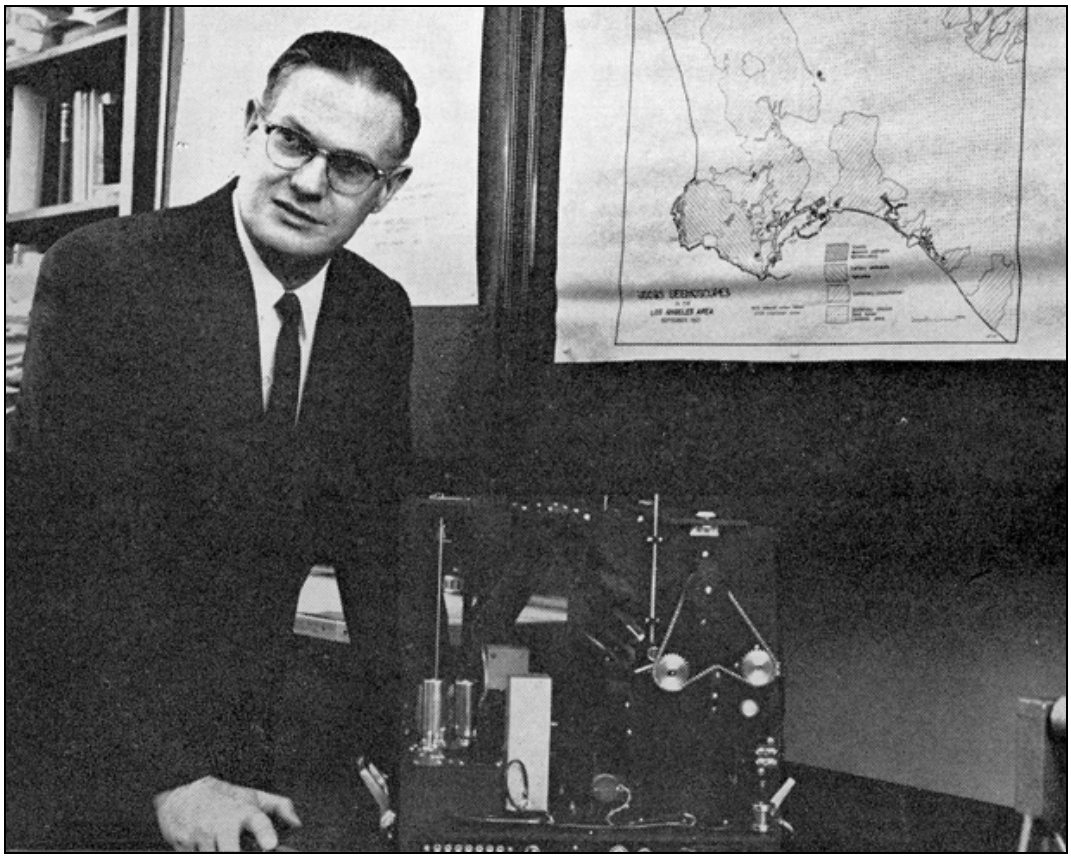
Copyright

Preferred citation

Hudson, Donald E. Interview by Shirley K. Cohen. Pasadena, California, November 12, December 10 and 17, 1997. Oral History Project, California Institute of Technology Archives. Retrieved [supply date of retrieval] from the World Wide Web: http://resolver.caltech.edu/CaltechOH:OH_Hudson_D

Contact information

Archives, California Institute of Technology
Mail Code 015A-74
Pasadena, CA 91125
Phone: (626)395-2704 Fax: (626)793-8756
Email: archives@caltech.edu



Donald E. Hudson with strong-motion accelerograph installed on top of Caltech's Millikan Library in 1966. Now referred to as SMA-1, this was the first in a series of recording instruments used to monitor the motion of Caltech's tallest building. Real-time monitoring continues today with R-SHAPE—Real-Time Structural Health and Performance Evaluation. See: http://www.r-shape.caltech.edu

California Institute of Technology

Oral History Project

Interview with Donald E. Hudson

by Shirley K. Cohen

Pasadena, California

Caltech Archives, 1999

DONALD E. HUDSON

TABLE OF CONTENTS

Session 3:

pp. 60-65

Reminiscences of G. Housner; common interests, including Asian art; travel to Europe and Japan; field studies of earthquakes. Retirement and appointment at USC [University of Southern California], 1981; reorganization of USC's civil engineering department. Caltech PhDs at USC: M. Trifunac and S. Masri.

pp. 65-77

Professional activities in recent years. Major developments in the field: international cooperation; instrumentation; growth of graduate programs. Earthquake prediction. Future of earthquake engineering. Edward Simmons and the strain gauge; patent conflict with Caltech. Reorganization of Caltech after Millikan era; Millikan's frugality and informality. Work for admissions committee.

CALIFORNIA INSTITUTE OF TECHNOLOGY
ORAL HISTORY PROJECT

Interview with Donald E. Hudson By Shirley K. Cohen
Pasadena, California

Session 1	November 12, 1997
Session 2	December 10, 1997
Session 3	December 17, 1997

Begin Tape 1, Side 1

Cohen: Tell me a bit about your family background: your parents, where you came from, what got you into your work.

Hudson: Well, my family started out in the middle of Michigan. We first came to Pasadena in 1924. My earliest education was at the elementary schools in Michigan, but very early on I became a Californian.

Cohen: What brought your family here?

Hudson: Hay fever—escaping from hay fever.

Cohen: Oh, okay. Allergies?

Hudson: Allergies. It was very bad in the middle of Michigan. We used to have to leave the area every summer and go up to the northern lakes. That was pleasant, but a little difficult. So, we had heard about California. We sat back in the cold weather and read very fancy brochures

that came from a lot of the California cities, and it looked better and better. It finally boiled down to choosing between Pasadena and Atascadero. It's a very lucky thing for me that they picked Pasadena and just happened to move in a few blocks from Caltech.

Cohen: What did your father do? Did he have some profession?

Hudson: He was in the contracting business and was able to semi-retire when he came out here. He was not in good health, so this was a very good place to come. He picked Pasadena partly because an old friend had come here before and sort of showed him the way. But it was an excellent move for us, because right away everything was much cheaper and much better.

Cohen: Yes, it must have been very pleasant here in those days.

Hudson: In those days it was wonderful. Pasadena was just getting started on its Civic Center. We moved into an apartment that was next to what is now the library, which hadn't been built yet. It was a great area for playing. There were big fields there, but they were preparing to build the library. City Hall had just been finished. Pasadena schools were excellent in those days, and I didn't have any trouble fitting in either way. My family was very happy here.

Cohen: So you stayed on. Let's see—where would you have gone to high school? To Muir High School?

Hudson: Well, they had a junior high school system in those days. I went first to the old Franklin Elementary School, which is right across the street from me—which is now where the birdhouse is. Then I went to Woodrow Wilson Junior High for a number of years, which I enjoyed very much. It was an excellent school with good teachers. I can remember them very well still. I was interested in Caltech from early on, and used to go to the then "Friday Night Lectures" as a student. I enjoyed that very much. That got me acquainted with the school. Once a year Caltech had kind of an open house where everything was set up to show the public. That was always very interesting to me. I was especially interested in the old mechanical

engineering laboratories where they had a fireman's pole that you could slide down to get to the lower labs. That was fascinating. I can remember the old spiral staircases at the end of Throop, which always interested me. So it was a very natural thing to think about coming to Caltech.

Cohen: Now, you would have been here already when the Long Beach earthquake struck.

Hudson: That was—let's see—1933. I can remember the earthquake quite clearly. The chandeliers swayed back and forth and we knew something had gone on. That was long before the days when I had a professional interest in the subject, but it stirred up a lot of interest. This was during the Depression and it seemed very unlikely that I would ever be able to get to college. Pasadena City College had just started and I went there to finish high school. In those days they covered the last two years of high school.

Cohen: PCC?

Hudson: PCC had a new technology course that was very well equipped. They had excellent laboratories and lots of good equipment. So I decided to take a two-year electrical technology course. I knew that I wanted to go on if I could, but I thought that would put me in a position for a better job. And that's the way it worked out.

Cohen: And PCC was completely free of tuition at that time? Like high school?

Hudson: It was very like high school. It was a wonderful school. I enjoyed it very much. I had excellent teachers, whom I remember very clearly to this day. In fact, I went back there several months ago to give a talk at a scholarship day they held at the engineering school. I was very impressed by the campus. It's a fine campus with wonderful buildings, and neat as a pin. PCC is flourishing .

Cohen: They have a student body of, what, twenty-five or twenty-six thousand?

Hudson: Yes, it's a huge place, but it's apparently very well run. I don't know how they do it or where they get the money. I have very good memories of that school.

Cohen: Caltech was just around the corner. Did you have some connection even then with Caltech?

Hudson: Caltech was just around the corner. I had gone to the lectures. There was a very close connection in those days between the engineering school at PCC and Caltech. Quite a few of the PCC students transferred into Caltech as juniors. They were very proud of the record they had of getting people into Caltech. So, they designed the curriculum to fit exactly so that there would be no problem with switching. I had a physics teacher in those days—Professor Forster [George Forster]—who made a deep impression on me. He was a marvelous teacher. He was wonderful at training, and had a special interest in cultivating the people he thought might go on. So they were always very happy to have a contingent go over to Caltech. I switched to Caltech in my junior year. I think there probably were about six of us at the time.

Cohen: Did any of those six people stay on like you have?

Hudson: None of them stayed on at Caltech, but they all did very well and wound up in the profession in very good jobs. I kept in close contact with them and still do. Although, I think just about the last of them is gone now. We used to do a lot of joint homework study, going around to the different homes.

Cohen: But now you had to deal with the tuition at Caltech as a junior.

Hudson: Yes. They didn't have so many scholarships in those days. I can remember in my senior year I went to see Dean Hinrichs [Frederic W. Hinrichs], who was the dean of students. He was an old military man, and very impressive. He was one of my teachers in the strength of materials. I had a talk with him about whether there was any chance of getting financial help from the school. And he said, "Well, you've done very well. We don't happen to have any

scholarships, but if we had any we'd certainly give you one." [Laughter] "So let me write you out this little note which will give you half tuition." So that took care of that. The tuition, of course, was only $300 a year.

Cohen: Yes, but during the Depression that was a lot of money.

Hudson: In Depression years that was big. Although it was easier for us then, I think by far, than it is now. With a summer job, which I always had good luck getting, particularly because I had a little technical background, I could save enough in the summer for my expenses—living at home, of course.

Cohen: I was going to say that you probably lived at home.

Hudson: Right. It was just a walk to school. That left me out of all the school social life, but that didn't bother me at all in those days. By and large, it worked out very well.

Cohen: Do you remember any of the teachers that were really an influence on you from those years?

Hudson: Well, let's see. Professor Converse [Frederick J. Converse] was the one who I worked the most closely with, I think, because I stayed on as a teaching assistant and taught mechanics as a graduate student. So I was always very much impressed with him. Of course, he lived quite a long life. I can remember his ninetieth birthday party, where he was still hale and hearty. He died a few years ago. Jim Daily was another. He was a young student assistant in those days. He later went to MIT and worked in the pump lab. There was Dr. Knapp [Robert Knapp], who was of course a very impressive fellow. These are the ones who I remember the most. But, at any rate, I decided to stay on as a graduate student. In engineering in those days there wasn't much encouragement to attend graduate school. Professors would always tell you that if you wanted to be an engineer, you'd have to get out and work. It required experience. Graduate school was very rare in those days.

Cohen: That's in engineering?

Hudson: In engineering, yes. And there wasn't much of a research component in engineering.

Cohen: Was that true in most institutions, or just Caltech?

Hudson: That was true at most institutions, yes. In fact, all the Caltech professors had come from the big eastern schools. In those days, the only way to advance in education was to move to another school. Very seldom did you just stay in one place for long. Quite a group of us did that here, and that was very unusual, I think.

Cohen: But also, they always encouraged undergraduates to go somewhere else for graduate school.

Hudson: Well, of course some of the departments won't admit their own undergraduates here. At any rate, I decided I wanted to go. I looked up some statistics and saw that there were fewer PhDs in mechanical engineering than there were states. So I figured that this must be a pretty good field. [Laughter]

Cohen: Now, what year are we talking about?

Hudson: This was '38. I got my BS in '38. And I decided to continue on. My first graduate year was extremely busy, because I had a teaching assistantship that paid my tuition. In those days teaching took a lot of labor. I was assigned a section of an applied mechanics course. There were four lectures a week, and one afternoon computing period.

Cohen: And you had to do the whole thing?

Hudson: I did the whole thing and had full control of the whole class. We had a number of sections, so we had some advice and help. But they really just threw us in. It was a sink or swim operation that took a great deal of time. And then, at the same time, I was taking some extra graduate courses, because I could see by then that I needed a better physics background. So I took a mathematical physics course that kept me very busy.

Cohen: Were these graduate courses?

Hudson: Yes. Well, it was a course that the undergraduates took here and the new graduate students from other places would take. So it was sort of a combined course. Professor Houston [William V. Houston] was the first teacher in that. The second one I had in that course was Willy Fowler [William A. Fowler], and it was very exciting. It made a big impression on us all.

Cohen: He was probably—well, of course he was young in those days. [Laughter]

Hudson: Well, he was very vigorous and very interested in the work, and he did a great job of teaching it. He would come in early and write the notes all out ahead of class. That way we could go a lot faster. But we caught on quickly and pretty soon the students would all come an hour early to copy down the notes, so that the course gradually worked back. So we were there a good bit of the time. But that was quite inspiring. And then I took some other physics courses at that time. I remember having a course with Professor Lauritsen [Charles C. Lauritsen]. Then, at the same time—how I ever found the time to do this I don't know—I got interested in geophysics through work for General Petroleum [Corporation]. That's a whole new subject.

Cohen: Right. Well, we'll deal with that when we finish school.

Hudson: So I took, along with mechanical engineering and physics, a number of the geophysics courses: seismology—

Cohen: Now, was that a really new field here at that time?

Hudson: Well, of course it was a big field, because they had Benioff [Hugo Benioff], Gutenberg [Beno Gutenberg], and Richter [Charles F. Richter]. They had just organized their own lab—the Seismo Lab [Seismological Laboratory]—that was flourishing. They had very few students and didn't encourage applications.

Cohen: Now, Benioff and Gutenberg would have been from the European tradition.

Hudson: Yes.

Cohen: Richter, I think, is American.

Hudson: He was American. Gutenberg was very impressive. I remember we had a class where there were just three students. But he would come in, and in a very formal European style, lecture to those three students. He was very well organized. All three students stayed in the field. One of them was Walter Munk, who is now a nationally recognized oceanographer at Scripps Institution of Oceanography in La Jolla. Ben Howell is a prominent seismologist at Penn State and has been there for years. Lastly there is myself—a mechanical engineer.

Cohen: That's quite a record.

Hudson: Of course I stayed in seismology from an engineering point of view. I later served a term as president of the Seismological Society [of America]. So I figure I paid my dues—a little.

Cohen: Well, that's an impressive array of courses you were taking at one time.

Hudson: Yes. Thinking back, I can't see how I did it.

Cohen: Were you still living at home?

Hudson: Still living at home, yes.

Cohen: Devoting yourself completely to your work?

Hudson: Yes, it was a very busy time. Well then, at the same time that I was doing this, I had gotten connected with Dr. Lindvall [Frederick C. Lindvall], who was a consultant for General Petroleum.

Cohen: This is while you were a graduate student?

Hudson: This is while I was a first-year graduate student. I learned that he was looking for someone to help him out with some consulting research he was doing. He was working on problems of orienting oil well cores. You'd pull a cylindrical core from the ground, but you didn't know what direction it was in. So you couldn't tell what the direction of the dip of the strata was. Dr. Lindvall was working on a magnetic system for determining the permanent magnetism of the core in various magnetic fields. And then he worked it backwards, finding out what his position had been.

Cohen: You mean whether he was going this way or this way—going horizontal—

Hudson: So he had set up a little lab in his basement up in Altadena, where he lived, and was looking for someone to help him. Well, he ran into a friend of mine—one of my PCC transferees who was looking for a job and decided to go work for him. But, at the last minute, he got laid up with some kind of medical problem and couldn't take the job. So he said, "How would you like to take it over?" So I decided to do that.

Cohen: Now, this was a consulting job that Dr. Lindvall had? It had nothing to do with his duties at Caltech?

Hudson: Nothing to do with those. That was a very good connection for me. Of course, in later years I worked closely with Dr. Lindvall on all kinds of things. He was my PhD advisor. After World War II, when the school was reorganized, he became chairman of the engineering division. So I was in a very good position. Dr. Lindvall knew me well and I was one of the people that he picked to help him rebuild the division.

Cohen: Now, you had this job along with all this teaching that you were doing, and all these courses you were taking?

Hudson: Right. And here again, I can't quite imagine how I did it. [Laughter]

Cohen: Maybe you didn't sleep very much.

Hudson: But that was a wonderful job, because General Petroleum's offices were in the old Higgins Building over on Second and Main, in downtown Los Angeles. In fact, there was an article about the building in the historical part of the paper the other day. It's been abandoned for some years and no one knows what to do with it. But in those years it was in very good shape and we had very elegant offices. I could see right away that there was a big difference between the science end of things and the engineering end. If you went to work for an oil company as an engineer, they gave you a hard hat and you started digging ditches out in the field. If you started as a geophysicist and a consultant, as I did, we had nice carpeted offices and everything very elegant on the top floor of a building. We were right next to the executive offices of the whole company. Obviously, this was the way to go. [Laughter] So that enforced my interest in taking the geophysics courses and doing that sort of work. That worked out very well for me. I worked for General Petroleum on and off for five or six years.

Cohen: And that was even after you got your degree?

Hudson: Even after I got my degree, to a certain extent. Again, I was very lucky. The man who was head of geophysics at General Petroleum, Mr. Shade, had a special fondness for Caltech students—

Cohen: Well, they were probably good workers.

Hudson: Right. We worked very hard and we were all very interested. He made a special effort to see that there was work for me to do part time that I could fit in any time I wanted. I worked summers and during the year at all sorts of odd times.

Cohen: You must have had a car already at this time. Or how did you manage that back and forth?

Hudson: Well, I think I can remember it well. I rode the old red cars through LA. In those days we still had those urban red cars. And one of them went just two or three blocks from my house and wound up two or three blocks from General Petroleum. So that solved that problem. It took a lot of time, but it was kind of a pleasant trip.

Cohen: So you were really just working then. It doesn't sound to me like you had much time for socializing.

Hudson: No, but that didn't seem to bother me any. I wasn't especially interested in that anyway. So I didn't miss it. I was very interested in what I was doing. Everything seemed to be building together nicely and going in the right direction.

Cohen: And how about the army during World War II, because it sounds to me like you were in school all this time?

Hudson: Right. Well, that's an interesting story. I got my degree—I just got under the wire—in 1942. I spent four years getting my PhD.

Cohen: And that's with Dr. Lindvall?

Hudson: That was with Dr. Lindvall. And just about this time, of course, all the war projects started up on campus. One of the main ones was the rocket project that Charles Lauritsen and Willy Fowler were running in Kellogg. That was where I had my office and lab. It was on the top floor of Kellogg. In fact, I was in the building when a rocket exploded in the basement one day. I can remember looking out my lab door and it was like looking into a furnace.

Cohen: Was that an accident?

Hudson: It was an accident. They were machining [making?] rocket [fuel] and it went off somehow.

Cohen: That was in 1942?

Hudson: That was around '42. One man was killed. And, of course, it resulted in a big to-do. From then on they had to be much more careful with safety things.

Cohen: But they didn't make them move out of the basement of Kellogg?

Hudson: Well, pretty soon they did. They moved that stuff up into the Arroyo—that kind of testing work. At any rate, they were just getting going on this rocket research and Lindvall was the head of their Jet Assisted Takeoff group (JATO) that was working out the methods of carrying these rockets on an airplane and launching them. So they had quite a large group of engineers—some very capable people. These people later on became very prominent at Caltech: Charlie Wilts [Charles H. Wilts], Bob Leighton [Robert B. Leighton], who just died. He was one of the bright, young fellows. He was quite a star.

Cohen: They were all working for Lindvall in this group?

Hudson: They were all working in his group there, or with Willy Fowler's group. Carl Anderson was with that bunch. They were all doing things that were completely different than what they had been trained for, but they were bright people and adapted very quickly. At that time, again, there were very few engineering PhDs. And the value of a PhD, I think then and now, is that people get practice in independent work. So they're resourceful and self-contained. That's just what you want for a new project. We had hundreds of physicists with PhDs, and astronomers, but no engineers. This was one of the reasons that induced Lindvall to move the school in that direction. We needed a lot more research in engineering and a lot more highly trained people. And that's the way it worked out.

Cohen: So this project continued through the war then?

Hudson: This project continued through the war, but very quickly they started a new project. The navy approached them on the problem of aircraft-launched torpedoes. They had a serious problem in that, when they launched the aircraft torpedo, when it hit the water it would often destroy itself or it would get deflected from its course. So they weren't hitting anything. Well, this is very discouraging when you fly your airplane into terrible danger and then nothing works. So, their only solution at first was to fly very slowly to launch the torpedo, but that's not a very good idea.

Cohen: They'd get shot down.

Hudson: That's not the time you want to go slowly. So the school had this project and undertook the project of strengthening and studying that aircraft torpedo to try to improve that situation. Well, we needed to be able to do testing.

Cohen: Who took charge of that project?

Hudson: Lindvall took over as head of that project. So they transferred him out of the rocket business at that time, and he took over this torpedo project, which eventually became China Lake NOTS [Naval Ordnance Test Station]. The first thing we needed to do was to provide some sort of testing facilities for the torpedoes. So we went out one day looking for a place which had a deep lake—not too far away, for convenience—and where there would be a kind of rough topography where you could launch some kind of launching system. So we got looking behind Morris Dam, up above Azusa. And we decided that that would be the place to put it. What we decided to do, finally, was to build a big blowgun—just a huge tube in which the torpedo would fit. We had a tank of compressed air on one end. Then we would turn the valve on very quickly and just squirt out the torpedo. It was a fixed angle. We chose an angle about like it would be from an airplane. That worked out very well. By then Lindvall convinced me to move over to this new project along with a lot of other people. Everybody wanted to work for him. Lindvall was one of these people who, when everything went right we got the credit, and when anything went wrong, he would take the blame.

Cohen: He was a very nice guy. I actually knew him too.

Hudson: So my job was to design this launching system: How long should the tube be? How high a pressure did you need? How big a tank? And so forth. How would you measure the velocity of the torpedo when it came out? And all that. For that our group worked out some high-speed camera equipment with Ike Bowen [Ira Sprague Bowen] from astronomy. We had a lot of astronomers working on the project in those days—both the rocket project and the torpedo project. These were all, of course, very highly trained research people. They were in a completely different field, but that didn't seem to matter at all.

Cohen: As you were saying before, they had learned how to think whatever had to be thought.

Hudson: Independent thought. That's what it takes.

Cohen: Did you have airplanes?

Hudson: Yes. We had good connections with the navy. Their planes tested torpedoes for us in San Diego. We'd start in with this launching tube and make preliminary tests [at Morris Dam]. Then the aircraft would go up and try it out. We had very good success right away, because once you could see what was happening—that is, you could take a high-speed photograph of this torpedo entering the water—you could see right away what was going on.

Cohen: Were these cameras already available? Or did people have to develop the cameras to do this?

Hudson: Well, we did the cameras too. When the torpedo enters the water it kind of blasts a cavity. Then the torpedo swings over in the cavity and its tail bangs into the wall and bends up the tail surfaces. Well, from then on it's lost all of its accuracy. So we could see that one thing to do would be to strengthen up the whole tail assembly so that when it banged a wall it wouldn't bend up.

Cohen: By "wall" you mean water?

Hudson: Water. To prevent this we put a shroud ring over the tail of the torpedo—just a circular, little ring. That seemed to solve the problem for a while, and worked very well. So it was decided that they would equip the torpedoes with these shroud rings—all the ones that left from San Diego. There was tremendous resistance from the navy about doing this, because they didn't want anyone interfering or tampering with their weapons, especially a bunch of professors. But this got put through, because by then the pilots who were doing the flying were so impressed at how much better it worked that they insisted that it had to be done. So it was a very interesting operation. For a time there were little machine shops all over Pasadena building these shroud rings.

Cohen: And where were the torpedoes themselves being built?

Hudson: They were done in the east mostly, at the main center at the Newport Naval Base in Rhode Island. They'd be sent out here and loaded onto ships in San Diego. Well, what we did then was to have this big system set up for building these shroud rings in little shops in Pasadena. There were hundreds of little backyard shops building these things.

Cohen: Was there any attempted security on this, or wasn't that important?

Hudson: Well, there were all the usual military securities. But in those days people bypassed a lot of things.

Cohen: I mean, just the idea that there were so many little places around town—

Hudson: This wasn't anything that had to be a secret, especially. It was the junior officers that pushed these things through. I can remember one of my colleagues in a graduate course was an admiral who had been sent back to school for advanced education. He was assigned to run this project, and we thought that was great. He was a technical man and we thought that he'd know what we were doing. But he was not only a technical man, he was first and foremost a navy man. And he was not happy at all with the way these professors were tampering with his torpedoes.

Cohen: Do you remember his name?

Hudson: It would be a kindness not to, I think. [Laughter]

Cohen: Okay.

Hudson: At any rate, we got along pretty well. We got a system set up to weld these strengthening rings on the torpedoes as they came into San Diego and then load them onto the ships. They managed to get a few thousand of them equipped just in time for the battle of Midway, where it came out very well. They had good success. So we all felt we had quite a

direct part in the whole process. It was one of those projects where a bunch of theoreticians were really able to make a contribution.

Cohen: But you must have been responsible for a great deal of the engineering, since there weren't very many engineers.

Hudson: Well, I was instrumental in starting the thing, but we quickly built up quite a staff. We had to have structural engineers to build all the buildings for the labs.

Cohen: So were you really in charge of these things for Dr. Lindvall?

Hudson: Sort of partially, yes. We had groups working on things, but he was the one who guided everything. Those were very interesting days. Of course, it was extremely fortunate to be able to do your war work right in your backyard that way. Azusa wasn't that far away.

Cohen: But you weren't formally part of the army or the navy or anything?

Hudson: No. Of course, all this time it was very difficult to get enough people out of the draft to do the work. We had constant battles with that. We had to struggle against that. I can remember going through all of the basic screening and just getting ready to board the bus for boot camp. At the last minute word came that I was due at a meeting in Washington. [Laughter]

Cohen: So you mean that Dr. Lindvall was even struggling for you?

Hudson: Yeah. It was very difficult in those days, because no one knew what to do. Everyone thought, "Well, is it our duty to sign up or can we do a better job for the navy as an officer, or what?" I think most of us decided that we could probably do better with outside—

Cohen: Well, I'm sure that's true. So you worked on that through the war years?

Hudson: Right. That was through the war years. At the same time I was doing a lot of teaching of special courses. They had a big war-training program, so I was teaching mechanics and strength of materials.

Cohen: So you were an instructor?

Hudson: Yes, I was an instructor at Caltech by that time.

Cohen: So you were an employee of Caltech also.

Hudson: Right. In fact, all during the war I was a Caltech employee.

Cohen: So you not only did this other work, but you were also teaching?

Hudson: Right.

Cohen: Again, you don't remember how you got all that done. [Laughter]

Hudson: Well, I don't know. I started teaching machine design. I inherited that course from Professor Clapp [W. Howard Clapp], a wonderful man and an old-timer who was just about ready to retire.

Cohen: Now, these were undergraduates that you were teaching, because the graduate program hadn't really gotten going?

Hudson: These were undergraduates, right.

Cohen: Was this part of the navy program?

Hudson: Yes.

Cohen: Who was teaching them?

Hudson: I was doing some of that. But also we had a lot of courses in the evening time—special ESMDT courses, I guess they were called. I don't know just what that stands for now. [ESMDT stands for Engineering, Science, and Management Defense Training program.—ed.] [Laughter] But we had local engineers who would come to get updated in their course work.

Cohen: I see. Something that Caltech doesn't do at all anymore.

Hudson: No. We had never done that before. But I made a lot of good connections then. A lot of the people who were my students then—who were much older than I was—were prominent structural engineers who later were very important in my career. So that worked out well too. But, again, it sort of filled the time. One of the interesting things in that time was that Professor Clapp's office was the old tower of Throop. I don't know if you remember the old tower up there.

Cohen: Oh, yes I do, sure.

Hudson: Well, that was his office. He had the whole thing. So I moved in and for several years that was my office. It was a wonderful office in a very interesting place, if you could get up there.

Cohen: And Millikan [Library] wasn't in your way, so you could see.

Hudson: Right. Of course, we wouldn't have had that fine office. It would have been [Robert] Millikan's office if there had been an elevator there. But there wasn't in those days. So you had to go up six flights of stairs to get there. It was quite amusing: You'd hear a feeble tap on the door and you'd say, "Come in," and nothing would happen. Then you'd go and open the door and a body would fall in. [Laughter]

Cohen: They used up all their breath going up six flights of stairs.

Hudson: But that was a great place. Later on that became also Professor [George W.] Housner's office. He moved in and the two of us had it for many years. That used to be the Caltech library. All behind this big, circular room—which was the dome—there were bookcases. That would have been the institute library. And there were a lot of old books back there.

Cohen: Maybe some of them are here now [in the Archives].

Hudson: That could very well be. That was a fascinating place. I kept that office for five or six years, until I finally moved into Thomas Lab that was just completed.

Cohen: So this takes us through the war. You were an instructor here and Dr. Lindvall then wanted to organize a new engineering program.

Hudson: Right. In fact, there is kind of an amusing story about the first instructor position. I had wanted to stay on at Caltech as a professor. By then I knew that's what I really enjoyed. I talked to the various people in the division. Franklin Thomas was the chairman of the division and Robert Daugherty was the head of mechanical engineering. I got no encouragement whatsoever. They said, "Well, we haven't hired anyone on our staff for twenty years and we don't expect to in the next twenty years." But I looked around and they all looked a little ancient to me. I figured that I'd just be patient for a while and see what happened. That was a pretty good move, because within five years I could've had any one of a dozen positions. Everybody died within a few years. [Laughter]

Cohen: So, what did you do during those five years?

Hudson: Well, that was the interesting part. After two or three years I got wondering if I would ever get an appointment at Caltech on the staff. So, finally I got up my courage—

Cohen: What were you actually doing those years?

Hudson: I was teaching mechanics—machine design—as an instructor.

Cohen: And each semester you got held on again?

Hudson: Well, there were no formalities in those days. No one ever had a contract. Nobody ever got a letter saying anything. You just kept going and teaching until somebody told you not to.

Begin Tape 1, Side 2

Cohen: Here you are being very patient as an instructor—

Hudson: Right. And finally I got up my courage and I visited Dr. Millikan, who was very accessible. Things were different in those days. [Laughter] And, although I was a machine design teacher—a subject about as far from his interest as you could get—Millikan always followed things very closely.

Cohen: So he knew of your work, certainly, during the war.

Hudson: He would stop me in the hall and ask how the students were coming and all that. So one day I said, "Well, I've been here several years. What's the chance of someday getting on the staff?" And he said, "I vaguely recollect that the board gave you an appointment a couple years ago as an assistant professor. Let me look that up." So he poked around in some papers and said, "Oh, yes. That went through a couple years ago." [Laughter]

Cohen: But nobody told you?

Hudson: Nobody told me. No one ever would have told me.

Cohen: That's really interesting. I imagine more money must have come with that. Maybe that was Millikan's motivation in not telling you.

Hudson: Well, maybe. Who knows?

Cohen: That seems incredible.

Hudson: Things were extremely informal in those days. There were no letters of notification, nothing in the file, no indication of what your status was, or anything else. But it didn't matter. Everybody was one big, happy family.

Cohen: Or else they went somewhere else.

Hudson: Or else they went somewhere else. One other way that Millikan helped me a great deal was when I needed a little money for some equipment I wanted to build for my PhD research. I talked first to the head of my department, asking for money. Then I talked with the chairman of the division.

Cohen: This is earlier then?

Hudson: This is earlier. "No money. We don't have any money. There isn't any research budget." So finally—again, thinking back I can't remember how I ever plucked up the courage—I thought that I'd go see Dr. Millikan. He was obviously the man in charge. So I made an appointment through his secretary and went and talked to him. I said that I wanted this piece of equipment and it needed to get built and I needed a little budget to do it. And he thought a minute and he said, "Well, that's fine. I've been waiting for some years for some engineer to come around and want some research money." [Laughter] So he wrote out a little note for three hundred dollars credit for my research.

Cohen: He really did run things, didn't he?

Hudson: He really ran things. This was a great surprise to me, and to everybody else. That was a bigger budget than the whole division of engineering had. So that was a lesson that you don't fool around with the lower echelons—you go right to the top. But it just shows how the school has changed. It was so informal then.

Cohen: So you became an instant assistant professor?

Hudson: Right.

Cohen: What sort of salary were you making in those days? Can you remember?

Hudson: Well, I can remember that I started out at $2,800 as an assistant professor. At the end of the war we all had a big problem of what to do with the projects—how to get them transferred over to some kind of civilian status and how to get people lined up with permanent jobs, if possible. In fact, that was about the last year of my job on the project—to try to reorganize things for the future. Well, there were different patterns followed. Different projects did different things. The rocket project decided to organize as a government lab at China Lake. So they sort of transferred everybody up there.

Cohen: And then that no longer was in the Caltech—

Hudson: That was no longer part of Caltech. Then JPL [Jet Propulsion Laboratory], of course, stayed with Caltech. So that was another pattern. We decided to go another route and get transferred over to civil service as an independent outfit. And that became NOTS: Naval Ordnance Test Station at Inyokern. So everybody transferred up there. Well, then we had the right civil service job descriptions for everybody. We were all set up in civil service positions.

That was my big job for about a year. I remember that at the time I had a choice of staying with NOTS as a GS-5, I think, which paid $5,000 a year, or go back to Caltech for my $2,800.

Cohen: And you would have had to move to Inyokern?

Hudson: Yeah. But I didn't hesitate for a minute. I wanted to stay in academic life. That's what I enjoyed. Lindvall had just become the new chairman, and he offered me a spot—sort of permanently—in the division. I was very happy to come back to the school on that basis.

Cohen: Now, were you still in mechanical engineering at this time?

Hudson: Yes. But here again, the divisions and the different groups were very vague. There really were no departments or anything else.

Cohen: But geophysics would not have been in the engineering school, would it have?

Hudson: No. That was a completely different set-up. That was a very different group there. But I kept my connections there and I still have them.

Cohen: So then you became an associate professor at this time?

Hudson: Yes. I gradually worked my way up and became an associate professor [1949] and then a full professor [1955]. Lindvall kept his eye on people and took good care of them. About that time, Housner was brought in by mechanics. We shared an office for many years and became very good friends. About that time Lindvall said one day, "Well, your interest in machine design seems to be getting more and more theoretical. You're making this more into a course in advanced mechanics than machine design, so why don't you just switch and become a mechanics professor? You and Housner can develop a new book on the subject. And we will get somebody else to do the machine design." So that's when I switched to that. That went very well.

Cohen: Now, that was much more theoretical?

Hudson: That was more theoretical.

Cohen: And your physics would have stood you in good stead then.

Hudson: Yes. So we wrote the new book and developed a course in mechanics. [*Applied Mechanics—Statistics* (Van Nostrand, 1949) and *Applied Mechanics—Dynamics* (Van Nostrand, 1950)—ed.]

Cohen: What year would that have been?

Hudson: This was right after the war in '46. We patterned the course specifically after the old mathematical physics course that Housner and I had taken as graduate students for so many years. We were much impressed by the fact that the physics students were getting something on a much more advanced and mature level than the engineers were getting. We couldn't understand that at the time. So we decided to rework the course and make it more theoretical to provide students with a background for graduate work. You see, with the old courses it was assumed that everyone went to work after their BS. It was a terminal course, essentially.

Cohen: Engineering?

Hudson: Engineering for mechanics, yes. So the new thought was that we would definitely expect more people, or most of them hopefully, to go to graduate school. We would give a background course that would prepare them for that. That was Lindvall's idea in getting the division reorganized. And it worked out very well, I think. Research began to boom and everybody got more active in developing things.

Cohen: This was in all the engineering groups?

Hudson: In all the engineering groups, of course.

Cohen: That was really a new direction. And you attribute that to Lindvall?

Hudson: To Lindvall, except for the aeronautics, which had its start ahead of that.

Cohen: Was that in physics at that time? Or was it completely separate?

Hudson: That was separate. It was part of the division. Electrical engineering was part of physics. And it was Professor Sorensen [Royal W. Sorensen] whom I worked with on another phase of the torpedo process. There was another interesting aspect of it. In addition to improving the torpedoes here, the navy decided to develop a whole new torpedo at Columbia University. A group was set up there and had offices in the Empire State Building. So, for several summers I worked on that too.

Cohen: You mean you went to New York and worked at Columbia, in some sense?

Hudson: I worked in the Empire State Building with Sorensen. So that was another interesting slant on that navy connection. I got very well acquainted with him, and he was a wonderful man. He was very important for the development of engineering at Caltech, because he gave it a science base right from the start. In fact Lindvall was trained in physics and expected to be a practicing physicist. Sorensen, in order to develop his electrical engineering with a science base, talked Lindvall into switching to electrical engineering and taking his PhD in that. So I think he was probably the first one—the first EE PhD.

Cohen: Sorensen was?

Hudson: Lindvall.

Cohen: Oh, Lindvall. I see. So Sorensen was actually older than Lindvall?

Hudson: Oh yes. And then there were other connections, because Sorensen later on became very interested in engineering education and was a member of a team of people that visited India to study Indian engineering education at the time I was in India. That's a whole new career.

Cohen: We'll come to that separately. But wait. Fill me in a little bit about where Sorensen came from. Because suddenly we have Sorensen here and I'm not sure—was he at Columbia or was he here?

Hudson: He had been here for quite a while. I don't know when he first came to Caltech, but he had been here a long time. [Royal Sorensen came to what was then known as Throop Polytechnic Institute in 1910 to start a department of electrical engineering.—ed.]

Cohen: But he was part of the engineering?

Hudson: He started the electrical engineering. You see, at that time the big research development in electrical engineering was the high volts lab [High Voltage Research Laboratory]. Power transmission was the big problem for the area, so the Edison Company set up this big high volts lab. And that was Sorensen's big job.

Cohen: And was that right here on campus?

Hudson: Right. That's the building which is now the math building.

Cohen: Sloan?

Hudson: Sloan. That was just one big room in the high volts lab back in those days. It was the prime demonstration lecture for all the open houses and whatnot. Everybody would go in and see this demonstration of one million volts—lightning bolts and things like that. So that was

Sorensen's big play. His interest from the beginning was to keep this as a very much science-based subject, which he thought was the wave of the future. So he was in the physics department instead of engineering.

Cohen: Because he wanted to have it research oriented?

Hudson: Because he wanted it research oriented. But then, when Lindvall reorganized things and decided the whole division should be research oriented, they moved the EEs back into engineering. But, before that time, the main research in engineering had been in aeronautics. And they always did have a strong research component with Theodore von Kármán.

Cohen: Yes. That would have also been the European tradition.

Hudson: Right. Of course, many of the staff people were Americans from Europe: Gutenberg and all of those people and Kármán.

Cohen: Okay. So we have Sorensen now in his place. Okay. Let's see, what shall we pick up now? I have this writing of the book with Professor Housner that you have talked about. Now, I have here the development of the earthquake engineering program—was that later?

Hudson: That was a little later, yes. But all these things were going on at once. We obviously worked harder in those days than I do now. [Laughter] Let's see, where to take that up? That developed naturally from several other fields. First, from a geophysics angle, the work we were doing with the oil companies influenced the move. One of the jobs that I did for the oil company was to work in a much broader way with geophysical prospecting. The oil company would contract out work to seismological groups that would do this oil field exploration. One of my jobs for General Petroleum was to study the methods of different contract companies. It was all very hush-hush and secret. No one would ever tell anyone else what they were doing.

Cohen: This was a big competition.

Hudson: This was commercial security. So one of my jobs was to poke around and learn everything I could about the methods of different geophysical companies and write a report on it for the company. Well, I was such a low-down, lowly figure that I escaped between the joints of their industrial espionage system. [Laughter]

Cohen: They just didn't notice you?

Hudson: Nobody knew what I was doing. So I made very interesting studies of geophysical methods in the different companies. We did seismic work, gravity work, chemical work.

Cohen: Well, how did you manage this? I mean, did you go to a company and say, "What are you doing?" or would you just eat lunch with the people?

Hudson: Yeah. I would just get acquainted in working with them. I was the company representative working with our project. This was an unparalleled way of learning a lot about the subject. So I did that for several years. That got me interested in the seismological end of things.

Cohen: Now, this was when you were still a graduate student actually?

Hudson: Yes. About the same time that I was working with Housner on the book, he was just beginning to develop the whole subject of earthquake engineering. He was a civil engineer, basically, who had gotten his master's degree from Caltech five years before. [George W. Housner got his master's degree from Caltech in 1935.—ed.] He worked as a structural engineer for five years, then he decided to come back to Caltech and get his PhD. So, about this time, everybody was becoming more interested in the science of earthquake engineering: how could you calculate what an earthquake would do to a building, and things of that sort. We had some pioneering work done in that respect by Benioff, and principally by Biot [Maurice A. Biot] in aeronautics. He just died two or three years ago. [Maurice A. Biot died in 1985.—ed.] He was

really one of the founders of earthquake engineering. And, again, here was the influence from Kármán , who knew all of the basic theory of structural mechanics. Kármán and Biot were writing their book at this time: *Mathematical Methods in Engineering* [McGraw-Hill, 1940]. And several of the chapters were structural dynamics problems related to earthquakes. At this same time I was taking courses from Kármán: elasticity, and things of that sort. Housner's PhD thesis was in earthquake engineering.

Cohen: With whom would that have been?

Hudson: Martel [Romeo R. Martel]. Martel was the engineer who developed all these things. Well, Martel had gone to the World Engineering Congress in 1929 in Tokyo, where he got very interested in earthquake engineering. That was just after the big earthquake in Tokyo that destroyed the whole city. This gave a huge boost to earthquake engineering in Japan. When your capital gets destroyed, it gets everybody's attention.

Cohen: I would guess.

Hudson: Our earthquakes are always a long way away from Washington, so it's been more of a struggle in this country.

Cohen: I hadn't realized that.

Hudson: That's the difference there. But, at any rate, Martel made very good connections in Japan, and that was the start of a whole new career there. We had very interesting connections with the Japanese engineers over the years, and still do. Let's see, where were we? [Laughter]

Cohen: I wanted to ask you how the earthquake engineering program developed, or how you got involved.

Hudson: Since I was working so closely with George Housner on the book and in teaching the course, it was just very natural to get very interested in earthquake engineering. Besides, that tied very much into my seismological background. So I just gradually worked and my own research turned into that field. It was a very interesting stage in the subject, because computers were just coming in and we were, for the first time, able to handle a lot of data and get information out where people could use it. So, we set up several of these NSF [National Science Foundation] projects in data processing: digitizing, accelerograms, and getting out standard data.

Cohen: When you say "we," you're talking about you and Housner and Martel?

Hudson: Housner and Martel and a whole bunch of graduate students who were working with us at that time.

Cohen: Because this must have been a very new field.

Hudson: It was brand new, yes. Housner really created this field. It was in the engineering discipline. He's thought of now as sort of the father of earthquake engineering. And he has stayed, of course, very prominent in the whole field. For a time we had quite a group of graduate students—a dozen or so, usually.

Cohen: This would be in the late forties?

Hudson: This was in the late forties and early fifties. The first sponsorship we got was from the old Office of Naval Research (ONR).

Cohen: They sponsored so many things.

Hudson: They gave the money for the first data processing reports. Later on the NSF sort of took this over and gave us very good support for many years. At the same time we were

developing laboratory work. At one stage Lindvall said to me, "Well, we need more work in dynamic measurements and things of that sort. Why don't you take a little budget here and fix yourself a good vibrations laboratory?" So I worked on that for several years.

Cohen: Lindvall was really on top of everything.

Hudson: Yes. He was a key figure, certainly, in the whole development of engineering here. And, of course, he was chairman for twenty-four years [1945-1969]. You stayed on the job in those days. Ever since then, after five years they're worn out. [Laughter] They want out.

Cohen: It gets complicated. At this time was there much cooperation between the structural and earthquake work and, say, the work going on in geophysics?

Hudson: This was strictly a personal thing. It was just that people knew each other. I had had all those courses from Benioff and Gutenberg and those folks, but Richter was always interested in the engineering aspect.

Cohen: But they were all from engineering?

Hudson: They had their own problems and their own research. There was very little connection, formally. But we had a very good working relationship. Again, this was the strength of Caltech: you didn't have to have formal arrangements to do things. You could just work with people and trade information. It worked out very well, I think. So we had Kármán and Biot in the aeronautics unit, and Benioff and Richter and Gutenberg and Housner and Martel in engineering, and no formal connections at all and yet all working very closely together.

Cohen: You certainly made this a center for that sort of thing.

Hudson: Right. Very quickly the graduate students built up. We started getting graduate students from other countries. As our reports got circulated.

Cohen: Was this ever a problem? I mean, now there's so much discussion about foreign graduate students.

Hudson: Well, we always had very good ones.

Cohen: And their English had to be good?

Hudson: And their English was good. Sometimes at first it wasn't. But we were very fortunate with the foreign students. We had some people sent up from—of course, the first connection was India. That's a whole new story. And then we had several people sent from Argentina who turned out to be very capable and very good. And then people from Chile and Yugoslavia.

Cohen: And this was just from your reports? They made the contact themselves?

Hudson: The papers and the reports would get out and they would contact us and—

Cohen: Say that they'd like to come.

Hudson: Right.

Cohen: So there wasn't any going out to find them or anything?

Hudson: No. They just showed up. In every one of those places, a whole new center for earthquake engineering developed—a building was built for the subject, and so on. Institutions were set up and, to this day, they are all flourishing.

Cohen: So which building is that? We're talking about where?

Hudson: In each of these places: one in Argentina, one in Yugoslavia, one in India. So we became, very quickly, quite an international group. And we had, of course, many visitors. Every time we had a big earthquake, we'd get more visitors. The San Fernando earthquake really launched—

Cohen: That was in '71. Were you still in your circular office, or were you out of there?

Hudson: We were out of that by then.

Cohen: Because that building came down in '71—well, it had to be torn down.

Hudson: Well, this is probably a pretty good place to stop. [Tape Ends]

DONALD E. HUDSON

Session 2

December 10, 1997

Begin Tape 2, Side 1

Cohen: Good morning, Dr. Hudson. I'm so glad to see you. Before we get started taking up where we left off, perhaps you could tell us a bit more about Robert Knapp.

Hudson: Oh, yes. I had a number of classes with Dr. Knapp over the years as a graduate student, and worked with him very closely in the mechanical engineering department.

Cohen: He was a professor there?

Hudson: He was a professor of mechanical engineering. During the war, he had sort of a parallel project to the one that we had at Morris Dam on torpedo launching from aircraft.

Cohen: Now, your project was with Dr. Lindvall?

Hudson: Dr. Lindvall, right. Dr. Knapp's project was working on the same problems using models—much smaller models—and working out the theory along with them to try to interpret the relationship between model behavior and prototype behavior. So we worked quite closely over the years on those things. Many of my good friends worked on his project.

Cohen: Now, when you say "parallel project," with whom was he involved? I mean, was this directly with the navy?

Hudson: With the navy, yes. He built up remarkably fine projects or equipment for studying such things: a water tunnel, a free-surface launching tank. These all grew out of the old

metropolitan water project that he worked on. He set up this pump lab where they developed the pumps for the Metropolitan Water District aqueduct.

Cohen: Was that here at Caltech?

Hudson: That was here at Caltech. And by just being able to improve the efficiency of the pumps by a very few percent, they were able to, over the years, make a tremendous savings in operating costs. For a number of years this was the finest pump lab in the world. It was sad that later, when California's big Feather River project came along, Knapp was no longer around. There was no one here to carry on.

Cohen: So he had retired by this time?

Hudson: He suddenly died. He died of a heart attack, very unexpectedly, at quite a young age. I guess he was fifty. So his whole project kind of vanished. So when the water project came along in Central California, all the basic research was done in European laboratories. I always felt a little sad about that.

Cohen: That there was no one to carry on?

Hudson: There was no one to carry on here, no. He had a number of junior people who, later on, became very prominent. But none of them were quite ready yet to take over. But that pump project—that's a whole different story. You must have quite a little information on that.

Cohen: Well, let's go back to our interview now. How did you get to the university in India?

Hudson: Oh, that's an interesting story. First, I ought to make clear the difference between earthquake engineering and seismology. Because we have two quite different studies of earthquakes at Caltech. At many other places, they have quite different aspects of the subject to investigate. A seismologist is interested in the science of earthquakes, using earthquakes to

probe the Earth and find out what they can learn about the interior structure of the Earth from studying the waves caused by earthquakes. The engineer is primarily interested in destructive earthquakes and their effects on man-made structures like buildings and bridges and so forth. And it turns out that these are quite different aspects of the subject. They take different instrumentation. The seismologist wants to put his instruments on a place where they are little affected by geology, so that he can study the Earth directly. But the engineer wants to know what happened to the ground right at the place where the buildings are. So he has to design and deploy his own instruments for making what are called strong-motion earthquake ground-motion measurements. So it was the strong-motion earthquake ground-motion measurements that our lab got involved most directly with. And, in fact, for a number of years we were sort of the headquarters for collecting information on strong ground motion and so forth. We had a number of handmade instruments that were installed by the US Coast and Geodetic Survey.

Cohen: When you say "they," who built those instruments?

Hudson: The Bureau of Standards, working with the US Coast and Geodetic Survey. And they gradually kept adding to this network of instruments. It was a very slow thing to develop, because each instrument was sort of handmade and a little different from any of the others. It took many years to get a dozen or so of these things scattered around. But they were very lucky. The people at the Coast and Geodetic were very knowledgeable about good places to put the accelerographs.

Cohen: What?

Hudson: Accelerographs, they're called. Strong-motion accelerographs. Just a month before the Long Beach earthquake, they put one in in Long Beach and got the first record that was ever recorded anywhere. 1933 was the first time we ever recorded the actual motion of the ground—heavy and large motion of the ground during the earthquake. So it's quite a new subject. And then, later on, Housner carried this on. He was very skillful, again, at locating or realizing where these instruments might well be put. We had only a few dozen, but he, for example, put in the

array of instruments near Parkfield just a few months before the earthquake there [1966]. He convinced the water department to put an instrument in at Pacoima Dam, just a short time before the San Fernando earthquake. So that gave us the very biggest and best record at that time.

Cohen: Did he intuit this, or did he just study the ground?

Hudson: Well, he studied the ground and the situation where earthquakes had occurred or where they were likely to occur next and that sort of thing. Nowadays the network has grown to where in California, I suppose, we have two or three thousand of these instruments. They are much improved, of course—much better. We worked for quite a while to be sure that they would be commercially available so that they would be easily accessible and much less expensive. The program was finally taken over, first by the US Coast and Geodetic Survey, and then by the State of California Strong-Motion Instrumentation Program.

Cohen: So Caltech was no longer involved?

Hudson: Caltech is no longer directly involved in it. We still maintain a very small network of our own still, but we essentially got out of that business, because much bigger outfits took over. But the point was that, for a few years, we were kind of the headquarters for collecting the data, analyzing it, and making it available to everybody. Anyone who wanted to know about strong motion earthquake ground motion had to stop by here. So we had lots of foreign visitors from all over the world: lots from Japan, South America, Yugoslavia, Turkey, India, all over.

Cohen: This would be the late thirties?

Hudson: This was around the fifties and sixties. It was in the 1960s that we were able to induce the Los Angeles City Council to require that every building over so many stories high had to have three instruments in it to record earthquakes, should they occur. And very quickly several hundred instruments got installed and we got excellent data there. That network was in just before the San Fernando earthquake. That's why we got such an unparalleled collection of basic

data on the San Fernando earthquake. But this explains why we had lots of foreign visitors. Amongst those foreign visitors was one in particular who stood out in many ways. That was Dr. Khosla [A. N. Khosla]. He was the vice-chancellor and president of the University of Roorkee. He was a distinguished hydraulic engineer in India. He was responsible for several of the large river valley hydraulic projects—putting in large dams for generating power for the new India. This was a very hot subject for the country at the time. They had just started working on Bhakra Dam, that at the time was the biggest dam in the world.

Cohen: I'm going to ask you about this afterwards.

Hudson: One of the interesting things about that is that the construction superintendent for Bhakra Dam was a Pasadena man who was famous for having worked on big dams all over the world.

Cohen: Who was that?

Hudson: That was [Harvey] Slocum. He wasn't connected with Caltech. Well, Khosla came to Caltech and spent a couple of weeks. This was in the late 1950s. He was very interested in what we were doing. He was interested in earthquake work. He was also much interested in my dynamics laboratory. I had set up a little laboratory for dynamic measurements of all kinds. He spent quite a little time looking over what we were doing. Finally he came in one day and said, "I'm very interested in what you're doing. I'd like to do the same things in my school. So I've arranged with Dr. DuBridge [Caltech president Lee A. DuBridge] that you should take a leave of absence and come over to India for a while."

Cohen: That was before he said anything to you?

Hudson: He didn't say anything to me. He didn't quite understand how we operated here.

Cohen: He talked to the boss first.

Hudson: Right. At any rate, he had it all set up. I knew that he was a very capable man. He was the finest and most competent engineer I ever worked with in any country.

Cohen: Had you ever been to India before?

Hudson: No. I had never been there. I had no idea what was involved. I had never been anywhere before. So the arrangement was that he would send over his best man to work with me for six months. We would plan the laboratory here, order all new equipment, and get everything packed up and ready to ship to Roorkee. And then I would come to Roorkee and spend six months or so. Then he would send two more of his best people to Caltech for a year.

Cohen: After your six months there?

Hudson: After the six months there. It was a very logical way to get things started. It was a small project. It was just an individual thing. It was operated through the Technical Cooperation Mission of the State Department. It was just a one-man operation right from the beginning, with no cumbersome bureaucracy anywhere. I guess that's probably why it worked very well. Later on this Technical Cooperation Mission became the AID [Agency for International Development] program.

Cohen: Oh. So that was the forerunner of that.

Hudson: That was the forerunner of that. I always thought it was very unfortunate that they changed the name, because AID has an unfortunate context in some other countries.

Cohen: That's right. And now it has an even more unfortunate connotation.

Hudson: Right. I remember asking one of the people in Washington who had settled on that new name, "Why in the world did you pick that name? It has a lot of unfortunate context." He

said that it never occurred to anybody. He said that it never entered their heads that there was anything derogatory about "AID." [Laughter] So, it's funny how blind some people get. At any rate, it worked very well for us. It gave us an official connection with the embassy and all of their supplies and things like that. So when I got there it turned out that this was quite a remote place.

Cohen: I was just going to ask you where it was. Near Delhi?

Hudson: Roorkee is about one hundred miles north of Delhi. It's just in the foothills of the Himalayas.

Cohen: I guess that makes sense, because that's the earthquake area.

Hudson: Right. You have the big earthquakes where the big mountains are. And they had had a lot of big earthquakes, but they had forgotten all about them. I kept looking around at the school, and I said, "I'm sure you must have had records of big earthquakes here." And they'd say, "No, no. We never have earthquakes here." Well, I got looking around in their archives and found that a few years before, the main dome of the main building had fallen off in an earthquake. So people lose sight of this very quickly. But, at any rate, this turned out not only to be a little remote, but it was also a very fine school. It's the oldest technical institute in Asia. It was started over one hundred years ago as a training school for surveyors for the North India canal system. The British put in an immense, very impressive system of canals to get the water from the Himalayas down to irrigate the main part of India.

Cohen: So it would have been the British that set up this university?

Hudson: The British set up the university. It was called the Thomason College of Civil Engineering in the early days. They built an immense building and very nice grounds. It was a very large campus. It was first of all just sort of a works for the canal system. It's a fascinating area. Because every problem of hydraulic engineering is—we've got a good example right next

door—because to get this immense drainage from the Himalayas all tamed into channels, you had to pass all kinds of river systems. So sometimes the canals went over the river in an aqueduct, sometimes they went under the river, and sometimes they mixed with the river and came out the other side. So there was every conceivable type of hydraulic engineering.

Cohen: They also had to deal with floods there, didn't they?

Hudson: Yes, of course. One of the things that I realized very quickly when I got there was how hard it is to go anywhere when there aren't any bridges. You have all this immense drainage coming down from these big mountains and virtually no bridges of any kind. So most of the year you don't move at all. You're just stuck.

Cohen: Did you have your family with you?

Hudson: I didn't have a family then. So I was alone. For me, it was a fascinating experience, because we had to set up everything. There were no hotels or restaurants anywhere within one hundred miles. I think I was about the only non-Indian within one hundred miles. Although later there were a few other visitors at the university. They had set up quite a water resources center at the university, and they had some foreign visitors, including a number of Russians. There was quite a lot of Russian influence then. The Russians were working very hard to get a good foothold in India. In fact, it always surprised me how uninterested the embassy was in all those efforts. They seemed to be quite unaware of it. Right away we set up the lab, but not before I set up the living conditions for myself. As I said, there was nothing like a restaurant anywhere. So the embassy provided me with an entire household. I hired a cook in Delhi who knew enough Hindi to get by, and just a teeny bit of English. We had quite a time. The university supplied a house. They had some quite nice houses.

Cohen: I would think left over from the Raj period?

Hudson: Well, some of them were. But others were fairly new that they built just for the professors to live in. And my house had four bedrooms and four baths—quite a good-sized place. In fact, my house became kind of a headquarters for all sorts of visiting Europeans. So I saw more important people in India than I'd ever seen here. I had the only safe kitchen within a long distance. Visitors would all come up there and I'd cook and take care of them. For me it was a very interesting experience. I wound up needing a staff of about—I had five or six full-time servants: a cook, a gardener, a sweeper, a watchman, and all kinds of people. So I had to set up quite a system of paying them off each week. I introduced the system of buying things on time. The cook needed a bicycle. Well, he couldn't raise that kind of money. So I loaned him the money and he paid me back so much a week out of his salary.

Cohen: That was a new idea then?

Hudson: That was a new idea. But I had to be very careful that everybody understood what the deal was and that I hadn't gotten him a bicycle and that it was his bicycle. Otherwise, he would have been suspected of monkey business. In fact, you couldn't ever get anybody anything without providing a note explaining exactly what you had done. Otherwise people would be sure that they had made off with things.

Cohen: Now, were you only there for six months?

Hudson: Six months, right.

Cohen: It seems like you had a lot to do.

Hudson: Well, it was an extremely busy time. I don't know how I did it. I taught several courses. I wrote a couple of books and got them mimeographed and distributed to the students. And I worked out a course in structural mechanics with the civil engineers that became the core of their earthquake engineering course. And then I gave a course in mechanical vibrations to the mechanical engineers. The students were all very interested. These were graduate students. But

they were all extremely cautious. They couldn't take new courses that had never been given before, because they wouldn't know what the syllabus was and what they were going to be examined on. So you had to be very careful in introducing anything new.

Cohen: You had to have a mantle of "old" around anything new.

Hudson: Right. But, again, we had very good cooperation from the university. They supplied me with some good graduate students.

Cohen: How many students were there?

Hudson: Oh, let's see. The whole school was—at that time the freshman class was two or three hundred people—about like Caltech. The whole school was maybe six or eight hundred. It grew very rapidly. While I was there it expanded immensely. This was due to the energy of Dr. Khosla, who went all around the campus and put in foundations for new buildings. No one knew how they were ever going to finish them. But he figured that, if he got them started, by hook or by crook something would happen. And it was a fascinating thing. For several years I used to go back every two or three years to see that place grow, because it just went like a weed. And pretty soon every one of those foundations had a new building on it. One of the new buildings was a big earthquake laboratory—Earthquake Engineering Laboratory. They had much better facilities there than we ever had here. This was all due to the man that they sent over to work with me, Dr. Jai Krishna, who turned out to be extremely able. He became vice chancellor of the university, and then president of the International Association for Earthquake Engineering. Some years back he organized their first Indian Academy of Engineering in Delhi. In fact, I was the first and, for many years, the only foreign member. So he just turned out to be one of these remarkable people, who was a great successor to Dr. Khosla. He did wonderful things for the university. In the meantime they sent us several other people to get PhDs. One of them was Dr. Nigam [N. C. Nigam], who is now the president of the university. So the last three or four presidents of their university have been Caltech people.

Cohen: So there is a very close tie.

Hudson: It has been a very close tie, and strictly informal. There has been no big mechanism whatsoever for doing it. An interesting sideline is that, at about the same time, the government of India got the idea that they needed a number of institutes of technology, patterned after Caltech and MIT. And they lit on a very ingenious way of doing that. They decided to invite different countries to start and sponsor the various institutes of technology. So they set up five of these all over the country. One of them was sponsored by the British in Delhi. Another was in Bombay and sponsored by the Russians. Another was in Madras and sponsored by the Germans. And then they decided that the Americans should set up one in Kanpur.

Cohen: I've talked about the Kanpur project, but I didn't realize it was part of a very large thing.

Hudson: Right. This was all going on just about the time I was there. So I got in on a lot of discussions in the government committees about these things. It was kind of natural, when we finally formed the Kanpur project and Caltech agreed to become a member of the steering committee, that I was their representative for many years on the Kanpur committee. Kanpur was a very successful venture for about ten years. Then they ran into diplomatic problems between India and the US and the program kind of became strictly Indian from then on. But it is still very successful. All five of those institutes are well known and are still going strong. They continue to supply lots of our graduate students here. We know that their number one, two, and three people are going to be very good. So, that was an interesting part of the project too. A special committee of the American Society for Engineering Education, of which Professor Sorensen was a member, came to India and spent several weeks looking the ground over for Kanpur and getting started. That committee all stayed at my place for a few days.

Cohen: So you really were the person that knew everything about—

Hudson: I was in a very good position to be helpful with all kinds of things. Let's see. Where were we?

Cohen: We had gotten into Kanpur. But I am just amazed that you did so much in six months. You must have come back here after that.

Hudson: Right. It turns out, I think, that on all of these foreign projects you are much more successful if you plan carefully ahead of time, get in and don't spend too long, and then get out. First, you don't get involved in local politics, which is very easy to do. Everybody wants you on their side. So I got the pattern of this from several famous visitors to Japan. When Japan was modernizing the country, they invited a number of foreign professors to come. Surprisingly, some of them stayed a very short time. One man up in Hokkaido, who became famous in that whole area for inspiring generations of Japanese students—there are statues to him and everything else—

Cohen: What is his name? Where is he from? Japan?

Hudson: This is a completely different story. But, the point was that it turns out that he had only been two or three months in Japan. That whole impact that he had was just in the matter of a few months. But the key to it is in planning ahead of time. We were able to design our laboratory, order all the equipment, and get everything collected and shipped over so that by the time I arrived everything was there. Another aspect of setting up the lab was training the Indians to work in the lab and use the equipment. It turned out that the school was very well equipped with basic machine tools and things like that, but they had very little idea how to do anything. For example, once we wanted to make an instrument and they said, "Well, we don't have any metal. We can't make the brass castings you want to make." And I said, "What are you talking about? Every kitchen in the countryside is full of brass pots. The one thing you've got lots of is metal, or brass. So you melt them down, and away we go." Well, they just hadn't been used to thinking in those terms. I helped them design the instruments. I thought it was important that they ought to build the instruments well and make them look nice. So we built some interesting devices, nickel-plated them and made them look good. Well that, again, started a whole local industry. It turned out, again, that the technicians were very good, but they had had no

supervision and no guidance. So the technician that I had in the lab there, who was completely uneducated—he had never been to any school—turned out to be a very resourceful man. He designed and built all kinds of things. He took a number of the instruments that I had sent over and copied them and made Indian versions of them. When I returned on one of my trips back to Roorkee—it must have been ten years later—they introduced me to a very distinguished-looking gentleman who was very nicely dressed. This was my old lab technician.

Cohen: Has anyone ever written up the history of this university and these ventures?

Hudson: Not especially.

Cohen: It sounds like it is a good story.

Hudson: I prepared a detailed report myself once I got back. This fellow started a company to make instruments copying the ones that we sent. And, in just a few years, he built up to where he was selling instruments all over Asia and the world, because, of course, he could give very good prices. His son had just graduated from the electrical engineering department of the university. Nothing like that had ever happened. And as for education—I thought this was an interesting thing—he was, again, completely uneducated. The only formal training he had was when a whole bunch of his relatives got together and saw an ad in some Hollywood magazine for a national technical television school—you'd pay so much tuition and the school would send you correspondence lessons and equipment that you could put together yourself. Well, in this country we would have thought that something like that was just kind of a scam. But all these folks collected this money. It wasn't easy for them. They pooled it and bought this guy the correspondence course. This was going to be their savior. Well, it turned out this was a very good course. They sent him excellent lessons. They sent him these kits of equipment from which he built an oscilloscope and meters of different kinds. When I was there it turned out that this was the only equipment in the school that worked. They had a lot of fancy stuff from Europe—Phillips Electronics equipment and whatnot—but, after a few months it would stop working and they had no one who could fix it and no one who even knew what the diagrams

were for. The Europeans didn't supply full information on things like we do. So for a long time we were using the stuff that he built, because he knew exactly how to make it work. And I thought that was a remarkable example of the outreach of a little, dinky school in Hollywood.

Cohen: Meanwhile, what was happening back at the ranch? I mean, when you got back here.

Hudson: Let's see. First we should complete the story of the school. I set up these courses, which we had some very good graduate students take. Two of the best were sent to Caltech later for a year, and were among the best students we had ever had. One of them in particular stayed in the field and has become an international expert.

Cohen: What is his name?

Hudson: Chandrasekaran [A. R. Chandrasekaran]. He just recently retired.

Cohen: That's a very common name.

Hudson: Yes, indeed. So the courses continued. After I left, they kept the notes that I had worked out. In fact, Krishna and Chandrasekaran published a book based on the notes. They gradually had more and more students. Pretty soon they set up special training courses and had students from all over Asia. That was the only place you could come in Asia where you could learn about earthquake engineering.

Cohen: Does that include China also?

Hudson: Well, at that time, China wasn't cooperating with anybody else. So the Chinese developed their own courses later on. They were far behind. But the Roorkee school, right from the beginning, was very successful, had a number of excellent students, offered many good courses, and became well known internationally to the point where, in 1964 I think it was, they felt they were ready to host an international world conference on earthquake engineering. So,

when it turned out that we had been developing over the years—this is another old branch of the story—a system of world conferences on earthquake engineering—the first one was in Berkeley in 1956—

Cohen: Now, who was behind these?

Hudson: Behind this was an organization of, basically, California engineers. Housner was prominent amongst them. A small group of a dozen or so people formed a slightly more formal group and decided to put on this world conference. This was quite an adventure. Four years later the Japanese took it up and decided to host the next world conference—the second one—and to organize the International Association for Earthquake Engineering, whose main function was to put on a world conference every four years. This, again, turned out to be a very successful undertaking. They had these world conferences every four years and still do. The last one was in Madrid. They've had them in New Zealand and Italy—

Cohen: Now, where is the headquarters of this group?

Hudson: Tokyo, Japan. They supplied office space and sort of a headquarters with a small staff to run this thing. I was fortunate enough to be an international president for four years during the time that they came back and had a world conference in Berkeley. And the association has been very successful. In addition to the conference they also publish a number of very basic books. One is a collection of all the building codes on earthquake design for all the countries. That's been very useful. And then they have a series of monographs on practical design for developing countries.

Cohen: Now, did the Russians and Chinese participate in this early on?

Hudson: The Russians did from the beginning to quite an extent. With the Chinese we immediately ran into the Taiwan-China problem. The original member of the group was Taiwan. Pretty soon we ran into this problem that there could be just one China. So we were directed by

UNESCO [United Nations Educational, Scientific and Cultural Organization]—this is a whole different story.

Cohen: I have UNESCO written down here somewhere.

Hudson: Yes, that was a whole new phase. We were directed by UNESCO to eject Taiwan from our association, and denounce them, and put mainland China in their place. Some of us had considerable misgivings about that. We were strictly a technical organization. We had no official involvement with UNESCO. They had no business to tell us what to do. But for all kinds of historic reasons, they decided to go along. Ever since, Taiwan has been out. Now, just last year Taiwan applied to be readmitted. This required a change in our bylaws, permitting more than one association from one country, which finally got passed. So it looks as though we'll have both Chinas in. Although the People's Republic vigorously protests every step of the way, we're getting gradually more and more cooperation between the mainland and Taiwan. I think that when another generation or two dies off those problems will solve themselves. I just got a new art book on Chinese painting. I noticed that it's now a cooperative effort between the Chinese Palace Museum in Beijing and the Palace Museum in Taiwan.

Cohen: Where I think they have most of the art.

Hudson: Where they have most of the art, yes.

Cohen: Well, that's interesting.

Hudson: So, we've had very good connections with Taiwan over the years. I made many trips there. We have many associates. Of course, Taiwan has lots of earthquakes too. Now, where were we? We got off the track on that world conference. Oh, but the point is that, by the time of the fourth or fifth world conference, the people at Roorkee felt strong enough and resourceful enough that they could host the world conference in Delhi. So that they did, and they did a beautiful job.

Cohen: What year would that have been?

Hudson: This must have been ‘64 or ‘68 or ‘70—right around there. Now, one of the reasons that they could do that was that one of the first things they told me when I got to Roorkee was, “These plans you have for the laboratory and the special courses and whatnot are very good, but in this country, nothing can be done without the approval of the prime minister. So we must get him interested in this.” Well, that sounded kind of unlikely to me. But it turns out that Khosla and Nehru [Jawaharlal] are old friends from way back. So Nehru used to come quite regularly to the school. They’d give him a degree or two every few years and things like that. He’d give speeches at the commencement. So I saw quite a lot of Nehru. And, sure enough, they got him to come and inspect our school. We showed him the lab and everything we were doing. He was very interested. So, from then on, we got the full backing from the government of India. Without that, of course, we could have done nothing. That was, again, just kind of fortuitous—when personal connections were involved from way back.

Cohen: It sounds like that’s how you do business in India.

Hudson: That’s how you do business anywhere, if you get right down to it. Anyway, it was an unparalleled opportunity for me to see something of a person like this at close-hand.

Begin Tape 2, Side 2

Hudson: An interesting sideline is that, by the time we had the world conference in Delhi, there was a new prime minister, Indira Gandhi, and she played quite a role in the conference. She gave the opening address. We had a very elegant tea party at her house for the conference officials where she thanked me very much on behalf of her father for starting the laboratory. So that was a remarkable thing. There were just a lot of very lucky things that happened.

Cohen: And that was really terribly interesting to you.

Hudson: It was very interesting. That maybe leads us into the UNESCO thing.

Cohen: Yes. I have here UNESCO. In between, I have something about research on problems affecting the state of California and also the committee of NRC [National Research Council] on earthquake engineering research. Does that come in between, or is it just sort of concurrent?

Hudson: Well, concurrent. Personally, I didn't do too much for the state of California. I had quite a few connections, but it was Housner who had the main connection there. I did work with Housner on several NRC reports.

Cohen: That would have been the National Research Council?

Hudson: Right. Housner had the idea of getting these comprehensive reports outlining the research field, forming sort of a blueprint for the subject. Well, they became very important. There were two of them. They were quite influential in shaping the field.

Cohen: So you worked on those?

Hudson: I worked on those. Also, at the same time, I worked with the NRC on seismology committees. They usually wanted some engineering representatives. Seismology and earthquake engineering were coming closer together throughout all this time. So I saw quite a lot of the basic planning from that point of view. But, at the same time, UNESCO was getting more and more involved in the earthquake problem. This, of course, is a major disaster for many countries. Many of the developing countries are just helpless. They have no materials and no money to do earthquake resistant design. This is why the developing countries are so interested in earthquake prediction. They think that's their only chance. Well, earthquake prediction turned out to be quite a blind alley. Now, everyone realizes, more and more, that you don't want to lose all your buildings in a predicted earthquake any more than in an unpredicted one. So the thing to do is to make them stronger. The major thrust of the Roorkee people, for example, is to

work with developing countries on very low-cost simplified structures. Most of the people in India in the villages have no houses at all. They just have a mud hut. They aren't even of sun-dried brick. They just stack up enough mud to make a little room. When the rain comes it all dissolves. So conditions are just inconceivable. But the Roorkee people made a lot of improvements. They showed how, by improving a little bit the quality of the bricks and the way they are put together, you can increase the strength a good deal. And by putting in bamboo reinforcing and things like this—

Cohen: Simple things.

Hudson: Very simple things that can be done by the local people without needing any money. So that's been one of the successful parts of the Roorkee project. But this got UNESCO interested in the whole thing. So one of the things they did was to launch a big intergovernmental meeting on the mitigation of earthquake disasters. They had people coming from all around the world. I was fortunate enough to be the chief US delegate on that. That got me into all the politics of the thing, which was quite illuminating to me—quite discouraging too. But two big advantages came out of that. First, through the excellent UNESCO translators, we made very good contact with the Russians for the first time.

Cohen: Now, were those meetings in France?

Hudson: These were at UNESCO headquarters. So, over a period of years, I was making many trips to Paris. And that was fascinating too. UNESCO headquarters is in a very interesting part of town. There are all kinds of little hotels around that enable you to get a feel for the country. So that I enjoyed very much. But the UNESCO political scene was not quite so much fun.

Cohen: Now, hadn't we broken with UNESCO?

Hudson: Yes, we dropped out of UNESCO sometime back. Every once in a while there is sporadic interest in seeing if they've got themselves reorganized enough so that we could rejoin.

It was a little sad that we dropped out. The earthquake part of UNESCO was very well run. They had an excellent man, Fournier d'Albe. He sounds French, but he was an Englishman. At any rate, he was an excellent man—very knowledgeable and understanding at working with everybody—a wonderful diplomat. UNESCO was thrifty and used their money very effectively. The headquarters staff was very good. So, in a sense it was a little unfortunate that we couldn't keep up with that. But one of the ideas they had was to organize a big investigative trip to four different seismic areas of the world. They assembled UNESCO teams of seismologists and engineers and visited Asia, South America, Europe, and Eastern Europe. There were four of these big ventures. I was fortunate to be a member of the team that went to South America. So I spent a month or two going around to all the capitals of South America, investigating the states of education, research, and whatnot in the country in connection with earthquakes. Again, this was a fascinating experience. Then we wound up in Santiago, Chile, and wrote a big report. One of the most interesting aspects of this was that our team leader was a Russian—a very prominent geologist—who had very controversial and different ideas from all the US geologists. And that was a constant source of all sorts of interesting problems. At any rate, it turned out to be a very successful trip. We visited all the main universities and research centers in South America, except Peru. There was a diplomatic problem between the government of Peru and the Russians. So they said that they wouldn't admit the Russian into their country. So the rest of said, "Well, if we can't go as a team, we won't go at all."

Cohen: Pre-Iraq? [Laughter]

Hudson: Pre-Iraq, yes. So we skipped Peru. I stopped there later on as a tourist on my way back, because I didn't want to miss Machu Picchu. So, again, I had an unparalleled opportunity to look at all the schools in South America. And the situation in the technical schools there was extremely depressing.

Cohen: Now, you weren't getting any students from those schools coming up to Caltech, were you?

Hudson: Very few. We were getting some. In fact, we got two excellent graduate students from Argentina—students who went back and started up earthquake institutes at their own schools, which were very successful. They became internationally-known experts. Also, we had one from Peru, who became an outstanding man. They came to Caltech and were very good students. They got doctor's degrees here and then went back and spread the gospel in their own countries. The other very successful operation of that sort was in Yugoslavia. They sent a team of technicians over to Yugoslavia—to the University of Skopje—to assist in setting up a network of strong-motion instruments in Yugoslavia. The also set up a successful earthquake engineering school in Macedonia.

Cohen: They sent their people to train at Caltech?

Hudson: They sent their people to Caltech, not only the technical people, but also technicians, which was something new. And, interestingly enough, practically every one of those technicians wound up in this country. One of them, who again never went to school in his own country, is now the president of one of the main instrument companies in Pasadena.

Cohen: So he didn't go back to Yugoslavia?

Hudson: Some of them didn't go back.

Cohen: They must have had a premonition of what was going to happen.

Hudson: It's a good thing they didn't. But, again, this was another aspect of these international connections. Now, UNESCO, as I say, gave us an excellent opportunity for making much better connections with the Russians. These UNESCO translators are really wonderful. You can sit down with a Russian who knows not a word of English and a UNESCO translator and pretty soon you're conversing back and forth without realizing that you're not speaking the language. They're very good. So that was one of the big advantages. We made personal connections with several Russians at that time, which we kept up over the years. And we traded technical reports

and books and things. So that was our main source of information from Russia for a long time. Nowadays there's always a Russian representative on the board of this international association. But they don't operate quite the way we do. The government appoints somebody—

Cohen: So you don't know if you have a real specialist?

Hudson: You don't know. That's been a difficulty. But some of them turn out to be okay. Enough technical people from Russia finally turned up at these meetings so that we got a pretty good picture of what goes on. They would latch on to you on some of these field trips. I can remember meeting in various Japanese gardens. Pretty soon one of the Russians would say, "Well, let's step up our pace a little and leave this guy behind. He's just been sent along to keep an eye on me." [Laughter] That sort of thing. So we understood the picture pretty well. But we've had very good cooperation ever since with the Russians.

Cohen: Now, coming back to the underdeveloped countries: they all want dams. Hasn't that been a major problem?

Hudson: Power is extremely important for developing countries. Energy. This is what all the arguments are about now, with the global warming. How are the developing countries going to supply the energy they need to raise the standard of living? Dams create a lot of problems, but they also create a lot of power. Now, India has gone through this stage of dozens of huge river valley projects with big dams. Every one of them was a struggle. There are lots of objections, especially when people are relocated. But they were very successful. Some of the biggest dams and finest water projects in the world now are in India. This was accomplished very much after the pattern in this country. The Indians were very impressed by the TVA [Tennessee Valley Authority] and sent generations of Indian engineers over to study there. That was the inspiration for their water resource school in Roorkee and is what launched Khosla on his projects.

Cohen: The TVA project?

Hudson: That was the thing that inspired him, yes. So those connections, again, can get very important and they are very personal things. Khosla finally retired from the school, and went on to become governor of the state of Orissa, which is one of the poorest of the Indian states. But, again, he had immense plans and did great things with the state of Orissa.

Cohen: Well, sorry to interrupt with the dams, but they present earthquake problems, don't they?

Hudson: Well, of course. Of course, right now we have this Chinese dam, which is the biggest in the world by far. The Three Gorges project. There's lots of controversy about that. Many of the Chinese engineers are much opposed to it. But politics are pushing it through.

Cohen: I had written down here all sorts of consulting. I don't know when—

Hudson: That was a minor thing. Strangely enough, I did most of my interesting consulting work in India, since there wasn't anybody doing anything and very few people they could call on to consult on these things. I got called in on all kinds of things. There were several major problems on Bhakra Dam I got involved with. They were just completing the dam at that time. So I got involved in the design of instruments and in the setting up of labs of all kinds, and that sort of thing. There were many more consulting opportunities there than there were here—for my spare time.

Cohen: I was going to say, "when—" Well, maybe you didn't sleep when you were in India those six months.

Hudson: Well, I was afraid to most of the time. One of the first things you do is hire a watchman, and he goes around all night and he has a special cry, because he doesn't want to run into any burglars. So he wants to be sure they hear him coming. He doesn't want any trouble.

Cohen: So that's what you had to do there.

Hudson: Well, it was very different. Strangely enough, I always felt entirely safe in India, personally. Although, I was astonished to learn later on that Roorkee was one of the headquarters of big game hunting. It was one of the places where rich Americans went. The other interesting thing about Roorkee was that it is close to the Himalayas. For about three or four weeks during the year the atmosphere would clear up and you would have an unparalleled view of the mountain range—about three hundred miles of the Himalayas—all the big peaks. Most of the year you couldn't see a thing.

Cohen: Well, it sounds like this was really an exciting time for you. And so, most of your students and research fellows were on the international level.

Hudson: Right. We were running quite an international school for a while. That's gradually changed, because the whole field changed. It became a much bigger thing—a much bigger operation than a place like Caltech could handle. State departments took over, and the engineering associations, and all that kind of thing.

Cohen: So what sort of things are going on now?

Hudson: Well, we have several new staff that are very good. We are still turning out graduate students in the field, but not quite as many. However, Caltech people are still involved in all these international societies and things.

Cohen: So it's mostly now a training place for people to go into these—

Hudson: It's mostly now for the graduate students to come, yes.

Cohen: Well, it sounds like the thirties, forties, and fifties were really exciting here.

Hudson: It was just the beginning of the subject. It was all very new. Anything you did was a big development. So we had the chance to skim off the cream for quite some years.

Cohen: Tell me something. Of all the honors and awards you've gotten through the years, do any of them mean more to you than the others?

Hudson: I got the Housner Award from the EERI [Earthquake Engineering Research Institute]. That's another story. This is a group of engineers and industry people and professors, and Housner was a very dominant figure in that for many years. Some years back, he set up the Housner medal, and one of the years I got that. I was very proud of that. I was happy to be the first member, and only foreign member for a long time, of the Indian Academy of Engineering. So, I've been very fortunate. I was in the right place at the right time and had the right associates.

Cohen: Well, one has to know how to take advantage of that—of being in the right place at the right time.

Hudson: I think we've covered most things, haven't we?

Cohen: I think so. Are there any other observations you'd like to make?

Hudson: Well, I think it's very hard to talk this way without sounding quite immodest.

Cohen: Well, that's okay.

Hudson: I was a very lucky person to have fallen in with all kinds of important people at a time when I could make a small contribution.

Cohen: I think you made much more than a small contribution. It's been very good. [Tape Ends]

Donald E. HUDSON

Session 3

December 17, 1997

Begin Tape 3, Side 1

Cohen: Good morning, Dr. Hudson. I'm happy to have you here with us again. I'd just like to pick up a few threads of things that we didn't talk too much about last time. Let me just ask you, first of all, about your long association with George Housner. When did it start and what were the highlights?

Hudson: It started when we were graduate students together. We shared an office for many years as graduate students, and then as young professors. I could see from the beginning that we had a lot in common—various interests. He got me interested in oriental art and I got him interested in music. So it was a good trade. He worked on earthquake engineering even before he got here. Housner spent five years in an engineering practice after he got his master's degree.

Cohen: Was his master's degree from here? From Caltech?

Hudson: Yes, I think so. His original degree—his bachelor's degree—was from the University of Michigan. Well, he got me interested in the earthquakes, among other things. The next thing that brought us together closely was when we were given an assignment by Dr. Lindvall to work up this book on mechanics—to completely revise the course on mechanics and work up a new book. So we worked very closely together on that for a number of years. That came out very well. By then I was getting more and more involved in earthquake engineering. We had a number of joint projects: first with the ONR and then NSF. We got very good support from NSF for many years for data processing and things of that sort. We had quite a little crew at one time working on those things.

Cohen: These were mostly graduate students?

Hudson: Graduate students and postdocs and so forth. So that went on very well. Then we did a lot of traveling. Neither one of us had families at that time. Our first big trip was to Europe.

Cohen: This was vacation?

Hudson: This was vacation, sort of, yes. We bought a little car and picked it up in London. We drove all around Europe. Then we left the car in Rome and went to Egypt. We had a wonderful trip. We had always been interested in antiquities, art, and things like that. So we really enjoyed that. Our next trip was in 1955 when we went Japan to reestablish connections in earthquake engineering that were made ten or twenty years before by Professor Martel [Romeo R. Martel] the father of Hardy [Hardy C. Martel]. Martel had made very good connections with the earthquake engineering people in Japan. We were really the first people from this country after the war to visit the Japanese. And we got quite a welcome. They were very eager to reestablish connections, so that worked very well. Besides, we were very interested in oriental art. Housner's got a very good collection of Japanese paintings and prints and things of that sort. So we took the opportunity to see all of the gardens and temples and whatnot.

Cohen: Was there still a lot of war damage in that time?

Hudson: No damage. We didn't see much damage.

Cohen: This is ten years later, actually.

Hudson: Yeah. Things had been very much cleaned up by then. Although Japan hadn't changed as much then as we could see it changing in later trips. It began to change very rapidly. It became more and more American. But during our first trip there a lot of the old Japan was left. It was really fascinating. Then, at about that time, we got started on these world conferences. From then on most of our travel was in connection with conferences and things of that sort. Also, of course, we investigated—or made field studies—of all the big earthquakes.

That's one of the pleasures of earthquake engineering, because you get to visit all the earthquakes—

Cohen: After they happen.

Hudson: After they've happened. Right. So those were the main connections, and they have continued all these years. We are still very good friends.

Cohen: Now, did you retire at about the same time also?

Hudson: Well, it was about 1981—I think it was—just as I turned sixty-five—the school put in a new policy for early retirements. They had a very attractive arrangement. You could retire completely at sixty-five and they would pay half of your full salary for three years, without requiring any service in return. [That fit my needs] just exactly, because I was interested in moving over to USC [University of Southern California] anyway at about that time.

Cohen: Why was that?

Hudson: Well, that's an interesting story too, because over the years a number of my very best graduate students went on as staff there. Consequently, I had more direct associates in earthquake engineering at USC than I did at Caltech. So it was a very natural thing to do. Besides, it's fairly close by. Arcadia is as good a commute for SC as anything. So I kept my house. I could even keep my TIAA [Teachers Insurance and Annuity Association] and all that. It was an ideal arrangement for me. And just about that same time USC was looking for a new chairman in their civil engineering department. So they induced me to come over and take over that job, which was quite a change for me as I did not have much experience with administrative work. To move suddenly to a very large department at a big university in a strictly administrative job was quite a change. But it was a great pleasure. I enjoyed it. Most of it. One of the problems was the person who induced me to come. He was a very forceful man they had as provost of the university at that time—Zohrab Kaprielian. He was a very remarkable man.

He had been the dean of engineering for a long time and was just about ready to change back from being provost to being the dean of engineering. He essentially ran the whole university for several years. He was a specialist in building up staff. He felt it was very important that the school got a lot more vigorous and up-to-date type staff. So he recruited a lot of people, including me. And then, just two or three weeks after I got started, he died suddenly of a heart attack. Immediately, I was on the search committee for a new dean.

Cohen: It didn't take long?

Hudson: Well, it took three years to find a new dean. It took the whole time I was there. So part of my problem was that, for the whole three years I was there, I essentially was in a ring with no referee. All the other division chairmen were old-timers. They knew the ropes from way back. It was pretty tough going sometimes to fight them off. But by and large it went very well. The civil engineering department was very disorganized at the time. The previous chairman had neglected it completely for some years. It needed a lot of work. So I did a lot of reorganizing of the department. I think I probably did them quite a lot of good. I helped out with recruiting. We added several very good new people. We had several excellent Caltech PhDs.

Cohen: That was sort of the backbone of the department?

Hudson: That was the backbone of the department. They had a good start in earthquake engineering. The man who had been one of my very best research students in earthquake engineering was there at that time.

Cohen: What was his name?

Hudson: [Mihailo D.] Trifunac. Another Caltech PhD who sort of ran the department in the absence of a chairman was Sami Masri. He is now working very closely with George Housner on joint projects in smart buildings—the automatic control of buildings. One of the suggestions

these days is that you might be able to cancel the effects of the earthquake out. As the building starts shaking, sensors shake it in another direction and cancel it out. So they're working on things like this. There was a very close connection between the two schools.

Cohen: Is that unique to engineering, or does that exist in other areas also that you know of?

Hudson: Well, I think it's in seismology too, and geophysics, and geology. They always work very closely together. Caltech is a member of the Southern California Earthquake Center. Its headquarters is at USC. They've had a very vigorous renaissance over there. I think, given a little luck, they are going to pull off the same deal that Stanford did.

Cohen: You think they're going to be of that caliber?

Hudson: They're getting there rapidly. A few years ago Stanford was just a country club for rich kids. But then they got busy. One of the people that pulled them through was a Caltech man.

Cohen: You're talking about engineering now?

Hudson: No, the whole university. The president of Stanford University, for quite a while, was—

Cohen: [Donald] Kennedy?

Hudson: He preceded him. It was a fellow from the Caltech humanities department—[John Ewart] Wallace Sterling. He was the one that really got them stirred up and busy. And they've done very well. I think SC's going to do the same thing.

Cohen: So you were only there, actually, three years?

Hudson: Three years, right. [Hudson was chairman of USC's Department of Civil Engineering for four years, from 1981-1985.—ed.] And then I was very fortunate in being able to induce a very capable man who was prominent in the field to succeed me as chairman. So I felt I was leaving them in very good shape. Since then they've added another very top-notch fellow in earthquake engineering from Columbia University. So they've done very well in that field.

Cohen: While you were over there did you still have ties here? Did you come and eat at the round table?

Hudson: No. I pretty well dropped out completely here. In fact, it was a very good way to transition because I was away long enough to end my connections here, and I broke connections completely at USC. As a result, over the last decade I was very independent.

Cohen: And you continued to work with George Housner when you came back?

Hudson: Right.

Cohen: When you say "independent," what have you been doing?

Hudson: Well, that's a good question. Most of the time, not much. I was reasonably active in earthquake engineering affairs until a few years ago when I ran into these health problems.

Cohen: Now, when you say "affairs," you're talking about the professional organizations?

Hudson: Professional organizations: EERI, and things like that.

Cohen: And so you took office? You were an officer, certainly.

Hudson: Well, in the international association, yes. Those things kept me very busy.

Cohen: Looking back at all these things, what would you think would be some of the most significant things that have happened in the development of earthquake engineering here and, of course, other places?

Hudson: Well, I think the growth of the international aspect of the field was very important. The International Association for Earthquake Engineering played quite an important role in that. The Earthquake Engineering Research Institute—a collection of professors and governmental people—helped speed the transfer from the academic world to practice very quickly. That was important. The development of improved instrumentation was also a major contribution. When we started the instruments were handmade and hand-designed. They were very expensive and difficult to get. Now there are three or four different commercial brands. You can buy them off the shelf at a modest price. Everything is now digital, of course. It improves the data processing very much, and it's much more accurate and much more rugged and reliable. So that's made quite a revolution in the subject. And then, I think, the growth of the graduate programs in a number of schools—mostly folks fanning out from Caltech. The only other school that really got started at about the same time and was a little independent of the Caltech influence was the University of Illinois. They had a very strong group. But the Michigan people came from here. The Berkeley people sort of did their own thing too and are now very prominent. There are now a dozen or so schools around the country that have very active programs and have turned out many good PhDs—all competing for the same NSF grants. So that's a problem for everybody. You can't just keep on exponentially increasing the number of research workers in the field. That's making it very difficult for the young ones.

Cohen: That's true of many fields of science.

Hudson: I'm sure. So there aren't the opportunities there once were. But still it's a field that's developing and growing. There are more and more companies that are hiring people as specialists in this field. Government activities. The state of California is doing a lot. So I would say that there are still good chances for PhDs in this field.

Cohen: What do you think of the field of earthquake prediction? Of course, the engineers aren't into that particularly.

Hudson: I think that's pretty well dead now. I think there is an awful lot of wishful thinking. The problem is that in many countries the economic situation just does not permit putting the right materials and design into the buildings. So their only hope is to try to clear out the population. This is true certainly in China and in India and in developing countries. They just don't have the economic means. Now, that's much better than it used to be. The Roorkee people made big progress in low-cost earthquake-resistant design for small housing. They are in a lot better shape than they were. But still, if you read your newspaper, any time there's an earthquake in many parts of the world—Turkey, Iran, and those places—they are very marginal. But now they all have earthquake engineering schools and are beginning to turn out trained people. A landmark event in that was the setting up by UNESCO of a special school in Tokyo, Japan, for training earthquake engineering students. They still support it. It's a very active group.

Cohen: Who was behind that?

Hudson: Well, Housner was mainly. I visited them for, I think, their twenty-fifth anniversary celebration just two or three years ago. In the meantime, USC has really blossomed. They have very good laboratory facilities now. They do associated work in the dynamics of structures.

Cohen: Is there a lot of cooperation between USC and Caltech?

Hudson: Well, through the personal connections of the students, yes.

Cohen: So it's strictly a personal kind of thing. They know each other.

Hudson: Yeah, right. The same thing has happened in hydraulics. Some of the civil engineering people in fluid mechanics do part-time research at Caltech, because using the labs is a little easier. So there has been a very close relationship.

Cohen: Of course, Neil Pings [Cornelius Pings] went from here to there in an administrative position [Cornelius Pings became provost of USC in 1981.—ed].

Hudson: Right. He ran the whole university for a number of years.

Cohen: I guess he'll be back next year. Well, at least he lives in Pasadena.

Hudson: Well, he's kept a place here all the time. I see him at the Athenaeum quite often. It was really sad the way the Academy of Engineering thing worked out for him. He was all lined up to be president. It was all in the bag. He was all ready to move. At the last minute the whole thing blew up, leaving the Academy in a terrible fever. They are still trying to work their way out of that. [Laughter]

Cohen: Well, are there any other observations you'd like to make from your vantage point of seeing the whole development?

Hudson: No. I think we've covered things pretty well. It's been just the kind of field that Caltech needs to look out for—something that's very new, where modest efforts can make quite a contribution. We don't need a lot of people with huge laboratories—mainly just somebody to sit down and think. And that's what Caltech is good at. Now I think we're busy in that department in trying to think of the next "earthquake engineering." What subjects are going to come along that are going to be just right? You see, earthquake engineering has now kind of moved on into industry, and the state and government agencies, and so forth—where it needs to be, because that's where it gets put into practice. And I think the field has always had a very good connection with the practical people.

Cohen: Tell me, is there any connection—there must be some connection—between the physicists who study materials and the earthquake people? Is there any back and forth there?

Hudson: Not really so much, no.

Cohen: You'd think that that would be a venue for cooperation. Maybe they're down at the atomic level, while you're at the molecular level.

Hudson: Right. They are quite different aspects. Although we have always worked closely with people in material science. Another very closely related subject is the development of the strain gauge—Edward Simmons.

Cohen: Is he the one that worked with the—

Hudson: He's the Renaissance Man.

Cohen: Well, I see him.

Hudson: But you haven't had an oral history. You should do that, because he's a fascinating man. He has a master's degree in electrical engineering from Caltech. He's one of these geniuses at instrumentation—one of these people who works all night and sleeps all day and does his own thing. He's completely unconcerned about anybody else or any conventions. You can tell that. [Laughter]

Cohen: Why the costume?

Hudson: Well, that's characteristic. He's a strange combination, because he's a very quiet guy who doesn't want any notice taken of him, and yet he sticks out like a sore thumb everywhere.

Cohen: I haven't seen him in a while.

Hudson: Well, he still comes to seminars. There was quite a lot of concern recently, because he was nominated for an alumni award, which he richly deserves. He has made remarkable contributions. But no one can quite see him getting up and giving a speech in front of the trustees and all that kind of thing. So I don't think anything ever came of it.

Cohen: He was a student here?

Hudson: He was a student here. And he was a technician. He worked in various labs. He worked for our earthquake group on several projects.

Cohen: Did he get a bachelor's or a master's degree?

Hudson: He got a master's degree in electrical engineering. And then he continued on. He worked for many years for Don Clark [Donald S. Clark] in impact studies. That was where he developed the strain gauge. Well, he had the brilliant idea that you could measure strain by just gluing down on a specimen a wire grid. Then, as the materials strained, the resistance of the wire changed. And he just measured that resistance as it changed and got a direct measurement of the strain. Well, this was a wonderful device, because it was very simple, very inexpensive, and it weighed practically nothing. The strain gauge was an instant success as hundreds of thousands of them were used on airplanes all over the world. This was just at the start of the war that this got developed.

Cohen: How did Caltech benefit?

Hudson: Well, again, this is a fascinating story. He had done this work for Clark in the impact lab. And this was work that was supported by, among other people, the Baldwin Locomotive Company. So the Baldwin Company picked up the patents. Then, right at the start of the war, there was a big hassle. I've mentioned how informal Caltech business arrangements were in those days in my connection. It was the same with Ed Simmons. He sort of worked for the

school for years, but nobody knew whether anyone paid him or not. The result was that he sued the school for all of the patent rights. Not only that, but he won. He won his case. He had to use his own lawyer. He beat out all the Caltech lawyers, and won the whole case. He won the basic patent rights.

Cohen: Now, what year would that have been?

Hudson: 1940 or 1941.

Cohen: Oh, so that was before the war.

Hudson: The war was just starting. This came in just at the time it could be very useful in the aircraft industry, for example. But, by then at that time, nothing was commercially available. So all the companies had to make their own strain gauges. At the locomotive company this was a little afield from their main work. It took them a long time to get organized. But eventually they got it commercially developed. Ed Simmons got a million or so dollars out of the settlement and, for the life of the patent, did very well. So you don't have to feel sorry for him. [Laughter]

Cohen: Has Caltech benefited from this? Has he seemed to give back?

Hudson: Just by his presence, I guess. [Laughter] That was a very awkward thing. It meant that Caltech never got the benefit in public relations for what was by long odds the finest technical contribution that the engineering people ever made here. And nobody ever heard about it, because the school was sort of embarrassed by the whole thing and kept it very quiet from their end. Just in recent years there have been several birthday celebrations for the birth of the strain gauge. There were special conferences where Ed Simmons was honored. At the time, he got the medal of the Franklin Institute for the development. He used to always—in those days he hadn't assumed his renaissance outfit—he always wore dirty white cords and an old green sweater. I have a very interesting picture of him standing in his dirty cords and old green sweater in front of the Franklin Institute in Washington, getting his medal. A really distinctive fellow.

Cohen: Do you have any clue as to why he picked that costume?

Hudson: He says it's comfortable and very convenient. Although it seems to be quite the contrary. In fact, one of the students said to him one day, "Why are you dressed so funny?" And Ed replied, "Well, I'm a rich man, and I can do what I please." [Laughter]

Cohen: Okay. Maybe that's exactly how he feels about it.

Hudson: He's very distinctive. He makes his own hats. He makes all his own costumes.

Cohen: He must live close by.

Hudson: He lives in his car.

Cohen: Oh, he doesn't have a home or anything?

Hudson: Well, no. He had a home. That was a scandal too. He had a home not far from the school. He and his sister and his mother. In due course, his mother died. He argued with his sister. Among his other proclivities, he doesn't like taxes. So he refused to pay any income taxes. Naturally, he lost the house finally. They kicked him out of there. So he's still living in his car. He has kind of a warehouse close by in Pasadena, where he stores a lot. He buys a lot of books at the Caltech Bookstore each year. You see him going out of there with loads of books. So he's got a little warehouse full of books and journals, junk, and parts and things, and apparently just lives in his car in the yard. Now, he does consulting work for a good engineering outfit in Long Beach. I was talking with one of them a while back and he said, "I tried to tell Ed that I'd fix up an apartment in our plant for him. And Ed said that he didn't want to get too far from Pasadena. He said that that was the cultural center of Southern California." Besides, he spends a great deal of time at the Huntington Library.

Cohen: Oh, is that right? He must give them something then.

Hudson: I think he does.

Cohen: If they've made him welcome there. Or they're anticipating—

Hudson: I think they must be aware that there are some interesting possibilities. Although whether he has any money left by now, I don't know. But actually, he would be a fountain of information on the early days of Caltech. Many of us have a very high regard for him and a very great respect for his abilities, but we're kind of embarrassed to be seen with him. [Laughter]

Cohen: Let me go back and ask you something about this informality in the forties when nobody knew if they were getting paid or what their position was.

Hudson: Well, this was Millikan's style. He was not a person for all kinds of formal arrangements. He didn't think they needed them. At that time, in all of Throop Hall there was one telephone in Millikan's office and that was it.

Cohen: You mean, if you had to make a call you'd have to come into Millikan's office and do it?

Hudson: If you wanted a pencil you had to check it out from his secretary. Things were very thrifty. All the money went to research. Well, you remember the campus? It was low-maintenance iceplant. And nothing went into the physical plant in those days. But there was a great spirit.

Cohen: Well, it was the beginning of a lot of things that were just happening.

Hudson: This was just a part of Millikan's operation. But he foundered on this patent thing. That's where all this informality caught up with him. I can remember well: I was at the faculty

meeting when Jim Page [James R. Page], the chairman of the board of trustees, got up and informed Millikan that he was no longer running the place. It was a very sad moment.

Cohen: How did Millikan take that?

Hudson: Well, he wasn't very happy about it. But Jim Page was a very forceful man too, and they realized that something had to be done. They needed a patent committee and they needed organization. Things began to change right about then.

Cohen: So they actually then went into more formal operations with vice presidents in charge of—

Hudson: Right. They set up a whole bunch of vice presidencies and comptrollers. It was quite a reorganization. One of the men brought in to do the reorganization from New York was Morrisroe [David Morrisroe], who liked what he saw here and decided to stay. Another one of Ed Simmons's bids for glory was that he was a great one for rummaging around in trash cans. One day he fished out of a trash can in Throop a list of everybody's salary. It had been thrown away from the board of trustees meeting.

Cohen: Was this before the days of paper shredders, or something? [Laughter]

Hudson: Well, he didn't know what to do with this. Finally he took it around to Sorensen and said, "What should I do with this?" Sorensen recommended disposing of it. But, in the meantime, he took a look at it and saw that Buwalda [John P. Buwalda] was making more money than he was, which got him very exercised, because Sorensen had been convinced by Millikan that he ought to donate his half of the million dollars that they got from this vacuum switch that they developed for GE—

Cohen: You mean, Sorensen saw that he was making less money than Buwalda?

Hudson: Yeah, he had a smaller salary. So he goes in to see Millikan all angry and said, "What's going on here? Why is Buwalda making more money than I am?" And Millikan says, "Well, he has a very expensive wife." [Laughter] He had a very interesting wife too. Do you remember her? Mrs. Buwalda [Imra Buwalda]?

Cohen: Yes.

Hudson: She lived until just two or three years ago. I can remember the thing that made a big impression on me: I sat across the table from her at the DuBridge retirement dinner, which they had at the Huntington Hotel. Towards the end of the dinner she upset a whole glass of water—she poured it all over everybody. And she started laughing away. And she said, "When I was young I would have been just embarrassed to death, but now I don't give a damn." [Laughter]

Cohen: Well, I guess there are always lots of good stories. You've had a good time here all these years.

Hudson: Oh, it's been great. There's been no place in the world I could have landed where they would have treated me so well. I am eternally grateful to hay fever for bringing my parents out here, and grateful to them for having moved within a couple of blocks of Caltech. I suppose if they had moved a few blocks further north in Pasadena, I would have wound up at the Adventist school up there.

Cohen: The Nazarene school.

Hudson: The Nazarene school. It's funny the way things work out. But at that time I started coming to the Friday night lectures as a student, always knowing that I'd come here. I didn't know how or even why, but now I know why.

Cohen: Do you have another thought?

Hudson: [I was on the] admissions committee at the time when Caltech was interviewing all of the student applicants and their high school teachers. So, for three years I made a trip around the East Coast—New York, Pennsylvania—and visited the high schools and talked with the teachers and students. This was really a fascinating experience. And I'm sure it was very good public relations for the school. I'm sorry they had to stop that, because it was a very good thing for the professors. It worked them into it in a very effective way. But those were great trips. My wife and I would sit down with a map and put dots on it to try to plan the optimal course through all these different schools. They were all in little towns in the back country, so it was a wonderful chance to drive around and see the east coast. It was really fascinating. And then I felt we did quite a lot of good in the schools, not so much for the students, but the connections with the teachers. I'd see the same ones every year, and they'd look forward to the Caltech professor stopping by. And they were always very impressed. It wasn't someone from the admissions office. It was a regular, standard professor.

Cohen: That was a good program. Did they feel that it got too expensive?

Hudson: It got too difficult to arrange. It was very hard to get the people to do it, because the young folks couldn't take the time out. So, the three years I did it I was sort of in transition towards retirement. I wasn't involved with the educational work so much, so I could do it. And I had long since become a full professor, so I wasn't worried about that. That's a problem for us now. It's very hard for the young people.

Cohen: To be a citizen, rather than work only on your own career.

Hudson: We had a little trouble, or questions that we ran into, in our Kanpur project. The arrangement there was that people were to be given a two-year leave of absence with no prejudice to their promotion in the tenure year. Well, that got a little hard for some of the administrative people to accept finally. They tried to discourage some of the young people from doing it. But the folks that wanted to go decided they wanted to go, so they went. The Kanpur arrangement was very good in the sense that the living in India was completely covered. So if

you took two years off from Caltech and went to Kanpur, you could put all your Caltech salary in the bank.

Cohen: So it was a financial incentive.

Hudson: It was quite a financial incentive.

Cohen: Well, thank you very much. That's a really good interview. [Tape Ends]

INDEX