Regional Oral History Office
The Bancroft Library

University of California
Berkeley, California

ERNEST S. KUH

Innovator In Circuit Theory And Computer Aided Design
Professor And Chair, Department Of Electrical Engineering And Computer Sciences
Dean, College Of Engineering, University Of California, Berkeley
Decades Of Service To Academia, Science, Industry, And Development In Asia

Interviews conducted by
Lisa Rubens
2004-2006

Since 1954 the Regional Oral History Office has been interviewing leading participants in or well-placed witnesses to major events in the development of Northern California, the West, and the nation. Oral History is a method of collecting historical information through tape-recorded interviews between a narrator with firsthand knowledge of historically significant events and a well-informed interviewer, with the goal of preserving substantive additions to the historical record. The tape recording is transcribed, lightly edited for continuity and clarity, and reviewed by the interviewee. The corrected manuscript is bound with photographs and illustrative materials and placed in The Bancroft Library at the University of California, Berkeley, and in other research collections for scholarly use. Because it is primary material, oral history is not intended to present the final, verified, or complete narrative of events. It is a spoken account, offered by the interviewee in response to questioning, and as such it is reflective, partisan, deeply involved, and irreplaceable.

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Conducted by Lisa Rubens 2004-2006, Regional Oral History Office, The Bancroft Library, University of California, Berkeley, 2007.

Copy no. ___

Ernie Kuh, 2004 Photo: Peg Skorpinski

To Bettine for her love and care, and for enriching our life

To Tony and Ted and their families for providing

Happiness throughout the years

Ernest

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Preface

When President Robert Gordon Sproul proposed that the Regents of the University of California establish a Regional Oral History Office, he was eager to have the office document both the University's history and its impact on the state. The Regents established the office in 1954, "to tape record the memoirs of persons who have contributed significantly to the history of California and the West," thus embracing President Sproul's vision and expanding its scope.

Administratively, the new program at Berkeley was placed within the library, but the budget line was direct to the Office of the President. An Academic Senate committee served as executive. In the four decades that have followed, the program has grown in scope and personnel, and the office has taken its place as a division of The Bancroft Library, the University's manuscript and rare books library. The essential purpose of the Regional Oral History Office, however, remains the same: to document the movers and shakers of California and the West, and to give special attention to those who have strong and continuing links to the University of California.

The Regional Oral History Office at Berkeley is the oldest oral history program within the University system, and the University History Series is the Regional Oral History Office's longest established and most diverse series of memoirs. This series documents the institutional history of the University, through memoirs with leading professors and administrators. At the same time, by tracing the contributions of graduates, faculty members, officers, and staff to a broad array of economic, social, and political institutions, it provides a record of the impact of the University on the wider community of state and nation.

The oral history approach captures the flavor of incidents, events, and personalities and provides details that formal records cannot reach. For faculty, staff, and alumni, these memoirs serve as reminders of the work of predecessors and foster a sense of responsibility toward those who will join the University in years to come. Thus, they bind together University participants from many eras and specialties, reminding them of interests in common. For those who are interviewed, the memoirs present a chance to express perceptions about the University, its role and lasting influences, and to offer their own legacy of memories to the University itself.

The University History Series over the years has enjoyed financial support from a variety of sources. These include alumni groups and individuals, campus departments, administrative units, and special groups as well as grants and private gifts. For instance, the Women's Faculty Club supported a series on the club and its members in order to preserve insights into the role of women on campus. The Alumni Association supported a number of interviews, including those with Ida Sproul, wife of the President, and athletic coaches Clint Evans and Brutus Hamilton.

Their own academic units, often supplemented with contributions from colleagues, have contributed for memoirs with Dean Ewald T. Grether, Business Administration; Professor Garff Wilson, Public Ceremonies; Deans Morrough P. O'Brien and John Whinnery, Engineering; and Dean Milton Stern, UC Extension. The Office of the Berkeley Chancellor has supported oral history memoirs with Chancellors Edward W. Strong, Albert H. Bowker, and Ira Michael Heyman.

To illustrate the University/community connection, many memoirs of important University figures have in turn inspired, enriched, or grown out of broader series documenting a variety of significant California issues. For example, the Water Resources Center-sponsored interviews of Professors Percy H. McGaughey, Sidney T. Harding, and Wilfred Langelier have led to an ongoing series of oral histories on California water issues. The California Wine Industry Series originated with an interview of University

enologist William V. Cruess and now has grown to a fifty-nine-interview series of California's premier winemakers. California Democratic Committeewoman Elinor Heller was interviewed in a series on California Women Political Leaders, with support from the National Endowment for the Humanities; her oral history was expanded to include an extensive discussion of her years as a Regent of the University through interviews funded by her family's gift to The Bancroft Library.

To further the documentation of the University's impact on state and nation, Berkeley's Class of 1931, as their class gift on the occasion of their fiftieth anniversary, endowed an oral history series titled "The University of California, Source of Community Leaders." The series reflects President Sproul's vision by recording the contributions of the University's alumni, faculty members and administrators. The first oral history focused on President Sproul himself. Interviews with thirty-four key individuals dealt with his career from student years in the early 1900s through his term as the University's eleventh President, from 1930-1958.

Gifts such as these allow the Regional Oral History Office to continue to document the life of the University and its link with its community. Through these oral history interviews, the University keeps its own history alive, along with the flavor of irreplaceable personal memories, experiences, and perceptions.

Lisa Rubens, Series Director
University History Series
May 2004

Richard Cándida Smith, Director
Regional Oral History Office

Regional Oral History Office
University of California
Berkeley, California

Introduction

The collection of oral histories at Berkeley provides a wonderful resource for use by the campus community in understanding the evolution of this great and unique institution. The addition of Ernie Kuh's oral history is particularly significant. Ernie's term of leadership came at a pivotal time for Engineering, for the campus, and for the Bay Area, and he influenced all those domains. In the 1970s, Engineering led the way for the campus in attracting more private support for both operational needs and capital projects, in opening the channels of communication and collaboration with Asia and with China in particular, and in greatly increasing efforts to support a more diverse student population on campus. This oral history highlights Ernie's key role in initiating those transitions, which continue and grow today.

In the 1960s and 1970s the groundwork was laid for the Bay area to ultimately become the most important center for innovation and entrepreneurship in information technology and biotechnology in the entire world. The region's great research universities, Berkeley, Stanford, and UCSF, have played a key role in that. The growth and development of the College of Engineering and particularly the Department of Electrical Engineering and Computer Sciences in the 1970s and 1980s has made Berkeley a driving force in the evolution of the semiconductor and computer industries. Important roots of this evolution can be traced to Ernie's leadership as Chair and Dean.

I first met Ernie when I came to the campus as a visiting lecturer in 1971. At that time he was the department chair in electrical engineering and I remember going into the Chair's office and having my first talk with him as an intimidated young faculty member. My main recollection from that meeting was that he immediately made me feel welcome and at ease. Over the 35 years I've known Ernie, we've become great personal friends and colleagues. Ernie is a towering figure in the history of the College of Engineering at Berkeley, and the campus as well. Those of us who worked with him are extraordinarily fortunate to have benefited from his leadership and support.

Paul R. Gray
Executive Vice Chancellor and Provost
University of California at Berkeley
April 5, 2007

Foreword

To write a foreword to Ernie's oral history is a task that is both easy and difficult. It is easy because Ernie is a life long friend and colleague with whom I worked closely during my tenure as Chair of EE, l963-1968, and his tenure as Chair and Dean, l968-l980. Furthermore, Ernie is a friend for whom I have deep admiration and affection. But the task is difficult because in the course of his long and distinguished career Ernie has contributed so much and in so many important ways as a scientist/engineer, educator, administrator and a member of the profession.

I met Ernie close to half-a-century ago while he was at Bell Labs and I was at Columbia University. Little did I realize at the time that he and I would become life-long friends and colleagues at Berkeley.

When John Whinnery was appointed as Chair of EE, he embarked on a program of building up the Department. Don Pederson was recruited from Bell Labs and was followed by Ernie and Charles Desoer. At that time I was a professor at Columbia University, and Berkeley was not in my field of vision. In l957, the EE Department of Columbia began to experience problems in its relationship with the Defense-Department-supported Electronics Research Laboratory, which nominally was part of EE. John Whinnery heard about these problems and called me to inquire if I would be interested in moving to Berkeley. For me, it was difficult to leave Columbia because I had a well-established position as a full professor. Eventually, I accepted the offer and moved to Berkeley in July l959.

In l959, Berkeley had a very strong circuits group consisting in the main of Ernie, Charles Desoer and Don Pederson. The book by Ernie and Don Pederson *Principles of Circuit Synthesis,* and the book by Charles Desoer and Ernie *Basic Circuit Theory*, became classics in their fields. A research area which stood out in importance was centered on the analysis and synthesis of active circuits. Work in this area was the forerunner of Berkeley's pioneering development of SPICE.

After I moved to Berkeley, Ernie, Charles Desoer, Arthur Gill, Aram Thomasian and I became the nucleus of the Systems Group. In the years which followed, activities of this group have achieved both national and international recognition. In l963, John Whinnery, who was then the Dean of the College of Engineering, picked me to serve as Chair of EE. My appointment coincided with the appointment of Professor Abe Taub as Director of the Computer Center. His ambition was to create a Department of Computer Science in the College of Letters and Science, and centralize all instruction and research in computer science in that Department. His ambition clashed with the intention of EE to build up computer science within the Department. The clash led to a serious conflict. It was a difficult period in the history of EE because the College of Engineering was dwarfed by the College of Letters and Science.

As one of my first actions, I asked Ernie to serve as Vice-Chair. He agreed to do so. This was his first step in an ascent which led him to the positions of Chair and Dean. Ernie played a pivotal role in the conflict with Taub. In l965, I conceived the idea of requesting the campus administration to change the name of the Department from EE to EECS. There was a lot of internal opposition to this idea but eventually it was approved, and the name of the Department was changed in l967. This could not have happened without Ernie's support.

Ernie's outstanding performance as Vice-Chair made him a natural candidate to succeed me as Chair. As Chair, Ernie brought in new faculty, instituted curricular reforms, strengthened relations with alumni and started new programs in circuits, systems, microelectronics, and computer science. At the same time, he continued to be active in research and met regularly with his graduate students. He was fair and judicious but was cognizant of the need for pressure when it was needed to achieve excellence.

Ernie's superlative performance as Chair of EE made him a natural candidate to succeed George Maslach as the Dean of the College of Engineering. On assuming this position in l973, Ernie proceeded with a sense of urgency to launch a number of important initiatives aimed at enhancing the quality of instruction and research within the College of Engineering, and strengthening ties of the College to industry and other units on the Berkeley campus. He established the industrial liaison program and asked me to lead it; he launched the Mesa Program to promote affirmative action; he created the Berkeley Engineering Fund and launched fundraising for building the Bechtel Center. In addition, he took a number of steps to promote curricular reforms and attract new faculty. No important facet of operations escaped Ernie's attention. Even though Ernie is not a back-slapping politician, he proved to be highly effective in his dealings with captains of industry and leaders in the academic and business worlds.

What is remarkable is that despite the heavy pressure of administrative responsibilities, Ernie continued to maintain a high level of research activity during his tenure as Dean. He met regularly with his Ph.D. students and collaborated closely with them. In fact, the work which earned for Ernie the prestigious C & C (Communications and Computers) Prize was done by Ernie while he served as Dean.

After serving as Chair and Dean for over twelve years, Ernie returned to teaching and research in l980. For Ernie it was a soft landing. He quickly returned to full-time teaching and research on the frontiers of microelectronics. In addition, he established close contacts with scientific establishments in China and Taiwan, and served as a much-sought adviser.

I see in Ernie a true role model for all of us. It was and continues to be a real privilege to have Ernie as my admired colleague and close friend.

Lotfi A. Zadeh
August 18, 2006

Interview History

Ernest Kuh, Professor Emeritus in the Department of Electrical Engineering and Computer Sciences in UC Berkeley's College of Engineering, is a world-renowned pioneer in basic and applied research in electrical circuitry and computer assisted design. Now almost eighty years old, he continues to serve on professional committees, to speak at national and international conferences and at major universities both here and abroad. His students are professors and administrators at major universities, as well as on the boards and in the administrative offices and research labs of leading companies.

I first met Ernest Kuh in the spring of 2002, when Charles Faulhaber, Director of the Bancroft Library, was giving him and his wife Bettine a tour of the aged warrens on the fourth floor of Doe Annex, which housed the Mark Twain Papers and the Regional Oral History Office**.** We agreed to meet the following fall to begin this series of interviews.

Over the next several months I studied the history of engineering and computers in the U.S., as well as the work of this extraordinary man. I interviewed many of his associates and students. Karen Rhodes, then administrative assistant to Richard Newton, Dean of the College of Engineering, was also very helpful in providing materials about the history of the College and the funding for this oral history. I had as well, the model of a series of other interviews done for ROHO by Ann Lage and Germaine LaBerge with former deans of the College of Engineering. I was confident that Professor Kuh's own research, publications, awards and honors and his legacy through the students he mentored and the institutions he fostered, together, would do justice to his achievements.

I was particularly interested in exploring the historical context shaping Professor Kuh's life—beginning with his father's work in the Nationalist Chinese government in the 1930s, Kuh's university life in the United States, his employment at Bell Labs, and then his long robust career at U.C. Berkeley. He was among the first Asian engineering students at the University of Michigan, Stanford and MIT. He was one of the first Asians to be hired at both Bell and Berkeley, and he worked with few other "minorities". While he was very loath to speak of any discrimination, I was eager to examine the dominant cultural attitudes and social and professional structures that prevailed in the l950s. Professor Kuh knew the major outlines of the history he wanted to relate. He is a very articulate and concise narrator, patient and forthcoming with trenchant observations in response to my questions, both naive and probing.

In addition to his strengths as a scientist, writer, teacher, scholar and colleague, Ernest Kuh has remarkable collegial and interpersonal skills, which made him a natural administrator. Much of my research and questioning was concerned with the growth of the electrical engineering program and the College of Engineering, and how this growth was affected by and in turn interfaced with the equally extraordinary growth of the computer industry –particularly in the Bay Area—as well as the university's evolution as an institution of global importance. Ernest Kuh played a critical role in opening UC Berkeley and the University of California to China and the Pacific Rim—arranging for scholars to come to the US and accompanying delegations to the Far East. The interview ends with Professor Kuh's observations on how China matured politically and economically over the more than thirty years he has traveled there.

It was a pleasure to conduct these interviews –most of which took place in his office in Cory Hall. Professor Kuh reviewed all of the transcripts, editing for clarity, and provided most of the pictures included. I learned so much and have already enlisted Professor Kuh as an advisor in further projects ROHO pursues on the UC-Pacific Rim connection. I hope I have done justice to this exceptional man. It has been an honor to bring his story to a more general public. And it should be noted as well, that in November, 2005, this interview was designated one of "The Ten Treasures of the Ten Million," in celebration of the UC Berkeley Library's acquisition of its tenth million volume. Ernest Kuh is indeed a treasure.

Lisa Rubens, Ph.D
Series Director, University History Series
Regional Oral History Office
University of California, Berkeley
April 2007

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BIOGRAPHICAL INFORMATION

(Please write clearly. Use black ink.)

Your full name Ernest Shiu-Jen Kuh

Date of birth October 2, 1928 Birthplace Beijing, China

Father's full name Zhong Xūn Keh

Occupation Government Official Birthplace Jiaxing, China

Mother's full name Cǎi Chu

Occupation _____ Birthplace Taiyuan, China

Your spouse/partner Bettine Chow

Occupation Housewife Birthplace Philadelphia, PA

Your children Anthony Kuh and Theodore Kuh

Where did you grow up? Beijing, Nanjing, Shanghai

Present community Kensington, California

Education Shanghai Jiao Tong University (1945-47)
University of Michigan (BS, 1949) MIT (SM, 1950) Stanford (PhD, 1952)

Occupation(s) Research Engineer, Professor of Electrical Engineering, Dean of Engineering (1973-1980)

Areas of expertise Circuits and Systems, Electronic Design Automation

Other interests or activities Travel, hiking, tennis, reading, Opera

Organizations in which you are active _____

SIGNATURE Ernest Kuh DATE 6/1/06

Chapter I: Birth and Background in China 1928-1947

Rubens: This first interview is our background information session and I'm very eager to hear about your early childhood and being raised in China. It had to have been an extraordinary period.

Kuh: Where shall I start?

Rubens: With your birth

Kuh: Nineteen twenty-eight. I was born in Beijing, and my father worked with the government. At that time, the situation was very unstable because Japan, you know, invaded Manchuria and there was talk that they were also going to invade the China mainland, including Beijing. So, my father moved around.

Rubens: What did he literally do?

Kuh: He worked for the government. I don't know exactly his position.

Rubens: Not a soldier or with the military?

Kuh: No, no. He did governmental administrative work. And he worked for two influential people who later became Premier of the Kuomintang government. He was good at this. I think so. He moved around a lot, first from Beijing and then to Tianjin, which is not too far. And then he moved to Nanjing, following the Kuomintang government. And I don't remember exactly how many years we stayed in Nanjing, but I think until shortly after the Japanese invasion in 1937, generally referred to as the Marco Polo Bridge Incident. The Marco Polo Bridge is a place outside of Beijing where the war started; that is the first shot was fired. There were lots of stories in the newspaper and all the news about the Japanese plans, so my father felt it was safer to move to Shanghai because it had a French-British Concession. He thought at least the Japanese won't go there.

That was 1937. I guess I was nine years old. I should add that my father, of course, got a degree from a university. He graduated in Chemistry from the Shanxi University. But my mother, Tsai Chu, never went to formal school. She didn't have a proper education. She used to push us pretty hard, but I guess I was not the most-liked one because I fought. So she didn't push me as hard as my brothers.

Rubens: Were you the oldest son?

Kuh: No. We had a family of six children. I was the youngest boy, and actually my sister is younger than me. So, there were five boys and my sister. My eldest

brother went to Japan to study first, and the second brother went to the United States.

Rubens: Would that be unusual? He must have gone to Japan before the invasions?

Kuh: I don't remember why. But my father sent him to Japan. He was fifteen years older than I am. I don't quite know why. But my second brother came to the States.

Rubens: Was there other family in the States? Or did your family have friends there?

Kuh: No.

Rubens: Okay. Where did he go?

Kuh: He went to the University of Indiana.

Rubens: Also, before we go on, how would you characterize your family in terms of class?

Kuh: Oh, I think we were upper middle class. We were not wealthy, but my father was well-to-do. His name was Zone S. Keh. He was always well-connected. So after he quit the government, I think he was in his mid-fifties, he came to Shanghai, got a job, first, with a bank. He was not in a management position, but he was in an advisory position. Then, later on, he joined the Nanyang Group, a conglomerate of many companies, which did many things. I don't know exactly what, but he was head of a construction company. So we were in Shanghai from '37 until I left China, I think the end of '47.

For almost ten years, I went to schools and I guess I was a pretty good student, because my father wanted me to skip a grade. Eventually, I went to the best school in Shanghai, called Nan Yang Model Middle School. They actually had a 100-year anniversary about two years ago. I planned to go to the celebration, but because of the meeting at APEC [Asia Pacific Economic Cooperation], a summit which President Bush attended, the celebration was canceled. Anyway, at Nan Yang, I enjoyed the school. I had many classmates who were very close.

Rubens: Was this a boy's school?

Kuh: Boys' school on one side; girls' school on the other side, so we didn't get to meet; but we saw the girls on the playground through the same gates. I loved soccer, so I played a lot of soccer. I was on the class team. I enjoyed that. After hours, on weekends, I went to swim. A friend of my father had a swimming pool in Shanghai, so I learned on my own how to swim. And I played tennis, or at least started to learn.

Rubens: Was the third brother pushed pretty hard too? Two were already away at school.

Kuh: The third brother always had health problems, and he was not a good student. The fourth brother was pushed very hard. Both he and I are good students, and from Nan Yang Middle School I went to Jiao Tong University. That used to be the best university that taught engineering in China. President Jiang Zemin also went to that university. He was two years ahead of me. When Jiao Tong University celebrated its ninetieth birthday, in 1986, they published pictures of what they called "Distinguished Alumni." President Jiang was in the class of '47, and I was in the class of '49, so our pictures are next to each other. [laughs]

Rubens: Did you know him?

Kuh: No, I did not then. Later I did. During that celebration, I met him. He was the mayor of Shanghai. And we talked about his plans and he told me he wanted to develop three things, and he had three top priority projects: Rebuild the Shanghai railway station, open up the Hongjiao Airport, and develop the subway. He did all that.

The celebration was nice, because I met other people and they invited Chancellor [Chang-Lin] Tien to go there too, even though he did not go to Jiao Tong. We met with members of the Shanghai municipal government leaders, including the party secretary, the mayor, and others.

Rubens: Was Tien invited in part because of you?

Kuh: No. He was, let's see, he was head of the University at Berkeley at that time, and they wanted to invite a few leading people –who were born in China and now were American citizens.

Rubens: I understand. By the time you were in high school, did you want to be an engineer?

Kuh: Well, I'll tell you. In school, I was good in math and science. In China, everybody studies engineering, and electrical engineering seemed to be the one area that was taking off, as far as the future was concerned. Actually, I left Jiao Tong—that's another story—after two years, and I came to the States really to start my engineering education. But the reason I left, was that in '47, the Communists gradually took over China and the students were on strike all the time because the students on the left and the students on the right were fighting. During the first two years, I did not really go to school very much because of all the strikes. So my father thought maybe I should come to the States to study. He arranged for me—he supported me—to come to the States at the end of '47, even though my fourth brother was still in China, because he was finishing up his degree. But I was only a sophomore.

Rubens: But the fourth brother did eventually go?

Kuh: Yes. He came after I was already in the States, a year and a half later.

Rubens: And he went where?

Kuh: He came to the University of Michigan. I was there, already. So he joined me at the University of Michigan. But I managed to finish at Michigan in one-and-a-half years—even though I did not have much electrical engineering education at Jiao Tong. I had basic physics, chemistry, math courses. I started electrical engineering, in the winter term, 1948, at University of Michigan.

Rubens: Let me ask you a few background questions.

Kuh: Sure. I may have skipped something because one thing leads to another.

Rubens: Of course. That's the way these oral histories unfold.

Regarding your childhood. You had a very full household. Did your mother have help in the house?

Kuh: Oh, in China, the family that is relatively well-to-do always had servants. So we had help. We had servants. We had servants to bring each of us up. It was a big household, yes.

Rubens: Did you have a particularly close relationship to your—?

Kuh: Yes, I did. I did. I went back to see her.

Rubens: What did you call her?

Kuh: Her name is Wang. Wang Ma. "Ma" is the mother actually. That's what I called her. And later on, when I returned to China, my third brother who was in China all the time, he found her and we went to see her. It was very emotional, yes.

Rubens: And was your house modern, in the sense of how it was equipped?

Kuh: Yes.

Rubens: In terms of electricity, having a radio and phonograph?

Kuh: Oh yes. It was; it was. It was not a huge house. It was big enough; a three-story house. I returned to China twenty-five years after I came to the States, and I went to see it. Our house was occupied by nine families. Because, you know, during the Communist time, they just gave everybody a place to live,

and it was not possible for us to go inside to see it. I shared a bedroom with my fourth brother first, then I had my own bedroom. It was a nice place.

Rubens: I'm trying to find out whether, as a young man, you had interest in electrical appliances, and—

Kuh: No. I am not very practical. I told you my interest was in math and science—physics, especially. So I did not have the hobby of playing with electrical gadgets. I didn't start electrical engineering until I was at the University of Michigan.

Rubens: Yes. So your extracurricular activities were soccer and swimming?

Kuh: Sports, yes.

Rubens: Was their music and art in the household?

Kuh: Ah, not that much, but music appreciation, I developed later on. My wife and I are really interested in music. We go to San Francisco Opera, Davies Hall and Cal Performances, and we went to Santa Fe Opera this summer. We really enjoy that.

Rubens: It's a later pleasure and appreciation in your life, though?

Kuh: Yes.

Rubens: It doesn't come from your childhood?

Kuh: Right. I never played any instruments. Neither did my wife. But my sister at home learned piano. She still plays. And my son—both sons learned piano, and the elder one plays piano regularly. He bought a grand piano in Hawaii, and his son has started to learn. With art, I am not very familiar with art until my wife—she's very much interested in art. We travel quite a bit. Every city we go to, the first thing she wants is a plan to go to this museum, that museum. So through her I learned something about art.

Rubens: I assume—we'll get to this in a minute—you met your wife in the United States?

Kuh: Yes.

Rubens: Between 'thirty-seven to '47, you're in Shanghai. You're coming of age, coming into consciousness. These were the years of the war. I mean, ultimately World War Two is going to—

Kuh: Yes. During that time where we stayed was in the French Quarter and it was protected. The Japanese came after Pearl Harbor, but there was a government

of Wang Jin-Wei. He served as Premier under the Chiang Kai-Shek administration. The Kuomintang government went to Chongqing, and he formed a puppet state. Anyway, he died before the end of World War Two and somebody else took over that government. In a sense, we were protected by that government. Of course, it was under Japanese control, as it turned out, but they did not do too many bad things to the citizens.

Rubens: Did your father talk about this very much? Was there anxiety in the household because of this?

Kuh: We more or less knew we were safe, but my second brother went to Chongqing before the end of the war. Chongqing was the government of the Kuomintang, and that's where the action was.

Rubens: The one who went to Japan—

Kuh: He came back, and worked in a bank. He had a very good position. But my second brother did not do too well after he returned from the States, so he went to Chongqing. Through my father's connections, he got a good job afterwards. But we stayed put.

Rubens: So in terms of anxiety or discussions about what was going to happen, was this a tenor in your household?

Kuh: Not much, not until the Communists came, and then we began to worry. By that time I had left so I did not go through that period. Most of my family left before the Communists came to Shanghai. They went to Hong Kong.

Rubens: So the two oldest boys are in China. One in Shanghai; one in Chonqing.

Kuh: That was before the end of the Second World War. Everybody was in Shanghai. Yes. But the first two brothers later went to Hong Kong, too. The third brother, throughout, lived in Shanghai; he took over the house, more or less. When Shanghai fell to the Communists, he had to move. These are a lot of details. [laughs]

Rubens: But the story is in those details. It's just a fascinating period.

Kuh: Yes, it is.

Rubens: Your own sons no doubt know this history.

Kuh: We took our two boys to China twice, very early, in 1973, right after Nixon's visit there. And I went again in 1979, because the universities in China invited me and my family to go. They went there twice, but my first son became a professor at the University of Hawaii and he's gone to China for professional visits and lecturing.

Rubens: What's his field?

Kuh: Electrical engineering. He's at the University of Hawaii. And my second son just went back to China last week. He's a banker, works with Citigroup. They sent him to Hong Kong, to Shanghai for some business, but he only stayed a couple of days. But the Chinese he learned helped him. His previous visit there had been in 1979. In twenty-five years, there has been enormous change. So we talked on the phone while he was there. He was enormously impressed with the development there.

Rubens: And of course you had not been back until l973, after Nixon opened the door.

Kuh: No, I could not go.

Rubens: Had you gone to Hong Kong?

Kuh: I had not. I came directly to the States.

Rubens: So there was no visiting. You did not go to Shanghai, Hong Kong.

Kuh: No visiting until I came to the West Coast in 1956. My parents actually came over here.

Rubens: They settled here?

Kuh: Yes, they did. At first they were not too sure. They came here, they went back to Hong Kong; they came again and settled here.

Rubens: I didn't know if you had gone to Hong Kong.

Kuh: No, I never did. I didn't return to China for twenty-five years. I did not start traveling until I became a professor here. Then I did a lot of traveling. We'll discuss that later.

Rubens: I want to ask you just two more questions about China. Were you raised with a foreign language? Did you learn English there? You were in the French Quarter—did you know French?

Kuh: Only English and Japanese.

Rubens: You did study English?

Kuh: Yes, oh yes. Everybody did. We started in the fourth grade.

Rubens: And did you—what was your attitude about the United States before you went? You had these two brothers who had gone.

Kuh: That's the place to be if you want to do some serious work. The situation in the United States was obviously, relatively, very good. Some people went to Europe, but many, many more came to the States.

Rubens: And how did you know about the United States? This must seem so obvious to you, but—

Kuh: Oh, we had contact through my brother, and through the friends who came here.

Rubens: Did you see films or listen to radio?

Kuh: Sure, we saw a lot of the Hollywood films in Shanghai during that time, *Great Expectations, Mrs. Miniver,* et cetera. And the University of Michigan always had a reputation in China because it had many alumni, famous alumni. That's why I applied to University of Michigan. So, I got in. I studied at Michigan for a year and a half.

Rubens: Right. Anything more that we should say about China then? Did you have any European friends at that point, or was your world a Chinese world?

Kuh: A Chinese world.

Rubens: But you knew English. You knew the United States was the place to go.

Kuh: Yes. We studied English from the fourth grade on, thus my reading skill was okay. But speaking was more difficult. So in the first term, when I came to Michigan, I decided to read more. I took a course on contemporary novels. We read Steinbeck, Hemingway. But that was a tough course for me because the assignment was to read something like six to ten novels and write reports. And that would be—

Rubens: Plus you were taking all your other courses in English.

Kuh: Yes. The other courses were easy.

Rubens: They were? Even though they were in English?

Kuh: Yes. I could understand people talking. I learned that.

Rubens: Were there college students when you were still in China who were supportive of the Communists?

Kuh: Oh, yes. That's why there were strikes. That's why, during the college days, there's a big problem with extremists. But I think they had good cause.

Rubens: Later on, you thought they had true cause. At the time—

Kuh: Yes, yes. That's right.

Rubens: —you decided to isolate yourself from it?

Kuh: That's right. Yes. I was not active politically.

Rubens: You were interested in your studies.

Kuh: Right.

Chapter II: Studying in the United States 1948 – 1952

Rubens: How did you get to the University of Michigan from China?

Kuh: In December l947, I literally took a slow boat to the United States, which took three weeks. That was a time when boats were named after generals or presidents. But the boat I took was not a regular liner—it was a freight boat; it had quarters for maybe twenty students and other people.

Rubens: Was it primarily students? Were there a lot of students?

Kuh: Yes, yes. I got to know a few of them. I don't know what happened to them.

Rubens: Where did the boat land?

Kuh: San Francisco. I had somebody—my relatives met it. Then I flew—did I fly? Yes, I did. I flew from San Francisco to Michigan.

Rubens: I see. So that was your first flight.

Kuh: That was the first flight, yes.

Rubens: And relatives? So there were relatives in the country?

Kuh: Yes. Actually, the wife of the Consul-General of the government was my remote cousin, so she helped me.

Rubens: Here in San Francisco?

Kuh: Yes, yes.

Rubens: That must have been pretty—

Kuh: That was fine. And the first accident I had was the first time on the airplane. I left my bag behind, which had even my passport. [laughs] So I really got worried at the arrival destination. Finally they found it for me.

Rubens: Where did you live in Michigan?

Kuh: I first lived in the dormitory, in a temporary quarter near the Willow Run airport. Then, after the first term, during the summer, I moved to Ann Arbor, because commuting was not easy. I lived in a rooming house, with some other Chinese students. But I was the only undergraduate, because most Chinese students were graduate students at that time.

Rubens: Michigan, of course, had a very important Chinese Studies program—Chinese history, Chinese studies.

Kuh: Yes.

Rubens: I can't think of his name at the moment. Someone very important was there, like Fairbanks.

Kuh: No, no. Fairbanks was at Harvard. Strong—

Rubens: Strong, yes. But I was going to ask, did you feel yourself a minority? Was this the first time you had been in this position?

Kuh: No, because my classmates are Americans, and we got along fine. There was no discrimination which we saw. I had a good stay at Michigan for a year and a half. I got to know some of the professors very well. I was a reader for one of the senior professors, and made some extra money.

Rubens: Really? In what subjects?

Kuh: Electric circuits. The Chinese students there were very active. They had a Chinese students' association. We had social functions. But, as I said, most of them were graduate students.

Rubens: But if you were included in that, you could—?

Kuh: Oh, anybody could join. I lived in a rooming house with many of those people.

Rubens: Were students interested in you? Were your classmates interested in you having come out of the part of the world that was undergoing such change?

Kuh: I don't think I remember that. That time was—especially the first term—I worked very hard and did not interact with classmates socially. But I did join the honors fraternity, Tau Beta Phi, and I remember that, during the initiation, we went to a beer place. I'd never drunk before, and had to drink. Everybody drank. I really got drunk. [laughs] I guess it was a typical initiation. I was a good student, so we talked about courses.

Rubens: And you were on the track studying engineering?

Kuh: I was already studying electrical engineering.

Rubens: And you were able to finish in a year and a half because your credits were accepted from Jiao Tong University**?**

Kuh: Yes. And I took classes during two summers.

Rubens: You went year-round? You kept reading those American novels?

Kuh: Year-round, yes.

Rubens: What was your impression of the university compared to the university where you had been, in terms of its state of knowledge and the seriousness of the students and then finally engineering? I'm asking three questions all at once.

Kuh: In terms of academic work, the teachers, the professors in China, in Jiao Tong were very brilliant. And the standard for the same kind of courses here, I think, were not as high. Actually in the first term I took two electrical engineering courses at the same time, even though one was a prerequisite of the other. I had no problem. Standards in China, as far as the teaching is concerned, at Jiao Tong, were excellent. As far as the students were concerned, because of the political situation, we did not get to do much, to take many classes. That was the reason I came here.

Rubens: Regarding engineering, were you in a position to evaluate if it was more advanced, pursuing specialties that had not been available in China?

Kuh: No. In China, in undergraduate courses, we used the text book written by MIT professors. So undergraduate education in Jiao Tong was excellent. But we never had much graduate research activity there.

Rubens: Okay. So, within a year and a half—

Kuh: I got my bachelor's degree.

Rubens: How were you making decisions about where you were going to go next?

Kuh: I think everybody wanted to go to MIT at that time. And I was accepted at MIT.

Rubens: Did you have the support of professors, and were they encouraging you to do this?

Kuh: Yes, of course, when you apply, you have to get letters of recommendation. But I was shocked when I got into MIT, because Michigan was so easy. At MIT you are competing with top students from all over. The competition was so tough, very tough. Actually, at that time, I got to know a life-long friend, Professor Charles Desoer. We were in the same class for two or three courses. And I had some of the best professors at MIT. The one closest to me is Professor Guillemin. Even before I went to MIT, at Michigan the professors recommended me to go see him. So I took his course, and he agreed to be my thesis supervisor for my master's degree.

Rubens: And was there a special aspect of electrical engineering?

Kuh: Networks. Yes, I learned from him. I think he was the greatest teacher I had.

Rubens: How do you pronounce his name?

Kuh: Gilly-min.

Kuh: He studied with Sommerfeld [Arnold], a famous physicist from Germany. I worked with Guillemin and I guess I was in a hurry. I finished my master's degree within a year.

Rubens: Were you admitted to the Ph.D. program?

Kuh: You don't get admitted to a program. You get admitted to graduate school. I decided not to pursue, continue at MIT, because I found it was tough, and I did not even take the prelim exam. I thought maybe I'll go to another place. So that's why I went to Stanford. I got in, and I came to Stanford in 1950.

Rubens: Did Guillemin recommend that you go to Stanford? Had you heard about other students who had gone there?

Kuh: I didn't know that Stanford had maybe the second best electrical engineering department.

Rubens: Where did Caltech fit in?

Kuh: Caltech was never a big place.

Rubens: For physics, I guess it was.

Kuh: For physics, for science, but for engineering, except aeronautical engineering, they're not that great. They have good people but the town is very small. It never entered my mind. But Stanford was the rising place. It was Terman, you know, in engineering, who did it. Fred Terman is a famous name in education. Actually, former Chancellor Bowker worked under him. Terman had two famous students, Hewlett and Packard. So he more or less started the high tech industry. It was clear that Stanford was going up. And I went to Stanford. I studied in the same area the so-called network theory, which had been developed by famous people Bode and Darlington at Bell Labs. I worked with them later.

I studied under Professor Tuttle. He's fine. We got along fine, and he gave me a problem for my thesis topic. I was very fortunate. I found a solution to the problem. So I finished my Ph.D. in six quarters.

Rubens: That's how Ph.D.'s were designed? The professor would give you a problem.

Kuh: Well, for a Ph.D., you work with the professor you choose, and usually don't have any idea what kind of problem to work on, so the professor gives you something to think about. That's always the case, or usually the case. So I finished in six quarters, from September, 1950 to 1952 in the spring. At that time, I was fortunate. I had support from him—from the professor—and the U.S. government had a program because Chinese students had a hard time, we were cut off from our home land. I forgot the name of that program, and I definitely needed that, because my father's support ended with my master's degree at MIT. That was, of course, wonderful. I never had to worry about anything. But then, from there on—

Rubens: You were on your own.

Kuh: I was on my own. I had very good financial support. There, I stayed on campus with a professor in psychology.

Rubens: You had a room in his house?

Kuh: Yes, a room in his house.

Rubens: And just very briefly, was there a Chinese community in—

Kuh: Yes, there was a Chinese club. Again, all for graduate students. I was the youngest there. I got to know a few people there. But during the period, I was pushing hard on my studies. I wanted to finish. Thinking back, that may not be the best strategy, because I took the minimum amount of courses to finish my degree. I could have taken more to broaden myself. I did not.

Rubens: Do you mean courses in other disciplines?

Kuh: Related areas as well as other disciplines.

Rubens: So both in terms of sciences but also in the humanities?

Kuh: Yes. I hardly took anything. Except I had to pass a language exam. I took German. I passed it twice: once at MIT and then at Stanford. But after that, I forgot it. [laughs]

Rubens: Let me just see if there is anything else that I want to clarify about your education. German is the language for scientists? You wouldn't have studied French in school.

Kuh: I never studied French. The one foreign language I took in high school was Japanese, which didn't help me, because it was forced on us. [laughs] I don't really know if I needed German, at that time. In the U.S., everything was written in English.

Rubens: So you must have had a facility for language.

Kuh: I don't think I'm very good in language. I learned them and then I forgot it. Later on, when I was on sabbatical in Japan and Germany, I regretted that I did not learn more German and Japanese.

Rubens: Had your father learned Japanese?

Kuh: No. No.

Rubens: You must have also had Japanese history too. They must have really had a nationalist perspective.

Kuh: No.

Rubens: Not something you remember?

Kuh: Not really. I just know about the war. The terrible things they did, the Japanese did.

Rubens: But there wasn't a propagandistic look at Chinese history through the lens of either Japanese occupied Japan or …?

Kuh: I don't know. I don't think so. Later on I spent two sabbatical years in Japan. I have many Japanese friends. [laughs]

Rubens: Back to Stanford, did you know Fred Terman?

Kuh: I wasn't close to him. But I got to know him.

Rubens: What was your assessment of him?

Kuh: He had vision. During the war, I think he was the head of the Radiation Lab at Harvard-MIT. They developed, among other things, radar.

Rubens: What was driving you to get through school so quickly? Did you feel you had to prove something to yourself, to your family, or—

Kuh: Not really to prove. I always, I guess, was very strict with myself to get things done.

Rubens: You were disciplined.

Kuh: Yes. Disciplined. And I was fortunate because the Ph.D. which usually took four to five years, and it took me a year and a half to finish.

Rubens: Did you publish your Ph.D. work?

Kuh: Yes. I did. I published my work in the *Journal of Applied Physics*. At that time, the kind of theoretical work I was doing, electrical engineering publications did not even include that. But later on, of course, IEEE—Institute of Electrical and Electronics Engineers—now it's the biggest professional society in the world. About 400,000 members. They have about fifty publications now. At that time, it's not much.

Rubens: In those days, when you said there wasn't much published, was yours of the quality that it could be published, or are the journals also looking for—?

Kuh: That area was not developed. The professional society was called the Institute of Radio Engineering [IRE]. And it had only one publication, the proceedings of IRE. Then there was the American Institute of Electrical Engineers [AIEE]. That was more power-oriented. The other is communication-oriented. These are old-time. Later the two professional societies merged and became the Institute of Electrical and Electronics Engineers [IEEE]. And now they have something like fifty publications covering from computers to semiconductors to circuits to bioengineering to plasma engineering to optical electronics. There are so many things, and it's a huge field now.

Rubens: I realize the infancy of the field. I guess what I was just trying to get at—was it unusual for a Ph.D. thesis to be published?

Kuh: I won't say it was unusual—it's unusual to be published in *Applied Physics*.

Chapter III: Working at Bell Labs 1952 - 1956

Rubens: Did you know that you wanted to go to work for industry once you finished your PhD?

Kuh: I'll tell you, at that time—that was 1952—the job opportunities were not that great. Bell Labs is the place everybody wants to go to. It has top people. It always conducted basic research, and had an outstanding reputation as the place to be, so I applied to Bell Labs.

Rubens: Did you know anyone there?

Kuh: No. No. They came after me. I got in Bell Labs immediately after my Ph.D. in 1952.

Rubens: You were based in-

Kuh: In Murray Hill, New Jersey. Bell had other quarters, but the most famous one is Murray Hill.

Rubens: By the way, you had not seen your parents?

Kuh: No.

Rubens: How did you communicate with your parents?

Kuh: I'd write them.

Rubens: Letters? These weren't the days of phone calls?

Kuh: No. No, there wasn't much.

Rubens: Did you have contact with any of your sisters or brothers?

Kuh: Yes. I think I mentioned that my fourth brother came to Michigan, and we were roommates together there. And after I left, he continued his Ph.D. at Michigan, in engineering. Then he later worked for U.S. Steel at their research lab in Pittsburgh.

Rubens: Did your sister go to college?

Kuh: Well, she came out—she was not a good student. But the future did not look good for her in China. I supported her to get her into a small college in the southern part of Indiana. I forgot the name of it. I don't think—I don't know whether she ever finished it.

Rubens: Why did you do that? What was the impulse on your part?

Kuh: I felt my father supported me through my master's degree, and at least I can pay him back by supporting my sister. So I did.

Rubens: He believed in females having the chance to go to university?

Kuh: Oh, yes. The only thing is she was not a good student, so he's not going to pay for her to come out.

Rubens: And you thought, whether she's good or not, she should have the opportunity?

Kuh: She applied and got into this small college.

Rubens: How did you establish yourself at Bell -you just picked yourself up and moved across country? How did you make these previous transcontinental journeys, by the way? I didn't ask about when you moved from Michigan to Stanford, how did you travel?

Kuh: For the trip from Michigan to Boston, I bought a car. I remember I paid $1,700 for a Ford.

Rubens: A new car?

Kuh: Yes. A new car.

Rubens: Of course there you were in the land of auto-manufacturing.

Kuh: [laughs] Yes. I think my brother and I drove to Boston, to MIT. From Boston to Stanford, I got a friend to drive with me across the country. I'd always wanted to see the country. And that was the way to do it. But after I finished at Stanford, I sold my car. I flew with United Airlines to New York. My friend took me to the airport. I remember that day. But I was not driving.

Rubens: By '52, within five years—

Kuh: —from '48 to '52. In four years I finished my two years of bachelor's degree, masters and year and a half, for Ph.D.

Rubens: And getting a job even at a prestigious place —but you're saying it wasn't that good a time.

Kuh: It wasn't a good time. There were two things. First, being a Chinese, to get a job in industry wasn't easy. It turned out I was the second Chinese entering Bell Labs. Bell Labs, even though a very distinguished place now, at that time, and earlier, they even discriminated against the Jews. There were very few Jews there. Fortunately, that recruiter from Bell Labs knew my professor.

Rubens: You knew you wanted to work in applied science or research, not teach?

Kuh: I wanted to work in industry. It never crossed my mind to be a professor at that time.

Rubens: And were there any other places that you considered working or that you applied?

Kuh: No. That's the only place I applied, and fortunately I got it. I do remember the time I got the letter from my post office box. The offer came. It wasn't much salary—it was over $6,000 at that time, per year. [laughs]

Rubens: Well, it had to be more than what the professors were making.

Kuh: I don't know what they were making. It was not a lot of money, but it was much more than I needed.

Rubens: You were still single at the time.

Kuh: Yes, yes. Actually, I got married after I came to Berkeley.

Rubens: You met your wife here?

Kuh: Yes.

Rubens: But it must have been an exciting time in some ways, to be heading off to your first job.

Kuh: Yes.

Rubens: Was the first Chinese hire at Bell Labs there at the time you joined?

Kuh: Most likely, Chester Lee was there. PK Tien, I think, went there maybe a month after I did, my memory is not that clear.

Rubens: Okay. What I'm really asking is if you had some sense of weight on you, some sense of consciousness that you were going to be one of the early—

Kuh: No, because I did not know at that time. I found out later on –someone told me perhaps because of affirmative action there had been a meeting with the Executive Director in research, Bob Lucky, and he was mentioning that—in the early days, when he first came and that was after me— there were very few Chinese employees and as far as he knew at that time, he mentioned me, and maybe others. I was number two.

Rubens: I get the sense from you experience at Stanford, at Michigan, at MIT, that you carried yourself with confidence, that you were engaged in your work, that you were—

Kuh: I think so. That's one thing I had, [laughs] confidence.

Rubens: Well, it's a critical—

Kuh: That's what my wife tells me sometimes. [laughs]

Rubens: But it's a critical factor in being able to strike a course and then pursue it, and not feel that you're representing your nation or heritage.

Kuh: No. I had no sense of that at Bell Labs. Even when I became an administrator here, I had no sense of that, only later on, when I visited places, people mentioned that, "he is the first Asian dean at Berkeley," and this and that.

Rubens: Yes, we'll get to that consciousness. It becomes so politicized once you get into a position of being chair and dean. It's a different era, where those things are being talked about. Sometimes the historian wants to look with the current lens to see how one would think about it back then. I wanted to just make sure.

Regarding your thesis, which was published: *Potential Analog Network Synthesis for Arbitrary Loss Functions,* would you explain what the subject was?

Kuh: I'm going to talk about that, because that's one of the job assignments I had at Bell Labs.

The circuit theory, which is referred to, after that period, means theoretical aspects of electric circuits, and usually it's divided in two. At that time, we called it network analysis and network synthesis. My thesis deals with network synthesis, which means—given a specification of a design, you want to produce a circuit which can do just that according to the specification. Does that make sense?

Rubens: Give me an example of what a specification is.

Kuh: Specification usually is, in terms of, let's say, plot frequency versus gain—the gain of the circuit is a function of frequency. In telephone transmission, you must maintain a certain level of constant gain and certain criteria of phase. Gain and phase correspond to the behavior of the transmission. The ideal case is the gain like this, within the frequency range, and the phase is like that. Then I will produce ideal transmission. Okay? So the problem I was facing at that time is to try to equalize the characteristics of the transmission medium—that means cable, coaxial cable, underground, submarine cable, which has irregular shape. You want to design a circuit, when you put them together, the flat gain, and the linear phase. These are the ideal thing. So my thesis deals with how you do that.

Network synthesis is divided into two parts. One is approximation. You want to find a mathematical function which approximates what you would like to get. You cannot match it exactly. But the mathematic function must be such that it can be realized as a real electric circuit. That's called realization. So the synthesis contains two parts: approximation and realization. And the thesis I was working is to use a physical theory or concept—potential theory, which physicists know—and to use that as an analogical, as analogy to network approximation. I used that in order to find the mathematical function, which is a rational function with certain properties. That's what the idea is. That's called approximation, a part of network synthesis.

So that's very briefly, the idea. It's hard for you to follow that, actually. It has a lot of details.

Rubens: Hopefully, this oral history will be deepened by your vita, by the published literature.

Kuh: Professor Kang, Dean of Engineering at UC Santa Cruz and one of my former students, can also explain it to you.

Let me say just a little bit more. With practical circuits, you cannot do exactly what you would like to do, so that's why you have approximation. With practical circuits, you cannot realize it with a mathematical function precisely. Approximation takes the specification to the realizable mathematical function. And from the realizable mathematical function, you realize the circuit. So these two parts constitute network synthesis. The "networks" at that time referred to circuits. So this is part of circuit theory

Rubens: Okay. I see. You're saying the term "circuit theory" will come a little bit later.

Kuh: A little bit later. Because the Institute of Electrical and Electronics Engineers, I mentioned last time, has a branch that first was called circuit theory branch, and later on—actually during the time I was the president—I changed that to Society of Circuits and Systems to make it broader.

Rubens: When you were hired, were you hired to continue doing theoretical work?

Kuh: One of the reasons I only applied at Bell Labs is the enormous reputation it had for research. And they had top people in almost all fields related to electrical engineering. In particular, they had two pioneers in circuit theory. I've brought this publication, the IEEE publication *Transactions on Circuits and System,* to show you. The three men featured in the two editions of *Transactions* that I edited [in l984 and l999] are pioneers. My professor Ernst Guillemin, at MIT with whom I did my masters thesis, and his contemporary, Hendrich Bode who was at Bell Labs, were on the first issue I edited. I was invited to edit the special issue to celebrate the centennial of the IEEE organization and I put Guillemin and Bode on the cover. Then later on, Sidney

Darlington—the other pioneer from Bell Labs—died, so I had the opportunity—I was asked to be editor of another special issue in his honor. [1999]

Rubens: That was a memorial to him.

Kuh: Yes. So the two were at Bell Labs.

Rubens: Hendrich Bode and Sidney Darlington. And these were already legends in their field.

Kuh: Yes. Pioneers. So these three are the top people in the field, the pioneers.

Rubens: So here you'd worked with one with your master's degree, and the—

Kuh: When I got to know them, of course, Bode was very high up. He became vice president. As to Darlington, I just got to know him, but I did not really work with him, because at that time, when my thesis was done, he also wrote a paper on a related subject. We had exchange and discussions. Later on, I invited him to come to visit Berkeley and he gave lectures and we had exchange and discussions. So these are the top people in the field, and I was fortunate to be able to honor them, using these special *Transactions* issues.

Rubens: Where were you, literally? If you would just describe a little—where did you fit in the hierarchy?

Kuh: I was a beginning Ph.D. student.

Rubens: Okay. Did you have a class or cohort of people who began with you?

Kuh: Some people are in the basic research lab. At that time, Bell Labs, one-tenth is basic research, then the rest is divided into different areas of technical areas. Under the transmission area, there is a Transmission Development Division. They decided to hire some young people with Ph.D.'s to do their own research. So I was hired in that organization. There is basic research—mostly mathematicians, physicists, chemists. But I was hired in a parallel organization, Transmission Development. Another parallel organization was Switching Development. Telephones have to switch. Another parallel operation was Military Development. That did a lot of work for the government.

So I was in transmissions. Then they had a small group of newly hired Ph.D. students to do basic research. There was also the development of telephone-relevant transmission system. When I joined there, I was maybe the second Ph.D. they hired. Then later on, this group expanded. A year later, Charlie Desoer—my good friend at MIT—joined.

Rubens: Did you have something to do with his being hired?

Kuh: No. Actually, I worked for him later because he was so good. He later got promoted to be a supervisor, and I worked for him. And then, Don [Donald O.] Pederson, who got there about the same time—maybe a little bit later—as Desoer. He was from Stanford. He went to Bell Labs from Stanford, as I did.

So we worked together on different problems and we interacted quite closely. I will describe that to you. My responsibility was to do basic research in network synthesis and to do fundamental development of transmission repeater designs. Specifically, there's a cross-country coaxial cable system, which means—a cable has loss, over a certain distance, maybe after so many miles, you have to insert a repeater to equalize the loss to provide the gain. I was involved in that. I was involved in the design of the submarine cable, from the U.S. to England, to London.

Rubens: I read that the first trans-Atlantic cable was laid in l956.

Kuh: Yes, yes. I worked on that. That has a special requirement: you cannot repair them, so reliability is very important, because they're under the ocean. You don't want to pull that out, so it has to have a long reliability period to make it worthwhile economically. The requirement is quite different from the land version coaxial cable. I worked on these projects and I did some basic research.

Now in network synthesis, I think the two key publications, one was the synthesis of the so-called driving-point impedances. [Kuh, E.S., "Special Synthesis Techniques for Driving Point Impedance Functions," IRE Trans. on Circuit Theory, CT-2, no. 4, pp. 302-308, December 1955.] Which means, you have a network, you apply input. At the same place you measure the voltage, if you apply the current as input. Or you apply the voltage, you measure the current. That's called driving point. Given a prescribed mathematical function, how do you find the circuit? So, I worked on that. I found some very good results. That was published. Then I did some work on the synthesis of delay line. I mentioned the phase. Phase is related to delay. If a circuit provides a good flat delay—which means the signal is transmitted with the exact form of the original signal after the transmission. The delay is important so the signal does not get distorted. You just have a time delay. I worked on the synthesis of a delay line, which actually is used for many communication systems at that time. The analytical approach is to design a very good delay for certain prescribed error criteria. That was published. [Kuh, E.S., "Synthesis of Lumped Parameter Decision Delay Line," Proc. of the IRE, vol. 45, no. 112, pp. 1632-1642, December 1957.]

In addition, there are other things which were published in the Bell Labs technical memo. There are many such technical memos. Most of the development work was published in the internal technical memo, because

that's for their own systems. These are the things I did. My boss at that time was the one who recruited me from Stanford, Alex Grossman. He was a very nice person. He did not have a doctorate degree, but he understood what's important. He actually collaborated with Darlington in some of the earlier work in filter synthesis.

Rubens: Remind me of his name.

Kuh: Alex Grossman. He's not well known, but within Bell Labs, people know about him. Later on, as our group got bigger, his responsibility got bigger. He was promoted to department head. There's another group that later became the Transistor Network Department. The transistor was invented at Bell Labs, and then the application of that caught on gradually. When we designed a repeater, we would use transistors, instead of vacuum tubes. Grossman was later in charge of the Transistor Network Department, and his responsibilities continued to grow.

Rubens: Now, I believe that you attributed to Pederson the formation of a work group. Is that right?

Kuh: No, no; let me go on with my time line here.

Besides work at Bell Labs, at that time I was a bachelor. I lived in a rooming house in Summit, New Jersey, which is about three to five miles from Murray Hill. There was a group of three or four people living in the same place.

Rubens: Who all worked at Bell Labs?

Kuh: We all worked there.

Rubens: How did you get to work?

Kuh: Driving. Everybody had a car, so we took turns driving

Both Desoer and Pederson were married, but with Desoer, he is a very impressive researcher. He has a constant aim to learn new things, including the basic material he needs to do research. So he organized—besides self study, he organized a special group among us, in the group, to do some study after work. At that time, the group may already have about half a dozen people. Some of the people joined in, including Ted [Theodore R.] Bashkow, who later on went to Columbia University and he became department chairman. It also included Bill Gross, who later became a vice president in charge of research at Ampex and then later on became the dean of engineering at the University of New Mexico. These are the people that decided to do some study together.

[By the way, Bashkow came to visit us about three years ago. We had a good time. I took him to dinner at Chez Panisse and we talked about old times.]

Rubens: So it's Desoer who is the—

Kuh: -organizer of the study group.

Rubens: Yes. And was there a special focus?

Kuh: Yes. There is a new way of treating differential equations. A book came out by Dick [Richard] Bellman, who was a professor at Stanford. I think the title was something on stability theory of differential equations. But I'm not sure of the title, now. He had an interesting way of writing a differential equation, from the actual physical medium, such as the circuits. The way we used to write circuit equations, are based on the 1900 physicist, [Gustav Robert] Kirchhoff. Kirchhoff's Laws. You have a Kirchhoff voltage law, Kirchhoff current law. So you write those equations, which becomes algebraic, integral differential equations. It's very complicated.

But in this book, a first order differential equation in the vector form is used to write such equations. So that was interesting to us, because we never knew that.

Rubens: Had you known Bellman at Stanford?

Kuh: I knew him. I took a class from him.

Rubens: But this was not something that—

Kuh: No. It was another course. Bellman became very well known in control theory. Later on he got interested in electrical engineering, too, but he died early.

We were very interested in this special way of writing differential equations because from this specification you can derive many other interesting results, which are represented by the vector differential equations. From the way we used to do it, we don't have that basic result—such as stability, such as—oh, then later on there are other things, observability, controllability—these things all come out when you're writing equations in this form, called state equations. Ted Bashkow said, "Gee, that's interesting." He played around and he found—after we studied these things—he found out that for a certain class of circuits you could also write an equation in that form. He calls that an A matrix, because in the differential equation book it's called A matrix—capital A. So that's interesting. For a special class of circuits we can understand more basic properties from this differential equation.

Later on, a professor in England, Peter Bryant, extended that in a more general form. I and my former student, Ron Rohrer, wrote a classic paper on the state equations. [Kuh, E.S., and R.A. Rohrer, "The State-Variable Approach to Network Analysis," Proc. of the IEEE, vol. 53, no. 7, pp. 672-686, July 1965.] That's in the proceedings of the IRE, or IEEE maybe. IRE became IEEE.

Rubens: How much later on? Do you want to take discuss that now?

Kuh: That's after I came to Berkeley.

Rohrer was my Ph.D. student. That paper was heavily referred to later on because people still—oh, here. [Refers to his publications list.] Number nineteen. "The State-Variable Approach to Network Analysis." That was published in the Proceedings of the IEEE, which is a general publication for the whole IEEE society. People wanted to learn the subject, so the editor invited me to write a paper. That was 1965.

Rubens: Okay. Back to Bell Labs, how long did this study group—?

Kuh: Oh, maybe it continued for a year. For some reason we quit afterwards. During this time, I really learned from Charlie Desoer—and of course I worked with him. He became supervisor. I see the way he does research, and I learned the way he does it. For sure, self learning is important, because we have not learned everything in school. We have to learn these things later. He made a strong influence on me on research. Then, later on, we collaborated in research and text book writing, and that I will talk about later. So that was Desoer, the study group, and the way he does research.

Rubens: Maybe it's not appropriate, but does that new way of writing equations then start to enter your work at Bell Labs?

Kuh: Not exactly, because this is something academic. But eventually, everybody used that form. Later on, because the people in control theory also used the same idea, and called it the state equations.

Rubens: Since I've interrupted you, and then I'll let you get back to the narrative, let me ask you about the work environment at Bell Labs during the day; was it collegial and cooperative—

Kuh: Yes, very.

Rubens: —or was there a certain pressure to be competitive?

Kuh: I did not feel that at all. The atmosphere was really good.

Rubens: Literally, just for a minute, what kind of space did you work in? What were you given?

Kuh: I had an office bigger than this. [Referring to his office in Cory Hall at UC Berkeley]

Rubens: Everybody had their own office?

Kuh: No, no. It was for four people. In a sense, it's good because the four all belonged to the same group, so we interacted. Charlie Desoer became a supervisor, so he had a small private office.

Rubens: That's why I was asking you. You mentioned that Grossman was moving up, and that Desoer moved up. But I didn't know if certain people were being picked out and then encouraged to move, and did that create a certain tension?

Kuh: No, not at all. We did not feel that at all. Even though he became my direct boss, he never treated me as a boss and employee kind of thing. No. We were colleagues.

Rubens: And you're saying, in general the atmosphere at Bell Labs—

Kuh: -was excellent.

Rubens: —was collegial. How many people, about, worked there?

Kuh: At Murray Hill, I think about 3,000 and later on, maybe more. Then they had branches at other places. Homedel, Whippany. Altogether at that time, Bell Labs had over 10,000 people. It was huge.

Rubens: Was there a social structure, or social activities that were attendant to the—?

Kuh: Yes. Within Bell Labs, there were frequent talks, both technical and non-technical, given by people inside and people outside. We were free to go. And there were, of course, office parties to celebrate, some events, such as somebody's birthday. And also parties to—farewell party for retired people, that kind of thing.

Rubens: So there was a cultivation of collegiality and sociability.

Kuh: Yes.

Rubens: You had mentioned earlier that it had been known to discriminate against Jews.

Kuh: I did not know until much later on, because at that time I was young. I was not sophisticated.

Rubens: Somehow when you mentioned the names "Grossman" I thought, well by then they had opened up.

Kuh: Yes. I think that was before the Second World War.

Rubens: I was wondering—I probably shouldn't take your interview time to ask you this—did Bell Labs get many German Jewish refugees during the war? Did scientists come to Bell Labs that you know of?

Kuh: Of course, there were some. I don't know any names.

Rubens: All right. And just one other question, just about Bell Labs, was there a political sensibility or tenor at Bell Labs? Was it known to be—?

Kuh: Maybe there was, but I wasn't sophisticated during this time. I did not participate. At lunchtime sometimes a few of us would go to the back of Murray Hill which is like a park; there was a lot of empty land. We took walks and we played horseshoes and that kind of thing. We'd chat; most were much older than I was, and they talked politics.

Rubens: It's just such an unusual period in American history. It's the height of the Cold War, and there's the issue of McCarthyism.

Kuh: And the president and vice president of Bell Labs all had close ties with Washington.

Rubens: Well, they had to have.

Kuh: Jim [James B.] Fisk, the president at that time, was the chief negotiator of nuclear disarmament with the Soviet Union. And another one, a key vice president, became the secretary of the air force, Donald [A.] Quarles. These are the people I remember. Quarles had much to do with the military. He went to Whippany. Whippany is the military lab.

Rubens: I imagine a large proportion of government monies were for military related development.

Kuh: Bell Labs' work was funded in a stable way: 2 or 3 percent of AT&T's revenue, so that was really the best time for growth. I don't think people ever go to Washington to get funding, except the military part. The money just came automatically. We had no pressure to get outside money. Not at all.

Kuh: Okay, let me change the discussion to focus on the second activity at Bell Labs which I started. Don Pederson had a former teacher, somewhere in North Dakota. He became the chairman of electrical engineering at Newark College of Engineering. Pederson was asked to teach evening courses. Then there were more courses to be taught, so he came to talk to me. Pederson's interest at that time was more transistor circuits. Transistors. He was not in the same group as me. He asked me whether I would be interested in teaching a course. I never taught any course before. That's something new. I said, "I could try,

but I don't know if I'm good at it. I don't know whether I'd like it or not." Anyway, he persuaded me to try. This was Newark College of Engineering, in the evening. Class started at 7 o'clock for two hours, once a week. I was asked to teach a regular course on the subject of network synthesis. Of course, I knew the subject matter.

So I started teaching. As you may gather, at this evening course, the students have had various kinds of backgrounds. It wasn't that easy—some are good; some are no good.

Rubens: They were people who'd been working in the field?

Kuh: No, they're all from industry. That's why it's an evening class. I enjoyed the lecturing part, but sometimes I did not get the response from the students I wanted. I thought my lectures were always very logical; I also liked presenting my material and writing up the notes. I liked it.

The next term, they asked me to teach another course. That's how I got introduced to teaching, After Don Pederson was recruited to Berkeley and had been there a year, when he asked me whether I'd be interested in coming to Berkeley. At that time, John Whinnery was the department chairman, and Mike O'Brien was the dean. They both came to the East to interview me. I think recruiting is quite different now. Candidates get invited to come here to give a talk and meet many people. At that time, I met with the chairman in his hotel room. I met with the dean. The dean actually also recruited Bill Gross. Gross was my colleague. He had a house not far from Murray Hill, so we met at his house. We both got offers to Berkeley, but Bill Gross decided that he would like to get more industrial experience. He joined Ampex but I came to Berkeley.

Rubens: Where was Ampex based?

Kuh: Ampex is in Redwood City.

Rubens: Did you have any concerns about giving up your work at Bell Labs?

Kuh: I had a little bit, and people close to me tried to talk me out of it, but I thought this is a wonderful opportunity to do something different. And Berkeley electrical engineering did not have a top reputation like Stanford at that time. They were growing, and Pederson was a very good friend, and he convinced me to come.

Chapter IV: Coming to UC Berkeley

Rubens: Pederson came to Berkeley in l955, a year before he recruited you to go there as well?

Kuh: A year or two before. Yes. At that time, I kind of—not really bargained—but I implied, "If I come, I would like to get an associate professorship." I worked for four and a half years at Bell Labs. The university came through with an acting associate professorship for my appointment.

Rubens: And are you making a distinction from being an assistant—from starting from a lower level?

Kuh: Right, right.

Rubens: Why "acting"?

Kuh: Because associate is with tenure. They don't want to give tenure to a fresh—I think Pederson at that time was still assistant professor. So I got a better deal. [laughs] And for some reason, the salary wasn't bad.

Rubens: Compared to private, compared to Bell?

Kuh: Compared to Bell Labs. Because I learned right away, in the summer time you can earn extra money, and that was the start of my getting research grants for a lifetime. I can talk about that later.

Rubens: I see from your vita that you start right away with consulting in San José—

Kuh: Yes. Yes, I did.

Rubens: But, when you're negotiating your salary and status, is it understood in the job, or do you need to ask to have, research time?

Kuh: No, no. This is implied. Everybody is encouraged to have research grants, otherwise—it's crucial now, but it wasn't so crucial at that time. You have to support students. You have to get extra summer salary. So right away, you apply to NSF, National Science Foundation, for research grants.

Rubens: Right away.

Kuh: Right away. It turned out my grant from the National Science Foundation lasted from 1957 until after my retirement. Of course I continuously updated my research each time I applied for renewal. So I had a research grant throughout my career at Berkeley, from the National Science Foundation, and others.

Rubens: Really? And how long would they last at a time? Were they two years?

Kuh: Two to three years, sometimes five years. Before it ends, it starts again. But I continued getting that. That money, at first, was good enough to support several students, but then the NSF grants have not grown that much.

Rubens: Leveled off?

Kuh: Leveled off. Later on, I had other kind of research funding. So, in my career, Deseor was responsible for my research, I feel, and Pederson was responsible for my teaching. That is my career. So these are the two people very close to me. Both unfortunately are not healthy.

Rubens: Later on there'll be the third—Zadeh. John Whinnery noted in his oral history that he was recruited too. They wanted him to come around the same time, but he did not come.

Kuh: He did later. I first came to know Lotfi Zadeh when I was at Bell Labs. Zadeh was already very well known at Columbia. He invited me to give a talk at Columbia.

Rubens: Just remind me his field.

Kuh: He starts with circuit and system theory, then he's moving to control and systems, and he became very well known in a new subject he developed himself—fuzzy logic. So he's now referred to as the father of Fuzzy Logic. Zadeh at that time was interested in circuit theory; he knew my work at Stanford and at Bell Labs. He invited me to give a seminar at Columbia and that's how I met him. He is originally from Persia. He went to MIT for his masters and I think got his Ph.D. from Columbia, working in control theory.

Rubens: Did you do other kinds of seminar presentations during your period at Bell Labs?

Kuh: Yes, some within Bell Labs. The one I remember the most was at Columbia because Zadeh was such an unusual person.

Rubens: What was unusual about him? His achievement? His stature?

Kuh: Yes, his achievement. As a Persian, he's always so modest and hospitable, and even when you enter any door, he always asks you to go first. [laughs] That kind of person. And when he became department chairman here, his poor wife had to entertain every week—we all went to his house for parties. Zadeh knew at that time Pederson, I, and then Deseor came to Berkeley, and he knew both Whinnery and Sam Silver, the two leaders at that time in our department. So it wasn't hard to recruit him. He knew what's going on here, and he came. I

came in '56. Desoer came in '58. Zadeh came in ’59. That was a time the EE department is really expanding.

Rubens: Did you have any involvement with computers while you were at Bell Labs?

Kuh: I did. In two ways: one is this guy, Dick Hamming, very well known in computer science. H-a-m-m-i-n-g. He’s a character. He loves to talk. Every time I’d run into him, he chatted. But his interest was really analog computer.

Rubens: Was he at Bell Labs?

Kuh: He was at Bell Labs. Digital computers weren’t as important at that time as analog computers, because with analog, you can learn something physical. By the name, you know, analog [does this make sense?] But he made some fundamental contributions to digital computers later on, too. After he retired, he went to Monterey Navy Postgraduate School to become a professor. IEEE honored him. There is a Dick Hamming Medal in his honor. So I got to know him and we just chatted; nothing technical. But he always tells me about new things in computers. And then, in our group, Ted Bashkow—the one who studied A-Matrix—got interested in programming. In our department, there is a group—maybe a dozen—computresses—ladies who do nothing but programming. They helped the engineers. I did not try to learn myself at that time; when you had some idea you wanted to test and needed to compute, they would do it for you.

But Ted Bashkow decided he wanted to do some programming himself. Programming, at first, is machine language. It’s very tedious, very hard. But at Bell Labs, they invented their own language. And that becomes easy to program. And that program itself did not succeed. Did not last, but during that period, it was very useful to the people within Bell Labs. Ted Bashkow was programming that, so he taught me a little bit about doing the program. I learned it and I programmed a little bit. Then, I guess I wasn’t that interested, and I did not do more programming, and I forgot how to do it. [laughs]

Rubens: Of course Bell developed Unix, the Unix operating system.

Kuh: Unix is much more important later on. Unix is key. Unix, which is a very different kind of operating system, was later on much improved by the Berkeley Unix. Berkeley Unix became very well known, throughout universities and industries. It became more famous than that of Bell Labs.

Rubens: That’s my understanding, and I just don’t quite have the sense of the dates.

Kuh: Right. That was then in the 1980s. Early 1980s. And the one who developed Unix—one of them, Thompson, was a Berkeley student. And I think he had some influence on the Berkeley Unix too.

Rubens: The date that Berkeley cites for pioneering research of computers at Berkeley is 1948.

Kuh: Well, that was Professor Morton. He started the computer group. At that time it mostly was just hardware. This will come up when computer science became an important part of the program; that happened during Zadeh's term as chairman, and during my time as the chairman of EECS. Later we merged the two departments, ours and the CS department in Letters and Science. I will talk about that. That's an important part of the development.

Rubens: Yes. Exactly. And the other question I wasn't going to ask, but you touched on it just a moment: Were there women that were of your stature or higher at Bell Labs? Because when you talk about this women's unit which was the programmers—

Kuh: Yes. A very few. I think there were two in our department. One had only a bachelor's degree. The other one, a mathematician, was in the same group as we were. That's that group supervised by Desoer of half a dozen people.

Rubens: Okay. And was it called—do you remember?

Kuh: No. They don't even give it a name. Just within the department there, three or four supervisors. That's one of them.

Rubens: Fine. I didn't think there were too many women in the—

Kuh: And in the research area there's one. I got to know her, not because of technical work. I played bridge after work. It was very interesting. There were a lot of excellent bridge players, including Bode, and every Monday we play, and the next week we get the score out. Bode always comes way up on top.

Rubens: "Score out" means—?

Kuh: Well, this is a term from duplicate bridge. Everybody plays the same hand, so you compare. There was a lady in the math research, she also played. I got to know her through playing bridge.

Rubens: But I want to ask you a bit more about the cultural life, the social life, playing bridge, that sort of thing. Did you go into New York City?

Kuh: Yes. Weekends. I had friends in New York.

Rubens: Of course, you had known Boston and I imagine you'd have gone to San Francisco some from Stanford. But New York's a different order of—

Kuh: Well, San Francisco was a little too far. I didn't go to San Francisco too often from Stanford. But at Boston, it's Cambridge-Boston together. New York, I

had a car, so weekends I'd go to New York, and I had friends. Most of the time I stayed overnight in New York, and we'd go out together with girlfriends. There were social fraternities, Chinese fraternities too, and they often had meetings and picnics, so on the weekends I was busy.

Rubens: In terms of your social life at Bell Labs, was it very mixed, cosmopolitan?

Kuh: At Bell Labs, besides evening teaching and self-study, I played tennis, I joined the Bell Labs tennis club. I played ping pong, and I won a doubles championship with my good friend Bob Aaron. And another time, with another friend, Wing Toy. I played bridge. And we always went out to eat with the people in the same house. So I wasn't lonesome even though there was no family there.

Rubens: But you mentioned then, the Chinese fraternity. Was that a social club for—?

Kuh: Social, strictly social. At that time, there were three or four Chinese fraternities. I got invited to join when I was an undergraduate at the University of Michigan. Called Alpha Lambda. In school, I think it's good to have that. There are many people close together; you get together with fraternity parties. But in New York, they're from mostly people working; they've already finished school.

Rubens: This is like a postgraduate unit?

Kuh: Yes. But every year they sponsor a Christmas party. Every year there was an inter-fraternity party a get-together. They sponsored picnics and so on.

Rubens: So, on many weekends, that was what facilitated you going to New York?

Kuh: Yes. Right.

Rubens: And was there something in New York that particularly drew you? Did you go to jazz clubs?

Kuh: No, no. Jazz is not my type. I did go to Carnegie Hall. I went to the Metropolitan Opera. Oh, and I had one friend who loves to do bowling. We did some bowling. That's about it.

Rubens: How would you then just summarize what it was that was most attractive about coming to Berkeley? Was it teaching?

Kuh: I didn't know before I came. But I knew that Berkeley is well-known for science. And engineering is developing fast with Whinnery and Sam Silver at that time. And Pederson. So I thought that was a good place to come. At that time, the teaching load was two courses per term. But then we supervised graduate students.

Rubens: Your first semester here, what were you teaching.

Kuh: I taught the course I learned from Guillemin. That's strictly a graduate course. But then I developed an undergraduate course on circuit synthesis with Don Pederson. Even though his primary interest was transistor circuits, he also was interested in circuit theory. So he decided we should write a book at the undergraduate level to teach students synthesis. That book later on became *Principles of Circuit Synthesis*. It was the first book that either of us wrote; we were co-authors.

Rubens: 1959 is when it was published. So within three years of your starting here, you have a published text.

Kuh: And that writing project was interesting. I got married a year after I came, and so we started to write the book shortly after I got married. My wife was working in San Francisco in a bank. She was pregnant, she wasn't too healthy then. But because of the writing, I had to—Pederson had a family, so he could not meet at school. His wife was also a professor at San Francisco State. They had three young children. So what we did is, after dinner—I think, twice a week—I went to his house to write the book. My wife even reminded me, not too long ago, that, at the beginning, we stayed in an apartment house in Albany. The apartment wasn't very good. We could hear the next-door neighbor's TV, and she had a rough time when I was away writing. In a sense, she said, that was good; because of that we moved to a house after maybe three or four months.

The writing was interesting because we both taught the course. Pederson was very talented. The way we write is not dividing into the traditional way. I write that part, he writes this part. It's not that way. We write everything together. So how do you do it? When we first get there in the evening—of course, at the beginning we planned the outline of the book. Then, each evening we met, we decided what we should do for that evening, with some outline. And then he just walked around the room and talked it out. And I more or less just took the dictation.

Rubens: Were you typing on a typewriter?

Kuh: Oh, no. I wrote it out longhand. There were equations and so forth. So I tell people that, "Gee, for this book, I wrote all by myself. He only talked!" [laughs]

Rubens: But it was a real collaboration.

Kuh: Yes. It was a real collaboration. Everything in that book was truly a joint project.

Rubens: Twice a week you would sit through and do this. How long did it take? Close to a year?

Kuh: Yes, must be. Maybe—of course, after those evenings, the thing gets typed and you have to review it. So it's more than just twice a week.

Rubens: Who typed it?

Kuh: Oh, I don't remember whether the secretary in the department or later on, with the final version, we hired somebody to do the typing. Yes. But the secretary in the department was very good. I think we acknowledged her in the book.

Rubens: And at the same time you're teaching—

Kuh: Two courses.

Rubens: You have a graduate course and an undergraduate course?

Kuh: Right. The undergraduate course became the text book. *Principles of Circuit Synthesis*. The graduate course, of course, is advanced material. A kind of continuation of what Guillemin tried to do at MIT, but things changed.

Rubens: And at the same time, you were writing lectures?

Kuh: Well, you prepare—every time you prepare a lecture, you have to—I usually write it out, the outline. I write some equations. It takes me—these are two familiar subjects, so maybe, I would say for one hour lecture, it takes me two hours to prepare it.

Rubens: Not bad.

Kuh: It wasn't bad, wasn't bad. It's quite different from later on with the new course. With the new seminar. That's much harder.

Rubens: Could you say something about your students when you came here. You'd had a lot of experience now at some of the premier places—Stanford, Michigan. Maybe Michigan wasn't premier, but MIT and Stanford. And your teaching had been at Newark. It must have been quite a different—

Kuh: The impression I had most was when I went from Michigan to MIT, and the students at MIT were very, very good. You could really feel the competition. Some of the assignments were very hard, and I felt a lot of pressure. So maybe that was another reason I decided to leave MIT. I went to Stanford; it was easier. It was easier. And here—it's hard to compare the places where I taught and where I was a student, but I think the students, by-and-large here, are good. They are much better than Newark College. Much better. And they are

motivated. They're not like the students now. Many of them, later years, I've found they were not so motivated.

Rubens: Really?

Kuh: Yes.

Rubens: Would you say a little bit more? Motivated in the sense of—?

Kuh: They really wanted to learn. They asked good questions. They don't miss classes. Later on, that wasn't the case.

Rubens: Interesting. Was it competitive, or hard to get into Berkeley?

Kuh: I don't think so. At that time, it was much easier then. Yes.

Rubens: One of my notes here is that—I guess it's under Morton's chairmanship—

Kuh: Morton was the chairman before I came.

Rubens: It was during that period, I think, that he was beginning a distinguished visiting lecture series.

Kuh: Oh, yes. We had quite a few people from Bell Labs as distinguished lecturers - including Darlington and quite a few others in different areas.

Rubens: That continued once you started? People were coming from different parts of the country, different labs?

Kuh: Yes. And there were also visitors who stayed for a term. People stayed for a week, two weeks, a month, a term, a year –for different periods of time.

Rubens: What I'm trying to get at is the intellectual climate that was here. Was there this kind of pulsing sense that—?

Kuh: It was very good. When I first came we had department colloquium. Maybe one or two seminars a week.

Rubens: This is different from the distinguished lecturer, visiting lecturers?

Kuh: Yes, these are seminars. Distinguished lecturers sometimes give the course, or sometimes just give two or three seminars. But now we have the whole page of seminars every week. So that has expanded. Plus the field became much broader.

Rubens: Yes, when you came there were basically three major divisions: the civil, the mechanical, and the electrical, is that right?

Kuh: There always was a Material Science Mineral Engineering. The three big departments are EE, ME, CE. There's always a Material Science, and there is a Nuclear Engineering, Industrial Engineering. So I think the department structure more or less continued but we changed our name later to EECS under Zadeh's chairmanship. [In l966] Then the Naval Architecture changed its name and now it's disappeared. And we now have Bioengineering. So the change in terms of coverage is much broader, but in terms of just the name of departments, they're about the same.

Mechanical Engineering, Civil Engineering had divisions. We do not at that time.

Rubens: I see. [John] Whinnery wrote a sort of —

Kuh: Oh, he was chair in a transition time. When Dean O'Brien was the dean, he wanted to have control of the college, so he made the whole college one department. Because the department chairman has the responsibility of everything. He made each department a division, so everything would go through him, as both the department chairman and the dean. That was a special period, but that structure disappeared. When I came, Whinnery was the department chairman and I think about '59 he became dean. Saunders became the department chair.

Rubens: Maybe contrasting to Bell Labs, was there a collegial environment here? Was there that same kind of—?

Kuh: When the department was small, people got together. I remember, frequently we had a table at the Faculty Club. We'd see a few of them together for lunch, and the department chairman often gives a party at their home. But now, the lunch became a department lunch in Cory Hall and Soda Hall—it's a huge thing. And the department chairmen seldom invite people to their home. But the department has a big Christmas party, which includes everybody, from staff to students. I don't even go any more, it's so huge. At the beginning, there was a small faculty Christmas party. So it's quite different.

I think maybe, as far as the social activities, you get to know the faculty wives here more than in the Bell Labs employees. But I was invited to a few close friends' home for dinner, quite often there too. So I always have a few key friends there and here.

Rubens: You must have been pretty busy those first couple of years: writing the book, a new marriage, moving, having a child.

Kuh: Well, I tell you, until I retired I was always busy. Always busy.

Rubens: I hope this isn't too personal, but did you have any difficulty finding a home? Was there any—?

Kuh: [laughs] Yes. I think in Whinnery's oral history, he mentions something about that.

Rubens: He does.

Kuh: When I first came, I know that they advertised apartments and when I went there, they said, "No longer available." I think it's kind of obvious. It was in the hill area. Not just maybe once or twice, it happened.

Rubens: That you actually experienced—

Kuh: Yes.

Rubens: —what was discrimination. Cultural, ethno-racial discrimination.

Kuh: Yes, it was. But it wasn't bad. It wasn't bad.

Rubens: It didn't color your life?

Kuh: No, no, no. When I first came here, I rented a room in a professor's house up on the hill. I stayed there.

Rubens: A fellow engineering—?

Kuh: No, he was in political science. I stayed there maybe for the first term, then I moved to a bigger place. It turned out not to be a very good neighborhood—Shattuck/Ashby area. Not a very good area.

Rubens: It's still a little dicey.

Kuh: Then after we got married, we had an apartment in Albany. It wasn't a very good building. Then we bought a house in Kensington.

Rubens: In buying the house there was no—?

Kuh: There was no problem. No problem. I think that things improved very fast during that period.

Rubens: You're coming at the end of the "hot" or militant Cold War, which leads me to just one more question. Did you have to sign a loyalty oath when you came?

Kuh: No.

Rubens: That fight had been won. That was over.

Kuh: I didn't have to sign one.

Rubens: I'd like to talk about the evolution of the curriculum in what would become EECS and the ways in which your research begins to transform.

Kuh: Okay, we can talk about curriculum and my research. And then I want to talk about my first sabbatical leave. Later on.

Rubens: You'll be here close to twelve years before you become chair?

Kuh: I was asked to serve at the end of 1967, because at that time, Desoer and I were finishing a book. So I asked Professor Zadeh whether he could stay on for another term as chair. I started in January 1968 instead.

Rubens: And then maybe we'll discuss the social climate of Berkeley, because those are going to be some of the real troubling times there.

Kuh: Troubling time, yes. It started that time I went for my first sabbatical. It ended when I did my department chairmanship and took my second sabbatical.

Rubens: Just reflecting for a minute about what we've covered today—Bell Labs, coming to Berkeley, some of your first publications, friendships, marriage. I don't know if there's anything else you'd like to include?

Kuh: I met my wife here in Berkeley at a party with friends. I was invited by somebody else. She was working at the Bank of Canton in San Francisco.

Rubens: Is she from the area?

Kuh: No. She was born in Philadelphia, because her father was studying at University of Pennsylvania, the Wharton School. Business school.

Rubens: What is her name?

Kuh: Bettine Chow. She went back to China after her father finished his degree. She was in China during the time of the Japanese invasion of China. She moved all around China with her parents and had quite an experience -even traveled to Hong Kong and to Chongqing. She had to go through what was then Indochina –Vietnam- to get to Chongqing. But she learned Chinese while there, between l937 and l943.

Rubens: English was her primary language?

Kuh: Her first language, right. She went to Washington later because her father was sent out by the government to work in Washington DC, and she—

Rubens: As a diplomat?

Kuh: Sort of, but more as a banker. Then she went to high school here, and then to George Washington University. She got a degree in business administration, but I always tell her she doesn't really have the business sense. What she has, what she loves, is art. [laughs] And then, after she finished in 1949, she came to San Francisco. By that time, her father passed away already, and her mother was in San Francisco.

Rubens: There was some family here?

Kuh: Yes. Her mother, her sister, and her brother, they all were in San Francisco.

Rubens: I was actually asking what drew her mother here. How did her mother end up in San Francisco?

Kuh: Ah, because her mother had her sisters here.

Rubens: You married in 1957 and your parents have by then moved to San Francisco?

Kuh: Yes, right.

Rubens: So your family was moved. And had she—I don't know how to ask this. She's marrying a college professor. Her family had had a business background. Did that play—was her family happy with you?

Kuh: Her father actually taught briefly at Shanghai Jiao Tong University. By that time, her mother had died too. She was the eldest.

Rubens: She was a free agent.

Kuh: Right! [laughs] Yes.

Rubens: Once she had children, did she continue to work?

Kuh: No. No.

Rubens: It wasn't done.

Kuh: In 1957 we were married; and in '58, we have our first boy, she quit working maybe a half-year after we married.

Rubens: When you say that her father moved around—

Kuh: Yes. In China. Remember this was during the war time.

Rubens: Was he sort of one step ahead of the impending revolution? Is that part of it?

Kuh: No, that was mostly during the Japanese War. The war with Japan.

Rubens: So she had some of the same experience that your family had.

Kuh: Yes. But they stayed in Chongqing most of the time, while we were not. And then they came out to the States earlier.

Rubens: Okay. I think that's an important part of the history to have. Let me now ask you about the response to the book you wrote with Pederson.

Kuh: Pederson and I wrote our first book, *Principles of Circuit Synthesis,* and that book was translated to French. It's the first book of that kind to teach circuit synthesis for undergraduate students. It got a good review for our approach.

Rubens: I have to tell you a quick little story about that book. Over the weekend, there were people coming back to observe the 40th Anniversary of the Free Speech Movement. One of the students—older man now—was a graduate student in engineering and he had that textbook, he thought, maybe the first year it came out, because he remembered that there were a few pieces of white paper that were inserted into it that said "erratum," where they made changes. And then it must have been printed again.

Kuh: Interesting! [laughs]

Rubens: It was a classic. He said he wished he'd held on to that.

Kuh: Okay. After that, Charlie Desoer joined Berkeley. We were going to do something on curriculum. At that time, the first course in the department was a seven-unit course in the junior year, required for everybody. That's a big chunk of the credits for the beginning junior students. Remember that we had to take many students from community colleges, so when they come here—that was a shock! Seven units for one course; if. they fail that course, they're through. I did not like that.

Rubens: Why didn't you like that?

Kuh: First, it's too big. No course should have seven units, because people take fourteen units and that determines the whole thing. Second, it covers everything in electrical engineering at the introductory level, and we feel that circuit theory was such an important field at that time; it should have its own course. Also, that course is tied to the laboratory, so students really spend too much time on that course. We decided to take a look, how should we do it? We decided to offer a single course on circuit theory. Let other people in the department take care of the others. Circuit theory was a major component of that course. After we taught it the new way, and that became the standard first course for electrical engineering—circuit theory.

Rubens: This was a junior-level course?

Kuh: Yes. There was a sophomore course, very elementary, so I did not include that. Most of our programs started the junior year. We taught that a few times. We included other people to teach it, who contributed in terms of what is the best way to do it. Finally we decided to write a text book. And I think we started around 1965 -quite a few years later -after my sabbatical. And that book came out in 1967 in the paper edition, called *Basic Circuit Theory.* That made a universal impact, because the approach was totally different. We emphasized the mathematical rigor. We defined circuit elements, not only physically but mathematically. We introduced a general treatment for circuit analysis. The reception was extremely good internationally. Domestically, at the beginning was good, but then people found it was too hard, too difficult to use. MIT used it. They liked it, but then after a couple of years they decided they wanted to write their own version.

Rubens: Was Illinois by then—?

Kuh: I don't remember. I only remember MIT and a few other schools. But internationally, everybody got so excited so the book was translated to Japanese, Chinese, Russian, Italian, etc., and had a huge adoption.

Rubens: Portuguese.

Kuh: Portuguese, too, yes. Oh, you know of it?

Rubens: I'm looking at your publication list.

Kuh: Oh, I see. Okay. [laughs] You do your homework! What's satisfying is, everywhere I go, they say, "Oh, we learned circuit theory from your book." This is in Europe, in Asia, and everywhere. And before long it's more than 100,000 copies. We lost count. But domestic adoption tapered off. The thing is, internationally, students usually have a much better background, good in mathematics and so forth. Domestically, they're not as good. We did our best here and we use that book. We liked it, of course and that made an impact. Even now, when I go to China, they always say, "Oh, we like your text book." That's *Basic Circuit Theory*, the second book I wrote again, with a co-author.

Now, let's change our discussion a little bit toward the circuit theory direction of research. The material covered in the book, taught in the course, are so-called linear circuits. Circuits are composed by electrical elements: resistors, capacitors, inductors, transistors, and so forth. Now, resistors—any voltage applied to a wire, the current flow through it satisfies Ohm's Law. The first thing students learn. And the ratio of voltage/current is equal to the resistance.

In addition, you have capacitors, which store electricity, and a capacitor is used for many applications because it can store then it discharges. An inductor is due to magnetic effect of the current through a wire. So these are the three basic elements of so-called passive electric circuits. And in the linear circuit

theory course, we really teach circuit containing those elements at the beginning, exclusively, because those three elements are the basic building blocks for electric circuits. That's what physics students learn first about electricity.

Voltage and current in a circuit must satisfy so-called Kirchhoff's Law. He was a nineteenth century physicist. With Kirchhoff's Law, with Ohm's Law, similarly for capacitors, you can analyze a circuit. So that's circuit analysis, or in the early days, called network analysis. Now, these are called passive circuits, because with these elements, you cannot amplify a signal. The signal just dies down because—they could not oscillate, but any wire has some resistance, so it damps out. You can never have an amplifier with only these elements. That's why we need active elements. Transistors—in early days, vacuum tubes. With the active elements, you can design amplifiers, which are crucial to electronics. You can design oscillators. In the early days of teaching circuit theory we covered mostly linear-passive circuits, and what people started to do next was to do linear active circuits and to do both analysis and synthesis, and that's what I did too.

Rubens: You say "people" start to do that, but aren't you a pioneer in that work?

Kuh: I won't say I'm a pioneer. Many people started at that time. The real pioneer was Hendrich Bode. He developed many important things. I studied some non-conventional active circuits. One is called the parametric amplifier. One is called negative resistance amplifier. I analyzed those and published some papers in that area. So, that's active circuits. Also, I did some work on synthesis. Just like the passive circuit, I mentioned approximation, realization and synthesize the behavior. With active circuits, you have to consider the properties of the transistor to do the synthesis. So, that's different. One of my students did the basic piece of work in active circuit synthesis—Sanjit Mitra. He's now a professor at UC Santa Barbara.

Rubens: Are you yourself going into a lab?

Kuh: No, I have students working in that lab; I never did myself.

Rubens: How many students would you have a semester?

Kuh: Not a semester—the graduate students I referred to continued to do work until they finished their Ph.D.

Rubens: Students would sign up with you, and I would assume you would select some students—

Kuh: They come to me. I talk to them and I decide whom to take. So, these are the Ph.D. students, the same all over the campus, you have them for four, five, six years.

Rubens: Are you giving them a problem in the same way you were given a problem at Stanford?

Kuh: Similarly. Not a problem, but in the area, which we'd then look into. So, that's active circuits and then let's move into so-called time varying circuits. In other words, the circuit elements can change with time. That's important for the future communication system design. Time varying circuits. Then generalized to non-linear circuits, which means the circuit elements have non-linear properties. It's not like Ohm's Law, voltage equal to resistance times current. In this case, voltage is a function of current. So, I did some work on non-linear circuits, later on, together with Professor Charles A. Desoer and Professor Leon Chua. We wrote a book called *Linear and Non-linear Circuits.* That's later on.

Rubens: Yes, 1987.

Kuh: Yes, so that's quite a bit later. With Desoer, in *Basic Circuit Theory*, we gradually included some non-linear elements in the course, even though the circuit book was strictly linear. Later on, we decided to get Leon Chua to participate to cover more non-linear circuits. That became the *Linear and Non-linear Circuits* book. Unfortunately, that book is getting too big, and people still can not include non-linear circuits together with linear circuit in a single course, it's too difficult. So that book did not draw too much attention, even though to us it's a broad coverage of circuit theory. But, people can not use it as a text book.

Rubens: That was the same publisher for *Basic Circuit Theory*—McGraw-Hill. A big publisher.

Kuh: That's right. I'm jumping ahead in terms of books. So, that's the third book. But in terms of graduate research, in addition to active circuits, I did work in time varying circuits and parametric amplifiers. I did work in non-linear circuits. Ph.D. students went through the program. I would say maybe not that many in these new areas. I can think of about two or three in active circuits, two or three in non-linear circuits and a couple in time varying circuits.

Rubens: So you would have ten students?

Kuh: I think before I became dean, I produced over a dozen Ph.D. students.

This is research. Then I got that tied to the teaching again. I introduced a graduate course in linear active network theory with one of my students who became a professor here, Ron Rohrer. I think last time, I mentioned we co-authored a very important paper in the state-based approach.

Rubens: Yes, and then you did a book with him also.

Kuh: That's right. That leads to a book, *The Linear Active Network Theory*. That covers many aspects of linear circuits, including passive, including time varying circuits, active circuits and it became a classic, but again it's too specialized. So, in terms of sales, it's not impressive at all, but people doing research often referred to that book. Using the material of that book, we can cover so-called distributive circuits like a transmission line, in contrast to a lumped element. In a transmission line, voltage current propagates through a long line, so by the time you apply voltage here and the current gets to the other end, it will take some time. That takes a different treatment.

Then I did some work in that area of research. So, that's covered in that book, and also at that time, Professor Lotfi Zadeh, came from Columbia. He introduced a course, "Systems Theory," as a graduate seminar. Many of the faculty sat in on this course, because it covered new material. He, together with Desoer wrote a pioneering book, *Linear Systems Theory*. So, that's from circuits to system. I learned something. In particular, I became interested in feedback systems. That material is also covered in the linear active network theory. These are different topics covering that graduate course.

Rubens: How many students would you have in a course?

Kuh: Oh, twenty-something. In graduate courses, we don't have that many students.

Rubens: I wanted to just ask you—maybe if this is all right now—when you talked about the genesis of the original circuit theory course being concerned about seven units in the junior year, you mentioned that you had junior college students who had transferred—

Kuh: Yes, we always do, even now.

Rubens: A large number?

Kuh: We used to have maybe one-third of the class from junior colleges.

Rubens: Is it still the same about now?

Kuh: That I don't know, because that was the original plan of higher education in the State of California. So junior college students can transfer after two years, they can stay at home and if they are good, they transfer in here.

Rubens: I don't know if that's true across disciplines now.

Kuh: I think it changes. At one time, those transfers were a big portion. It may not be as many now.

Rubens: That was going to lead me to ask you next, in general, how you would characterize the undergraduate students. Did you see them getting better as the—

Kuh: No, as I said, my feeling is at the beginning the undergraduate students are very motivated to really try to learn. I mentioned last time. Later on, after my tenure as the department chair and as the dean, I come back to teach, I feel they are not so motivated. I get a little irritated when they skip classes. Apparently everybody does that.

Rubens: I'm trying to talk just about this period when you are developing these courses. Many of them are graduate courses, of course.

Kuh: In the graduate course, the students are extremely good throughout, because the admissions system is different. The graduate students are really motivated. So, that's quite different. I'm talking about undergraduate students. That's changed over the years. My feeling is that they are not as good in later years than in early years.

Rubens: But in these earlier years, up until about '68 or maybe somewhere—what would you correlate with? Did the upheavals on the campus having an influence on the—

Kuh: Could be. But it started in '64 and ended more or less in '70. It could be. Or a student may have had a different kind of interest. In the early days, they're constantly concentrating their effort in engineering.

Rubens: I'm wondering if the department was growing, if it was getting larger, if you had a larger number of students and so the concentration wasn't as—

Kuh: I don't know. I can not comment on that. I don't know.

Rubens: I'm wondering also if now is the time to talk about your relationship to industry, both in terms of you own consulting, but also if that's driving some of this—

Kuh: Well that started when I became department chair.

Rubens: But didn't you have an earlier—there was an earlier consultation.

Kuh: I had a consulting arrangement with IBM in San Jose, for quite a few years.

Rubens: When did that start? I think that starts close to when you come here yes.

Kuh: Shortly after I came here, people learned about this new faculty member introducing something new in this area of circuit theory. They had a need to do work on so-called time domain equalization. The signals get transmitted in

a system and then get distortion. I mentioned earlier, in the frequency domain, you measure the frequency response. You have to equalize it. But for the digital application, you need to equalize the transmission media for a digital purpose. So, I worked on both frequency domain and time domain equalization.

Rubens: Again, this is at the theoretical level.

Kuh: This is in terms of—to correct the transmission behavior so that the signal gets transmitted correctly, i.e., will behave well in terms of digital requirement, which is different from the analog requirement. That was my consulting job. I worked for them and I enjoyed that experience.

Rubens: How would you allocate your time? Was there a certain report that they were waiting for?

Kuh: No, not a report. This is a research lab at IBM, San Jose. I just presented my work to them, mostly orally.

Rubens: Was it a big IBM office?

Kuh: Yes, later it expanded to Almaden research center. At that time, it was in San Jose.

Rubens: That wasn't their primary—

Kuh: No, they have other work, including magnetic storage, which was very important for their earlier computers. But, my work was on the time domain circuit synthesis.

Rubens: Would they give you equipment to use?

Kuh: No, this is again theoretical.

Rubens: All theoretical. But I didn't know in terms of if some of the—by this time were you working on a computer?

Kuh: Well, it's related to work using the computer. My students use computers.

Rubens: But you did not. You were doing this theoretically, working it out on pencil and paper and thinking it.

Kuh: I gave talks on what I did. We interacted. At the peak period, I went there once a week. Later on maybe once a month.

Rubens: I see. Did that last into the sixties?

Kuh: I don't quite remember. It could have.

Rubens: This may not be appropriate to ask you. I don't mean it invasively, but you have the consulting and then you do well with the text book. Is life finally becoming a little bit more comfortable for you?

Kuh: Well, the pay wasn't that much in terms of text book or consulting, but it helped. It helped yes.

Rubens: I was wondering if that one book became the basic circuit theory text.

Kuh: Well, you may not understand. In terms of royalty agreement, in an international edition, the royalty is much lower. Often they have paperback, instead of hardcover.

Rubens: And you are dividing it amongst two people.

Kuh: So that's not a major source of income, but in the best years it surely helped.

Rubens: What other kinds of relationship is there with industry.

Kuh: Well, that has to go to the department chairman later on.

Rubens: So prior to that, even in terms of seminars, meetings with—

Kuh: Well that we always have.

Rubens: Is industry driving the research? Is there dialectic between what industry needs and what research is taking place at the college?

Kuh: There are two kinds. If you have top research labs, Bell Labs, IBM research, then they are interested in basic research. They do basic research themselves. If you talk about Hewlett-Packard and Intel, at that time they are primarily interested in applied research to get products out. So that's the difference. In terms of pure research, at that time, as I mentioned previously, there are only three places: Bell Labs—a huge place; IBM—very large; and Xerox Parc. That's it. A little bit at GE, and little bit RCA at that time. Until this day, maybe you can add Microsoft. They do software research, which is fundamental. But, it's nothing like Bell Labs. Bell Labs was the premium place for basic research. Most of our students go there after they finish.

Rubens: That's what it sounds like. Steve Kang [a former student of Kuh's] is in the university for a while and then goes to Bell Labs for a good deal of time.

Kuh: Yes, many people do.

Rubens: So the kind of research you're doing here at the university is also pure research. Is that right? It's not called applied, in this period, up until the early sixties.

Kuh: That's right.

Rubens: So, it's coming out of your understanding of what is out there, of what is needed. Also what is not in the curriculum. Did teaching stimulate some of the kinds of thinking that you were doing?

Kuh: Well, the key mission of the research university is that teaching and research go hand in hand, because when you do research, you introduce the material to the curriculum, first through seminars, then it becomes graduate course material. Later on it becomes undergraduate. You have to keep updating your courses to make it more up-to-date. Unless you do research, you can not change the content of the course. That's why it is very important to spend time on research. It is important to have research universities, because otherwise the material will be out of date and you need to constantly keep it up.

Rubens: So, it's a very yeasty process. Things are really fermenting, they're interacting.

Kuh: This is nothing new on my part. A lot of the research universities are like that.

Rubens: I understand, but we're describing how you operated. Now, it's also during this period that the College of Engineering is expanding itself in many different directions. How did you keep abreast of that? Were departmental meetings enough? There were some seminars. What were they called?

Kuh: Well the department meetings—every department has committees of different kinds: personnel committee, curriculum committee, student activities. There are so many committees. Of course, everybody served. A scheduling committee—you schedule a professor to teach different courses at different hours. So, there are many things. Later on it expanded.

Rubens: Yes, we're going to get to that. What kind of committees are you participating in? In that period do you remember?

Kuh: That's not crucial. Let me talk about the department chairman job. Everybody does that, serve on different committees. I don't even remember.

Rubens: That's exactly what I'm asking. There was nothing that you gravitated to or that you particularly spent a lot of time on. Were you assigned to committees?

Kuh: Oh yes the department chairman does the assignment. He has the authority to do that. I took my first sabbatical leave in '62. Actually that was the first time we went abroad since I came from China. Through my professional contact, I

got an appointment at Imperial College, London, for half a year and at the Technical University of Denmark for half a year. That was my first sabbatical leave. That was very exciting for me and for my family, to go abroad. I had partial support from the university, partial support from a National Science Foundation grant. I didn't have to do any teaching, but I gave quite a few seminars. I continued my research, interacted with the professors there and did a lot of site seeing.

Rubens: These people knew of your texts? They knew of your work?

Kuh: Sure, they followed my work very closely, they know my work.

Rubens: Were the people there engaged in similar research?

Kuh: Oh yes that's why I went there.

Rubens: Any one in particular that you want to mention with whom you worked?

Kuh: Well, at this period, there's nothing—I'll come to this later. Sabbatical leave is a crucial part of university professors' experience. I advise people to take that. It not only gives you an opportunity to go away from your home to do something different, it's really lifetime experience. So I will never miss the sabbatical leave.

The next sabbatical leave, I took it when I was the department chairman. That was a little bit unusual. The next sabbatical leave I took when I was dean. That's totally unusual. After that, Berkeley went to the quarter system, Berkeley went to the quarter system and the system became more flexible. You can take it after two years for a quarter. I never missed it. I continued to take that.

Rubens: You can take it every two years for a quarter?

Kuh: Yes. So we went to many places and interacted with many people and really the place that benefited me the most was Japan. I will mention that later on. Also in Germany, I spent quite a bit of time, because Germany has this Alexander von Humboldt Foundation, which supports U.S. senior scientists. They give you a very comfortable living in terms of their support. It's a well known program in Germany. They sponsor it. Their special program with the U.S. was the senior scientist program. Most of their visitors from other countries are junior scientists, but with senior scientists, they really give you good treatment. One time they gave me a car to use.

Rubens: Where was this based?

Kuh: You applied at different places. Actually you can not apply. The university there has to apply for you. I went to Munich, in the summer times. I had a

one-year grant, but I spread it out through three periods. That was very rewarding and enjoyable.

Chapter V: Chair of the Department of Electrical Engineering and Computer Sciences 1968- 1972

Rubens: How you become chair—

Kuh: Professor Zadeh served as the department chairman for five years. In 1967, he announced he would quit early that year. I don't know how I got appointed, but the only thing I remembered was the meeting with Dean Maslach. I went to his office to talk about this job. He asked me. I thought about it. I wanted to try something new, so I took it, even though I knew it was a big undertaking. At that time the department had some thirty faculty members.

Rubens: This had grown dramatically since you came?

Kuh: Not so very much, but from in the twenties to the thirties -maybe to the upper thirties. At that time, one big issue was computer science, as I mentioned earlier. Professor Zadeh changed the name of the department from electrical engineering to electrical engineering and computer sciences, because during his tenure another computer science department in the College of Letters and Science was established. There were constant frictions in terms of recruiting, in terms of course coverage, in terms of students. There were some faculty members who did not like Professor Zadeh's very aggressive treatment on computer science, dealing with people once his mind was made up. Even though he is so nice, but once his mind is made up, he's tough. Some of the faculty members from here went to the other department, and we constantly had to fight. I inherited that.

Then, because of my book commitment, I was writing. I convinced the department to let me start January 1, 1968 instead of the fall of l967. Right after I took office, two faculty members in the area of computer science said, "Oh, we are going to leave and join the other department."

Rubens: The other department was—

Kuh: In the College of Letters and Science, called "Computer Science." So there's computer science and EECS [Department of Electrical Engineering and Computer Science, within the College of Engineering.]. Professor Zadeh is the first one to introduce this idea of EECS. I remember he had a meeting here. He invited key people from major universities to talk about that so that people can see that the computer is coming, it is important for electrical engineering to get deeply involved. But most of the students, at that time, in computer science were in Letters and Science. It came out of mathematics.

So, that was a little bit of a crisis. People wanted to leave right away. Even though these two are not really stars.

Rubens: Is that in part why they want to leave? Do they think that they'll have more movement in—?

Kuh: I don't know exactly why. A little bit—I would use the term troublemakers. So I had to recruit other computer science faculty members. I had to continue this debate in terms of course coverage in that relation. But, I was pleased. I hired some very good people during that time. They are big stars. Manuel Blum and Elwyn R. Berlekamp -who later on became the associate chair for computer science after we merged into one. Berlekamp had a joint appointment with the Department of Mathematics.

Rubens: You're bringing faculty from outside?

Kuh: Outside, yes. Both came from MIT. Another one, Michael Stonebreaker, came from Michigan. There are other people hired in EE during my tenure as chair, among them some distinguished people who later became deans, Dave Hodges and Paul Gray, now the provost. So these are some stars I hired.

Rubens: Let me repeat this. You are responsible for hiring Paul Gray?

Kuh: Yes, he came from the University of Arizona. But his area is integrated circuits, an area of considerable strength in our department because of Don Pederson. One area I did not really succeed with was in bioelectronics. We tried to go into more in bioelectronics, but it is very difficult to hire leaders. Some we gave offers, but they did not come. Others came. They are fine, but they are not leaders. So, that program, bioengineering, did not really develop until very recently. Now, bioengineering is good. It's become a separate department in engineering.

Rubens: What is bioelectronics?

Kuh: Bioengineering is broader than bioelectronics. It is a very broad field, which includes in the early days, instrumentation to study biological science. Later on, it worked on medical problems, blood flow, and lots of engineering problems. Now the new thing is bioinformatics, which is close with genomics. So it is very broad. Now we have a good bioengineering department. There are many people who have joint appointments with us, with mechanical, with others.

Rubens: But you were already thinking about this in trying to cultivate the ground?

Kuh: Sure, at that time I immersed and developed that area. MIT did extremely well in that area.

Rubens: Are you using MIT, Stanford or Illinois as measures?

Kuh: Yes we are comparable. MIT is always much bigger.

Rubens: In 1966, a report comes out that ranks Berkeley third. That's right before you are going to become chair.

Kuh: Clark Kerr mentioned the reason we went ahead of Harvard is because of engineering. They evaluated five areas. Engineering is one of those areas. Actually later on we continued to do very well. That continued in the eighties. I served on the national committee to do the evaluation, in the eighties. Then another one in the nineties. The next one is coming up.

Every ten years there is a review. I served on the so-called NRC/NAS committee to review the academic departments in terms of graduate programs. That's the report you refer to. Engineering is always rated among the top three or four in the country.

Okay, so that's one problem with computer science. Then we did some hiring. The other problem is I thought we needed industrial input. There were recruiters who used to come to the department whom I know well from IBM, from Bell Labs, from GE, from Raytheon. I decided to organize an industrial advisory committee.

Rubens: No such thing like that existed?

Kuh: No, including people from these companies. I asked Bill Gross, as I mentioned a close friend of mine who was VP at Ampex, a smaller company. Then, Chape Cutler from Bell Labs, Dick Shuey from GE, Al Hoagland from IBM—of course, it changed several times. At the beginning it was Al Hoagland who was an assistant professor here. He went to IBM later on. He was on the committee and so forth. With about six other members. We had meetings—

Rubens: Are these research places? When you say Bell, GE, IBM—

Kuh: Oh yes.

Rubens: And applied.

Kuh: Yes, all these are big companies, but they have good research laboratories. We had meetings. We'd get faculty involved with this, because they needed to see how we can benefit from industry. Out of that I started the first industrial liaison meeting, sponsored by the department. We invited other people from industry to come.

Rubens: Now, is this including Bechtel?

Kuh: That was later on. Bechtel, I invited when I was dean, I broadened that for the whole college.

Rubens: But at this time you don't have Bechtel.

Kuh: No, because they don't do much electrical.

Rubens: This is all electrical.

Kuh: This is all electrical in the department. I really started these industrial liaison activities. We had the first meeting. As I alluded to, I invited, at that time, the executive vice chancellor was Budd Cheit, to give a talk. He was very good.

Rubens: You asked him to talk about the needs?

Kuh: I told him about the industrial liaison program. I don't remember what he talked about, but he's such a good speaker; he's very good. I think that was a success. Industry liaison started at that time. I suspect that that was the reason why I was picked as the dean later.

Rubens: Now, I don't want to move too quickly to your becoming dean.

Kuh: No, but this is related to that, because that did not exist at other places. I remember in chemical engineering, they wanted to learn from us. Two key professors came to me and tried to learn from us. We got them included in our program when I started the college program. Because chemical engineering happens to be in the College of Chemistry, but it's engineering. Other schools have it in the college of engineering. They were interested, so I told them what we did. We got them to be part of this liaison program. But that was later.

Rubens: So you did not have a model for this industrial liaison program? This is something that just as you are working out your circuit theory, you think, "What's going to—"

Kuh: I thought that was important.

Rubens: Would you give a statement about what you think it would do for the college?

Kuh: Well many things. Number one, you get additional support from industry. Once they are members, they see the need. They are big companies and it is easy for us to ask them to support us so that we get additional funding. Number two, the students and faculty get to interact with industry at the industrial liaison meetings. They see the real world problems. They get to meet engineers from industry.

Rubens: So, the meetings were for students as well, not just faculty.

Kuh: Yes, faculty and students. Number three, the faculty need to be in close contact with industry to help industry for consulting, to help them get research grants from industry. Research money came from industry, starting at that

time. Before they figured UC is a state public university that didn't need money.

Rubens: So there was not such a thing as sponsored projects before that.

Kuh: Very little, insignificant, because most of the research funding came under the federal government. In terms of funding from industry, there were big needs in terms of student interaction, faculty interaction, faculty research support. This is crucial. And in terms of curriculum too, because they introduce something that they think is important, we for some reason did not cover. So for many reasons, obviously it's the thing to do, that's why I started that.

Rubens: Was there any opposition to it at all?

Kuh: Not during the department time. When I talk about college time, there was opposition. That came later. That's the industry liaison program.

Rubens: I don't know if you are about to go on to something else, but I want you to reflect for a minute, if you can, why you were picked to be chair. You basically, I think implied that you had not developed any particular field of committee work -that doesn't stick out in your mind.

Kuh: I think that when Professor Zadeh was chairman, toward the end of his tenure, I served maybe a year as vice chairman in charge of scheduling or whatever. To be appointed department chairman, it depends on the faculty input. The process goes like this: the dean sends a message to every faculty member for their choice, and then he takes a look. He picks from among the input from the faculty and maybe he then talks to some senior faculty members to make a decision for himself. Then he recommends that to the provost. He is then appointed. I think primarily the faculty input is important. Of course the department chairman's input is very important. Professor Zadeh knows me well. Maybe he gave me a strong recommendation.

Rubens: But he didn't talk to you and say, "Look Ernie, I'd like you to do this. I feel you can."

Kuh: He did not. So when Zadeh talked to me later, it was a surprise. He mentioned the faculty also mentioned Desoer, but Desoer is more a research scholar. He didn't want to get involved. I don't know whether he officially said no or if he informally said no. So maybe at that time there was also a feeling in the department, "We need somebody in this area too." So I was asked to become the chairman.

Rubens: What about the student activism in the sixties and seventies?

Kuh: No that's one thing that I haven't talked about. The students and FSM and the Cambodian war. At the beginning, we were not affected at all. Engineering students concentrate on their studies.

Rubens: It seems that the College was separated from the Sproul Plaza area. You are on the north side of campus, and of course the requirements for students are demanding.

Kuh: Yes, but some faculty are more liberal. They participated in the activities. During that time, '69 to '70, I was on sabbatical. Actually I served as chairman for a year and a half and then I went away on sabbatical. I went to Japan. I always had a back-up. Professor Mac Hopkin was vice chair at that time. He's very down-to-earth. He works very hard and I trust him. So I asked him to be acting chair. Mac became a very close friend of mine and he served as the acting chair, and later acting dean.

The Cambodian war time came and there were big problems on campus, including on the north side. Students went on strike and he didn't know quite what to do. So being very conscientious, he called me in Japan to talk about the situation. I said, "Gee, I'm far away. I don't really know the situation. You make your decision based on your judgment." He did a wonderful job. Essentially, faculty can support the anti-war movement. I guess it was the Nixon time. The students at Kent State got shot. I told him, "You decide yourself, because I don't have a good feeling."

At that time we didn't have Internet to communicate. You just read a bit from the paper. He supported people who wanted to have class discussion about this kind of thing, to have not really a strike, but he supported the kind of study and protest. As a result, I think we did a very good job as far as our department was concerned. There was no big problem, but I have to give credit to Mac Hopkin. He did the right thing.

Rubens: What about earlier than that? What about during the Free Speech Movement period and your own experiences?

Kuh: That was before me, in '64.

Rubens: Well, before you are chair, but as a professor, do you remember students—?

Kuh: Not much. As I said, engineering students did not get involved.

Rubens: Do you remember going to Academic Senate meetings?

Kuh: Yes. I myself went to Senate meetings on the campus, of course, and the campus of course had some major problems. They appointed committees to deal with students.

Rubens: Mike Heyman ran one committee.

Kuh: I remember that one of my friends who died, recently, Professor T.Y. Lin was appointed professor on campus to teach a course in a broad area. Maybe he even mentioned it in his oral history, his experience. I remember Professor John Whinnery was appointed to deal with students. I did not get involved in the Senate.

Rubens: Did you form an opinion?

Kuh: Well the department was- It was not a big deal in engineering, on this side of campus.

Rubens: I'm interested in whether or not you had a relationship to other parts of the campus—if you had friends or discussion groups.

Kuh: Of course we are more conservative than the other side of campus—the FSM, Mario Savio. At that time there were other troublemakers. We supported the president, Clark Kerr.

Rubens: In terms of your connections to Letters and Science or to any other social science—

Kuh: Not much, at that time.

Rubens: It's a period of extraordinary productivity for you, in terms of publishing—

Kuh: I was young. I did not get involved outside the department. I did not participate in the Academic Senate committees or anything. Those activities came later.

Rubens: Now, you are attending also your professional associations?

Kuh: Oh that's always active.

Rubens: You need to say something about that.

Kuh: I'll save that for the later part of our interview. I served as president of the IEEE Circuit and Systems (CAS) Society in the last year of my chairmanship. Even after I retired as chair—even during the dean time, I became very active and served on the board of directors of IEEE.

Rubens: But you are giving papers, I can see this.

Kuh: That's different from professional relations. I'm sorry, you mean professional—

Rubens: No, I meant participation in your professional organizations.

Kuh: Oh that is crucial. The technical meetings are crucial to make presentations at meetings.

Rubens: That's just a fact of your existence.

Kuh: That's everybody. Everybody has to be productive. Usually before a paper gets published, you present at the meetings.

Rubens: Every year you're doing one: I'm just reading from your bibliography. Every year there's a paper being presented throughout the late fifties, continuously.

Kuh: Oh, yes, yes. That's the nature of a professor doing research. That's not unusual.

Rubens: I think it is marked though. You are being modest.

Kuh: Also you supervise graduate students and you write papers most of the time together, because this came out of continuous interaction and discussion. There were many joint papers with students.

Rubens: Are there in the period, up through your chairmanship, some outstanding students who you recall that you were particularly close to?

Kuh: Well Professor Sanjit Mitra, before I became chair.

Rubens: Is that an Indian name?

Kuh: Yes, he went to Bell Labs to work. After that he came back to UC Davis as a professor. Then he went to UC Santa Barbara and later on served as department chairman. So we were close. Professor Ronald Rohrer. He was appointed a faculty member here and taught my courses.

Rubens: Directly once he graduated, he had a position here?

Kuh: He was the one who was constantly on the move. He was not happy to be at one place. I remember in the early days, I found him a position at Fairchild Semiconductor, because I knew Les Hogan; he was the president. Rohrer then went to different places after he graduated, then he joined the faculty and stayed on, I think, until '69 or '70. We co-authored a book.

I should say something on one course he taught, which eventually made a big impact. I was teaching the graduate course on network theory. When I became department chairman in 1968, I asked him to teach the course. Being a very unusual individual—in a graduate course you can cover almost anything—I gave him my notes, he decided he's not going to use them. He says, "I will

like to make this a project for graduate students to do so-called circuit simulation to analyze large circuits, using computers." It became a term project. What he did was that at the end of the course, he came up with a computer program called CANCER, Computer Analysis of Nonlinear Circuits Excluding Radiation. It was a very good program. People didn't quite like the name CANCER. Anyway, that program was established by him during the time I was department chair, because I did not continue to teach that course.

That project was picked up by Don Pederson, and he continued for many years with his students. The early work only deals with one part of a circuit simulation, solving the so-called resistive circuits. You have other parts to deal with—integration and so forth, in order to have a program to analyze general circuits. It's not simple, but Pederson with his students, actually a number of Ph.D. students, continued and later called that SPICE [Simulation Program with Integrated Circuit Emphasis]. SPICE became a very well-known product. Pederson had the vision, the foresight to release this program to the public without charging anybody. That program became extremely popular and was used by other universities, and by industries. Eventually, SPICE became the circuit simulator for the entire community of electrical engineers. That was a huge contribution. Because of that, Pederson was honored in many different ways. We established a laboratory after Pederson. His former students' companies got wealthy, using his program. They contributed money, so the DOP Center was established—we can walk by there—the DOP Center for Electronic Systems.

Pederson also did other things, of course. He established one of the very first integrated circuits laboratories in a university. Integrated circuits are the key to what industry does, at Intel and many places. He established almost the first, maybe the first university laboratory.

Rubens: When is this?

Kuh: When he did that it was about '62 or '63 when he started. Later on, Pederson and I and Rohrer were honored by Japan. It's a major honor called the C & C [Communication and Computers] Prize. Each of us received $50,000 prize money and they flew us first class to Tokyo for this big event. My contribution was mainly the work I did after becoming dean. The contribution of Pederson is from SPICE. Rohrer's is original SPICE plus other things. For that we were very pleased.

Rubens: When was this award?

Kuh: 1996, I believe. This year, again, Berkeley got the same honor. Professor Dave Patterson in computer science together with the president of Stanford University, John Hennessy. This was a second time for Berkeley. There are many outstanding pioneers in computers and electronics who have been honored.

Rubens: Would you also reflect on the explosion that is taking place in Silicon Valley at this time?

Kuh: Oh yes. During the period Fairchild was formed from Shockley Semiconductor and then, out of that, Intel, National, AMD, all sorts of companies came out of Fairchild. In the meantime, all sorts of companies came out of Hewlett-Packard. That was the beginning of Silicon Valley.

Rubens: Do you remember discussions here? Are you talking with Pederson about—

Kuh: I talked to Pederson about the research. When I went on sabbatical during the time I was dean, I started to do work in layout of chips, and I thought about the electronic design automation, computer aided analysis and design. He was doing SPICE, I was doing so-called physical design. This came later. We tried to collaborate and even though we both knew it was a good thing, it never came through as an official project. But we are considered the pioneers in this area. There's another award which is given by the EDA consortium, the Electronic Design and Automation Consortium called the Phil Kaufman Award. It has been given ten times now, once a year to one person. Pederson got the second one. I got the fifth one. So that's the Kaufman Award for the EDA consortium.

Rubens: This is the nineties that you are awarded this?

Kuh: I believe it is '98. Later on Berkeley did extremely well. Professor Sangiovanni-Vincentelli got it. Professor Newton, now the dean, got that last year. This was an area I went into later on. Computer-aided design. It's called the electronic design automation. There's an industry, including many of the companies more or less started by people here, helped by people here. Berkeley is a power house in EDA.

Rubens: I had asked you off tape, if just prior to your becoming chair, in the Silicon Valley growth years of '65 to '68, about the response to the extraordinary money made in this industry.

Kuh: Of course, everybody was aware of that. We're very close with the companies in the area of integrated circuits. We had top people in the area, so we were close with Intel and National and so forth. Professor Pederson had many students. He's concentrated in integrated circuits. For me it's more circuit theory. So there's excitement of course in that area, and later on in computer-related design.

But, back to the department chairman period. Just before I took over, Professor Zadeh pushed very hard for computer science. He had a vision that computer science was so important, he not only changed the name, he had a group here which did something basic in terms of designing a computer which

is a mini computer. At that time, there's a company called SDS. I don't remember what that stands for—

Rubens: A Silicon Valley company?

Kuh: It may not be exactly in Silicon Valley.

Rubens: But a California company?

Kuh: Los Angeles, I believe. They essentially built a computer based on the computer we built, headed by three professors. The main person was Mel Pirtle. He left later on. He's a good computer architect. Then, Wayne Lichtenberger. He's more or less working on software. But the key guy is Butler Lampson. Three people, all associate professors or assistant professors, a young group. They had many outstanding students and designed a computer that made an impact.

Rubens: Is that here?

Kuh: Here in Cory Hall, starting in Cory Hall. Zadeh was pushing that. Perhaps because of that, he made some other people in the department mad, because he was somewhat heavy-handed. When I took over—

Rubens: Did you have a particular opinion?

Kuh: Well, I certainly supported that. I knew what was coming. The university decided to invest some money in the company, which turned out to be a bad investment.

Rubens: Is Zadeh suggesting to the university that it should be done?

Kuh: I don't think so, because people know that SDS was a good company which depended on our technology, but competition came at that time from Digital Equipment in Massachusetts. Digital became a powerful company. So that more or less took over the mini computer industry. But our project continued when I became department chairman. Pirtle and Lichtenberger, after a year, decided to quit. The project was sponsored by ARPA. Now it's called DARPA, the Defense Advanced Research Projects Agency, which supported many things, including starting the Internet. Anyway, ARPA supported this project.

Then they decided to quit, the project moved to Hawaii. Wayne Lichtenberger went to the University of Hawaii. Pirtle joined NASA. Lampson, the computer science star, decided to quit. Lampson later on went to Microsoft. He later on won the biggest prize in computer science, the so-called Turing award. Three of our faculty members have received that, including Karp, Blum, and Kahan.

It's referred to as the Nobel Prize for computer science, because there is no Nobel Prize for computer science. Lampson later on got that award.

I had to hire somebody quick to continue the project, when these people decided to leave.

Rubens: So this is happening while you are chair?

Kuh: Oh yes. So with the help of Professor Zadeh, we hired Herb Baskin from IBM. He's a very knowledgeable engineer and he was willing to come to help. He's very good as a designer, as an architect, but he never had academic experience, so teaching was not his expertise, his strength.

Rubens: What drew him?

Kuh: We convinced him to come. We gave him a good arrangement. He came and it did not really work out. His personality is such that he confronts people—he's confrontational. He later on quit. That was not a good solution, but the project died anyway.

Rubens: It's now being supplanted by what these others are doing elsewhere?

Kuh: Well digital—that was a long time ago. Even Digital Equipment [DEC] which was among the top, in terms of mini computers, the company dissolved. Hewlett-Packard took over; that's a history in computers. We used to have DEC Computers. Most of the universities used DEC computers instead of IBM during that period. So that was a venture out of department research and development that did not succeed, but got us the reputation and trained some very good students and got the university to invest, which lost money. [laughs] That started in Professor Zadeh's time and ended during my time.

Rubens: There was a lot of coming and going during your chairmanship.

Kuh: Sure.

Rubens: The one sustained growth is this industrial liaison activity. That's specifically for the electrical engineering.

Kuh: Yes, for our department. But it wasn't big. It wasn't big at all, but it got started. That became much bigger when I became dean.

Rubens: You were going to build on—

Kuh: Not really. I had to start from scratch.

Rubens: Well, we'll get to that later on. What we didn't talk about is—how you go to Japan in '69.

Kuh: We should talk about that sabbatical.

Rubens: Should we talk about that now? Should we say anything in particular about when you were at Imperial College?

Kuh: Not that much. It was just an ordinary sabbatical. I enjoyed working there, interacting with people. But it's the second sabbatical leave in Japan that really benefited me and I developed close ties with Japan. I had been chair for a year and a half. Then I got a U.S.-Japan grant sponsored by the NSF to go to Japan.

Rubens: Did you decide ahead of time that you were going to go to Japan?

Kuh: Oh yes, because I had known people in my profession in Japan. Professor Toshio Fujisawa, a professor at Osaka University, and Professor Ozaki, on another campus of that university. All in my area. They first welcomed me to spend time there. Osaka University is one of the top seven imperial universities in Japan, together with Tokyo, Kyoto, Osaka, and so forth. There's no University of Japan. These are the imperial universities.

I was also close in my profession with this Dr. Hitoshi Watanabe, who was in the NEC (Nippon Electrical Company) research lab. Later on it just changed to NEC. So he invited me to visit him to serve as a consultant. I'd go to Tokyo every month to work with Watanabe and his group. That was the year Japan started to have student problems and riots. It was very bad. The campuses closed, including the Suita campus of Osaka University, where I was. Many students were much more violent than at Berkeley.

Rubens: Did this surprise you? Were you fearful?

Kuh: It surprised me, because—not fearful—but it surprised me. Usually, I figured the Japanese are very polite. But they became violent. So they closed down that campus.

Rubens: Had you been asked to teach or were you—

Kuh: No I never had teaching responsibilities—just give some seminars. At that time, we lived in Kobe. Kobe and Osaka are close to each other. This professor in Kobe University, Professor Hirano, said, "Why don't you come to our place. Our campus is still open." So he set me up in an office in Kobe University. The other campus, Toyonaka, Osaka, where Professor Fujisawa was, had arranged an office for me there. So before my office was supposed to be in one campus, but that closed down, so later I had two offices, on the Toyonaka campus, where Professor Fujisawa was, and at Kobe University, where Professor Hirano was. Of course Kobe is very convenient. Actually Professor Hirano sold me his car. I interacted mostly with Professor Fujisawa,

because he is the one who is a very established researcher, very well-known, so we work together.

Rubens: Are you calling this computer assisted design or is this still—?

Kuh: Not yet. It's non-linear circuits. Between Fujisawa and me and a researcher at NEC, we wrote a couple of papers in non-linear circuits. His name is Ohtsuki. He worked under Watanabe. So that was the joint work with them, which actually led me to continue in non-linear circuits research. I had two students who finished with me on non-linear circuits. One has returned to Taiwan. He became an industrialist, as president of the First Computer Corporation in Taiwan, and is doing very well. The other became a professor at the University of Illinois. Not too long ago he went to Lebanon, and became the Dean of Engineering at the American University in Beirut.

Rubens: Should we say their names?

Kuh: Yes, one is Ming Chien, who had been my student. One is Ibrahim Hajj.

Rubens: Was he originally from Lebanon?

Kuh: Yes. And Chein is from Taiwan. I guess his family is also wealthy, gave half a million dollars to the Soda Hall, the computer science building. There's a room named after his mother, I think, in Soda Hall. Actually, the college fundraiser got together with me to propose to Chein to give this contribution.

But in Japan, I got to know Watanabe well, because every month I went there and got to know his group, as well. Many people came to Berkeley from NEC. There are so many of them, partly because Watanabe got promoted. Later on he became a vice president.

Rubens: Of the—?

Kuh: Of NEC company. People under him, many of them came to work with me, including Ohtsuki who later became a professor of Wesada University. And also a very important person, Dr. Satoshi Goto, who later became vice president in charge of information technology research at NEC. With his help, we got additional money from NEC and established an NEC distinguished professorship here in the department.

Rubens: Does this happen while you are dean?

Kuh: No that was after. They gave money for Soda Hall. We invited the chairman, the CEO of NEC, to come here to give a keynote speech in the industry liaison meeting. So the relation developed in the first sabbatical leave in Japan. There must be twenty or thirty people that came from NEC who came to work in this

department. In addition, a former student of this department, Dr. Keneko, became the president of the NEC Corporation, in Japan.

Rubens: Let me get this clear. These twenty or thirty people that are coming—are they coming to work, to teach, to lecture?

Kuh: No, they don't teach, they just work in research with professors. I hosted many of them and then other faculty helped, too.

Rubens: But they are not graduate students, either.

Kuh: The Japanese don't send graduate students. The companies send researchers to spend a year or two here.

Rubens: It is an apprenticeship or almost or a tutorial.

Kuh: No, collaborators. Later on the department established tight guidelines. For every visitor they send to the department, they have to give the department a hundred thousand dollars. Thirty-five thousand is given to the professor he worked with. For example, I got money from people they send to work with me. The rest supported the department Industrial Liaison Program. That's later on.

Rubens: I see. That's a very clever arrangement

Kuh: When you go to Soda Hall, you'll see many Japanese company names. We really recruited key people to support us. They gave big money. Laboratories were named after big companies. The tie with Japan—not just from my own effort, but with other faculty members—became extremely important in not only the research collaboration but the physical—

Rubens: Endowment.

Kuh: Yes. When we were in Japan, of course, my two boys were still in grade school. They went to an international school in Kobe, the Canadian Academy. My wife tried to learn Japanese at the YWCA.

Rubens: Did you know any Japanese?

Kuh: Well, as I told you, I studied Japanese in high school in Shanghai, but I'm not very good in languages. Since my friends all speak English, we communicate in English. My wife had to go shopping, so she learned some Japanese. I was dependent on her to do all of that kind of inter-action.

Rubens: So she kept the house. You didn't have a—

Kuh: That's right. Because we had a car, we drove all over Japan. Japanese people are very hospitable, if they know you. We were treated very well. When they give a party, usually they keep the wives home. They don't invite the wives. They never have their wives to a big party. My wife told them at the beginning that she wants to be invited. Every time there was a party, she was the only woman there.

Rubens: I assume there were not women at the faculty.

Kuh: Of course not, but we got to know some of the faculty well as well as some of their wives. Also from Osaka, Fujisawa came here to spend a year and another professor from Osaka University came here, too, and later sent their students here. So we developed a close tie.

Rubens: Among the faculty that you are meeting, there aren't women on their faculty?

Kuh: No, no not at all, none. Talk about wives, we had some social interaction with close friends of ours, and they invited us to their homes. That's rare. Usually Japanese don't do that. They have parties outside in the club.

So I quit in 1972 as department chairman.

Rubens: You quit?

Kuh: Yes. Usually the department chairman serves for three to five years. I started in '68, January. I quit in the summer of 1972, but actually I served for only three and a half years, during a four and a half year period, because of my sabbatical.

Rubens: Why did you quit?

Kuh: Well, as I said, department chairmen serve only for three to five years; I didn't want to continue another year. That would be five and a half.

Rubens: But you had taken the sabbatical.

Kuh: I took the sabbatical during that time.

Rubens: Had they already talked to you about becoming dean?

Kuh: No, not yet. In '72, I'm back to the department. I became a professor doing teaching and research. I started as dean in 1973. There's a one year lag.

Rubens: All right. Were you happy to let the burdens of the department chair go by the way?

Kuh: I won't say I was happy, but we had good people.

Rubens: Who took over from you?

Kuh: Tom [Thomas E.] Everhart. He became, later on, a very important person. He became the Chancellor of the University of Illinois, at Urbana. And later, he became the Caltech President.

Rubens: Did you have a hand in picking him?

Kuh: Well, I recommended him as department chairman. The dean makes the decision. He's one of the three people I recommended.

Rubens: Did you feel strongly that he should be the one? Who else did you recommend?

Kuh: One was David Sakrison, who later on became chairman, after Everhart. I don't remember the other. When I was dean, maybe by the end of the seventies, Everhart got an offer to be the dean of engineering at Cornell. I told him, "You can have my job. I'm going to quit in a year." He couldn't wait, so he went to Cornell. He did very well at Cornell as dean, and then as chancellor at Urbana, and president at Caltech.

Rubens: He was ambitious?

Kuh: He was very ambitious.

Rubens: What did he do? What was his research?

Kuh: He was in electron-microscopy.

Rubens: Did you give him a little more guidance than you had gotten from—

Kuh: One thing I should mention is that, I guess in the letter I sent to you, Professor Zadeh helped me in many ways. In the letter I sent you, I mentioned Desoer, Pederson and Zadeh. I really appreciated all their advice, especially that of Professor Zadeh. I constantly looked for him even when I was dean and he helped me. I don't think Everhart is that kind of person. Of course as his predecessors, both I and Zadeh gave him suggestions about what to do.

Rubens: Do you think he wasn't as receptive either?

Kuh: No, I won't say that.

Rubens: You said, I'm quoting from when you were given the honorary doctorate at Hong Kong University, you write—

Kuh: Hong Kong University of Science and Technology, which is a different university.

Rubens: "Hong Kong University of Science and Technology, 1997." You're saying that you learned many things from him pertaining to leadership and how to deal with people. Do you want to—

Kuh: And how to write even, because my English was never that good. I read his letters and kind of got into his style of writing. That's the time that I started to do dictations, so my secretary helped me.

Rubens: At some point, you mentioned a secretary and that you had good assistants.

Kuh: That's later on in the dean's office.

Rubens: But nevertheless, even as chair there was good secretarial help?

Kuh: Oh yes.

Rubens: Did you have issues—well personnel matters? Let's put it this way, personality conflicts that you had to resolve?

Kuh: There are always the oddballs in the faculty in the department which caused problems. It caused problems for every department chair.

Rubens: But nothing that is particularly outstanding that—?

Kuh: I won't say that. People tried to push their area and tried to hire in that area, so the department chairman has to judge how to grow in what areas. There's always that. But our department is by and large very congenial.

Rubens: This is the period when the computer and the—

Kuh: That was unpleasant.

Rubens: One other question. As department chair, did you have meetings with other department chairs?

Kuh: Yes, the dean had the dean's advisor council, including the department chair and vice chairman. Of course, I often went to the dean's office to talk to George Maslach. I had very strong support from George. I had a very good relation. The department expanded at that time. We had to get FTEs, full-time equivalents, so he had to support me, so we expanded.

Rubens: We should get that figure of how it expanded under your—

Kuh: During my deanship, they provided some figures. I don't have the exact the number. I think I expect that it expanded quite fast.

Rubens: I think so. Those were extraordinary years during your chairmanship. I meant to ask you quite a while ago: I read somewhere that an introductory social science or writing course was begun.

Kuh: That's later on. Maybe it was all along, but it's not a significant part.

Rubens: Because if you are admitted to the College of Engineering, then that's where the students stay. They don't take any courses in Letters and Science. There's not a mandatory—

Kuh: No you do. Everybody has to take at least three courses in social sciences and humanities.

That writing program was not my contribution. It has been there, I think.

Rubens: You traveled after you ended your tenure as chair of the department.

Kuh: Yes. That summer we again, as usual, did some traveling. We went to Russia as the delegate of the IEEE to visit the so-called Popov Society in Russia. I guess that's the Soviet Union at that time. That's corresponding to IEEE. So they invited IEEE, so there was a delegation of ten people, and I was a member of that. That was very stimulating, to see the major communist country operating. I don't think we got much out of the technical part, but as a visitor, we saw how Moscow was at that time, Leningrad, and Novosibirsk.

Rubens: You were there two weeks?

Kuh: No, one week and a half, to see how people and society functioned. It was interesting.

Rubens: Later you will compare it to China and we can talk about that later perhaps.

Kuh: On the same trip, we went to Sweden on the way to—my wife accompanied me on the trip—to visit the Swedish lab of telecommunications. I gave a talk there. I had been to Sweden before, so that was a very brief stop. The second trip I took that summer was to visit Poland, at the invitation of the Polish Academy of Sciences. The most interesting place was Gdańsk. Gdańsk was the start of the Second World War and we saw the historic monuments. The professor there took us around. It was an interesting historical place. I had been to an Eastern European country before, to Czechoslovakia and Hungary. But this was my first trip to Poland. I got to know some of the people there, and one person in particular—I mentioned her last time—Dr. Marek-Sadowska. She came to work for me on research. She was an associate with me for many years—this was in the nineteen eighties

Rubens: You had met her in Poland?

Kuh: Yes. Later on she became a professor at the University of California, Santa Barbara. She has a good reputation now.

The people in Poland treated us royally. I remember one professor invited us to their home, and I was really surprised. They served three courses of soup. I never had that before. Each one is different and all very tasty. We got to know some of the Polish people. They were much more warm, compared to the people we met on the visit to the Soviet Union.

Rubens: And the science?

Kuh: The science, as I said. They are better off, as far as I know, in electrical engineering. That's where I got to know Marek-Sadowska. When she applied to me, I accepted her.

Chapter VI: Dean of the College of Engineering: 1973-1980

Rubens: Let's discuss how you became dean of the College of Engineering.

Kuh: After my travels in the summer of l972, I came back to the department to do my teaching and tried to recruit more students for research. But in the spring of '73, I got a phone call from the chancellor's office to go to talk with the Vice Chancellor Mark Christensen. During that meeting, he said that Chancellor Bowker wanted me to be the next dean.

Rubens: The former dean was already on the—

Kuh: I should mention that there was an acting dean, because when Bowker came, he recruited George Maslach to be provost, yes.

Rubens: This was a new position as provost. Is that right?

Kuh: Yes. You had two provost positions: one for Letters and Science, and one for professional schools. So Maslach was offered that position.

Rubens: He was the first?

Kuh: Yes, of course. Since then they have discontinued that. It's back to one provost now. Anyway, Maslach became provost. Professor Bob Weigel, in civil engineering, served as the acting dean from '72 to '73. Everybody figured he probably would be asked to serve as dean. I was surprised when I went to the chancellor's office to talk to Christensen, and Bowker wanted to ask me to be the dean. So I said, "Yes."

Rubens: You really were surprised?

Kuh: I was surprised.

Rubens: This had not been an ambition of yours once Maslach had—

Kuh: No.

Rubens: Maslach served a long time.

Kuh: Maslach served for eight or nine years. Before Maslach, Whinnery served for four years. Before Whinnery, O'Brien served for fourteen years.

I certainly did not expect the nomination and had done no planning for it, because I'd rather come back to the department to continue my scholarly work. Yes, I was surprised. I told Mark Christensen, "This is a big job. I need to think about it." So I did not say yes at that time. During that period, I was also IEEE Circuit and Systems Society President, so I was busy. I had to

attend the annual meeting in Toronto. After that meeting, I came back. I thought about it. I decided to accept it. I made an appointment with Chancellor Bowker and we talked. I asked him for permission to do two things: one was that I would like to have a nine-month appointment. Usually, major administration jobs on the campus are eleven months. I told him, "I would like to have nine months. I would like to have an acting dean, during the summer." That's one thing. The second thing was that I would like to take my sabbatical. I always enjoyed sabbatical. He said, "That's fine. No problem." He agreed.

Rubens: Had you planned where you wanted to go on the sabbatical?

Kuh: No, no. because I had my sabbatical just a year before in Japan.

Rubens: Right, I wondered if you were planning to go back there.

Kuh: I just wanted every six years to take a sabbatical. I discussed it with Bowker and he was very supportive. He said, "That's fine."

Rubens: Did he lay out to you at that point any vision he had for you?

Kuh: No. It's up to me essentially. As I mentioned to you last time. I suspect because of my activities as the department chairman to promote industrial liaison activities, I think maybe that was one of the reasons.

Rubens: Yes. I was looking to see if he was going to say, "I like that. I wish you would continue that."

Kuh: No he did not. There is a search committee. So the search committee—I still remember some of the people on that committee. Usually for the major administrative positions, the search committee's recommendation is important.

Rubens: Just very, very briefly, did that cause any tension? Did what's his name Weigel—did he aspire-

Kuh: I don't think so. He's a very nice person. We got to like each other and remained friends.

Rubens: He was content to not be appointed dean then.

Kuh: Well, that I don't know. Of course, if he were offered the deanship, I'm pretty certain he would have taken it.

So the next thing which is significant or important to our lives was the trip to China. That was during the summer of '73, before I became dean. [China trip 1973 discussed later in Chapter Nine.]

When I became dean, the College of Engineering was a very important part of the campus. It is a very distinguished college. It's always ranked among the top three in the country. I think we have about thirteen percent of the college enrollment on the campus.

Rubens: It looks like, during your deanship, the percentage goes from ten to thirteen.

Kuh: Maybe so. I don't quite remember. Anyway, the college suffered during the governorship of Reagan and Brown. That happened during my deanship. Brown cut the budget severely. The good thing is that we had an energy crisis. So energy and resources became a top priority. Then, high tech began to develop. We had these two things in our favor. I took advantage of that and asked for resources. Chancellor Bowker even went to the president's level to mention the importance of these areas.

Provost Maslach was always very supportive. I had a very good relationship with both Bowker and Maslach, when he was my direct boss. So we managed to grow the faculty maybe about ten percent, from two hundred, to two hundred and twenty, during that period, in spite of the budget shortage.

Rubens: It's one of the issues that is coming up all throughout that period, whether you can replace your retirees? You're not going to have many retirees. There are a few new hires. There's competition with other colleges. But nevertheless you are—

Kuh: I was very grateful to Chancellor Bowker. He's so supportive.

Rubens: And it's specifically these new areas?

Kuh: Well, these are not really new areas, but in energy and resources we need to beef up. So we hired people during my time, in energy, in minerals, in environment and in high technology. Of course, the positions I have to get from the provosts, but recruiting was done always by the department chairman. Young faculty members came from different places. During that period, I remember some good ones, including Bob Brodersen, a star now. David Messerschmitt, who later on became chairman of our department, EECS.

Of course, I remember the ones that were here. Professor Chenming Hu, who was a star in the electronics area. He was hired because he was in power electronics. I also hired Professor Felix Wu, in power system, at that time. Hu had been teaching at MIT; Wu had been teaching at Pittsburgh. Both of them were Berkeley graduates and both were hired to strengthen our department. They all went away and then came back. During that time, I remember Professor David Dornfeld was hired in mechanical engineering. He's an expert in manufacturing. Professor Jim Evans was hired in mineral science.

Who else came during that time. Oh, in computer science, Professor Carlo Sequin from Bell Labs was hired. We hired some very good people.

That was the beginning of the deanship. One thing that took place very early, even before the deanship was the merger of computer science into EECS, we talked about that earlier. Before I became dean, the chancellor had appointed Christensen, the vice chancellor to look into this. I already communicated with him, closely on some of the issues, and tried to get support from him. Computer science in Letters and Science wanted to fight. The chairman at that time decided to have an outside visiting committee to see the problems in order to make recommendations. I don't think that the chair in computer science was too smart. The conclusion of that committee was, "It shouldn't be two departments, so maybe you should think about merging."

Rubens: Merger meant for computer science to come into the—

Kuh: It wasn't clear. Mark Christensen had to decide what to do. That's why I interacted closely with Mark and influenced him on the decision. That brought CS in Letters and Science into the College of Engineering. That took place at the very beginning of my deanship. I appointed Dick Karp as associate chair in CS, working with Tom Everhart, chair of EECS. That was the structure: the chairman was in EE and the associate chair in computer science, until very late in the nineties.

Rubens: Were there any defectors from CS?

Kuh: No, they joined the department. There was no choice.

Rubens: Did the transition go well enough? I didn't know if people left or—

Kuh: I don't think people left because of the merger. People left, because they were not that good. That's why it's important to have somebody like Dick Karp, with great authority and prestige to be the associate chair. He worked out well.

Rubens: That was your decision?

Kuh: Yes, actually the three associate chairs during my time were outstanding. Dick Karp, first. He served for two years. Elwyn Berlekamp served for two years. Manuel Blum served for three years. All of these are distinguished people in computer science. Then they hired some outstanding people. David Patterson, who recently was initiated to both NAS and AAAS, and a few other very good young people.

Rubens: So the department is growing during this—

Kuh: Oh yes. I guess during my chairmanship, I also hired this professor from Italy, Ferrari. He later on served as the associate chair too. Carlo Sequin, as I

mentioned served as the associate chair later on in the eighties. He came from Bell Labs.

Okay that's the story on computer science.

Rubens: Let's talk about students. Are you starting to draw more students? You had mentioned that for a brief while the student body had gone down, but it looks to me like it's going up.

Kuh: We did all right.

Rubens: Then it starts growing. The phrase that seems to be used is, "no growth, but"—what was the word? The question is how to maintain vitality and exert leadership in education and search for new knowledge. It seems nevertheless you are growing.

Kuh: We grew gradually to thirteen percent of campus, as I mentioned. The faculty grew ten percent during that time. The important thing at that time—academically, of course, we're strong. We needed to keep up recruiting. There was a new area we pushed, interdisciplinary study. Before I even became dean, Bob Weigel, the acting dean, had a college faculty meeting in downtown Berkeley. I think it was at the Marriott hotel, to talk about the future, before I was even appointed dean. The theme seemed to be that "interdisciplinary is important," energy, resources and other things. At the very beginning of my deanship, I wanted to push that activity, so I established an assistant dean in charge of interdisciplinary activities.

Rubens: That's you who established that?

Kuh: I appointed Bill Godden, a professor of civil engineering, to head that. He did wonderful things, strengthening the different group activities and made more visible and did some publicity. Energy resources, earthquake engineering, system engineering, bioengineering. These are the subfields under his control. Plus, engineering science, as a major. People study joint degree with physics, chemistry, mathematics, statistics. Eventually I set a part of the Bechtel Center for interdisciplinary studies. At the Bechtel Center dedication we had a seminar on different aspects of the program. Godden chaired that meeting.

There were about eight or ten interdisciplinary programs. Some have done extremely well. Bioengineering became a department later on. The engineering science program attracted good students majoring in physics and engineering, math and engineering. That still continues. These draw the best students, actually.

Rubens: It's like cherry picking from the different departments?

Kuh: Well, we don't pick them; they apply.

Rubens: There's a fund that you developed with the Sloan Foundation—

Kuh: The Sloan Fund. Later on we got money from IBM, to support that, too. I knew it was important, IDS. I pushed it and got support from IBM.

Rubens: What is Sloan?

Kuh: Alfred P. Sloan was the president of GM in the thirties. He's very well known. He supported cancer research. Sloan Cancer Foundation. Then they have the Sloan Scholars for young faculty.

Rubens: Are you initiating this in terms of getting the grant?

Kuh: Oh yes, fundraising is an important part of my job. I wanted to talk about that. The top priority was the library. Our engineering library was in the fourth floor of O'Brien Hall, tiny for a big college. I knew I wanted to establish a good engineering library. I knew that IDS needs headquarters for an interdisciplinary center. I knew that in order to get funding from different places, we have to have meetings. The conference facility is important. That's why I have to plan the auditorium together with conference facilities. In addition, the student activities, they did not have a home.

Based on these needs, I had the idea of the engineering center at the very beginning of becoming dean.

Rubens: From the beginning?

Kuh: Yes, the very beginning. Then this leads to space requirement and planning. We had original ambition to remodel Hearst Mining at that time. We had needs for Cory Hall remodeling. We had needs for this engineering center. The only thing is that the state of California was in such difficult shape, especially the university budget. So even though we started planning, wrote memos for the needs, the only encouragement I got was the engineering center, but even that, we needed to do private fundraising. The fifth floor, that's another story. Cory came later on, so I can talk about that later. That's the beginning of thoughts of buildings for the engineering colleges.

Rubens: So you're really thinking this out. No one else had been discussing this?

Kuh: I'm sure that George Maslach thought about the space issues, but not an engineering center. The other needs are clear: the Hearst Mining. So I think there was a memo about the planning for this space in the College file. The important thing is how to do fundraising for the engineering center. At the very beginning, I tried to know some of the key people in industry. I think maybe during the first year, I hosted a lunch with the leading alumni. I visited some of these people first. One of the key persons is Ed [Edgar J.] Garbarini.

He was the president of Bechtel Power and is one of the three heads in the Bechtel group. I visited him—

Rubens: You hadn't known him. You're trying to, in a calculated way, think, "Who are going to be key people that you can tap."

Kuh: So I visited him; he has his office on the top floor of Bechtel Building. It turns out that he was extremely supportive and friendly and encouraged me, offered help. I got the motivation and the suggestion of fundraising from him. He made a donation himself right away, a commitment. Then I visited the CEO of PG&E, Shermer [L.] Sibley. We honored him later with the Sibley Auditorium in the Bechtel Center. Sibley was killed in an accident, during the time I was dean. He also served on the board of GM, so I developed close ties with GM, too.

Rubens: But you went to him?

Kuh: I went to him, and both he and the president, Jack Bonner, also a Berkeley alumnus. So I got to know them. From Bechtel, I got Garbarini. From PG&E, I got Jack Bonner, and from Chevron, Eneas Kane, another Berkeley alumnus. He's the head of research, the director of Chevron research. He became vice president later on. I went to see him.

And then there was Don McLaughlin, chairman of Homestake Mining, of course, the former dean and the chairman of the board of regents. I went to see, and got him to help. Then Lou Oppenheim the president of Kaiser engineers. See at that time, in the early seventies, the key people, key alumni were all civil, mechanical engineers, not electrical engineers. I had to get to know them. The first time I got these five people together was to invite them to come to Berkeley. We had a meeting, I remember, at the director's room of the Faculty Club. We'd talk about some of my plans. I got strong support from all of them.

Rubens: Did you have a planning sheet to hand them? Did you have—

Kuh: I don't remember, but I don't think so.

Rubens: You had not met these people before?

Kuh: Well, I went to see them. I had to get to know them first. Actually most of the key people are civil engineer alumni. Civil engineering was the number one department in the country. They had produced some real, top people. I had to count on the support of civil engineers.

Rubens: Are you working with Zadeh?

Kuh: Well, not yet.

Rubens: Okay, this is your baby.

Kuh: Well, not yet. No, this is just planning. This is just planning. I had to write up things for support in order to plan the engineering center. Before that, we had to think about who could be the main contributors for this building. Of course, Stephen D. Bechtel's name came up, because he was also the distinguished alumnus of the campus. He had not given major money other than the room in the alumni house. There's a Bechtel room in the alumni house. That's a major goal. I had to plan an initial alumni meeting. I think this is all written up in the *Matrix.*

Rubens: I don't have these same names. I'm looking at your advisory board.

Kuh: That's different. This is an informal group. In the meantime, I had formed an advisory board. The advisory board had to be national. It had to include key people in electronics.

Rubens: So this is happening before?

Kuh: This happened about the same time during the first year I was dean. I had to plan a meeting to invite the distinguished and wealthy alumni to come to Berkeley. So that's the outgrowth of my alumni meeting when I was the department chairman. I asked Professor Zadeh for help in planning this meeting. I picked Eneas Kane as keynote speaker and chair of the meeting because he is well known among the engineering professors. He is from Chevron. So with Eneas Kane and Professor Zadeh, we started the first distinguished alumni meeting. That took place—I think it was '74. Later there were meetings for a few times.

Rubens: It struck me that it was such a natural. I was wondering why it hadn't happened before.

Kuh: Major fundraising was never considered by the College before. Berkeley being a public institution, it was very hard to do the fundraising. Chancellor Bowker wanted to start to do something, so when I talked to him, he encouraged me. When I proposed the Bechtel Engineering Center, he decided that he would assign it as his number one priority for the entire Berkeley campus. He told people. Then he helped me to recruit Gene Trefethen, Trefethen is a well-known Bay Area industrialist. He was the president of Kaiser Industry. He's a close friend of Steve Bechtel. He is very wealthy and made contributions to the arts, and to many charities.

Rubens: He was the head of the UC Foundation.

Kuh: Could be.

Rubens: Yes, I looked him up. You're going to then start your engineering fund.

Kuh: That was much later. These funds cannot be started until I have something solid accomplished in order to get broad support. Next I met with the second echelon of the alumni and I had dinner with—they are wealthy, but not from the big companies, like what I mentioned. This includes the president of Tudor Engineering, Louis Riggs, and the Bentley Associates President, Don Bentley, etc. I met them individually and together for lunch to talk about my plan for the Bechtel Center. Although they were hesitant, I eventually got support from these generous people.

Rubens: So you are identifying who are these key—

Kuh: Oh, yes, I got the Berkeley assistant chancellor, Dick Erickson. The organization is just like Vice-Chancellor Don McQuade has now. At that time Erickson was assistant chancellor. They have an organization to help us, but for fundraising, you are not supposed to do it solely from your college. I had to get Chancellor Bowker to agree that we wanted to start our own, in order to get the engineering center funded. They helped me to collect the names. I myself had to get the major companies, to try to identify the top echelon of people from Berkeley. From that list we invited people to come to Berkeley for the first distinguished alumni meeting, including two key vice presidents of GM, Paul Chenea, Vice President of Research, and Ernie Starkman, who was a professor here. He went to GM to be vice president, in charge of environmental activities. That was the picture I showed you with Bowker in Starkman's office when we visited GM.

Kuh: Then we started the fundraising. We contacted potential major targets, including the Kresge Foundation in Detroit, and GM and IBM, and so forth. We went to see the chairman of GM, because they have a major say in the Kresge Foundation, in Detroit. Out of that, Kresge decided to give us three quarters of a million dollars to establish the engineering library (at that time that was a lot of money). The engineering library was named Kresge Library. That wasn't easy, because Kresge was the target of many universities. Being a state institution, we needed to get the chancellor to go there. We needed the alumni representation, GM representation. We visited Kresge together.

Rubens: Was that a real coup?

Kuh: That was the second major source, besides Bechtel himself.

Rubens: How much had Bechtel—?

Kuh: Bechtel had to contribute half the total amount for it to be named the Bechtel Center.

Rubens: I saw two estimates. It was first estimated at five million.

Kuh: Five million was the initial amount. Later it became six.

Rubens: So, from the beginning Bechtel said he would give two and a half?

Kuh: No, no, no.

Rubens: I'm wondering how that works.

Kuh: I had to get him, his company, his son—his son Steve Bechtel Jr. was the president at that time. So we met with him. The top management at Bechtel are very wealthy, because they get the Bechtel stocks. It's a private company. Ed Garbarini and all the major people in Bechtel contributed. That's why there are rooms named after so many Bechtel people. For instance, the Garbarini Room, the lounge, the Keily Atrium outside the Kresge Library, with that art piece that my wife helped to select, etc. Anyway, many people contributed from Bechtel.

Rubens: I guess I'm trying to ask—I'm sorry for interrupting you—if you knew you had a major pot of money from Bechtel before you got this Kresge Foundation money—

Kuh: It's all at the same time. The money from Bechtel—of course, I visited Steve Bechtel Sr. a couple of times. Trefethen was a good friend of Bechtel and talked to him. And then Ed Garbarini from the inside. Finally they made the commitment to support this.

Rubens: At that point are you public about calling it the Bechtel Center?

Kuh: I don't remember. That's why we have these brochures and programs to refer to here.

Rubens: I don't see it called The Bechtel Center at this point in *The Matrix.*

Kuh: It should be there.

Rubens: You mentioned there was going to be a center. It evolves how you are talking about it. You announce a very general outline to propose a new engineering center. This is in spring of '74.

Kuh: Oh that's very early.

Rubens: Or the fall of '74. Then later it announces the engineering center project has been pledged four point two million. It doesn't say who has given it, but it says, May '77, now that you have four point two million of the five million needed. You announce that it will be Stephen Bechtel. I think that is the first time, at least at that level. Sibley Auditorium is also named.

Kuh: Well that's afterwards. PG&E contributed two hundred thousand dollars. That's not easy, because utility companies usually don't give anything. But

both Sibley and Bonner are Berkeley graduates [Jack Bonner, past president of PG&E; Sibley had been Chairman and CEO].

Rubens: Apparently in the wake of Sibley's death, they ask for contributions to a memorial fund.

Kuh: Exactly, yes.

Rubens: We're jumping ahead. This is really hard work. It's really targeting and pampering.

Kuh: Yes, but from that I got to know the alumni well, and after the Center was more or less funded, I announce the Berkeley Engineering Fund.

Rubens: Okay that's what I wanted to know. I don't know the relationship. The Berkeley Engineering Fund—

Kuh: I think in 1978, I proposed—it's clear that the engineering college needs private funding in the long run. It needed industry support. I proposed to Provost Maslach that we will start two big projects: the Berkeley Engineering Fund and the Industry Liaison Program.

Rubens: Yes, I think that is '79.

Kuh: '79 is the first Industrial Liaison Meeting, but when I proposed it, it was '78. I even estimated how much money we could get. Of course, that went way above that, later on, very quickly.

Rubens: It did. The other thing that is expanding is the alumni association.

Kuh: At the same time.

Rubens: All of these are pieces in how the expansion is going to go forward.

Kuh: The Engineering Alumni Society—

Rubens: It doubled in the year '74 to '75. It had about 800 and then it goes to 1700 members.

Kuh: Paid members. There's branching. For instance, I went down to Los Angeles several times.

Rubens: One in Hawaii?

Kuh: Hawaii is not that active. There is one on the East Coast—

Rubens: Do you assign the task or do you encourage your chairs to then develop?

Kuh: I encourage them, but the main thing is the Associate Dean Mac Hopkin—he was a great help. He's the guy I really counted on. He was the acting chairman when I was the department chairman on sabbatical. I appointed Mac right away as the associate dean. At that time, there was only one associate dean in the College. The rest are assistant deans. In the college administration, we had an assistant dean, interdisciplinary, assistant dean for graduate activities, assistant dean for undergraduate activities, assistant dean for research. Professor Hopkin was the associate dean. He's very close to me; I can trust him. Later on he served as acting dean, when I was away on sabbatical. He handled alumni activities.

When we meet at our monthly meeting, at the faculty club with the alumni board, Mac Hopkin was a member and helped me. The alumni society consisted mainly of younger people. The leadership is from younger senior people in industry. It is a different group from major fundraising. But it's an important part, because they become future leaders. So I pushed that very hard on that.

Rubens: But we were talking about raising the money for the Bechtel, and then you said that you created the engineering fund. But the Bechtel money has been raised and the architect has been hired, and it's going forward, when you decide, "We need to keep up this fundraising."

Kuh: That's a separate project, the Berkeley Engineering Fund and the Industrial Liaison Program, and. I will talk a little bit more about them.

Rubens: All right, just one moment. Is there anything more to say about the early planning phase of Bechtel? It just seems to go forward in a very smooth galvanizing way. People are excited about this; this is new. It's so needed.

Kuh: One important issue that came up is the site. We picked the naval architecture building, an old building, to be demolished to use as the site. Then the other side of the campus, some liberal faculty and students didn't like it, because that was an historical building, designed by John Galen Howard. Some people said, "You can not tear that down." We had to fight them. Bowker decided it's not worth to fight. We should select another place.

I got Trefethen, Garbarini, and Oppenheim to come to the Berkeley campus to try to find a place. We looked over Davis Hall, that's civil engineering. That space, between Evans and Davis Hall and Hearst Mining and McLaughlin Hall, was empty. That used to be called the Maslach Meadow. It actually was used as parking and it was not very nice. I think four of us—Trefethen, Garbarini, Oppenheim and I— decided that's the place.

But in order to promote that place, we had to deal with protests from some of the people in Evans Hall. They said, "That's a nice open space. You can not

build a building there." I had protests again from different sources, including a Chinese friend of mine from mathematics and also some people from Cory.

Rubens: Who was the Chinese friend of yours?

Kuh: Professor Wu. Anyway, they wrote letters. And then there was the chairman of the statistics department, Professor Elizabeth Scott. She's very powerful. There were many protests.

Rubens: Is this protest about appearance, about blocking the view?

Kuh: Oh yes, everything. That's why when we talked to he architect, and we told him, "We need to build a low profile, underground building for the center. We were very fortunate to have a wonderful architect, a Japanese architect, named Matsumoto.

Rubens: It's the first Asian American firm that's hired on the campus.

Kuh: Is that right?

Rubens: George Matsumoto. He's a Cal grad in architecture.

Kuh: He's wonderful. So I decided to have an all-college faculty meeting at Asilomar, to bring up the issue of the site, among other things.

Rubens: Yes, '77.

Kuh: I invited Chancellor Bowker and he couldn't come, so Mike Heyman came and gave a wonderful speech. Of course, I gave the main speech. I really told the faculty, "This is it. I don't want to have more protests about that space." I had to fight both within the college and the outside people.

Rubens: So within the college, the protest is also about the use of space not just that private money—

Kuh: No, no. The protest, which bothered me, was from the outside. But with Bowker's support and Heyman knows the power priority. As long as the college doesn't raise any fuss—

Rubens: And by then you already had Matsumoto on board and saw that you could do a low level—

Kuh: I don't remember quite the order of which came first. Anyway, the design has to be low profile, mostly underground and he did a wonderful job.

Rubens: It sounds like you also brought students in on the planning.

Kuh: It's necessary to get student support, because even though our students do not go on strike on these things, you want their support. That's important. Besides, I planned a student quarter for the engineering students in the Center—

Rubens: —Activities center. So you need to solicit their input. Apparently there's one woman student who's quite active in that. She's an award winner. I didn't write down her name. She speaks, I think, at the groundbreaking.

Kuh: But Steve Bechtel Sr. was very upset about these protests. He said, "Let's get going." He's very impatient. I had to calm him down. Finally we got that all set. I guess we started building the place in 1978. That took place—

Rubens: June 29, 1978, is the groundbreaking for Bechtel.

Kuh: I had a college faculty building committee, which was very helpful, very good. It was chaired first by Hugh McNiven, a civil engineering professor. Later on by Dodge Angelakos, an EECS faculty member. The key to that committee was that I was not on the committee. I wanted them to decide. Mac Hopkin served on the committee, the associate dean. Dave Brown, the college manager, plus some others.

Rubens: College manager, what does that mean?

Kuh: He's the executive officer in the College. He's the top staff man, Dave Brown, a very capable person. Then I had the faculty representing the engineering library, Professor Larry Talbot. The planning of how to use the space is important. They met with Matsumoto constantly. I think I only met the committee once or twice, but they had a monthly meeting to talk about things

Next, I want to talk about the College Advisory Board, because that came at the very beginning, parallel with the Bechtel Center Project. I was very close with Bell Labs. I thought I needed to appoint a key person to be on the advisory board with national stature. Bruce Hannay was the vice president and director of research at Bell Labs. I visited him and invited him to come and he agreed. Berkeley had such a good reputation, that people were eager to come to help. He agreed to help.

Rubens: It's your idea to create a new advisory board for the School of Engineering.

Kuh: Yes, for the Berkeley campus. There was a system-wide advisory committee for all engineering schools at UC, called the Engineering Advisory Council. That reports to the president.

Rubens: But that's about engineering matters on the campus, is that right?

Kuh: The Engineering Council is the system-wide advisory council that reports to the president. There were some members on that council that I wanted to select for the Berkeley Engineering Advisory Board. The key here is to have an advisory board representing our interests. I felt we needed to get Bell Labs and IBM. I was very close with people at IBM. I invited Art Anderson who is the president of a branch of IBM, to join.

Rubens: From the general product division.

Kuh: Yes, the general product division. He was the IBM research director too, before he became vice president.

Rubens: Had you known him when you consulted earlier?

Kuh: I may have known him, because he was the San Jose lab director too. I had Art Anderson. Eneas Kane was on the engineering advisory council. I got to know him well, so I asked him to serve as the first chairman of the advisory board.

Rubens: From Standard Oil.

Kuh: I had Mel Curry who was the president of Hughes Aircraft. He was a Berkeley alumnus, a former student of John Whinnery.

Rubens: I notice that he is identified and being with the Office of the Secretary of Defense.

Kuh: He was there later on, as the top man in—

Rubens: Research and engineering at DOD. But he came from Hughes?

Kuh: Hughes, yes. Then the chairman of engineering advisory councilors is Bob Bromberg from TRW. So I made him ex-officio.

Rubens: I didn't quite understand what that meant, to be ex-officio.

Kuh: Because he's the chair of the overall Engineering Advisory Council. But Eneas Kane was made the chairman of our board. Then I had somebody from GM, somebody from GE, somebody representing civil engineering—

Rubens: From the US Geological Survey?

Kuh: M. King Hubbert. He's the expert in energy matters and very well known. So I had him. I had a good group of maybe a dozen people.

Rubens: A big group, fourteen.

Kuh: Shermer Sibley served on that.

Rubens: Osborne from Carnegie. He's a professor from the Carnegie Institute. And one other. Well Starkman. I guess he was mentioned.

Kuh: Starkman is from GM.

Rubens: An amazing group.

Kuh: It's the top level people. They were very dedicated. So when I had meetings—

Rubens: Had you informed them specifically what you were asking them to advise you on?

Kuh: Well, different things. The main thing for the engineering advisory board was to advise on our academic programs, research activities, future directions, and sometimes alumni activities, plus fundraising. I got support from them on different things. They gave us good advice. Every time they came I had faculty members to present material to them, in terms of what we do.

Rubens: You invited students?

Kuh: Yes, student leaders, to meet them. Always, it was a whole day program when they came.

Rubens: The first meeting you have on campus is June 1974 -early in your tenure as dean. They weren't involved or enlisted in the effort to build an engineering center.

Kuh: No.

Rubens: This was a completely separate—

Kuh: Yes, completely separate. There's some overlap of membership, for example Ed Garbarini. I invited him to serve.

Rubens: Yes, regarding Sibley. Because you are moving on many fronts with this deanship.

Kuh: That continued. I used them very heavily for their input, their advice. Also we benefited from them greatly. Every time we needed to get money, IBM came through. For example, they gave quite a bit of money to support IDS, Interdisciplinary Studies, too. That contact is important. GM gave quite a bit of money for different things. So this structure is not only for advice, but to get their support.

Rubens: When you mentioned Heyman coming to the Asilomar faculty meeting, you also had this advisory board come.

Kuh: I had quite a few of them, including Les Hogan, the president of Fairchild; I mentioned him before. He came to our meeting. Garbarini came to our meeting at Asilomar. It was nice for them to meet with the entire faculty of engineering.

Rubens: I had noted it was the first time that you had invited that liaison advisory board there. So apparently you had those every four years, the Asilomar gathering?

Kuh: No, that meeting is not regular.

Rubens: You happened to have one four years before.

Kuh: Yes. I think that was the only meeting. I think when Maslach was dean, he had a meeting at Lake Tahoe. When Bob Weigel, was acting dean, he had the meeting in Berkeley. The meeting I had was Asilomar. That occurred the same time when we had problems with the Bechtel Center.

Rubens: So you could smooth that out?

Kuh: That meeting was very enjoyable to spend the whole weekend there. No, it was not a weekend.

Rubens: It looked like it was almost a week. Here it is in my notes, June 3 through the fifth.

How long did these people serve on the advisory board?

Kuh: Some served longer than others. Some were rotated out, because their own position changed. Sibley died. Ernie Starkman died from GM, so I appointed somebody else who turned out to be very senior, even more helpful from GM. Some stayed on the whole period. Later on, because it is a big job for these top people, Eneas Kane decided to step down as the chairman. I asked Bruce Hannay of Bell Labs to chair the board. This is a yearly meeting. Every year we meet.

Rubens: They continue today?

Kuh: They continue today. It's a bigger board. I don't think they are that close, because it's bigger. During my time, it was twelve to fourteen people. I could count on - most of the time- that eighty or ninety percent of the people would come.

Rubens: We'll go on to talk about is the industrial liaison program.

Kuh: And the Berkeley Engineering Fund. Also during that time, I had some outside activities I want to mention.

Rubens: Yes, you become a member of the National Academy of Engineering in ’75.

I also have in my notes a story that ran in *The Matrix*, early in ’74 that the students are concerned with poor teaching. I was wondering if this is something that is a stimulus to you later, for that report that you do for the academic senate. That was when you were the head of the budget committee. Did student complaints play a role?

Kuh: No, no. That’s always constant, complaints by students. There are times when the campus decides to emphasize the evaluating of professors, research and the teaching.

Rubens: I didn’t know if it was a particular concern that is coming out of that. Also, during this period, the number of women tripled in the program. By ’76, Cal is ranked tenth among American universities that have engineering programs.

Kuh: We had a grant from Ford, which supported specifically women in engineering. From the Ford Motor Company. I visited them and requested their support.

Rubens: You are initiating this?

Kuh: I think so. The main contribution of affirmative action was the MESA program. That was started by Professor Somerton of mechanical engineering. It started at Berkeley, by Bill Somerton. It became a state-wide program.

Rubens: It was associated with the Lawrence Hall of Science and some local high schools. Then Somerton took it into a state program.

Kuh: Well he started the program. Among the people who helped me—at that time there was a vice chancellor called Norvel Smith. He’s black and his wife Mary, from the Oakland area, really helped. I remember I worked with her and Somerton. Unfortunately Somerton died. I always paid specific attention to that program and supported it.

Rubens: Because?

Kuh: Well, I know it is important, as was the effort to include women. Then we also had a very good person, Sheila Humphrey in our department, who started the Women in Computer Science program and recruited outstanding women students who later on became very well known computer science women faculty.

Rubens: What was her position, was it administrative?

Kuh: She has the position now with the department as academic administrator or something like that. This year she's borrowed by some college to help other people. She's outstanding.

Rubens: So that's happening under your tutelage.

Kuh: Just to recap what we've covered: I started the deanship in 1973. By 1977, I think the Bechtel Center was in good shape with fundraising and architecture design and so forth. So I was willing to take a year of leave to go on sabbatical. From1977 to 1978, I went on to sabbatical again, and this time first to Germany for the summer and then to Japan for the year. I think it's important because during this period, I learned something on electronic design automation, which is referred to as EDA. That's my second area of concentration in research. I worked with Professor Fujisawa at Osaka University again, because I found that we can work together well.

I also went to Tokyo to see my friends at the NEC research lab, especially Professor Ohtsuki. By that time he left NEC to join the Waseda University, the leading private university in Japan. I also worked with Dr. Goto. He was still at the NEC lab. Subsequently, he spent a year and a half with me at Berkeley to do joint research. In Germany, I was at Munich with Professor Rudy Saal, and I got t know Dr. Ulrich Lauter of Siemens. He was a pioneer in EDA and later he came to Berkeley at my invitation.

Rubens: He came back with you or at another time?

Kuh: Yes, at another time. Later on Goto rose very high up at NEC research lab. He became the vice president in charge of research in information technology.

Rubens: NEC lab is?

Kuh: NEC is one of the biggest electronic companies in Japan. NEC research is famous. They are tailored after Bell Labs. NEC research lab essentially corresponds to the Bell Labs of the old days.

Let me say a little bit about electronic design automation, what this means. Electronic design automation means automatic design of electronic circuits and systems, which means you have to introduce computer-aided design, especially for circuit chips, computer chips. Just to give you some idea, the chip nowadays has over a billion devices, a billion transistors. To quote Gordon Moore the chairman of Intel who first proposed the Moore's law which means that the device on a chip, doubles every eighteen months. He mentioned in one of his speeches, "By now there are more transistors on all the chips throughout the world than the ants on the earth." He's predicting this number will be twenty-five times more than the ants on the earth. It's a huge amount of devices, mainly transistors.

So how do we design the chips? Each chip has billions of transistors. It has to function correctly according to some specification. In the late seventies, the field was in the infant stage. People had to lay out on a chip devices and to interconnect all those devices, manually, without using automatic tools. That's called physical design, layout design. That was what I was interested in, because I know this is not right. You should be able to do that automatically. In addition, I know that this area depends on certain areas I learned from circuit theory, i.e. graph theory and combinatorics.

During that sabbatical year, together with Professor Fujisawa, and Professor Ohtsuki, we discovered a new architecture of design chips, based on gate sequence. Gate is a basic element in computers. If you sequence them in a particular fashion, one dimensionally, then we found that we could take advantage of graph theory to solve the correct order. We developed a basic algorithm to design the sequence of the gates, which corresponds to the layout of gates on a chip, thus making the chip layout automatic for this type of architecture. Other people came up with a similar idea, too, but I think our results are better. We established the result using graph theory algorithm. We were very pleased. That work, of course, was published, and that was the start of my chip layout research.

Rubens: Had you been in touch with them, before you went to Japan? Had you been writing then?

Kuh: Not technically, but we knew each other well. Before the previous sabbatical, I worked with them on non-linear circuits. That's circuit theory, which is totally different from this.

Rubens: So this emerged while you were there.

Kuh: I had plans. Actually one of my Ph.D. students, Benjamin Ting, started to work with me in the early seventies on interconnecting chips on a printed circuit board, which is different from designing the chips. I never mentioned Benjamin Ting before. He started with me in the early seventies. He got his Ph.D., in 1976, focusing mainly on printed circuit board design.

Printed circuit board is an interconnect scheme to interconnect chips. I started with that. Later on in Japan, we started on the chip layout, which is a much larger problem. I think even before that, I had visitors coming to Berkeley, especially Professor Shirakawa, at Osaka, also, who spent a year here working with me.

Rubens: When Shirakawa was here, what did you work on?

Kuh: On the interconnect of the circuit board. But chip design is much more complicated than just the gate sequence. Basically it involves several sub-problems. Let me just describe them briefly. Because the total circuit is huge,

you need to partition that into smaller parts. That's referred to as the partitioning problem.

The next problem is called the placement problem. You place the devices, modules, and building blocks on a chip in an optimal fashion so that you can interconnect them easily. This is the placement problem.

Finally, there is the routing problem, i.e. you interconnect them together. At the beginning you only have one layer to use on the chip, later on two layers. Now it's multiple layers. Even though the chip is tiny, it's possible to have multiple layers for interconnecting.

Technology has advanced so much. These are the three key problems: partitioning, placement and routing, and I worked later on all these problems. In addition to the chip layout design, there's the separate problem called validation. Once the layout design is done you have to prove it's right. One sub-problem under validation is testing. And there is the other problem of simulation—when designing a complicated circuit you want to do simulation to prove that a circuit is designed right. I worked later on simulation, and one of my students worked on testing.

The work I have done on EDA, includes physical design, which is a layout design, and validation. These are the main sub-areas. So after my sabbatical—without going into details on other things I did on sabbatical, I contacted Don Pederson, my good friend who became very famous for his work on simulation and software SPICE, which I mentioned before. I tried to convince him that we should write a joint proposal to NSF to combine all these areas. He was interested, but for one reason or another, I continued as dean and he's always so busy, and we never got together to do that. But his knowledge on how real chip design works by engineers and my knowledge based on the theoretical foundation helped to promote the EDA. That's why he won the EDA Phil Kaufman Award the second year it was awarded. I won it the fifth year. His work is mainly because his SPICE and circuit simulation. My work is mainly because of the automatic layout design.

Rubens: What date was that—the Kaufman Award?

Kuh: Either '97 or '98. I just want to mention a side story about Aart de Geus, the CEO and Chairman of Synopsis, one of the two huge companies in EDA, whom I know. He called me one day. I was in my office. He said, "I have some good news for you?" I said, "Gee, what could that be. Are you going to give me some Synopsis stocks?" He said, "That's not quite true, but maybe it's even better." He told me that it's about this award, the Phil Kaufman Award. My wife and I went to the ceremony, as did Don Pederson and his wife Karen. They always have this event in San Jose. Aart de Geus is a very well-known guy in EDA industry, because Synopsis has over one billion

dollars in revenue, about the same as Cadence—they're the two big-time EDA companies.

Rubens: Are you using that term EDA? Is that being used by then?

Kuh: Yes, EDA is used. EDA is a little bit broader than physical design, or layout design.

During that sabbatical year, I did two things: one is to join the first IEEE visit to China. I was a member of a ten member delegation. I spent two weeks in China to promote exchange. I met the professional societies in China. That was interesting and I'll talk about that later.

I came back from sabbatical in 1978. At that time, I thought, "I need to do something else besides finishing up the building." For the future it's important to have more financial resources. It's more important to develop close ties with industry. I proposed to Provost Maslach two ideas—and there are documents but I don't have that file now. One was to start a Berkeley Engineering Fund. The other was to start the Industry Liaison Program. Both depended on help from our alumni. For the Berkeley Engineering Fund, I got Ed Garbarini—he's the closest to me and he's also one of the major sources of support from the Bechtel Corporation—to be the chairman of the Berkeley Engineering Fund. In turn, between him and me, we recruited some key people on subcommittees. I remember, I asked Lou Oppenheim of Kaiser to be the head of major funds. I don't remember how much constituted the major fund. Then there were committees in charge of annual giving. Every year we have to get money. There are committees to contact outside the Bay Area. There are committees for smaller grants rather than major funds. We got that organized.

Rubens: I read in the first year, you raised a hundred thousand dollars.

Kuh: Yes, I think so.

Rubens: There are overlaps, for instance Garbarini had been with the advisory board. So some of them are the same people that you are—

Kuh: The same people. They all serve on the alumni board too. So I saw them frequently. As I mentioned before, these are mostly civil engineers, because our civil engineering department was so outstanding throughout. They produced many top people. But then I needed to work on getting the electrical and others-

Rubens: -on board? Was that a hard sell?

Kuh: It wasn't easy, because we were not like Stanford. We did not have people like Hewlett and Packard. We would get second level people. We had to

recruit the people from Hewlett-Packard to help. I think Ed Garbarini continued to serve as chairman when I retired from the dean. Later on Lou Oppenheim became the chairman. That continues to this date. A huge amount of money is raised now.

Rubens: That money, how is that—?

Kuh: It's up to the dean to spend it. During my time, I said it's very important to help the library, because the library moved to huge quarters in the Bechtel Center. We wanted them to have enough resources to buy things. So it's up to the dean. In the last year, I gave money from Berkeley Engineering to the departments. Also through that, I recruited more people to the Berkeley alumni organization and membership increased partly because of that.

Rubens: It hit a dramatic number here.

Kuh: That's the Berkeley Engineering Fund.

Regarding the Industrial Liaison Program: The EECS department and the civil engineering department always had some kind of tie with industry. I thought maybe start with them. We'll have a college-wide Industrial Liaison Program so that we have a tie for all the departments with their industry. I proposed a college-wide Industrial Liaison Program, and we called it the ILP. At the beginning, when I talked with the department chairman, I did not get wholehearted support from EECS and CE, because they already had their own, even though they were informal. But, of course, being the dean, I convinced them it's good to have it in the college. So we started that. I will give you pamphlets from the Berkeley Engineering Fund and the Industrial Liaison Program. For instance, here is the second annual report of the Berkeley Engineering Fund.

Rubens: Okay, I haven't seen these.

Kuh: [Referring to pamphlets and reports.] The preamble to the Industrial is the alumni meeting, 1975. Maybe it was the second one. This is the second industrial liaison meeting, in 1980. This is the beginning of the Berkeley Engineering Fund when we just started. This is a typical example of how Garbarini and I announced the program; these are some examples of the publicity. But the Berkeley Engineering Fund turned out to be very lucrative and successful. I remember when we set up the first industry liaison meeting, which essentially was a follow up of an early alumni meeting. We invited both the top executives and some working engineers. That's why I combined the Engineering Advisory Board meeting with top executives at the same time. Later on, of course, we used the Bechtel Center.

At that time, it wasn't finished yet. It was clear that we need many rooms for meetings. We need an auditorium, we need conference rooms for different

groups, but we managed even before the Bechtel Center was completed. We gave technical talks which were important for engineers, but we needed to have broad presentations to tell the executives about the engineering school on the Berkeley campus and what we plan to do. Attendance was very big. I think three hundred people. Usually it is a two-day meeting. For the general meetings, the plenary session and the more popular technical meeting, we held them in big auditoriums which we'd have to find throughout the campus.

Rubens: The first official meeting of ILP was June 8, 1979. There were 160 members of industry.

Kuh: It grew very quickly.

Rubens: There were 186 in 1980 and then it must have grown after that. With Berkeley students and faculty the attendance may have been 200-300.

Kuh: Oh yes, the faculty participated, some graduate students participated. They were invited too. The usual program in the daytime has plenary sessions on hot topics. In the afternoon we divided it up. In the first evening we always had a banquet at the Pauley ballroom and we'd get keynote speakers. We got Andy Grove, the president of Intel, for example. Later on, we had John Mayo, the president of Bell Labs. We got Kobayashi, the chairman of NEC and all these top people to come to talk. As a whole, it was very successful, and the College of Chemistry found out and decided to join us later on. It then became a two-college program. This continued for about twenty years until 1997 when Paul Gray was dean. At the beginning, again I asked Professor Zadeh to chair perhaps for one or two of the meetings. We had the Industrial Liaison Committee and we had a staff we added to the college. That staff began to work on not only industry liaison meetings, but also the Berkeley Engineering Fund.

Rubens: Is that an example of what the Engineering Fund is paying for? For the staff for the—

Kuh: Well, we have to get money somewhere, so that's changing over the years. I mentioned before, because of these programs and meetings, professors got to know the engineers in industry, and develop consulting arrangements. They get funding of research from industry. During Paul Gray's tenure as dean—I think it was the second or third year—this thing had kind of run into a rut. So he checked with me and decided that even though the college-wide program was a total success, each department wanted to do it differently. Thus from that time, it separated into department activities.

Rubens: ILP?

Kuh: Yes the ILP. Maybe it was still called the ILP, but the department EECS decided to do much more. It had become a huge thing. I don't know about

other departments. I know they have theirs. Right now EECS has developed a huge fundraising program from that and developed a strategy to emphasize in different areas in each year, because you cannot cover so much in one year. So one year we cover one aspect, another year cover another aspect. Also we have one day devoted to one company. IBM sponsored that. Another day is devoted to another company. So it's now a huge operation in the department, which I'm not that familiar with and can't give you the details.

Rubens: So it's a whole different picture than when you were—

Kuh: ILP for the college lasted for about twenty years.

Rubens: That's a long time.

Kuh: It generated many useful relations and benefits.

Rubens: Do you think that there were tensions that it may have exhibited or even stimulated about the relationship among the different programs?

Kuh: Some programs like EECS became very big. Other programs from the small departments, they are difficult to draw attendance. So some are very small, but we offer the same two days during that time. That was a good way to have a college-wide thing.

Rubens: EECS is really becoming—

Kuh: It's huge.

Rubens: It's the driving star in the College of Engineering. As dean did you have to settle, if not disputes, criticisms?

Kuh: I always tried to be even handed in terms of resource allocation, in terms of relations. But just look at the pattern; the last three deans are all from EECS. Paul Gray, Dave Hodges and now Richard Newton. Only in one period—there was Karl Pester from civil engineering. Before that I was the dean. Before that George Maslach was from mechanical. Before that John Whinnery was from EE. So EE played a bigger role for the whole college, and that's nation-wide, as well.

Take a look at Stanford. Their past few deans are all from EECS. Even the president, John Hennessey, is from CS. MIT is the same thing, except the new president is from biology. It's a woman. That's the first time they did that. At big schools, the University of Michigan, the dean is from EECS.

Rubens: So I know there was the issue of CS coming into your college and that must have raised questions about whether tenure would move ahead or ladder increases move ahead without discrimination.

Kuh: Well there's always friction between EE and CS within the department. And this is true elsewhere, too.

Rubens: But I was wondering if you had to specifically handle any of that in terms of the other departments in engineering.

Kuh: Well, as I said, I tried to be even handed. They know that EECS is the place that students are coming. We have a much bigger work load. We have many more students. It represents more than one-third of the college.

Rubens: And we've talked about recruiting faculty when you were chair.

Rubens: My understanding is that once you are dean that you really had a role in making the College of Engineering formidable within the whole panoply of colleges, that there's incredible success: the Bechtel program, the fund, the liaison program. Engineering has to be taken seriously in a way that it may not have been before, by the campus as a whole.

Kuh: I won't say that, but I started a few new programs: ILP, the IDS, the Berkeley Engineering Fund and of course the beginning of major fundraising. For a public university it was not easy. When I started, people from industry would say, "You're a public university, you don't need private money." So that's why we never had built a building in the modern period with private money. The Bechtel Engineering Center was the first one, I believe that is why Chancellor Bowker named the Bechtel Center his top priority, and I got enormous support from him. After that, the Berkeley Engineering Fund and ILP followed.

Rubens: I just wanted to be absolutely clear so that you got the recognition that you should. This was an idea that you had been churning over in your head. You had talked to perhaps some other people, but then you went to Bowker.

Kuh: Yes, sure. When we had the first alumni meeting, he came to open up the meeting to help. Later on, when I approached him for this project, he said, "That's fine." So he helped me to recruit Gene Trefethen, whom I mentioned was the key person. Bowker helped in many ways.

Rubens: Now I wonder if you could reflect on or think about your meetings with Bowker and the other deans. How often did the deans meet?

Kuh: The deans meet as a group with the chancellor.

Rubens: How often? Is it once a month?

Kuh: Something like that. It was the Council of Deans meeting.

Rubens: What were they like? Letters and Science used to—

Kuh: I enjoyed it, because I learned what other colleagues were doing, and I enjoyed it because the engineering college is a big entity on the Berkeley campus. At that time there were maybe fifteen deans. Some were very small programs. Let's see, nothing specific comes to mind. There are other meetings. There's the Council of Engineering Deans for the UC system. We met maybe two or three times a year. They learned what I was doing. So I think they learned more from me than I learned from them.

Rubens: Would those rotate where they would meet?

Kuh: Rotate to different campuses, yes. When Saxon was the president, he often hosted dinners at his house for the Engineering Advisory Council –the state-wide council- together with the deans. I got to know Saxon quite well. I mentioned to you that we had Andy Grove on the council. He didn't like some of the people on the council who were more conservative, slow-going, so he quit after one meeting.

Rubens: The head of—

Kuh: Intel, yes. At that time the chairman of the council was Irwin Jacobs, the CEO of Qualcomm, the well-known company in San Diego. They are in cell phone and wireless business. Irwin Jacobs was a professor of MIT, and later on formed the company, Qualcomm. He was a chairman of the council. There are some overlaps of membership between that and the Berkeley Engineering Advisory Board. I mentioned before. His son Paul Jacobs, a Berkeley alumnus, now is the President and CEO of Qualcomm, and is now a member of the Berkeley Engineering Advisory Board.

Rubens: This was a very yeasty interactive period, because so many of the supporters of the Bechtel Center also were some of the same industry leaders.

Kuh: No, Bechtel support came all from Bechtel friends. My fundraising effort at the beginning was mostly with the engineering alumni organization. Very little money came from Silicon Valley. I got money from PG&E.

Rubens: Okay, I guess I was looking at Fairchild.

Kuh: No, not to the Bechtel Center.

Rubens: That's the advisory board.

Kuh: Fairchild support came later on after my deanship to support the fundraising for Cory Hall and a consortium for CAD, a lot later on, with the help of my friend Les Hogan.

Rubens: Okay, all right. In Tien's oral history, he said that when he was chair that he relied on you tremendously. His quote is that you helped him in many ways.

Kuh: In his memorial service, I was asked to be the speaker. Of course, he was younger and he came a few years later.

Rubens: Of course you went to China with him.

Kuh: Yes, I went to China with him. When I became dean, the department chairman of ME was not doing well. So two senior faculty members came to me to talk about their next department chairman. From that discussion I appointed Tien as chairman of ME. Also at that time, Tien was being recruited to MIT. I convinced him to stay. I tell people that's the best thing I did for Berkeley, to keep him here.

Rubens: Was it a hard sell?

Kuh: I don't think so. He became chairman. He's very dynamic. He sees the future here. So later on, when every time he has some important thing—after my deanship, we had lunch together and he asked for my advice, including his appointment as vice chancellor of research, including his appointment as executive vice chancellor at UC Irvine. Finally, of course, his chancellorship here. I was on the search committee. So we were very close.

Rubens: Shall we speak just a little bit about receiving the Chinese Delegation? Had you returned from your sabbatical when the professors from Jiao Tong University came?

Kuh: Oh yes. Mac Hopkin made the arrangements for me, because I wasn't here. He did a good job. He was always the most dependable and had good judgment, and arranged the itinerary. I had met Professor Chang, from Jiao Tong University, in Shanghai, when I first went to China in 1973, and in 1978, he arranged for ten senior faculty in Engineering to tour the U.S. It turned out to be the first Chinese delegation to visit the U.S. after the establishment of diplomatic relations between the U.S. and China. Chancellor Bowker received them. I still remember that when they came, the Campanile played the Chinese national anthem. Of course, that was exciting. I'll talk more about the outcome of that visit later.

Rubens: How did your deanship come to an end?

Kuh: It ended in 1980. I know the deanship is usually held for a period of five to seven years. I never heard about a review for my deanship. I think my relations with the chancellor were extremely good. So maybe they did not even start a review. But I thought I needed to do something else. I always had in mind to serve one term, perhaps seven years. So in the summer of 1979, I told Chancellor Bowker, I wanted to quit in 1980. He said, "That's fine, he understands." Maybe to other people it was a surprise, but not to me and not to some of my good friends, not to the chancellor when I told him I decided to quit. He accepted that. I don't think I ever had a review of my tenure.

Rubens: What drove that for you? Did you want to get back to your research? This whole area of EDA was just—

Kuh: At that time the only dean from EE in the past was John Whinnery. He served for only four years. He decided to return to the department to work in the technical research area. He moved into a new area. So I thought he's a good role model. I followed his footsteps and came back to the department. I started in a new area.

Chapter VII: Embarking on a New Field of Research; Returning to the Classroom

Kuh: As a result of my sabbatical in l978, I had already been thinking about this new area of research, EDA.

Rubens: You had acquired students?

Kuh: Not really. I was just beginning to. I only had one student, Benjamin Ting, working in that area. What he did was quite different, though, even though it is EDA.

Here I should say that in ’78, after I finished my Japan sabbatical, I received an award from the Humboldt Foundation from Germany, the Senior Scientist Award. That’s for a year, but of course, I could not take a year at that time – since I had my deanship to finish. Thus I spent a summer after Japan to visit Munich. I spent two months in Munich.

Rubens: What is the award called?

Kuh: Alexander von Humboldt Senior Scientist Award. Humboldt is the biggest university in Germany. At the time it was in East Germany. But Alexander Humboldt has a foundation, and set up the Humboldt Award. Between the U.S. and Germany, there’s a senior scientist award. There are many Humboldt fellowships which are given internationally to many, many countries. That’s a much bigger program, but the senior scientist award with the U.S. is different. We went to Germany for two months to be followed by two more periods later.

Rubens: Literally, where did you go?

Kuh: Munich, the Technical University of Munich. I have a good friend—actually the award was initiated by them. Professor Rudolf Saal applied for me, so I spent two months in his institute that summer. Since the award is for one year, I spent a total of three periods. They allowed me to do that. After my deanship, I spent half a year. Then later on I spent another three months there.

Rubens: What were you working on?

Kuh: I continued my research on EDA. I got more results and that gave me the ideas of what to do after I retired from the dean. Toward the end of my deanship, students in the department started to contact me and wanted to work in this area. This area was hot, so I accepted some students. That started my research after my deanship.

Rubens: Also, I want to know if you had ambitions after being dean to move higher in UC administration

Kuh: When I was in Germany on sabbatical in 1980, Chancellor Heyman called me. Actually. I was in Israel first. He followed me to Israel. He didn't get hold of me, until I went back to Munich.

We talked—he did not offer the job to me—but it's clear that I was on top for the provost job.

Rubens: That would be the provost for?

Kuh: Maslach's position. I think he appointed Maslach as the vice chancellor of research. I told him I wasn't interested. I know that the provost job is a job where you have power, but you shuffle papers. You do not have an organization. The College of Engineering is a huge organization. So I wasn't interested. I told him that. I think then he became more interested in appointing a woman. Professor Doris Calloway—she was a nutrition expert.

You know Heyman was always interested in affirmative action. So maybe he had his own interest in appointing her, but I think I was on top of the list.

Rubens: He wouldn't have called you if he wasn't serious about it.

Kuh: Sure.

Rubens: So he's exploring it with you. He says to you, "Would you consider?"

Kuh: I told him right there I wasn't. There were other universities interested in me. For instance, Georgia Tech, a big engineering school. It's the biggest, probably. Georgia Tech contacted me. I went there for an interview to be the president.

Rubens: When is this?

Kuh: Oh, maybe mid- or early-eighties. I interviewed. Also I knew that they wouldn't be interested in me, because Georgia Tech is a Southern university. I don't think they want to appoint a Chinese to be the president. Of course, I was one of the leading candidates. They invited me for the interview.

Rubens: So they had recruited you. You had not been looking.

Kuh: They asked me. There are some other universities I didn't even respond. I responded as not interested. One other place was in Texas A&M. I went there. That was not the top position, so I wasn't interested.

Rubens: But you were willing to at least visit the campus and have the discussion?

Kuh: To visit, yes. The University of Texas also, I visited.

Rubens: Really, UT at Austin?

Kuh: Yes. I visited.

Rubens: I was going to ask you—this is so incidental, but this brings up if you knew Hans Mark.

Kuh: Oh, yes, very well. He was chairman of nuclear engineering when I was the dean.

Rubens: That's right.

Kuh: I got along fine with him. Later on he went to NASA, Mountain View, to be director. Then he went to the Department of Defense. Then he ended up at the University of Texas as the system-wide president. I saw him when I visited Texas. Yes, I know him.

Rubens: Was it he who invited you to come?

Kuh: No, he's the head of the system-wide. The Texas campus president invited me to look at the campus, but I was not interested. I was serving on the chancellor search committee on the Berkeley campus. My name came up twice. It turned out I was nominated by Hans Mark to be the chancellor here. Of course, I took my name out, since I was on the search committee.

Rubens: Oh, I see, but that's quite an honor.

Kuh: Well, to be on the search committee was interesting, to meet with the regents.

Rubens: It's quite an honor to be nominated to be chancellor! When was that?

Kuh: That was in the nineties, when we appointed Chancellor Tien**.**

Rubens: I met Hans Mark, by the way, when I was doing oral histories on the Free Speech Movement in l964. You mentioned to me that you'd seen my article in the California Monthly about the 50th anniversary of the movement. When Robert Berdahl became Chancellor of Berkeley, Hans Mark wrote to him about his own experiences at Berkeley, and so I decided to interview him about his experience with FSM.

Kuh: Where was he involved?

Rubens: He was an opponent. He had a very articulate and fierce position. He was still chairman of nuclear engineering at that time. The chancellor had put together the council of chairs, including Scalapino. I wanted to interview smart people who had a position—

Kuh: Scalapino, I remember he went to the Greek Theater and chaired that meeting, tried to support President Kerr. I remember that.

Rubens: Do you? You were there.

Kuh: [laughs] Yes, I was there.

Rubens: Maybe we should map out a little bit about where we are going to cover from here.

Kuh: Okay, I thought about this. One segment is related to my research, related to my research funding, related to my students, related to my industry relation, related to the research. That's one segment. One segment is various committee activities. This includes Berkeley committees, UC committees, other university committees, and committees in Asia—Hong Kong, Taiwan. Third is about my many China trips.

Rubens: Even during the deanship you were producing publications and papers, consistently.

Kuh: Well that will be covered when we talk more about the research.

Rubens: I just want to note here, that in '79 your CV shows twenty papers. Some of these are co-authored.

Kuh: Most of them are co-authored.

Rubens: There are twenty seven from 1980 to 1989. When it states they are group publications, for instance, the Hughes group publication, what does that mean?

Kuh: Oh that's my students, without my name on it.

Rubens: These are all publications by your students.

Kuh: By my students, by my visitors. They are under my supervision.

Rubens: The last entry you have here is '96. Seventy-five different ones.

Kuh: These are students here, visitors here at Berkeley.

Rubens: So we will be talking about these, when we talk about research.

Kuh: Research, not technically, but—

Over the period of twenty-some years, after the deanship, I supervised more than twenty graduate students, mostly Ph.D.s to completion. I had more than

twenty visitors, during this period. With students they spent on average five years. Visitors averages one year per visit. That constituted a research group of mine, after the deanship.

Rubens: You do have listed in your curriculum vitae all your papers and committees served on, the academic committees including the ones for other universities.

Kuh: They are all lumped together and not so categorized.

Rubens: In l981, in a news paper in *East West* article, you are interviewed about an award you received. I don't know what the journal *East West* is.

Kuh: It's a newspaper monthly for the San Francisco area. Now it's replaced by another paper. They talk about the Asian American people in science, art and education. That kind of thing.

Rubens: So it's a community paper. You say something really interesting. It's talking about your awards. Then it says the stereotyped impression of Chinese has been carried on to Americans, because in general Chinese people are hard working, but introverted. You point out that—this is 1981—there still aren't Chinese who hold managerial positions at Bell or at other well-known universities. You said, "Chinese engineers often feel inadequate in their verbal skills, thus they tend to be confined to their own social circles."

Kuh: That was quite true, yes.

Rubens: I wondered just if you would reflect back—because we've brought you up to this date, to 1980, to the end of your deanship. We talked about considerations that you had and that other universities had about your assuming the presidency. Do you think you experienced—

Kuh: That's strictly my own decision what to do and what not to do. I think I was appointed dean, not because I am a Chinese. I never thought about that.

Rubens: I think that is very clear.

Kuh: But other people accredited me. I remember I went on the Asian trip for Chancellor Bowker. He asked me to give talks at various UC Alumni chapters. They would always introduce me as the first Asian dean of a big university. So apparently other people recognized that. But after me there were many deans and chancellors of Asian descent—Chancellor Tien, Chancellor Henry Yang at Santa Barbara. He was the dean of engineering at Purdue. There are other Chinese deans and administrators.

Rubens: I just thought that it was interesting. You are being interviewed by a community newspaper and you are pointing out that in '81.

Kuh: At that time, that was still true. Very few at any major universities had Asian administrators.

Rubens: Did you feel even here that there was a certain confinement in your social circle with other Chinese members of the faculty?

Kuh: Not really. I think there are always Chinese faculty members, distinguished at major universities. Very few become administrators.

Rubens: I guess I'm asking if your social world was—

Kuh: We always got together and are very close with the other Chinese faculty.

Rubens: Yes?

Kuh: Oh yes, sure. We had a Chinese gathering, we called it a "shoot the breeze" gathering. That means you like to get together and talk and talk. We went out for dinner usually with two or three tables and came back to somebody's home to chat, frequently. Sometimes we'd celebrate each other's birthday. So we're close.

Rubens: So this is not just in engineering.

Kuh: No the whole campus.

Rubens: And that was the mainstay of your social life.

Kuh: Well, I also get together sometimes with the people in the department and other contacts too.

Rubens: But this was one of the groups.

Kuh: One of them yes. I have some very close friends in the Chinese group, yes.

Rubens: Would the discussions ever pick up university politics? Inevitably there must have been—

Kuh: Sure.

Rubens: Well, we are going to come to the—

Kuh: People would always talk to me if they had some problems. Later on, especially after my deanship, after my chair of the budget committee; they knew that I was a very close friend of Chancellor Tien. If they had problems—

Rubens: Was Tien part of that group?

Kuh: Oh, yes, sure. We celebrated his sixtieth birthday in a restaurant. We had about forty or fifty people. We celebrated my birthdays, sixty and seventy.

Rubens: I just noticed October 2 is yours –a few weeks ago.

Kuh: We were very close. It's unusual that this Berkeley campus has had really distinguished professors—the Nobel Laureate Professor Y.T. Lee, Professor S.S. Chern in mathematics, Professor T.Y. Lin. In the early days, Y.R. Chao in oriental language. Professor C.H. Li in biology.

Rubens: So you knew them?

Kuh: Oh yes. We were very close. Also because all these member belonged to the Academia Sinica. That is the Chinese Academy of Science. So we would get together abroad.

Rubens: Tell me about The Academia Sinica; when was that formed?

Kuh: Early this century, perhaps late last century.

Rubens: So it precedes the Chinese revolution?

Kuh: Yes, yes.

Rubens: It was one of those ongoing—?

Kuh: Oh yes, meetings every two years.

Rubens: Because I read your report to—was it Deng Xiao Ping—but it went to quite a higher—

Kuh: There is a parallel Chinese Academy of Sciences, which is different from the Academia Sinica. That's mainly people from mainland China. It is, of course, much bigger than the Academia Sinica. I'm a foreign member of that.

Rubens: But Sinica is an American Chinese organization?

Kuh: No, no, no. It started from China. They moved to Taiwan. It continued. The president of the Academia Sinica is always a very distinguished person, including the former ambassador Hu Shi, a well known Chinese scholar. Others include the former minister of education. Of course, Professor Y.T. Lee, now has extremely high prestige within Taiwan.

Rubens: How is one inducted into that?

Kuh: Oh by election. Just like the National Academy of Science here.

Rubens: When were you elected?

Kuh: I was inducted in 1976, I think.

Rubens: Okay. Then you became a foreign member of the Chinese Academy of Sciences.

Kuh: That's much later. That's '98.

Rubens: We'll do it more systematically. I never paid attention to—you were the Miller Research Professor of '65, to '66. What did that mean? Was that like an endowed chair?

Kuh: Well, every year they appoint half of a dozen professors to the Miller Research Institute to relieve one from teaching, where one concentrates on research. That's on the Berkeley campus.

Rubens: Now, you hold the William Floyd professorship, and that has been endowed, which you got in 1990. So we'll come to that.

Kuh: I was the first endowed chair in the College of Engineering, actually the second. As far as our department is concerned, Professor Pederson got the first chair in EECS. Then there was an endowed chair given to the college. I was appointed. I'll talk about it because the donor happened to be a close friend of President Gardner. Gardner gave a big party at his house in Kensington. That was very, very nice. Chancellor Tien and many people were there. Usually chairs don't get that kind of treatment.

Rubens: What was Floyd's money from?

Kuh: From the early days in electronics.

Rubens: He's not associated with one particular—

Kuh: He had a company. I forgot the name. It is still with the college.

Rubens: The first endowed chair—that sounds late.

Kuh: Well, an endowed chair was rare in Berkeley before. Now, there are many. The first endowed chair, as I said, was the Buttner Chair, given to Pederson. That's for the department. The second endowed chair in the college was the Floyd chair.

Rubens: Does that have to be cultivated? Does that have to be suggested or did he come to the college saying he wanted to do that?

Kuh: I'm sure at that time. Now with the Berkeley Engineering Fund and excellent alumni relations giving money for a chair is a standard thing. I am sure that the deans who followed me did a lot of hard work to convince wealthy people to do that.

Rubens: How were you picked to be given that chair?

Kuh: Usually the dean has an ad hoc committee, consisting of senior faculty members. Then the dean will notify all the department chairmen to nominate. So the nomination goes to the ad hoc committee and they make a recommendation to the dean.

Rubens: So it's quite an honor?

Kuh: I guess so.

Rubens: I didn't look it up, but I assume it's a remunerative.

Kuh: It's not really, because in the early days of the endowment, they made only partial funding. They finished the funding not too long ago. I think Floyd gave a total of $500,000 for the chair. Maybe at the beginning he gave $100,000.

Rubens: It needs to come up to--

Kuh: It needs to come up, so financially I never benefited, but the honor was given to me. But now it's completely funded, so the person who succeeded me on that chair in mechanical engineering, he gets the benefit.

Rubens: Now that you're retired--

Kuh: --the title stays. I'm a Floyd professor emeritus. The ME professor, Professor David Bogy, occupies that chair now. So he's the second holder of that chair. Afterwards the engineering college got many chairs. There are rigorous procedures how long people can serve on a chair. It's usually five years, but they can be reappointed.

Rubens: All right. I actually had one more question before we start your research. I was a little concerned about how to raise it exactly. During you deanship, these were the years of extraordinary corporate explosion. There were incredible amounts of money being made in industry.

Kuh: No.

Rubens: That's going to be later? That's going to be the next decade?

Kuh: Much later.

Rubens: It's the period we're going into right now.

Kuh: It is.

Rubens: The late eighties and then the nineties. My question is going to be, how were faculty compensated? How were they kept? So that's going to float out there. That's why I didn't ask you.

Why don't we turn to your research?

Kuh: Well, I think after I quit the deanship, I came back to the department to start a new area of research. I made some preparation during the last years of the deanship. I took a sabbatical leave in 1977-78 to Japan. I mentioned that. Also, in the summertime, I always took leave to continue my research activities. My student supervision actually continued until the late seventies. When I finished with my students then, I did not start with new ones. Perhaps for a gap of two years, I had no graduate students. On the contrary, the National Science Foundation support continued. I was very pleased and proud that from the second year I came to Berkeley, in 1957, I had an NSF grant. That continued until a few years after my retirement. So during a period of forty years, I had NSF support.

However, the National Science Foundation support remained at about the level of $100,000. At the beginning it could support maybe three students plus my summer research. Later on, gradually, to just one student. So clearly I needed additional research money. I had to get into a new area. That's crucial. I always take about six graduate students. To support six graduate students, it costs a lot of money. Even in the early eighties, one needed about $50,000 per student. So that's $300,000, plus my summer research and other expenses. Now, I'm sure you need more than twice as much.

Rubens: This is the calculation to get them through?

Kuh: No, no. Per year.

Rubens: Per year!

Kuh: Per year you need that much. This is quite different from the social sciences; it's huge. The NSF money was clearly not enough. But I was very fortunate in the early eighties. The first thing was that the State of California decided to fund research with industry matching. They saw the need to bridge industry and university research. So they first started the so-called MICRO program. The MICRO program is for industry to give you money, the state will match that, one to one. I had the advantage of knowing many people in industry to get industry support. It was not that difficult. Then the university would match it. I think that started in 1982. I quit the dean in 1980. So I managed to get,

even in the very first year, maybe ten companies to support me. That was matched by the university. That was a substantial amount of money.

Rubens: Did you literally have to go knock on the door of these ten companies?

Kuh: Oh definitely. Some of them know my research. So it wasn't hard.

Rubens: Were any of the same companies that had supported Bechtel and had supported the industrial liaison.

Kuh: No, not Bechtel. Bechtel was civil engineering. It has nothing to do with my research.

Rubens: Oh it had to be in your particular field.

Kuh: The key people are from Bell Labs, IBM, Silicon Valley companies and Japanese companies. I think, when I reviewed my files, I must have over twenty companies which supported me on and off during this period.

Rubens: About how much would each give?

Kuh: It varies from fifteen to $35,000 a year per company plus the matching by the state. So that took care of my research money. In addition, in the mid-eighties—maybe they did it before that—Silicon Valley companies, especially in semiconductors, such as Intel and National and Fairchild saw a need to do joint research with the university. So they've created the Semiconductor Research Corporation [SRC], with funding from government and semiconductor companies. That corporation's main charge was to support electronic engineering research at universities. Professor Pederson was asked to be in charge of the Berkeley program. He was the most well known in that area. The money was quite large. I participated in that.

They started, as I said, in the mid-eighties and continued until now. Of course the nature of the thing has changed quite a bit. Berkeley was designated as one of the two centers of excellence, together with Carnegie Mellon. That means we two got a much bigger share of money than other universities. Then we convinced them that we need to do basic research, so they don't need to tell us exactly what to do. We did write proposals, and it had to be renewed every year. That money continued from the very beginning until just a few years ago. These two sources—the MICRO program of the state, together with the SRC money—really helped.

Rubens: Let me ask you a question about the first, the MICRO program. Did the development office of the university—

Kuh: They had nothing to do with it.

Rubens: Did it lobby in Sacramento to get that going. I'm kind of curious where it came from in the legislature.

Kuh: I don't think so. Maybe the president of the university helped.

Rubens: Maybe industry itself.

Kuh: Maybe industry itself.

Rubens: Then SRC—

Kuh: Semiconductor Research Corporation, started by industry.

Rubens: Did it supplant you then to individual companies and raise money?

Kuh: No, they got together, a few major companies, and decided to fund this project and then got support from government.

Rubens: So these are two different things that are going on parallel. It's not that—

Kuh: No, my work started before, two years before. In addition, in the late eighties, there was a corporation called Sematech. Sematech was created strictly for the purpose of increasing research productivity in the area of chip manufacturing and design. That was formed with the first president, the founder of Intel, [Robert Noyce]. He had tremendous prestige. So that got money from companies which did integrated circuit manufacturing and chip equipment. That also funded university research.

Rubens: Is it contracting with the university?

Kuh: It's not quite. It just gives the money. When Bob Noyce died, the second president, Bill Spencer, was recruited from Xerox. He's a close friend of mine, Bill Spencer. He was the vice president of research at Xerox. He did a great job getting Sematech really going. It is still a very active organization.

Rubens: It remains active.

Kuh: It remains active. I remember the time Bill Spencer was appointed. A few of us were at Washington, attending the National Academy of Engineering meeting. The congress gave a reception for Bill Spencer, because roughly half the money is from industry and half from the government and Bill did a great job. He remained a close friend of mine. Bill Spencer was corporate vice president of Xerox. He started with Xerox lab head in Palo Alto, the well known research lab called Xerox Parc, which did many basic research. He also helped me in the MICRO program and gave me money for research every year automatically for many, many years.

Rubens: I don't want to dwell on this if it's not important. Under the MICRO program, you are seeking money?

Kuh: Yes industry money.

Rubens: Under SRC, it's being disbursed. Is there competition here in EECS over that?

Kuh: There's not much competition, because people know who does research in this area.

Rubens: They know who's in which particular area.

Kuh: So I always had a share of that.

Rubens: You were computer assisted design.

Kuh: Pederson was the original one in charge. Then later other people took over Computer-Aided Design.

Rubens: Okay, all right. Then Sematech—

Kuh: Sematech gave additional money and had close ties with the our people.

Rubens: And probably targets who they are giving—

Kuh: The amount of money to the university is not that big, but they provided input to SRC also.

Rubens: So as a result of this, then most of this money went to your students and your research?

Kuh: Yes, yes, that's right, but to other professors, too. And many people on the faculty benefited. I was fortunate to have had continuous support from all these agencies—NSF, MICRO, and SRC. That took care of my research funding. Of course, for the MICRO support, I had to go out of the way to contact industry. Every year, I would submit proposals. Some come automatically. Others you have to convince them. But I was also fortunate to know Japanese companies. SRC and MICRO allowed Japanese companies to support us as long as they have a US branch office. I had support from NEC, Toshiba, Hitachi, Matsushita and you name it, quite a few of them. Because I also accepted visitors from them.

Rubens: Now we are talking about a period of expansion though. Now it is when industry is really starting to—

Kuh: Now, it's coming down.

Rubens: Now. But I'm saying here in the mid to late eighties.

Kuh: From the mid-eighties to 2000.

Rubens: This is the big rise.

Kuh: The big rise that's right.

Rubens: Should you talk about your students?

Kuh: Yes, I think during this period, I must have had over twenty students, mostly Ph.D.s completed. I was very pleased with that. Each student spent about an average of five years with me. I also had—it must be more than twenty visitors. They came for one or two years from all over. Many are from abroad. They were Japanese mostly, but also I had German and British visitors, Indian visitors, Chinese visitors, from Taiwan.

Rubens: From Taiwan or mainland?

Kuh: Taiwan and mainland. So it must be almost thirty in the period. Did I point to you—there's a web page, which gave all the information on my former students and former scholars.

Rubens: I don't think so. I'll look that up. This group publications.

Kuh: Publication is part of it. I'm talking about the—

Rubens: I'm wondering who they were, but I see it identifies them. Oh wonderful. That's a useful website.

Kuh: This is the heading on my web page. Here's the circuits and the layout. The reason I call that, is that circuits is my first area of research, which continues. Layout is my second area of research. If you click that—I had a wonderful secretary who later became an administrative assistant. Her name is Tahani Stepnivitch, a very smart and efficient worker. She designed the whole thing. She learned about the web by herself way before many of our professors did. She created this. This editorial lab news, news from alumni, events, and unfortunately Tahani quit about ten years ago. So it's not up-to-date. Maybe I'll send this to you, the page. It covered different things.

Rubens: It will show me who some of these visitors are.

Kuh: Yes it does.

Rubens: And students.

Kuh: Editorials. I asked people to contribute, but that is difficult. At that time, web was in the infant stage. People didn't even know what that is. For example, in it she talked about Professor Kuh's retirement, world travels, staff changes, lab news, visitors, different people, news from the alumni.

Rubens: How would you like to do this? Are there certain students that stand out in your mind that are important to talk about?

Kuh: Yes, yes. I think there are four students that in this later period of research are important to mention. Four students, I think, really made an impact and helped me and did well. The first one was Benjamin Ting. I could have suggested him to talk to you, but his wife is very ill so I didn't want to bother him. He's the first one who actually finished his Ph.D., during my time as dean. He started a totally different kind of research from my previous research. Essentially in the design of electronic systems in the early days, you had a printed circuit board which connects all of the active devices together to create a system. The printed circuit board is to interconnect different devices, modules. How do you connect them? That's his research. He did a study, mainly to determine the routing of wires, interconnects them with constraints, physical constraints such as the width between pins—how many wires you can go through. Pins for the interconnections. Devices have pins to go out and to go in. You have to make the connection. Then many layers. It's quite a complicated job. He developed the algorithm to do that. That is his Ph.D. thesis.

He went to—I don't remember exactly the chronology, but he spent some time at Hughes Aircraft. He built up a group. Later on, he became manager. He hired many of my students who were training in the summer, and for permanent jobs. The unfortunate thing is toward the mid-eighties all the major systems companies like Hughes, like Boeing, they decided that computer aided design was very difficult to do by themselves, because the companies like Cadence that specialized in EDA were formed. They did strictly computer-aided design and they produced powerful and general software. For each company to do that it was very costly. So they decided to phase that out.

I had a very good relation with Hughes Aircraft for about ten years, until they decided to phase out the group in computer aided design. Actually, I talked to Mel Curie, the president at Hughes—he's a member of our advisory board—about how important this area was. He showed me what they do. He agreed with me, but the situation changed, so that area was phased out.

Rubens: So when you say the area at the company—

Kuh: Each big company had its own CAD group. The only companies that continue with a CAD group were IBM and Bell Labs, because they had large groups of researchers in the field. Now, they discontinued it. This was the situation on CAD activity in these companies. Then more start-ups in CAD emerged and

then some of these companies were bought out. So now the two major companies in IC CAD are Cadence and Synopsis.

Rubens: Now does Hughes—do companies like that still give money through any other mechanism?

Kuh: Well, they have other activities. In the meantime, Hughes was bought by GM. So the relation is totally different. In Cory Hall there is a room named the Hughes room. We were very close to them and they gave money. Mel Curie was a graduate student here, John Whinnery's former student. I know him very well. We had very close ties. About Benjamin Ting—when he came to the Bay Area, he wanted to start his own business. So I helped him to get together with a key person from Texas Instruments. They got along fine. That was before all these CAD companies got started. He had this idea. But he needed funding. To get funding was hard at that time, because there were very few venture capitalists. It was not easy. So I said, maybe we can go to Taiwan to get some funding. So we went to Taiwan.

Rubens: Literally?

Kuh: Yes. I talked to Morris Chang. He's now the CEO of TSMC, the biggest foundry company in the world. I even talked to the premier and tried to get support. But we were ahead of our time, and for one reason or another the company never got created.

Rubens: It never took off.

Kuh: It never took off.

Rubens: What was it that he wanted to literally—

Kuh: Computer aided design for electronics. Later on that became the Bay Area's hot area with companies like Cadence, Synopsis.

Rubens: He was just early.

Kuh: Too early, a little bit too early, so it did not catch on. Later on he formed his own company. He's very creative. He decided it's too much work to do business. He had patents. Patents were sold to companies in Silicon Valley. So he got his income from the patent royalty. Since I was advisor of that company, I benefited, too.

Rubens: This was honorable on his part that he wanted to give you credit?

Kuh: No, because I was an advisor. I was an advisor of the company. He had asked me to serve on the board. I said, "No, just 'advisor' will do." I helped him in

dealing with reviewing his proposals and gave suggestions on patents. It was not much work, but I'm amazed; money still comes in.

Rubens: The name of the company that he then formed?

Kuh: It's called BNR. He has about five people doing some creative work. They work with the companies which use his patent. That's what he does now. The thing is that he's a visionary. He started early, hired many of my students, trained many of my students at Hughes. He's very close to me. That's Benjamin Ting.

The second student is, among the students he trained is Chi-Ping Hsu. I think in terms of creativity, he's the best. If it's a decade ago, he would have gone to the university to teach, but the area became so hot, and everybody wanted him. At first he worked with Benjamin Ting at Hughes and then he joined Cadence and then went to other startups. They in turn were bought back by Cadence. So he's now a corporate vice president of Cadence in charge of Synthesis. He is extremely strong, technically. He's a man with great integrity. Everybody talks about Chi-Ping as the person with talent, with integrity, with ability. When I was asked to write a chapter on physical design for the volume, *The Best of IC/Cad: The Twenty Year's of Excellence in CAD,* I asked Chi-Ping to be my co-author. This came out in 2003. The chapter was on physical design.

Rubens: Was he an American born Chinese?

Kuh: No, he was from Taiwan. Benjamin Ting came from Hong Kong. Chi-Ping is well known in the field. They respect him.

Rubens: Where is Cadence located? Silicon Valley?

Kuh: Yes, San Jose, and all over in the world there are branches. Now talking about Cadence—this is a side story—in the mid-eighties when CAD companies started to emerge, before Cadence, there was a company called ECAD, which was very successful. One day I got a phone call. The management wanted to come to visit me. They came. They asked me to serve on the board of ECAD. Everybody knew at that time that Berkeley was the center of research in physical design because of our work. They talked to me and they later on wrote a letter with the details of the offer. I agreed. The key person of ECAD is Chinese, Paul Hwang. Paul Hwang came out of National Semiconductor and did a great job. He formed ECAD and it became very successful, in the early days of CAD. About the same time there was another company called SDA, helped by Richard Newton and a former student of Don Pederson, Jim Solomon. He also came out of National Semiconductor, which did well in a different areas of semiconductors. The two companies merged—ECAD and SDA became Cadence. So from the ECAD board, I became a board member of Cadence. I served for many years. I helped them set up the scientific

advisory committee. I chaired the scientific advisory committee of Cadence. I recruited some top people including Richard Newton and others.

Rubens: You are on the board of directors ’84 to ’91, and the scientific advisory board, ’88 – 91.

Kuh: Yes. So that was very helpful to Cadence and also broadened my view of this area. That’s my relations with Cadence.

Rubens: When you say it is “broadening your view—”

Kuh: Look, this is a book of CAD. I only wrote one chapter. It has many areas. That became a field. CAD is now a field within electrical engineering.

Rubens: Right. Is it having a direct relationship to what you’re actually researching?

Kuh: Exactly, the same area. That’s why I was asked to serve on the board. That’s why I trained and educated many students and they are all over in industry.

Rubens: Where is the research literally taking place?

Kuh: Universities where we are, right here.

Rubens: Just even physically, is this when the remake of Cory Hall comes about? I just forget the date of that.

Kuh: Well that’s just the support. The research has nothing to do with—that’s related to things you ask. We, of course need space, so this is again a sidetrack to another area. Do you want me to talk about that?

Rubens: Maybe we will get to it. I just didn’t know what the relationship was, because I know it’s starting in ’81.

Kuh: We needed space, so we had to do fundraising.

The third student was Wayne Dai. Chi-Ping Hsu finished about ’83 or ’84. The third student I wanted to mention is Wei-Ming Dai. He finished about ’88. He is always very motivated and has many ideas, but also is brilliant in research. He worked with me for about five or six years. He got his bachelor’s degree here and got his Ph.D. in 1988. He did a very good piece of work.

Rubens: Is he American born?

Kuh: No, he came from China. He decided he wanted to teach. So he went to UC Santa Cruz. He was recruited by UC Santa Cruz. While at UC Santa Cruz, he was very active. He supervised many students and got a lot of research money. He was not only good in basic research, but he was also good in

applied research. He got research grants from all over. Then later on he decided he's interested in forming a company. He started his own company. He asked me to help right away. His company is called Ultima Interconnect.

I helped him in many ways, technically, as well as making contacts. He was the CEO. The company grew to about forty people. Then he had an idea at that time to get in touch with China. So he developed some relations with China. He did quite well, but the company remained private.

In the meantime, there's another company called BTA, Berkeley Technology Associates, formed by Professor Chenming Hu, the one next door to me. His is more device area working on device modeling and simulation. Ultima was in layout, timing, etc. The two companies merged. It became Celestry Technologies. This was very common in Silicon Valley.

But it did not take long for Celestry to be bought by Cadence. Cadence was buying everything, so it was becoming the largest company in CAD. Wei-Ming Dai was very innovative, very creative. In the meantime, after the company was bought by Cadence, he had another company established in China, and he's the CEO of this company called VeriSilicon. That's his company now.

Rubens: Did you help him with the contacts in China?

Kuh: A little bit, but by then he knew so many people. He's well-known. He did some very creative work. In the meantime, he's a professor at UC Santa Cruz.

Rubens: He still is?

Kuh: Well, there's a problem, because he had to pay attention to the company in Shanghai, so he had to quit his professorship. I tried to tell him not to, because the university professor is a great job. He shouldn't have, but he resigned from UC Santa Cruz.

Rubens: Now, these students, have they been generous to the College of Engineering or to EECS, particularly?

Kuh: I don't think so. They have made money, but not big money, but they will. Wei-Ming Dai's, whole family is brilliant. His brother worked for startups. Now he's a key vice president at Cadence. His sister got her computer science degree here, married a Ph.D. in EE and then formed the Marvell Technologies, which became a huge and successful company. They provided major funding to CITRIS. In the CITRIS building, there is a microfabrication lab named after them, Marvell Technologies. So they gave major funding.

Rubens: After Dai?

Kuh: It was named, actually, after Marvell Technologies. So the two Dai brothers and the sister all came from China and succeeded. Okay, that's Wei-Ming Dai. I became very close to him.

The fourth student is the one you are going to interview. He's a very subdued, unsophisticated person, but technically he's creative. He is a professor at UC San Diego and has many students of his own, he publishes many papers and he's still very close to me. We wrote research proposals together. We did some research together. I still supervise two of his students from UC San Diego. He also started a company. [laughs]

Rubens: Now he came to you as a Ph.D. student?

Kuh: A Ph.D. student. He finished about 1984. He first went to AMD—that's a good semiconductor company. It competes directly with Intel. He worked for two years there. I got him into UC San Diego, because I know a good friend of mine, Professor T.C. Hu. I invited T.C. to give a seminar here. I introduced C.K. Cheng to him and they got along fine and they hired C.K. C.K. joined UC San Diego in 1986. He has been there for almost twenty years. He's a good worker. He was appointed vice chairman in computer science. We get together frequently. His company has also become very successful. It's a small company. It was bought by Mentor Graphics, perhaps the third largest CAD company after Cadence and Synopsis. His main interest now is university teaching and research. So I think he can tell you a little bit more about this area of research. You can ask him about my work and our relation.

So these are the four students in this area. All contributed to CAD industry. I have other students who are professors on the West Coast at UC Santa Barbara and USC. They are also doing well.

Rubens: Their research all remains in the area of--

Kuh: Some branched out to other areas. [Kwang-Ting "Tim"] Cheng at UC Santa Barbara works on testing. Testing is an important part of IC design. Tim is currently chairman of the ECE [Electrical Computing Engineering] Department. Then Massoud Pedram at USC. He's also a very brilliant and hard working person. He got a Presidential Fellowship, which is not easy. Only very few people have received that honor. He has a big group of students and he is now chair of the systems group in the EE Department at USC. So these are about the students.

We can talk about research and then we can go into maybe CAD consortia.

Rubens: Let's talk a little bit more about research.

Kuh: The research is more technical, so I'll leave it to C.K. to tell you more. I mentioned Benjamin Ting as a pioneer in this area—interconnected printed

circuit board. But later on, it's the chip design which is crucial. But then you have the same problem with physical design, how to interconnect transistor devices—first millions and now billions on a tiny chip. We call that physical design. This originated in my group, physical design.

The problems involved can be grouped into three or four key areas as I mentioned before. One is called partitioning, i.e., to divide the system or circuit to smaller parts. In order to implement a system onto a chip, one partitions the system to different pieces i.e. to smaller size so one can manage. Professor C.K. Cheng did some work on that. The second area is called placement. How do you place subsystem modules onto the chip at different places of the chip. This we did some very fundamental work with C.K. Cheng and others. On the placement problem there are two subproblems: building block placement and small cell placement. Building block you place blocks of different sizes and different functions together, in order to facilitate the interconnect. In small cell placement, you have uniform cells, called the standard cell with "point modules," which means you ignore both the shape and size. We developed software which became well known. One is called BBL, Building Block Placement. Later on we changed that to BEAR, which was done by Wei-ming Dai. The earlier work on Building Block Placement was done by Nanping Chen. He was one of the first, working with me on layout design. Both were adopted by industry, such as the Digital Equipment Corporation and ECAD, which later became Cadence. They all used the philosophy of our Building Block Placement.

The other area is called small cell placement. Because it is too difficult to design chips with Building Block Placement. So industry used standard cells. Every cell is of the same size, same shape. For that we also did some fundamental work. We provided software called PROUD, done by Ren Song Tsai, now a professor at Tsinghua University in Taiwan. Other places in Germany, where I worked in Munich, also developed a system similar to PROUD, but much more elaborate. So their system got to be adopted more in industry. But the original idea of PROUD was adopted by industry. In placement, I think we made a great contribution.

The third area is called routing. After you do the placement you have to interconnect the pins, just like the printed circuit board. There are different styles of routing. We first developed the so-called channel routing. Channel just like a street. The problem is how do you do channel routing in two layers. Then, to minimize the width of a channel, there's the problem of global routing. Global routing is to set a global strategy as to how to do the detailed routing. Here again, we did some fundamental work. So there are problems of global routing and detailed routing.

Channel routing is one kind of detailed routing. Then there's what's the called switchbox routing. It is a rectangular area with pins coming out on every side and how do you interconnect them?

To summarize, these are the three areas in physical design: partitioning, placement, and routing. In all of them we did a great deal of work. That's the early stage. Then later on, the problem is not just physical connection, but also you have to worry about constraints such as speed and crosstalk because one wire will influence another. This is what we called, later on, timing-driven layout. We had to consider many constraints imposed in order to reach the desired speed of the chip, as well as power consumption. So the second phase of our research is timing-driven design.

Later on my students worked on that and worked on the power consideration, which is important. And then we did work on validation after the physical design, in order to verify if it is correct. There are subproblems of simulation and testing. The student who went to UC Santa Barbara, Tim Cheng, worked on testing, and later on I had students working on simulation. Another student, Shen Lin, developed a simulator called SWEC, [A StepWise Equivalent Conductance Timing Simulator], which is a second generation of SPICE. After working at IBM for a couple of years, Shen Lin joined a startup company, working on the latest simulation tools.

The advantage over SPICE is that it's faster, and can handle bigger circuits. We never had the creativity of Don Pederson to broaden the software to the industry and other universities. So SPICE remained well-known to everybody. SWEC only to a few experts. C.K. Cheng continues working on simulation, and I also did some work on simulation after SWEC. That's another aspect of CAD.

Rubens: Just for those who aren't in this field and aren't used to the work process, are you reviewing? Literally, what is the work process like? Are you sitting and talking with your students? Are you looking at formulas and adjusting them? Physically how does it literally happen?

Kuh: We're just doing basic research and seeing the problems exist. How do you formulate the problems and solve those problems? So we know the SPICE simulator, which depends on many different algorithms, which in turn depends on some mathematics. Some have limits. We have to improve on them. We have to partition the circuit into smaller pieces. One is when you do the simulation, you have to solve a large number of equations. So how do you speed up the process? One is to do integration. When you do the circuit simulation, you have to develop an integration algorithm. All these combined. To develop software is a very tedious process. It takes time. It takes many iterations. So that's the process.

Rubens: So are you literally reviewing? You're reading, you're going over?

Kuh: I don't go into the code. They do the code. We just talk about the basic research, including algorithm development, how do you solve these problems. I see all my students, every week. During the peak, I had maybe six or seven

students, and had four or five visitors. I had a whole room full of students in that CAD lab. I spent one hour per week with each.

Rubens: Usually individually?

Kuh: Individually. Then I would have group seminars. My visitors would talk. That's the kind of typical structure of team research.

Rubens: Because this is what constitutes your teaching load, is that right?

Kuh: No, these are seminars. Some are formal, others are informal. The visitors come and we have seminars.

Rubens: So the period we are talking about is the mid-eighties--

Kuh: Until my retirement.

Rubens: Are you teaching undergraduates?

Kuh: I teach undergraduates and I teach graduate courses. Some of the graduate courses are regular seminars. I guess I should talk a little bit about teaching.

When I came back to the department, I taught an undergraduate course, based on the course we call EECS 104, which Professor Desoer and I started with that book. We figured that we needed to add some new material, especially non-linear circuits. So we invited Professor Leon Chua to join us. This led to the writing of the book, *Linear and Nonlinear Circuits*. That was published. From the early eighties to the mid-eighties we taught a course together. We wrote the book together. That's the undergraduate teaching activities.

Rubens: '87 is the publication date.

Kuh: Yes, but that book came out—again it became too hard. It involved too much material, so it was not as well received as the first book. *Basic Circuit Theory* which made a much bigger impact than this book. But we added quite a bit of material. It's a big book.

Rubens: And you used it in your classes anyway?

Kuh: We used it and it was used in other places, for example, Professor Wei-Ming Dai used it at UC Santa Cruz. Other places used it, but it did not get adopted by many, because it was much too hard.

In terms of graduate teaching, I started first to teach a course on circuit simulation and a graduate seminar course on CAD. Just on the circuit simulation part, I had to learn quite a few things. I had my graduate students helping me as TAs.

For the graduate seminar course, I organized a basic course on circuit layout. I offered it quite a few times. That's all new material, a collection of published papers. I also invited visitors to give lectures from time to time. To teach a graduate course which is totally new, is hard work. That's the philosophy of a university like this, you start with research, you offer graduate seminars, and then that course becomes a regular graduate course. The material was later transferred to undergraduate courses.

Rubens: When you talked about your research groups and developing the software, I wonder if there was an encounter with the office of technology or whatever it was called—the patent office?

Kuh: Not exactly that, but I remember the department by then had an office of software.

Rubens: The EECS itself?

Kuh: Yes. We distribute software to industry. They paid a nominal amount of money. Later the work load got to be too much, so the department decided to quit all of that. The encounter with the university patent office had to do with a particular area of research done by another student and a visitor. It has to do with the Field Program Gate Array (FPGA). There are companies in Silicon Valley which do only that, like Xilinx, Altera, etc. These are companies which do a special kind of chip design. You can program the chip. Once the chip is designed, there's the software. These two people working with me, my student Narasimha Bhat and a visitor, developed an idea which is different from the standard. So they wanted to file a patent. Then we met with the university patent office, and then I learned something about this exclusive vs. non-exclusive patent. The arrangements are different. 'Exclusive' means you have a company sponsor, and the patent belongs to them together with the university. Other people have to pay royalties. There's non-exclusive, which is given to other companies too. So anyway, the patent was filed and they decided to have non-exclusive with the lead company, Texas Instruments. I decided I was not involved in the invention, so the patent should be issued to the two inventors, the student and the visitor, along with the university. They got the standard arrangement. Inventors got half or one third of the royalty. They negotiated with the patent office. That's about it.

Rubens: Was that a big--?

Kuh: I don't think it was big.

Rubens: What did you call it?

Kuh: FPGA, Field Programmable Gate Array. 'Gate array' is the kind of cell, like what I mentioned standard cell. Gate array is an array of cells. So that's what the patent's about.

Rubens: I'm not getting the distinction. The BEAR software and PROUD, are those non-exclusive?

Kuh: Those are just software, we don't even think about patent. The FPGA work contains specific ideas, which can be patented. Software you usually don't patent. The biggest contribution of Professor Pederson's SPICE is that he decided from the beginning that he wanted to make that software available to everybody. The university never got money directly from that, but as a result, because it's the first thing people do is circuit simulation, students use them, industry used them. So that became extremely popular. It is the standard circuit simulator program even to this day. Companies were formed which got a lot of money. They gave money back to the university and created the DOP Center. It became very successful.

Rubens: What you are saying is that these others were just not that order of contribution?

Kuh: It's much less. The impact of SPICE is huge.

Rubens: Are these still used?

Kuh: Oh yes, there are different versions now. Industry has companies that make different versions, which are used in industry. The original SPICE, I don't think is being maintained now. See, with software, you have to maintain it. It is very difficult. Pederson had a generation of students working on SPICE. That's difficult. My students on SWEC, only one student did that work, and that was used strictly by my group and some other people in industry. But we cannot maintain it.

Rubens: What makes the difference of maintaining it or not? Just if you have a critical group?

Kuh: Right, to keep the program up-to-date, you need to maintain it. That depends on students who continue the work, and that's difficult to do.

Rubens: Is that a missed opportunity, looking back at it?

Kuh: That takes a different kind of people to get that done.

Rubens: We have not discussed fundraising for re-doing the fifth floor and the CAD/CAM consortium.

Kuh: The fifth floor may not be such a big story. It was because I was thinking that you need literally a lab. I was trying to see it physically. It fits in with the CAD/CAM consortium. We got a lot of money from industry. The whole thing is that you need money to support research. You also need space.

Rubens: I just wanted to go on record, Ernie that I had a wonderful discussion with C.K. Cheng. A couple of points that he pointed out that I thought were so terrific that he said you're more than an advisor and intellectual generator—that wasn't his word. It was two words—that you provided vision and leadership. But more than that, you were a cheerleader. He said the kind of personal support that you brought and the enthusiasm and the constant encouragement-.

Kuh: --that's nice of him.

Rubens: --were qualities that were very extraordinary and unusual, and that's what he hopes to bring into his own teaching; it's that which has influenced him tremendously. He said also particularly the way you organized material was so cogent and so clear. He had studied three of your books in Taiwan before he came here.

Kuh: Oh, really. He never told me that.

Rubens: So he said that he was quite prepared. I wanted to tell you that and I wanted to have it on the record, here.

Kuh: One reason I suggested him is because I have worked with him for a long time. I also know many of his students.

Rubens: That's what he said. He said also that it was you who really gave him that idea, "Why don't you go into business?" It was very important for him to have you on the board when he opened his company because in laying out his paradigm shift of merging logic and layout—you said, "Why don't you found a company?" He then created CLK CAD. One question he asked me to ask you is, how did you develop such a sharp sense of business?

Kuh: I don't think I had that compared to some other people like Richard Newton. He's really outstanding. I have had contact with industry during that time. I was department chairman and especially during the dean period. Then later on I served on the board of Cadence and interacted with the community EDA, Electronic Design Automation.

Rubens: Going way back, you had done some consulting. You had not been ever in an ivory tower. You've always been in some way aware of or sat on the board or consulted for businesses.

Kuh: Yes, but that is early consulting with IBM. That's strictly a research collaboration. Later on it was mostly with government. Also I was on the board of General Motors Institute. Even though it's a university, it had industry flavor. We met with the GM board of directors to talk about the university there.

Rubens: I was going to ask. We didn't discuss that.

Kuh: That's just a minor thing tied to industry. But mainly it's because the deanship that really broadened my view.

Rubens: Coming to the position for the Bechtel Center, meeting with all the--

Kuh: That's just the consequence of that, but all along we had developed this Industry Liaison Program and got to know the college advisory board members very well. I worked well with them.

Rubens: So were you beginning to—would you read the business page of the *Chronicle.*

Kuh: We always subscribed to two things: the *Wall Street Journal*--

Rubens: You did at home?

Kuh: Oh yes—and *Business Week*. We always did for many, many years.

Rubens: Why was that?

Kuh: Oh, I had some investments in companies. I wanted to know more about the business world. The Wall Street Journal is a wonderful paper. It has different things, not just business. We read up all their front page stories.

Rubens: I love those.

Kuh: The full stories.

Rubens: So you had developed, you had educated yourself.

Kuh: I wouldn't say educated. I just tried to know more.

Rubens: To keep up.

Kuh: I don't have a business background. I only took an undergraduate course in economics at the University of Michigan. I did poorly. [laughs] That's true. But that was the first year I came to the U.S., so that's—[laughs]

Rubens: Exactly. I'm just wondering since I'm on this business line, when things start to explode in the late eighties, do you see that business or increased wealth had any particular impact on people you were mentoring?

Kuh: Sure, even the character of the students and faculty have changed a great deal, because they found out there is wealth beyond what can be earned from being a professor. For young people, you can become overnight a millionaire.

People are interested in doing innovative work with industry. Especially if you look at Stanford. Yahoo started there. Google. These are good examples of what students can do. Students' orientation has changed a great deal, leading toward industry. More of our students go to industry after they finished. The faculty members become more involved with the companies. In that respect we're behind Stanford and MIT. The private universities started way before us. But now the pity is some faculty think too much of that. They don't emphasize much about scholarly work. That's bad. We should have a balance. We have always been strong in scholarly research, teaching work. We also have business related research work, which make impacts.

Rubens: Could you give me an example of what would be scholarly as distinct from business impact?

Kuh: That's very clear. You do research without thinking about short term impact. Many of our so-called systems theory group such as in control theory, communication theory, they study mathematical related work in engineering, which has very much long term impact and no short-term impact. So it's closer to science.

Rubens: So Berkeley is strong in that area?

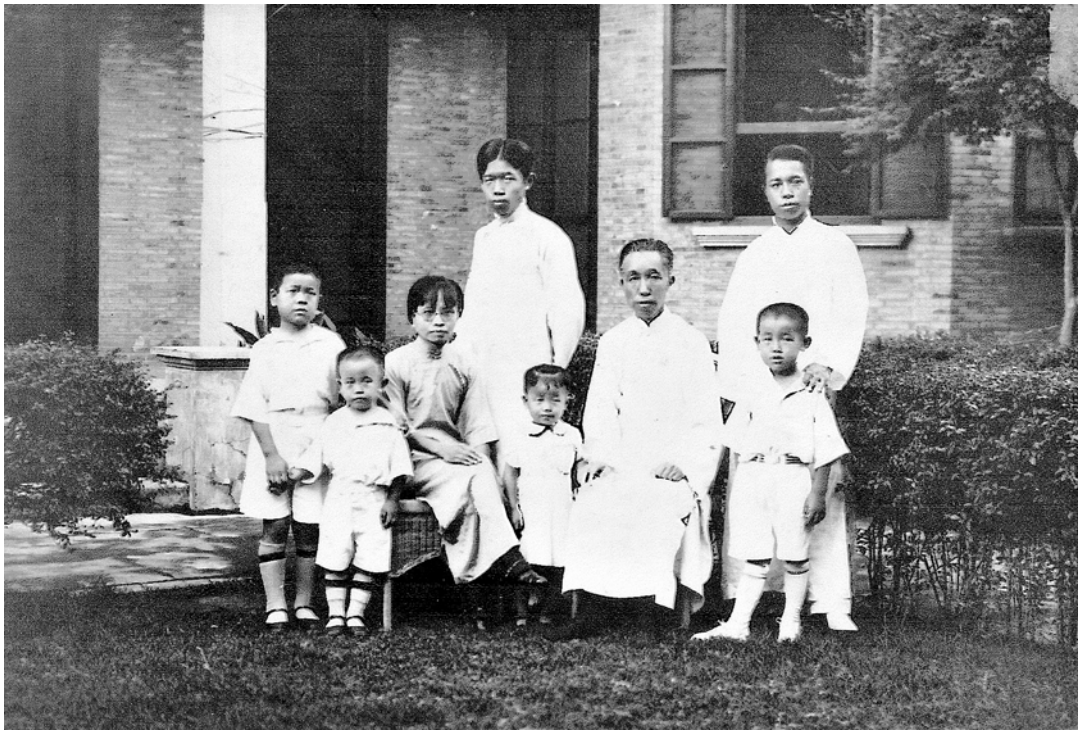
Kuh: We're strong in that too. My two close friends, Professor Desoer and Professor Zadeh, they are the leaders in the so-called systems group.

Rubens: It was post deanship to you, but it must have been an issue about what to pay faculty to keep them.

Kuh: Well, yes. That's a problem. In the UC system, we convinced the system to give special salary scale for engineering and business school professors. That started maybe in the early eighties. So the university saw to it. But that's minor adjustment. Still that broke the system. Before, every body gets the same salary scale. Other than law and medicine before, everybody is the same. The next step was engineering, computer science and business, a second category.

Rubens: Were you a part of that? Did you help design that?

Kuh: No I didn't. We always argued the salary is not good enough, so administrators know about it.



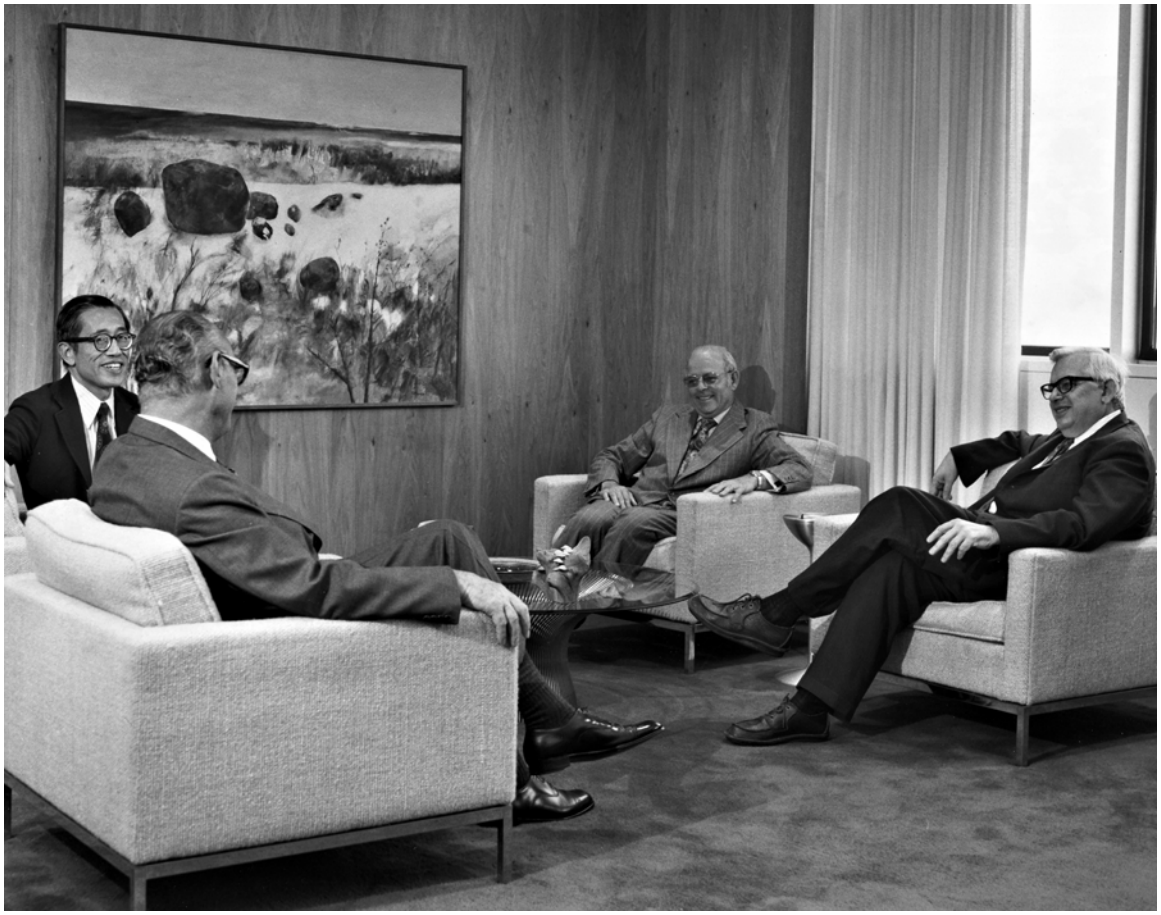
Family home—Beijing, 1932. Ernie second from left

Family Home—Shanghai 1944. Ernie with glasses front row center

Engineering Alumni Society Past Presidents—1974. Standing: Phil Bradley, Andy Marshall, Ward Downey, Lou Oppenheim, Ray Lundgren. Seated: Jim McCarty, Sam Ruvkun, Clyde Bentley, Ernie Kuh

First Meeting of Alumni and Industry Leaders—UC Berkeley, 1974. Eneas Kane, VP for Research, Chevron Corp; Ernie Kuh; George Maslach; Ward Downey, Chair, Engineer Alumni Society (1973-74)

Five Deans: George Maslach, Michael O'Brien, Donald McLaughlin, John Whinnery, Ernie Kuh—Berkeley, 1974



Ed Garbarini, Ernie Kuh, GM VP Ernie Starkman, Chancellor Albert Bowker at General Motors headquarters—Detroit, Michigan, 1977

Groundbreaking of Bechtel center—UC Berkeley, 1978. Eugene Trefethen, President, Kaiser Industries; Ernie Kuh; Chancellor Albert Bowker

Elizabeth and Stephen D. Bechtel, Jr.—UC Berkeley, 1980

Ernie Kuh Speaking at Dedication of Bechtel Center—UC Berkeley, 1980
Photos courtesy of Bechtel Corporation

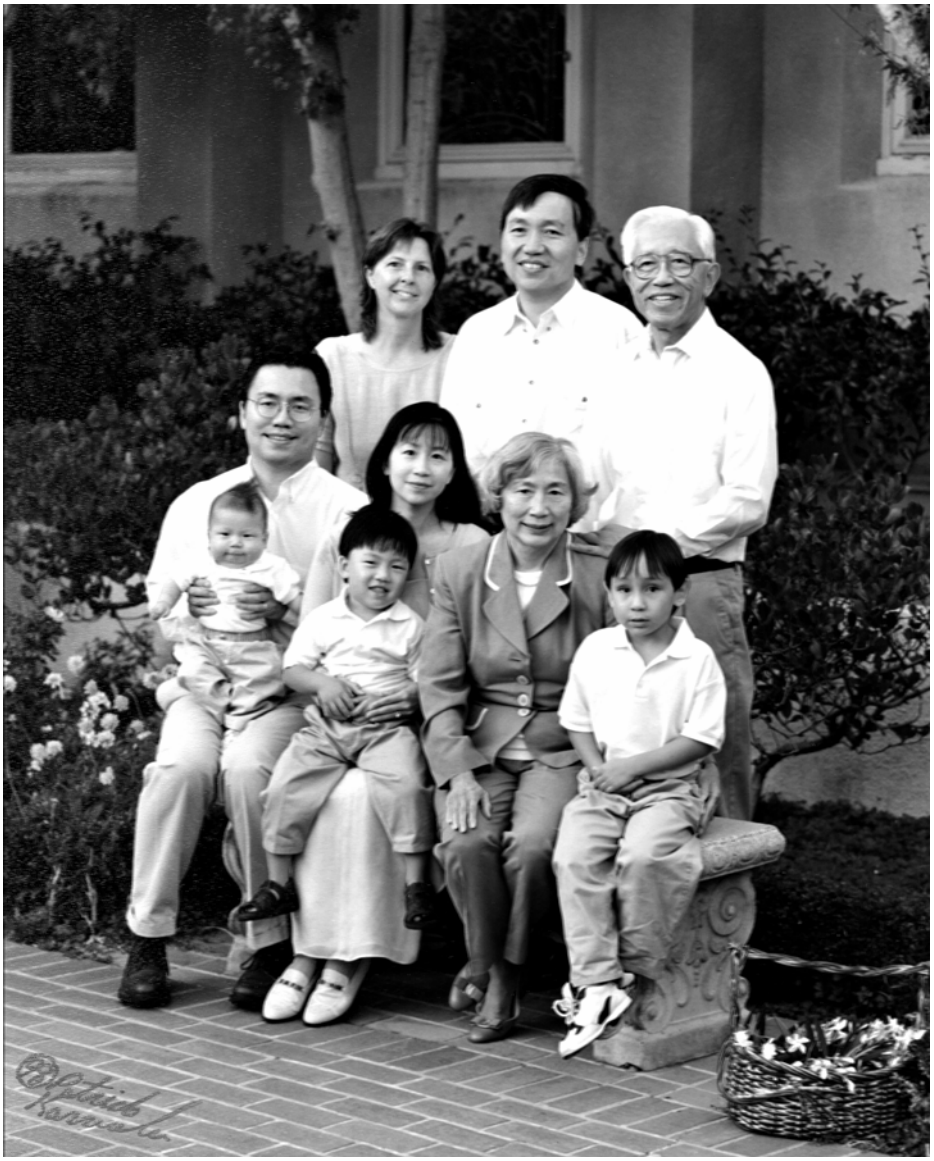
Madame Zhou En-Lai, Deng Xiaoping, Ernie Kuh, Bettine Kuh—People's Great Hall, Beijing, China, 1983

Ernie Kuh and Chang-Lin Tien—Tienanmen Square, Beijing, 1984

Ernie Kuh with Jiang Zemin, Mayor of Shanghai, 1986.
Jiang was later President of the People's Republic of China, 1993-2003

Japanese Society for the Promotion of Science, Computers, and Communication (C&C) Award—Tokyo, Japan, 1996. Don and Karen Pederson, Ernie and Bettine Kuh, Ronald and Casey Rohrer

Phil Kaufman Award, EDA (Electronic Design Automation) Consortium—1998. Aart de Geus, Chairman and CEO, Synopsis; Ernie Kuh; Richard Newton, Dean, College of Engineering, UC Berkeley



Ernie Kuh 70th birthday celebration, 1998—Berkeley, California. Back row, standing: Joan, Tony, Ernie. Middle row, Ted, Christina, Bettine, Matthew. On laps, Evan, Jason.

Chapter VIII: Service to the Universities, the Academy, Government, the International Community, and the Profession

Rubens: Tell me about your committee work.

Kuh: There were many committees that I served on. Even during my tenure as dean I served on many outside committees. I was elected to the board of director of IEEE. That was very demanding. I served on the review committee of the University of Michigan, which appointed the dean there. Of course, I served on many more committees and boards afterwards, for example I served on the National Science Foundation Advisory Committee and many others.

Rubens: As of ’81, you were a member of the Electrical Engineering and Computer Science Industrial Advisory Board. Was it presumed you would join? What is that?

Kuh: That’s a department committee. We haven’t talked about that.

Let me just group all of them in separate categories. The university committees under that UC system versus outside, including international. That’s one category—university-wide committees. The second group of committees is government: NSF, NIST, NAE (the National Academy of Engineering), and NRC (the National Research Council). The third category is professional society committees: IEEE, CAS Society. These are the major committees that I participated in.

There are too many to go through. That’s why I gave you some samples. One is the UC Berkeley Budget Committee. I think that is significant. I can say a few words about that. Then I would like to talk about outside advisory committees. There were the University of Michigan review committee, the MIT’s visiting committee, et cetera. Then I would like to mention some international university committees, such as Hong Kong, Taiwan and China. I don’t know if we have time to go through all that.

In the first category, let’s talk about UC Berkeley first. I think I mentioned to you already. There are three most significant, most important committees: the budget committee, number one; the chancellor search committee, number two; the law school review committee, number three. These are the most important. I enjoyed very much serving on all three of these committees. I think the committees made some impact.

The budget committee, if you don’t know, is the single most important committee for the Berkeley campus. The reason that Berkeley is ranked so highly throughout is because of the budget committee, because it reviews appointment cases, promotion cases, merit increase cases, department or college budget allocation. Rarely the chancellor or provost will veto our recommendation. This is most crucial. Even though other UC campuses have

the same committees, they don't have such power and strict regulations. They don't take the same form. I think the reason we can appoint and promote really good people is because of the budget committee. The special resolution, which deals with the grossly incompetent faculty, came out of that.

Rubens: Let me just ask you a question. You are nominated to be on that committee, is that right?

Kuh: You're nominated by the Committee on Committees, yes. You serve for three years usually. Usually there is always an engineering professor represented on the committee of nine people. It changed from seven to nine over the period. In the last year, when I served as chairman, there was another engineering professor who served on that committee. That's because that engineering professor has to do all the preliminary reviews of the engineering cases; the chairman can not possibly do that. The chairman has other duties. That's why during my term as chairman, we reviewed the special problem of grossly incompetent faculty. That report came out with a great deal of concern and study as to the best way of dealing with that. Fortunately, as I mentioned to you before, we had two former deans of the law school on the committee, Ed Halbach and Sandy Kadish who helped me draft the report.

Rubens: Now was this your idea? Did you, as chair, raise the topic?

Kuh: No, I think the problem came through the committee over the years. We realized that there is such a problem. There are professors who are totally inactive, but they hang on. How does the university get rid of them, because he or she has tenure. So that's why we came up with this 'grossly incompetent' description, which means they are more or less incompetent in teaching and research. For that the campus has a case to make, but the department chairman has to initiate the case. Every faculty is reviewed at least once within a five year period. During that period, if a professor is judged grossly incompetent, the chairman can propose the case to the dean and go through the procedure. I may have mentioned that because that happened shortly before the early retirement [VERIP], we didn't have to use it afterwards for many years.

Rubens: Because, in fact, people took the--

Kuh: VERIP. Many people took early retirement. But I think the time has come to use that, because there is no retirement age and some people want to hang on. If he or she is totally non-productive, then a case can be made.

Rubens: Did you have a sense of how the issue had made its way up? Were there a couple of outstanding cases that someone had brought to the—

Kuh: Oh yes, through the regular review of the budget committee cases. Especially one I won't name. That has come up. That's why we studied the problem carefully.

Rubens: So this was not a particular issue of yours, something that you had—

Kuh: I made a presentation to the Academic Senate, when the committee work was finished.

Rubens: The whole?

Kuh: Yes, they approved it. Then the Berkeley campus sent it on to the system-wide. Other campuses reviewed it and only one school, UCLA, did not approve it. It took them a long time to go along. Finally it was approved. It's a system-wide rule.

Rubens: By the way, had you been throughout your career, attending Academic Senate meetings? Were you a regular?

Kuh: No, but as the chairman of the budget committee, it's crucial to attend the meeting. Also we met together with Chancellor Heyman, once a month with the committee chairman of key committees. So we met together. I also attended system-wide committees representing Berkeley. Once, Chancellor Heyman asked me to attend a regents meeting to make a presentation. I went with Heyman to Los Angeles for that Regents meeting.

Rubens: On this particular topic?

Kuh: [pause] I think it came up along with other things also, yes.

Rubens: I actually meant before you were dean and even chair, had you attended academic--

Kuh: I attended some meetings but not many with the exception during the FSM time. There were meetings of interest, but not all the time. When I first started, as I mentioned earlier, I was writing a text, had a new family. You know professors are usually so busy with their own work and only a small minority attend the regular meetings. Usually when a hot issue comes up, people attend the meetings, sometimes, they cannot even reach a quorum.

Rubens: Yes, that's exactly what I wondered. By the time you became the chair of the budget committee, you probably had a greater interest in the--

Kuh: Yes, I had to make the presentations. Ed Epstein was the chairman of the senate, and he was good.

Rubens: During the period was there pretty good attendance at the Academic Senate?

Kuh: I think it's about the same.

Rubens: One issue that was afoot was the divestment of the university's holdings in South African companies.

Kuh: I was not involved in that. There were many, many issues I had no special interests or was not involved.

Rubens: How do you become chair of the budget committee? You were appointed to it in '85. In '88 you become chair.

Kuh: That is a decision within the committee on committees and the budget committee's current chair. They get together and decide. They decide the next chair.

Rubens: One serves as chair for just one year?

Kuh: Yes, three years is by rule the maximum number of years as a member. The third year, one person out of nine becomes the chair.

This kind of committee you get tired of it, because you review all the personnel cases. You have to write them up. I think I enjoyed being the chair, because you run the meeting and then you hit the broad issues, such as the grossly incompetent issue. You write letters to the chancellor. Then you initiate the discussion with the chancellors and provosts in difficult cases.

Rubens: Are people lobbying you?

Kuh: No, that's one thing that's a tradition. There's supposed to be no contact among the budget committee members and the administration and faculty. There's no contact.

Rubens: There's been an honorable tradition about that?

Kuh: Yes, I think so. Maybe there are cases unknown to me where there is some lobbying, but you are not supposed to.

Rubens: You did not experience it?

Kuh: Not at all. Nobody approached me.

Rubens: I spoke to Dave Hodges, who said that when you joined the budget committee, this is his phrase, you showed, and this is his phrase, that "engineering has a place at the table," that it can be seen as the intellectual equal of any of the other departments. He thought that that was your real accomplishment, that there had been consistently a prejudice against

scientists; I don't know what he meant, perhaps that they did not have a broad regard for the whole campus.

Kuh: That was maybe before my time. I think already engineering has come up.

Rubens: Oh certainly, and I think you had a lot to do with it. Hodges also said that your work though the Dean's Council of Deans, and the support you got from Bowker, really showed the rest of the university what engineering could do, that it really made engineering and yourself a serious "player at that table" was his expression.

Hodges and I then got off into talking about the two different times that studies were made about the issue of overrepresentation of Asians in the freshmen class, in the admitting class.

Kuh: I had nothing to do with that. I thought he would say something about my teaching and research.

Rubens: Yes I'm sorry I didn't say that earlier. He said you were a wonderful classroom teacher. You were well organized and clear. When he looks back, he thinks that you were probably the best teacher that he ever had on campus.

Kuh: Well that he exaggerates.

Rubens: I'm quoting from him and my information interview. This is what he said. He did talk about the teaching, about the book, about two books. What is it you just said to me that you thought he would talk about?

Kuh: Research. He's not that close to me, but he knows I move from one area to another, to electronic design automation, which is closer to his field. But I guess he didn't get to it.

Rubens: He said, "Get back to me if you need to."

Is there anything else you want to say about your tenure on the budget committee?

Kuh: No, I think that's about it.

Rubens: Then you moved to the chancellor's search committee.

Kuh: That's just one example. I think that was interesting. I'll just mention briefly. The chancellor's search committee has a faculty subcommittee, which is the most crucial part. That usually has three members from the Berkeley campus and two from other campuses. I was a member of that committee.

Rubens: How would you get on that committee?

Kuh: Just like any committee of the system-wide. The president makes the recommendation. I was pleased that our committee came up with the name of Chang-lin Tien. That succeeded. There was extensive discussion on some candidates. There were so many cases. If you go through the list, there are, as I mentioned before maybe, about 200 names. Some of the typical names are considered by committees for presidents and chancellors from all over the country. But some you can disregard, dismiss right away. Finally you have to think about the top ten candidates.

The other case I mentioned is serving together with Budd Cheit on the law school review committee. That opened my eye to the other side of the campus. The law school, the business school are not top ranked like engineering, because major private universities usually have strong traditions and endowments for business and law schools. The public schools don't have those kinds of resources to run a professional school, except engineering. I understand the problems. I met with good people and reviewed many problems.

Rubens: You're reviewing everything, is that right? You review the curriculum, the hiring the promoting.

Kuh: Everything and the dean.

Rubens: The dean and what they are emphasizing at the time, I assume, and then it was development, fundraising.

Kuh: Well that of course came up, but at that time, it was not a key issue. But they had to build a building, so of course that's important. I think during that time maybe they started.

Rubens: You are on this committee from '91 to '93. Was there any outstanding finding that you came up with?

Kuh: Well, we gave a very thorough report. I did not give you that report. There were very extensive recommendations. I also interviewed the budget committee chair at that time to find out how law school professors fared. We reviewed the compensation. Many things were involved, yes. So it opened my eyes to another professional school. It was a very good school, but we came up with some recommendations.

Rubens: When you look back on it, were there one or two things that were the outstanding problems of why it wasn't ranked more highly?

Kuh: The main thing, as I said, were the resources of the public school, to support a professional school. That's why, now, the professional school tuition has gone up so much recently. For the law school and the business school, there are

additional tuition fees to enter those schools. So they tried to increase the resources.

Rubens: One would think that the law school could have set up something like the Industrial Liaison Program.

Kuh: I'm sure they had something, but my impression is that they were not that active. Maybe they are now. I'm sure they had some review committee or models.

Rubens: The last couple of years there was the scandal with its dean. It was impacted by Prop 209, the affirmative action.

Kuh: So they always get on the news. That's another thing the dean has to face, yes.

Rubens: But apparently now they just--

Kuh: They found a very good new dean. Ederly.

Rubens: That's what I understand. And they launched a huge capital campaign. We'll see how that goes.

Okay, had you worked with Budd Cheit before?

Kuh: Well, as fellow deans. He was the business school dean when I was the engineering dean. So we overlapped for perhaps five years. He's a great guy. As I mentioned before, he was executive vice chancellor when I was the department chair, I invited him to our first industry liaison meeting to give a keynote speech.

So I like him. It's the same thing with Dean Sandy Kadish of the law school. We have had very good relations.

Rubens: He was the dean of the time?

Kuh: He was a contemporary of mine at the Council of Deans. But later on we served on the Budget Committee and on the Committee of Committees together. So I've known at least two deans very well.

Rubens: Now, you wanted to discuss one other committee?

Kuh: Well, I served for a long time on the UC Davis engineering college advisory committee.

Rubens: Well just one more about Berkeley, just about the committee on committees.

Kuh: That's not interesting.

Rubens: All right, fine.

Kuh: I should go into others. Just the system-wide, let me just mention quickly, UC Davis I served for a long time as the dean's advisory committee, because I convinced the chancellor there to hire that dean.

Rubens: Of the College of Engineering?

Kuh: Yes, he was a former student here.

Rubens: What was his name?

Kuh: Mohammed Ghausi. He did very well to really change the UC Davis engineering school from a kind of teaching college, to a research. He did very well. He served for a long time, at least ten years.

Rubens: How is that you got on that committee?

Kuh: The dean appointed me. The dean's advisory committee.

Rubens: From?

Kuh: Ghausi appointed me. He recommended to the chancellor to appoint me.

Rubens: When you say a long time, let me look at my notes: you were there '87 to '98.

Kuh: That's right.

Rubens: That is a long period. How does that work?

Kuh: Just once a year, we review their program and give recommendations. On the committee, most people are from industry. I had an engineering advisory board that had mostly industry people too. Some of these committees like MIT's visiting committee—maybe I should talk about that next.

Rubens: Okay.

Kuh: I got on that. I served two terms, three years each.

Rubens: This is 1985. From 1985 to 1991? Again you are picked by the dean of the engineering school?

Kuh: By the provost there, I think. He knew me. We served on some IEEE committees together. He became dean and then provost. He invited me to serve even though the appointment officially came from the MIT alumni organization for some reason. They nominated people. Of course, the university administration also suggested the people. That's a high powered

committee. For the first three years the chairman was Frank Cary, the retired CEO of IBM. They had top industry people. They also had four or five university people, including a professor from Stanford, including a woman professor from UC Santa Barbara. She's very distinguished.

Rubens: Who is she?

Kuh: Evelyn Hu. She is a member of the National Academy of Engineering, very distinguished. She now heads the UCLA and UC Santa Barbara center on nanotechnology. She was on my committee. I forget the others. The second time, the chairman was the chairman of Analog Devices, Ray Stata, also a very well-known person. He's a very wealthy person, an MIT alumnus, and he gave a lot of money to MIT. Now the MIT EE building is named after him. During the six year period, when they had the meetings, the president and chancellor of the MIT system—even though it's one institution—both came to meet with us for two days.

Rubens: Really?

Kuh: Well the engineering school is the biggest thing at MIT. There was one problem, I think which we resolved and made some impact: At MIT, the EECS department has had the tradition to keep their graduate students for a long time without finishing up. Doctorate students can stay there for nine years before they finish up. Master's students for six or seven years after their BS. The chairman brought up the subject. We studied that problem. The committee recommended to offer a master's of engineering degree for five years starting from freshman year. If you decide on that track, you don't go to research later on, you take that. It's more technology oriented. That kind of degree, we may consider it here. There's a committee to study that now. You get a bachelor's and master's at the same time—a master's of engineering. There's no research. The Ph.D. degree is from the bachelor's of science. After a four-year program, you enter the Ph.D. degree. Then they have to set up the guidelines so that professors will not keep the students that long. After that review, the department, I think enforced the issue. It became more or less like other schools, keeping the duration much shorter. So I think we made that important impact.

Rubens: When was this about? Do you remember?

Kuh: Well, unfortunately, I had to miss two meetings, so I don't remember exactly when.

Rubens: That was earlier in your--

Kuh: Later.

Rubens: I was going to ask you. I was thinking while you were telling this, you must have gotten ideas that could be useful at Berkeley. You're using an example.

Kuh: No this idea came up again here recently.

Rubens: So it's not necessarily something you brought back. Are you in favor of that kind--

Kuh: Yes, I think it is good to have two tracks. This has not been decided here yet.

Rubens: This is a silly question. We can cut it out: when you go to a two day meeting like this as a visiting committee member, do they pay for you?

Kuh: Oh, yes, sure. They pay everything for the trip. They treat us well. I don't think they paid the industrial members, but they always paid the academic. It's good to interact with industry people. That way I also got to know some key people there.

Rubens: Sure, MIT is still considered the leading--

Kuh: By tradition, they are number one. But in recent reviews, Berkeley, Stanford, and MIT are tied for number one.

Rubens: Are there any other issues?

Kuh: No that's about it. Let's go to international. I served on several committees, at universities in the Hong Kong area. I served on the advisory committee for the Institute of Information Science of the Academia Sinica in Taiwan. Let me just mention that. One task, I undertook was to serve as chair to recruit a director of that institute. I was successful in picking somebody from Northwestern University to go to Taiwan to serve as director. He's still there, so I was pleased. For that, I worked closely with Y. T. Lee. He's the president of the Academia Sinica. The computer science institute is one institute in the Academia Sinica. It's called information science, not computer science. But I also helped Y.T., because when he went there from Berkeley, he did not know much about computer science.

Rubens: Oh, really?

Kuh: Well, he's a professor of chemistry. I arranged for him to visit Xerox Parc. That is the top computer science research lab in the country. He appreciated that.

Rubens: What was it that you thought that was outstanding about him that you would make a good director of the Sinica?

Kuh: I'll tell you, it is not that easy to recruit somebody from the U.S. to go back there. They have to be interested. The pay, I think, is comparable, but to change from U.S. to Taiwan, unless you really want to go back to Taiwan, it's not that easy. I contacted many people and convinced him to serve.

Rubens: So willingness is the number one quality?

Kuh: Yes, but he has to be good enough.

Rubens: He's still the--?

Kuh: He's still the director.

Okay, let's talk about Hong Kong. The key university I advised from the beginning is the Hong Kong University of Science and Technology. They started a new university, appointed President of San Francisco State University, Chia-Wei Woo as their president. He was a physics professor of UC San Diego, and was a provost there, too. Then he was appointed as San Francisco State president. From there, he went to Hong Kong, to head the appointment as president of HKUST, the Hong Kong University of Science and Technology and to start the new campus. At that time, Hong Kong decided to do something about higher education. As a side comment, I think they have overdone it. There are too many universities. But HKUST was well funded. The money came from the jockey club. At the beginning, $600 million was allocated. President Woo and the architects built a beautiful campus in the new territory in Hong Kong.

Rubens: This was the Hong Kong Jockey Club?

Kuh: Yes, the Hong Kong Jockey Club. They are the wealthiest organization in Hong Kong. President Woo, of course, I knew him for many, many years. He came to talk to me about the idea of starting the engineering school. I also recommended Professor Ping Ko of our EECS department to help him, because he is from Hong Kong. So naturally he appointed me as a member of the engineering advisory board. It has good people. Many deans from the U.S., plus the Rector of the Imperial College in London Eric Ash.

Rubens: How often would you meet?

Kuh: At the beginning, maybe more often. Later on, once a year. It included Chancellor Henry Yang at UC Santa Barbara, former dean at Purdue. At that time he wasn't chancellor yet. I think we really help them to get them oriented. They had so much money. Their target for faculty is huge, for instance the number of positions. You can't believe it. We got them to trim down to concentrate on areas of maybe of interest to Hong Kong to make it more reasonable. We helped them to recruit department chairmen.

Rubens: Where were they drawing their faculty from?

Kuh: Mostly from the U.S. The salary was so good. It's much higher than the U.S. professors. They had so much money at that time, and they attracted quite a few good people from the U.S. They also appointed Professor Eugene Wong. He was their vice president in charge of research. He did a great job. I think he made an impact on HKUST.

Rubens: That would require trips to Hong Kong?

Kuh: Yes, once a year. So I served for many years. The dean, H.K. Chang, did such a good job, and later became the president of Hong Kong City University. He still is the president of the City University.

Rubens: That's a more prestigious or bigger university?

Kuh: Less prestige. There are three top universities: Hong Kong University is the oldest; the Chinese University is the second oldest; and the Hong Kong University of Science and Technology. These are three research universities. They try to really raise up the standards. The Chinese University was organized, originally by Clark Kerr. Clark Kerr helped them and recruited Professor C.M. Li of the business school here to be their first president. Hong Kong has always had a tie with UC Berkeley.

Woo, by the way, did a great job setting up the new university, HKUST, with enormous resources. So that's the third.

Rubens: And do you have any particular links still to them? Do they send scholars here, or do you send--?

Kuh: No, no, not that way. It's mainly through administration. Their first dean, H.K. Chang, was a professor at USC. Also, the current dean I knew very well. He was from Intel. There are some contacts, but not much.

The Chinese universities, let's save that for the Chinese relations section. So this ends the university advisory committees.

Rubens: I just wanted to make sure. I thought you had mentioned one other--

Kuh: I helped UC Riverside to get their engineering program straightened out. I helped UC Irvine, working with the dean, with their problems. These are minor things. Anyway system-wide I served in many functions, including the chancellor's search committee for Irvine. I think that is the end of this. For the University of Michigan, unless you want to ask questions, I'll give you the written report. That's another example.

Rubens: Was that typical of the extent to which your views were made.

Kuh: That's a very thorough review. It actually included two groups. Later on I wrote the report for both groups. We were a little bit critical of them.

Rubens: Yes, it must be a fee of diplomacy to write something that--

Kuh: Yes I tried to be more diplomatic, but we essentially told them what the problems were. Maybe as a result they have an EECS like us. The current dean at Michigan is a former student here, Steve Director. He was a member of that review committee too. He was dean at CMU at that time.

Rubens: How is Michigan ranked now?

Kuh: Berkeley, Stanford and MIT are number one. Next comes Urbana, Illinois. The next group is maybe Michigan, Purdue and—

Rubens: That's pretty up there.

Kuh: Oh, Michigan was a big school. It's bigger than here.

Rubens: It seemed to me that one of the critical elements, in reading your review of Michigan, was the lack of collegiality among the older faculty and the younger faculty.

Kuh: They didn't seem to interact very well.

Rubens: It seems so different from Berkeley. But I didn't quite get what you thought accounted for that.

Kuh: Many universities are that way. Our department is unusual.

Rubens: That's what I'm really asking. What accounts for that?

Kuh: I think there's a good tradition. I think the administration in the early days with John Whinnery as department chairman, made a difference. He recruited good faculty. I think he set up a good example to make our department more collegial.

Rubens: I've asked you periodically throughout these interviews if there was competition or hurt feelings or—

Kuh: Well, you can always find some individual cases, but on the whole it's very minimal.

Rubens: Well, they all seem to advance simultaneously.

Kuh: I think one thing is the system with the budget committee review is very thorough. The department chairman and the dean do not have that much

power. In some other universities, the department chairman hands out merit increases and salary increase. Sometime the dean does it. Here it's strictly an academic, scholarly review. Maybe that's the reason. The atmosphere was created very early. I think I give credit to John Whinnery.

Rubens: Yes, you do. So is there anything that you wanted to say more particularly about Michigan?

Kuh: No.

Rubens: Was it difficult?

Kuh: No, it wasn't difficult. We enjoyed that committee, worked very nicely together.

Rubens: That was a national committee?

Kuh: Yes, a national committee of faculty, of professors, chairmen from different places.

Rubens: Is industry on that committee?

Kuh: No, it's strictly academic. There was a similar committee at UC Riverside. I chaired that committee and reviewed the College of Engineering at Riverside. I mentioned briefly that I helped them get that started.

Rubens: Was there a big parallel to Davis?

Kuh: No, they are much smaller, much newer.

Rubens: Yes, but the emphasis of getting them to do--

Kuh: The problems are different.

Rubens: Is it much more applied?

Kuh: No, I don't even remember right now, but they have different problems.

Rubens: On what committees do you continue to serve? I know we are going to get to Taiwan.

Kuh: Not any more in Taiwan. The Academia Sinica is the only thing I want to talk about.

Rubens: All right. This is National Chiao Tung University?

Kuh: Oh that's only recently that Dean Newton asked me to help redevelop a tie. We signed an agreement to exchange in a broad way. Richard Newton wants

to have ties with leading universities in Asia. Yesterday the president of Tsinghua University in Taiwan came and I brought him to see the chancellor and tried to set up something. That has not materialized. But in the past two years, I've been helping Richard Newton to develop a tie with the National Chiao Tung University. An agreement has been signed, already, specifying that they will send some of the best of their undergraduate students here to the department. This is the one thing that we will start right away. But other plans include very broad exchanges.

Rubens: When was the last time you were in Taiwan?

Kuh: In July when I attended the Academia Sinica meeting.

Rubens: Are those yearly?

Kuh: Every two years. I went there, not that frequently, but both Chiao Tung and Tsinghua invited me to be there. I was a chair professor at Tsinghua as a visiting professor and received an honorary degree from Chiao Tung. I'm very close with both.

Maybe we should talk quickly about the government. I served for many years as a consultant for the NSF as a member of its Engineering Division Advisory Committee. I interacted with their director and reviewed their programs. Too bad I do not recall exactly what we did. I just know that we're very close. The NSF is always changing their organization to get into new areas. So we had input in terms of new divisions, new groups within engineering.

Rubens: Now the NSF had been one of the mainstays of you research funding.

Kuh: There's no conflict at all, because research funding is so small from the NSF. This is strictly advisory. The government is very careful.

Rubens: How do you become an advisor?

Kuh: Usually they ask the leading university professors and the administrators. Also, since I'm a member of the National Academy of Engineering since 1975, they also nominate people. They ask the academy to nominate people on these committees. As to the National Academy of Engineering, the thing I remember the most, maybe I mentioned it to you: in 1975, when I got elected, Vice President Nelson Rockefeller came and gave a wonderful talk. I remember that very well.

Rubens: What did he talk about?

Kuh: I can't remember. It's 1975.

Rubens: But you remember him.

Kuh: Oh yes, sure. He was such a charming and impressive person. I also remember very well one nice reception at the eighth floor of the State Department for NAE [National Academy of Engineers]. I served on the nominating committee for one year and we met at the Bechtel building in San Francisco, because at that time Steve Bechtel was the chairman of the nominating committee. He invited me to serve.

The third one is NIST, the National Institute of Science and Technology. I served for many years on that at different levels. First just electrical—then at the institutional level as a member. I reviewed mainly technical things.

The fourth one is the NRC committee at various times for different functions, including the review of graduate schools ranking.

Rubens: National Research Council?

Kuh: The third area on committees—I mentioned three areas—is professional. I was most active within IEEE. That's my own area. I guess the initial thing was that I was elected chairman of Circuit Theory Group. That was 1972. During that year, the function changed. I proposed to change the circuit theory group to the Circuits and Systems Society. Then I became president of the Circuits and Systems Society. When IEEE had been formed, I don't know how many years earlier, by the merger of two big organizations. One was the IRE, Institute of Radio Engineers; the other was the AIEE, American Institute of Electrical Engineers. We merged them to become IEEE, maybe forty or fifty years ago. Now it's the biggest professional society worldwide, with over three hundred thousand members. My initial contact was with the Circuit Theory Group. I served on their board when I was at Bell Labs.

Rubens: Oh, I see.

Kuh: So I was the president of the society. I was elected as a board member of IEEE. I served a two year term. That was a very busy board. We'd meet six times a year. It was during the time I was dean. I did not particularly enjoy that board, because there was friction between very professional people and those who were more scientific. The professional people wanted to talk about the implications to the society. They wanted to talk about the engineering union workers, because the membership had many people from industry. There was always some kind of friction.

Before, IEEE was always an academically oriented society. The presidents of IEEE usually came from a university, or were very prestigious people from industry. From that time on, they formed the USAB [United States Activity Board]. IEEE is supposed to be transnational. They wanted to promote the professional benefit of engineers, which was not my cup of tea. They were always fighting. There was also a regional activity board in conflict with a technical activity group. Regional activity was usually aligned with USAB.

The professional activity and technical activity had conflict. The important thing for many of us is to have the science orientation prevail as their top priority, because that's what all the journals and technical meetings are sponsored by—the technical activity. I was a member representing technical activity. So that's why we always had conflict on the board.

Rubens: I can understand what you are saying about unions. But implications to the society, what was that? Environmental?

Kuh: Not much. In terms of lobbying the congress and doing things for the engineers. I wasn't involved. The technical people did not think that should be a priority, so they were fighting. Now it's better. Of course, for the CAS Society, I did quite a few things. One thing was that I chaired a committee for long-range planning.

Rubens: That's where Kang worked with you.

Kuh: He was the secretary of the committee. He may have been president of the society at that time. But most of that committee consists of past presidents. And he was a junior member. He was organizing the whole thing. I got key people to serve. I essentially came up with the names of the committee, including special task forces. The list is there. We divided into four areas. We had very extensive discussions and came up with a report.

Rubens: Can you summarize just for the oral history what this was. We'll have the report in the appendix. This was in 1990. This was a committee meeting.

Kuh: Yes.

Usually there are thousands of people attending annual international meetings. We started the international symposium in the early seventies. I guess I played a role in that. I was very active in that. But the three things that I'm very pleased with—I edited three special issues I mentioned. One is the issue of the fiftieth anniversary of the founding of the IEEE. Another is the centennial issue of the AIEE or IRE.

Rubens: The hundredth anniversary of the AIEE.

Kuh: Yes the AIEE, which later on became IEEE. So I edited the special issue in January 1984.

Then in '99 I edited the special issue for Darlington. I invited top people to write papers. Then I edited a special issue in my technical area, physical design.

Rubens: Yes, this is October '83, yes?

Kuh: It must be eighty-something. Yes it was very early.

Rubens: Yes ’83, it reads you were “the guest editor IEEE Transactions on Computer Aided Design of Integrated Circuit Systems.” Here’s an article, “On routing in microelectronics.”

Kuh: I think I invited some pioneers to write papers.

Rubens: In fact it says, “formed January ’82.”

Kuh: The IC/CAD journal was formed in 1982. So the founding editor, invited me to edit this special issue, because at that time this area was very hot.

Rubens: I read your introductions. Those must have been really demanding. You must have been under a lot of pressure to have them be top notch.

Kuh: Yes, and I was pleased with those special edited issues.

Rubens: I have a note to ask about a notice: “January 27, Interconnect modeling and simulation: a distinguished lecture in computer electrical engineering.”

Kuh: That’s just one lecture. There were many such things I attended.

Kuh: Do you think we’ve covered most of your significant committee work?

Rubens: It gives a quick overview. I think there’s a lot.

Regarding your memberships—The National Academy of Engineering, The National Academy of Science, the Academy of Arts and Sciences.

Kuh: I’m only a member of the NAE. I’m not a member of the next two.

Rubens: You’re not a member of the Academy of Science or the Academy of Arts and Sciences?

Kuh: No, I did not get in there.

Chapter IX: Travels to China; Scientific, Professional and Administrative Exchange in Asia

Rubens: I'd like to have this chapter begin with attention to your early trips to China. And then, because you particularly have had such a vital role in opening up scientific and academic and even business relationships with China, Hong Kong, and Japan, to discuss the evolution of that activity and your on-going relationships in the far east..

Kuh: I did not prepare it, but I thought I would try to depend on my memory and talk it out. As I told you before, The first time I returned to China, after I left to study in the United States, was twenty-five years later, in 1973. I talked about this some in my first interview with you.

This took place shortly after President Nixon's historic visit in 1972, and after China had sent some delegations over here –but very few. A delegation from the Chinese Academy of Sciences visited Berkeley, as well as other major universities. They gave a reception and the Berkeley campus gave a reception. There was a good exchange. They then visited other top universities, Stanford, Harvard, MIT, and maybe Princeton, Colombia. Anyway, we, the campus host, including a number of Chinese faculty, had a very nice visit with them. One of the Chinese professors, I don't remember who then said: "We'd like to pay a visit to China." We didn't get a firm answer at that time.

Then we were fortunate to have an invitation from the Chinese Academy of Sciences.

A few of us at Berkeley, including Chang-Lin, decided how to go about preparing for the trip. We organized a small group of five people. Professor Eugene Wong of our department, Professor C.S. Hsu of Mechanical Engineering, and Professor Hsing Wu-Yi of Mathematics. That's five of us from Berkeley. Then Professor Hsu requested if he could include two of his friends, one from Stanford and one from UCSD to join us. The one from UCSD was a very distinguished Chinese professor, Y.C. Fung. We all knew him, some superficially, some knew him quite well. Of course we agreed. The one from Stanford, no one except Professor Hsu really knew him but since he was from Stanford, we said "Okay, we'll have him."

Rubens: What were their disciplines?

Kuh: Professor Fung, was very broad—bioengineering and mechanics. Professor Zhao from Stanford was in aeronautical engineering. Anyway, the group was formed. We elected Tien as our secretary and asked him to make the plans and contact the Academy for the detailed arrangements of the itinerary. We decided to go in mid-June for a one-month trip. We also asked them whether we could include our family members. So I brought mine. Professor Tien

brought his. The Stanford professor brought his. The UCSD professor brought his whole family. Thus there were four families.

We entered China through Hong Kong. Since this was during the Cultural Revolution, we decided to buy the Mao Zedong jackets. Everybody had one to wear. We walked from the end of the train station in Hong Kong into China through the area which is now called Shentsen. At that time it was nothing and now it is a huge city and has large manufacturing business sections and a population of 4.5 million people. It was amazing. That was thirty-one years ago and it had absolutely nothing.

Rubens: What is it that you are calling it?

Kuh: Shentsen, if you see the map, it's there, because it's big city now. Actually, together with Shanghai, they are the biggest import-export cities. We took the train from Shentsen to Canton, the biggest city in the south. We were met by the representatives of the Academy. They provided maybe seven to ten cars. Essentially each family had a car. That was very unusual at that time, because there were hardly any cars on the streets. We were treated royally. We stayed for maybe just one day or so. We visited the commune, got a briefing on how it worked. The people who took care of us accompanied us for the one month. There were three people. They were very nice people, but most of the things they would talk about were the slogans, "Serve the country. Serve the People. Self-reliance." That kind of thing.

Rubens: Were they actually scientists?

Kuh: No, they were not. We learned a lot about the country just by talking with them. When we got to Beijing, we had the same kind of treatment in terms of taking care of us well, staying in the best hotel and having the cars. The official reception was given by the president of the Academy of Sciences, President Kuo Mu-Jo—he's a very famous social scientist— and well known author. Many people in the U.S. knew about him. President Kuo and I had a picture taken together and it was published in the *Matrix*, together with my talk, after we returned. That issue, I don't know where I put it. You returned it to me, right?

The first thing that impressed us was the dinner reception at the People's Great Hall. There were seven tables. Including the host, there must have been sixty, seventy people, but the head table was a huge table where I sat. It was a round table, which seats more than twenty people. I sat next to the vice president of the Academy. Our head, Professor Fung, and Chancellor Tien as the secretary, sat next to the president of the Academy, President Kuo. We talked about various things, and that was very interesting. But the most memorable occasion was when we went to visit Tsinghua University. That was the place where the Cultural Revolution started. They had no class then, but we met with some professors, administrators and the students. The most

interesting part was meeting with the students. The professors and administrators did not say very much. They were very quiet. But the students were very outspoken, aggressive in a nice way, very articulate. We talked about what the country should do.

Rubens: Were they interested in learning about the United States?

Kuh: Oh, yes, of course they were.

Rubens: Or were they interested in condemning the United State?

Kuh: No, they were not. We knew about these people. We called them Hun Wei (Red Guard) Soldiers, but they were not soldiers; they're very young. They were the people who caused problems during that period. Maybe some of them started the Cultural Revolution. I gave my book on basic circuit theory to the professors. They didn't say anything. It turned out that later on, that book made a great impact, because it was a new treatment of circuit theory, and they never understood circuit theory that well; but they studied it. Since then, every trip I go back to China, I always met people who used the book, knew about the book. So essentially that opened the way for their education in electrical engineering.

Rubens: Did someone translate in China?

Kuh: Yes, they translated it. As I mentioned before, this book is translated into Japanese, into Italian, into Russian, and it's adopted especially all over in Southeast Asia. From there we visited a district which was famous, because they used some revolutionary approach to agriculture there. There were two famous places they always talked about in that period. One had to do with their petroleum production in the Northeast of China, where we did not go. One is this area, which was on the way to Xian. We decided we wanted to visit it. That was interesting to us in terms of the farming activities, the communes. It's a beautiful area. It was well planted —rice among other things. That was an eye-opener for me and many others who had never been to the countryside of China. From there we took the train to Xian. Xian is the ancient capital of China with many historical sites. At the train station the Academy representative plus the province representative met us and had a meeting with us at three o'clock in the morning. One of our professors, the youngest one in the group, Professor Hsiang in mathematics, got so interested in the discussion and asked questions about the rice production and other kinds of data. Most of us were very tired by then.

We visited the Jiao Tong University in Xian. The same name as the Jiao Tong University in Shanghai. My wife and Eugene Wong's wife decided they were not interested so much in visiting universities, because there are so many historic sites. They read up on China and decided to visit a museum, which has the recent archeological findings, dated 6,000 years ago. They went by

themselves and had a great time with my two boys. We also visited the tombs of Empress Yang and we all took a bath there. Maybe I mentioned to you before; we visited a place where they caught Chiang Kai-shek during the Xian incident.

Rubens: Yes, in our first interview, but not in detail.

Kuh: Before the Sino-Japanese War, there was internal fighting between the Communists and Nationalists. The person in charge of the Nationalists there thought that maybe since the war with Japan was coming, it was better to get the Chinese Nationalists and Communists together. So when Chiang Kai-shek visited Xian, they captured him and tried to bargain with him to have a unified front against the Japanese. There was a place, a pagoda where Chiang Kai-shek was caught when he tried to escape. We visited many other historic sites.

Rubens: What was the name of the place your wife went to?

Kuh: Banpo. That's a famous place. From there, we took a long train ride to Nanjing, the capital of the Nationalist government before the war. We walked by our old house. It was interesting.

Rubens: Did it look the same from the outside?

Kuh: Yes, it looked the same, but many people now lived there.

Rubens: I think you told me nine families.

Kuh: That was the Shanghai house. One interesting development was that they just completed the bridge across the Yangtze River in Nanjing. That was a big accomplishment. Before the war, they used ferries. We took pictures on the bridge and there were hardly any cars. Our whole group of twenty-some people were walking on the bridge and taking pictures.

Rubens: The cars they arranged for you, were they made in the Soviet Union?

Kuh: No, they were made in China, all made in Shanghai. From there we went to Shanghai. Many of us gave technical talks in Shanghai, not in Beijing. The Academy of Sciences sponsored the talks. We went to Jiao Tong University, but it was closed; and we could not get in. In Beijing, the university started to open. During the early days of the Cultural Revolution they were all closed. Shanghai was still like the old days. There was nothing new. It was a very old town. That's where I visited our home in Shanghai. Then we did some sightseeing.

Rubens: Your talk was on circuit theory

Kuh: On whatever research I was doing, yes. Then I mentioned to you before, I met my brother and the host invited him to go with us to visit the famous scenic city, Hangzhou.

Rubens: Was this the same trip where your nanny--?

Kuh: That was much later. I think I mentioned this before. My brother wanted to invite us to his place for dinner. At that time, they had to ration food. They could not buy much meat, at most once a week, perhaps. During our visit, the host knew that he was going to invite us, so they gave him special coupons to buy anything he wanted for dinner. He really cooked a good dinner for us in his cramped house.

Rubens: Was it a single?

Kuh: No, there were multiple families. I think they shared one kitchen and shared one bathroom. There were two families, I believe, one downstairs, one upstairs.

Rubens: How long since you had seen him.

Kuh: Twenty-five years.

Rubens: He never left?

Kuh: No, he never did. We returned to Shanghai from Hangzhou. I remembered Hangzhou when I was a kid. It is still as beautiful as ever. There is the famous West Lake where people take scenic boat rides. We then returned to Shanghai and to Canton. They arranged for us to go to a hot spring near Canton to rest for a day or two, before we left for Hong Kong.

Rubens: Did you see much development in terms of computers there?

Kuh: When we visited the Academy of Sciences, they had maybe one computer which they built. They showed it to us; they were very proud of it.

Rubens: That they had built it?

Kuh: Yes, they built it themselves. Self-reliance, that was the key theme then. They wanted to build everything themselves. But they may have had other computers for military use but they did not show us that.

Rubens: Were you one of the first academic groups to be invited?

Kuh: We were the second. There was another group, which included U.S. professors from all over the country, although the majority were from the East Coast. That included Professor Ron Shen of physics here. He went before us.

Rubens: Did you meet with him to prepare?

Kuh: I'm sure we did. They went early. They had one advantage—they met Premier Zhou Enlai.. We did not, because he was sick. So we only met with the president of the Academy of Sciences.

Rubens: You mentioned the vice president and I didn't get his name.

Kuh: The vice president of the academy was Professor Wu, a physicist; very distinguished.

Rubens: Your trip was all people of Chinese descent. Was that true also of the first trip by academics?

Kuh: Also theirs. Only the Chinese got invited. At that time there was no exchange with the foreigners. So we got invited because of our contact with our Chinese host. They knew us by name, at least, some of us.

So that was the first trip. It was an eye-opener. It was exciting. It was interesting. The only thing was that during the Cultural Revolution there were some inconvenience.

My second trip with my wife was 1977, the first exchange visit for IEEE. There were ten delegates, headed by the president of IEEE. Our host was the Ministry of Electronics. At that time, everyone in the United States was interested in visiting China and developing exchanges, so IEEE contacted the Chinese Electronic Society, that happens to be people within the Ministry of Electronics.

We saw many factories in Beijing and Shanghai. I would not use the word ancient, but they were very old and dirty and had tiny rooms. There was nothing to really talk about. They were way behind industrially.

At that time some of the universities started to open. This is shortly after the Cultural Revolution. When we visited the library of Peking University, they didn't have money to pay for the IEEE journals and magazines. The IEEE president agreed to send them the whole set free for them to use. They were very appreciative of that. Of course later on, we found out that was copied all over in China, so most universities had a set. That was our second U.S. trip to China.

In 1978, when President Carter decided to open the relations with China, diplomatic relation was established, and Deng Xiao-Ping was invited to visit the U.S. I met him in Washington as a member of CSCPRC, the Academy's China Committee. Of course I didn't get to talk to him, just during the reception.

That gave him a chance to see how the U.S. was at that time, compared to China. So maybe he understood in his mind, at that time, that China needed to drastically change in order to catch up. He was the top person in China then, but he did not have an official title as a leader. He never wanted that. I think he was just the vice premier. Right after the Cultural Revolution, there were still some old guards at the head of the government, but he was the most influential one. He survived the Cultural Revolution and turned out to be the most powerful person. Deng changed China in the next fifteen years. He was the prominent leader of China and everybody gave him credit for planning and rebuilding China.

In 1981 I joined a group sponsored by CSCPRC. [Committee on Scholarly Communication with the People's Republic of China] That's the China committee I mentioned earlier. This was a National Academy committee headed by Lou Branscomb, a vice president of IBM. He was very good. He used to be the president of the American Physical Society. We had China experts and leaders of various Academies. Our committee met frequently and talked about China exchange—real exchange, bringing people here. I went to Washington frequently because I was a member of that.

Rubens: What's the weight of the talk about exchange? I can understand that the talk is about how to help them modernize, but what are you getting out of it?

Kuh: No, this is not just about science. People here were interested in China, especially with the social scientists, and the historians. They were extremely interested in China. Anytime you mentioned China, there was so much interest among the American people. It was not exclusively a scientific exchange at all. It was the cultural exchange, that was the main thing. So that committee met frequently. Professor Townes of Berkeley, later on, took over the chairmanship of that committee.

Rubens: When China finally standardized it's translations to pinyin, did Berkeley accept it at the same time?

Kuh: Once they changed it, of course. One thing that's interesting that you may or may not know. The characters were changed too to make it much more simplified for about 1000 key words. So for a period—even now—I do not know some of the characters. I have to guess, but I've learned more now. That conversion made the language easier to learn.

Kuh: To finish up the visit of '81, we learned a lot and had a good time.

Rubens: That was eight years after your first visit. Are you seeing some modernization and progress.

Kuh: Yes, progress. Mostly in Beijing, hardly any in Shanghai.

Rubens: In terms of the state of computers, are people talking to you about that.

Kuh: Slowly, there was not a drastic improvement.

Rubens: Who else was part of the delegation of the CSC?

Kuh: It included the treasurer of the National Academy of Science and the foreign secretary of the National Academy of Engineering, my friend, Bruce Hannay. He was the vice president of Bell Labs. He was the chairman of my engineering advisory board.

Rubens: Yes, I knew I knew the name from somewhere.

Kuh: Then I mentioned that social science was represented by Fred Wakeman, from the Department of History here at Berkeley. I don't remember the name of the organization. Then the corresponding person in the humanities, headed by somebody in the east. These heads of the different councils went, and it was a delegation of about ten people.

During that visit Bruce Hannay and Lou Branscomb, chair of CSCPRC, and I talked with the key members of the Chinese Academy of Sciences who represented engineering. That gave them the idea to start their Academy of Engineering. So that was the impact made at the academy level. Of course, the Academy of Science and Engineering had developed other exchanges later. That was a short trip.

In 1982 I was invited to go to China, together maybe with a dozen Chinese scientists and engineers, by the Chinese government. The agency was the State Commission on Planning. We were there for one week in Beijing, giving lectures in different areas. We met with the vice premier Fang Yi, to whom I wrote a letter afterwards, which we'll include in the appendix to this set of interview. By then we knew more about China, and especially the universities. I specifically made some suggestions about the universities and the Academy. I mentioned the difference between the U.S. system and the China system. We have no research within the National Academy of Sciences. It is just an honorific organization. Their research in the Chinese Academy of Sciences is huge, like in the Soviet Union. Also, I pointed out that at their university, they have the tradition of keeping their own students, which is very bad. It's an inbreeding system.

Rubens: Did you think that more independent labs should be created?

Kuh: No, not labs.

Rubens: You were making the distinction between basic research and--

Kuh: For the Academy. Yes, they need to do more basic research. They need to collaborate with universities and there was no relation. I read over that letter recently. Some of my suggestions they have accepted. Later on, perhaps the early 1990s, the president of the Chinese Academy of Sciences, Professor Zhou, visited Berkeley. We had lunch together at the chancellor's house; by then Tien was the chancellor. Then he asked some of us to give opinions on certain things. I wrote another letter which is in the file.

Rubens: Of the Chinese Academy of Sciences?

Kuh: Yes, he visited us here. These two letters indicate the suggestions I gave to them, put in writing. Of course when we were there we talked about these things too.

Rubens: When you said the National Commission of Planning, was that their commission of planning?

Kuh: Theirs. I think it was the State Commission on Planning. That was the top organization for planning. After the official meeting, my wife and I went to Urumagi, Turpan and Dunhuang in the far Western part of China. We were fortunate that the famous Dunhuang caves just opened and we saw fabulous collections of frescos, dated some 2000 years ago.

The next trip was 1983. That trip was organized by a professor here. He's the professor at the University of Santa Clara. He does research in graph theory. Of course I also do that. He invited me, a professor from Purdue, a professor from Ohio University. Four of us stayed together for a one month seminar to the Chinese Academy's graduate school. They hosted a month-long class on advances in graph theory, but I spent one week there and gave four lectures. Others stayed longer. We took advantage of that trip and visited Kunming which was new to us. We also visited Chengdu, and did some sightseeing.

Rubens: Your wife was with you on that trip?

Kuh: Oh, yes; she accompanied me on all these trips, except on the Academy's delegation.

By the way, because the professor at Santa Clara's father was a top general in the Nationalist China, who actually knew Deng Xiao-Ping, we were received by him again, a second time, in the People's Great Hall. That was the second time I met him. He told us about his plans for the economy. By the end of the century he said, he hoped that the professors could earn salaries of 800 yuan per month. At that time, it was perhaps 40-50 yuan. He had a long-term vision. Every time he met with us, the vice premier in charge of science—Fang Yi was there. And for this meeting, Madame Zhou En-Lai was there. Actually, in one of the pictures when I was with Deng, she was right at his side. So that was a nice visit.

Rubens: Did she say anything particularly?

Kuh: Oh yes, she was outspoken. She's well-respected.

Then in '84, a few of us were invited back to China. I remember from Berkeley Professor Ron Shen of physics and Chancellor Tien. He wasn't chancellor yet. It was just very few of us, to celebrate China's thirty-five year anniversary for the founding of the People's Republic of China. We were received by premier Zhao Ziyang, who later was disgraced during the Tiananmen Square incident in 1989. That was a trip strictly to celebrate. It was a very impressive event. I remember in the Tiananmen Gate where we observed the celebration, Deng Xiaoping came standing on a limousine convertible followed by all the ammunitions. He was the head of the military in addition to the title vice premier; it was very clear that he had the power. Before that in one of the trips, I think it was in '77, with IEEE visit, we also had a reception at Tiananmen Square with a celebration. At that time, the premier was Hua Guopeng. He served very briefly right after the Cultural Revolution—he was kicked out by Deng Xiaoping. So China changed quite a bit during that time.

In '85, when we had the International Circuit and Systems Conference in Japan, in Kyoto, the Chinese Academy wanted us to organize a side symposium on circuits and systems. I was asked to be the honorary chairman. The counterpart, our host, was the vice president of the Chinese Academy of Sciences, Professor D.S. Yan. We had a meeting in Fragrant Hill, outside of Beijing. The hotel was designed by the famous architect I.M. Pei. It was a brand new hotel at that time. The Chinese really had a good organization. They had people from all over China come.

Rubens: How many people about were there?

Kuh: On the U.S. side?

Rubens: Yes.

Kuh: I would say at least fifty and maybe fifty from Japan. From China they had several hundred. That was a meeting jointly organized by us, held in Beijing, in 1985.

The next two trips were in '86. One was a private trip, because the company on whose board I served wanted to explore business in China.

Rubens: Which board was that?

Kuh: This is the ECAD board. There were four people from his company, plus my family. We went and had a great time. I had a good friend in the Chinese

Academy of Sciences, vice president Yan. He hosted us. At Shanghai Jiao Tong University, they hosted us. I made some contact for the company.

Rubens: Did anything come of it eventually?

Kuh: They developed some business with them. Then on the next trip, Shanghai Jiao Tong University celebrated their ninetieth anniversary. That was a good celebration. That was when President Jiang was the mayor and I first met him. We had a detailed chat of his plan for Shanghai. It was a good discussion. I have a picture of that too. During that trip, we also visited the northeastern part of China, Harbin, Changchum, Shenyang and Dalien, the four big cities. Everything was different. The northeastern part was called Manchuria. That was occupied by the Japanese for many, many years.

Rubens: It was 1931 when they went in.

Kuh: Yes, and you still can see some old Japanese influence in the buildings. I lectured at Harbin University of Science and Technology and the Dalien University. It was a good trip.

1988, I think was the next trip. I am just trying to remember chronologically. Maybe I skipped some. I was invited primarily by Fudan University to lecture. That turned out to be the best university in Shanghai now. Throughout this period and even before that, the president of Fudan, Tsinghua, Peking, and the head person at Jiao Tong all came to Berkeley, and we signed agreements between Berkeley and these top four universities. But these agreements were very superficial. It turned out that helped many of our social scientist and linguists who went to China to do research. China sent some visitors to work with us. I had three Chinese scholars, actually during the later part of my deanship, who stayed on for two years. Two of them turned out to have done very well. They published some papers and they continued their research after they went back.

Rubens: What did you mean by the fact that they were superficial?

Kuh: Because there was no official program, and most of the exchanges were only for one time. Of course, the tie was there so that enabled our social scientists to make some contact. Subsequently they may have visited China again, but there was no official program. During the visit of our engineering delegation to China in l979, Provost Maslach agreed to pay for some of the scholars.

Rubens: Did you have to lobby for that?

Kuh: The Maslach delegation went to China at the invitation of Tsinghua University and Shanghai Jiao Tong University; they were the hosts. We discussed about having exchanges.

To recap, the ’88 trip was to Fudan. I gave lectures. I stayed in Fudan’s guest house. President Xie was my host. She had earned her Ph.D. from MIT. She’s well-known and had visited the U.S. before many times. She also arranged for us to visit the famous Yellow Mountain (Huangshan), a scenic place in China. That was quite a trip. We took the cable car up from the back of the mountain, but the host suggested we shouldn’t climb to the peak because it’s very narrow with steep steps. We all stayed in the back of the mountain. We saw the sunrise at four o’clock in the morning. It was quite a sight. Many people who visit China visit the Yellow Mountain.

There was supposed to be a trip in ’89 and that would be technical, but the meeting was cancelled because of the Tiananmen Square incident.

Rubens: I have been thinking all along while you were talking that we were leading up to this. I can’t remember what was the source of the conflict for the Tiananmen Square stand-off.

Kuh: In the late 80s, the Chinese government became more liberal and there were professors from the university spoke out about the changes that were supposed to be made. The party secretary, Premier Zhao was a very liberal person too, very good, and he supported that. But then it got out of hand, with demonstrations in many cities, so the Communist government, high up, decided to clamp down. Toward the end of May, 1989, there were a lot of demonstrations in Tiananmen Square. There was a statue raised representing peace. There were so many people at the square every day, and finally the government decided to act, even though Premier Zhao was much more sympathetic. There was a real division within the government. Zhao had to come out to speak to the students, and he even cried in the public. He tried to calm them down. Then Li Peng the vice premier, with the support of Deng Xiaoping decided to fight it out. They brought in the army and many people got killed.

Rubens: So this is in June and you--

Kuh: I was supposed to go in September for the meeting, so that was cancelled. I think we did not go to China for maybe two years. During that period I accepted a student from Tsinghua. He was getting his Ph.D. from Tsinghua even though it was under my supervision. In the early 90s they had the Ph.D. examination for him and they invited me there to serve on the committee. We visited Tsinghua, spent some time in Beijing. Then we took a sightseeing trip to the interior of China.

Rubens: You think this was ’91?

Kuh: I think it was ’91, but I don’t quite remember the exact date. We went to inner Mongolia and to the province next to that. It was interesting. Every time there

is an official visit, they also tried to arrange some side trip for us. My wife also went, on this trip. Let's see what I skipped.

There were many trips afterwards for different reasons.

Rubens: I shouldn't interrupt your thinking, but to just jump ahead: In '99, you are given the honorary doctorate of engineering at Chiao Tung.

Kuh: That's Taiwan.

In Hong Kong I got the honorary degree from the Hong Kong University of Science and Technology (HKUST).

Rubens: That's in '97. Once you're there do you go back to China?

Kuh: No.

Rubens: You get a big C&C prize.

Kuh: No that's Japan.

Rubens: Japan in '96. I'm just wondering if these are--

Kuh: These are separate trips.

Rubens: Now Nanjing, you're an honorary professor Nanjing in '95.

Kuh: I was appointed an honorary professor at six major universities. Every time there was a ceremony: Shanghai Jiao Tong, Tsinghua, Peking University, the University of Science and Technology in Nanjing, Tianjin University—and Chendu University of Science and Technology. I had six honorary professorships in China.

Rubens: Does that mean you went every time?

Kuh: Sure, that's a big event for them and they always have a ceremony. I went each time and I'd have to give a talk each time.

I don't remember when I got the honorary professorship at Tsinghua. I remember at Jiao Tong it was on the trip in 1979.

Rubens: Tsinghua is '85.

Kuh: Okay that was during the international meeting.

Rubens: Then Tianjin is in 1985.

Kuh: Tianjin, yes.

Rubens: Now this is Hong Kong--

Kuh: Hong Kong is separate. That was the early nineties. I remember that.

Rubens: You got the most Distinguished Scholar Award. We never discussed that.

Kuh: No ,we didn't talk about Hong Kong and Taiwan. So far we've focused strictly China.

Rubens: That's '93 in Peking and Nanjing is '95. So the question is whether you went to China between '91 and '95.

Kuh: Well, there were different occasions that I don't remember now. I chaired a meeting. There was an international meeting of semiconductors circuits and devices. I chaired the meeting and helped them organize that. That may be the 1995 meeting. During that meeting, President Jiang received me and Bill Spencer.

Rubens: Between '91 and '92, were there other trips?

Kuh: There must have been some trips, but I just don't remember now.

Rubens: Okay, we'll fill it in if we need to.

Kuh: You don't have to include everything. This past year I went. The year before I went. Three years ago I went three times.

Rubens: In 2000?

Kuh: In 2000 or 2001, I went three times for different purposes. Oh, that was the year I got elected to the Chinese Academy of Sciences, in 2000 . What was interesting is that they distinguished the foreign members from their own, for which we were not too happy. Because they had Premier Zhu give a talk to them, but they did not invite us because they were afraid that he might say something that was confidential. Chancellor Tien tried to fight it, but they wouldn't let him go either. At the meeting, they took a huge picture in the People's Great Hall of about 1000 people including their members and a few foreigners with the top government officials. I was standing right behind Premier Zhu and Chancellor Tien was right behind President Jiang. So they honored us that way.

There was an international conference in information technology, IFIP. I was asked to serve as general co-chair. I declined it. Then they asked me to be the head of the group on electronics. I agreed because I knew the people, I know the field. That's another reason I went. A third reason—in Tianjin, they organized an Asia-Pacific Conference on Circuit Theory. They invited me to give a keynote speech there. So that's a third trip. Three trips in one year.

Then we had meetings in Shanghai. I went. That's another trip maybe two years ago. They were technical meetings. Then my students formed a company there. So I went to this company and then this year I went to Chengdu mainly, because they asked me to chair a meeting and to meet with their new university president.

Rubens: What was the meeting about?

Kuh: This meeting was an international conference on circuits, systems and communications. This will be an annual event. This coming year, it will be in Hong Kong. The later trips are mostly technical meetings and I visited my students' company twice. But during one of these trips, I had a chance to see the latest integrated circuit manufacturing companies. They have really the latest facility. One is created by Richard Chang from Taiwan. He worked at TSMC. That's the famous company which does the foundry business in integrated circuits. He brought in maybe two hundred people from Taiwan to join him. He used to be at Texas Instruments. He's very knowledgeable. He founded the company to do the foundry of integrated circuits and now it is a public company on the market, so you can buy its shares now.

Rubens: What's it called?

Kuh: It's called SMIC, perhaps it means Shanghai Manufacturing Integrated Circuit? I don't quite know what it stands for. Anyway, it's very famous now. People know about it.

Rubens: This is Taiwan?

Kuh: No, it's in Shanghai. I'll try to tell you the latest development. They have caught up. There is another company formed jointly by a Taiwan investor and China, which is even newer than this one. It's called GRACE. They are all in the Shanghai-Pudong area. Pudong is the new part of Shanghai. It had essentially nothing ten years ago. It opened up and now it has an international airport, a large industrial area. It also has a fast train, which goes from the airport to downtown Pudong. This is the super fast train, using the magnetic levitation, which never touches the track.

I recall another trip. The Shanghai government, together with the organization which was formed by returned students from the U.S., organized a meeting dealing with the technology of the future. I was invited to go there and give a talk. I met with the mayor of Shanghai, Mayor Xu. He's the one who really developed all these things. He reached his retirement age a year ago, so now he's the president of the Chinese Academy of Engineering.

Rubens: When do you think that was?

Kuh: Maybe four years ago. China and especially Shanghai, really developed during the last five to ten years. I think it is because that both President Jiang and Premier Zhu were the mayors for sometime. They decided to develop Shanghai.

Rubens: Is it also because there was Taiwanese money? Is that key to development?

Kuh: Not at the beginning. They had to open up Pudong. Professor T.Y. Lin had an idea to open up Pudong, he talked with the government and Pudong was developed from almost nothing to a metropolitan part of Shanghai. The tallest buildings are in Pudong. On one of the trips we stayed at the Hyatt Regency which is eighty-some floors up. It has a wonderful view of the old Shanghai. That must be another trip -maybe it was the same trip. One year, we were supposed to celebrate my high school's 100 year anniversary in Shanghai, The Nanyang Model Middle School. During that week, one of the first EPIC meetings—that's the Asian-Pacific heads of state meeting was held in Shanghai. President Bush went. Anyway our high school had postponed the celebration. Of course I was there for another reason. Maybe to visit the companies.

Rubens: But indeed did you go to the hundredth anniversary?

Kuh: No, I did not. They sent me the material afterwards. They postponed that for two or three weeks later and I couldn't go. Industry really developed, especially in high tech. The investment came from Europe, from Taiwan, and later from the U.S. I think their integrated circuits development have more or less caught up with us. They have so many design houses, which does the design. They have the foundry which does the manufacturing, but they don't have the super modern technology, with wide wafers—twelve inch. They have the eight inch. The larger the size, the more IC chips you can put on one wafer. The IC chips include more and more transistors. They don't have the ultra-modern equipment yet, but they have the things they need. For Chinese domestic use, it's plenty. For export to Asian countries, they do extremely well. There are other companies which came up besides SMIC, GRACE, in Shanghai and one in Beijing. So the electronics industry has really come up.

Rubens: Isn't American manufacturing taking place there?

Kuh: Not in this area. Motorola has a factory in Tianjin. That started a few years ago, so they're not the most modern ones. They have the cell phone business. Now, there are many research labs set up in Beijing and Shanghai—Microsoft, maybe I mentioned that.

Rubens: No.

Kuh: Microsoft decided to set up two research labs abroad, besides their research lab in Redmond, Washington. They decided to put their labs in places where

they have the best talent in software research. One is in Cambridge, England. One is in Beijing, China. Bill Gates came to Berkeley and talked about that. He talked about the reason he set up their lab in Beijing. The first director, a very capable person, was a friend of mine. Now he's no longer there. He came back to be vice president at Redmond, Washington. They continue to expand this laboratory. Then Intel has a research lab. IBM has a research lab. Lucent has a research lab.

Rubens: I don't know Lucent.

Kuh: Lucent is the former Western Electric and Bell Labs. It's a pity they took over Bell Labs and it has collapsed, more or less. The business in communication is so competitive, and they have not done well. GM set up in China a manufacturing division in Shanghai. A German company, Volkswagen has had a tie with Shanghai. The automotive industry came from abroad, it started the industry but China has its own now. There are all sorts of high tech manufacturing companies started in Shanghai and Beijing.

Rubens: You've been going to China for thirty -

Kuh: Thirty-one years.

Rubens: You were going so regularly that information was coming into you. Do study? Do you read certain magazines? Do you meet with people here to talk about China?

Kuh: Well, just my professional contacts. My students have companies there, so I know what's going on. I visit them quite often, so I keep up.

Rubens: Do you read any foreign journals?

Kuh: No, I don't. My contacts are more superficial. I'm not into the details of the operations of the companies. But the chairmen of the boards of SMIC and GRACE are professors whom I know well.

Rubens: What's his name?

Kuh: Professor Wang of Peking University and Professor Zhou of the Chinese Academy of Sciences. I also know quite a few professors in Tsinghua whom I interact with on research.

Rubens: So are there any forthcoming plans to go to China?

Kuh: Well actually there's a meeting in January. They asked me to go, but that happens to be the day before my last appointment with my eye doctor. I'm on the committee. I have a paper there jointly written with my student, but I'm

not going. There will be future trips. I think we've covered what is most important.

Rubens: Turning to Japan—the last time you were visiting a professor was in '81.

Kuh: I thought we covered Japan?

Rubens: We did, but I just wanted to ask if you had made, in the nineties, recently, did you make any trips in Japan?

Kuh: Maybe the last one was the big award I got from the C and C, the Foundation for Promoting Communication and Computers.

Rubens: What did we say that was '96?

Kuh: Yes, but I went there also afterwards. I went there last year. This former vice president of NEC, Dr. Goto, after he retired, he joined another private university, Wasada University. He was asked to start a new campus in Kyushu the southern island. Japan has four islands. Tokyo is on the main island. Kyushu is an island further south. He formed a branch of Wasada and asked me to serve as the advisor. Apparently it helps to get government funding.

Rubens: Is it a science university?

Kuh: Yes, Waseda University is the most famous private university. I went there and gave some lectures and talked to them about the organization. That was the last trip to Japan, last year. I'm sure I had other trips to Japan.

Rubens: I know, but I think you should talk a little bit about Hong Kong.

Kuh: I took so many trips to Hong Kong. The first official contact was with Hong Kong Polytech University. They asked me to be the external examiner. That's an appointment for four years, so every year I had to go.

Rubens: What does that mean that doing as an external examiner?

Kuh: This is the British system. You examine their curriculum, the degree.

Rubens: Every year?

Kuh: Every year. You talk to the students, yes. So that's one relation. The relation later was with the Hong Kong University of Science and Technology, which I talked about, started by President Woo, who was the president at San Francisco State. I served on their advisory board for the College of Engineering.

Rubens: That would require how many--?

Kuh: That's every year, or year and a half. I went to that meeting many times. That's where I got my honorary degree too.

Rubens: That's in '97.

Kuh: Yes. Then I got this special Chinese scholar's award. What do they call it? I was the third one to receive it in 1990.

Rubens: Most Distinguished Chinese Scholar Award.

Kuh: I remember the date because I got the letter when I was on sabbatical in England, that I would be honored. Then afterwards, I participated with the Hong Kong University Advisory Committee, maybe just for one or two meetings. Also, the City University had a special conference. They invited me to be on the panel. In addition there was the Chinese University which I visited a couple of time, because I know the people there. I had relations with these five universities.

Rubens: These were all Hong Kong?

Kuh: These are in Hong Kong.

Rubens: China for you, seems to garner the most trips, the deepest investment--

Kuh: I think it's the most interesting part.

Rubens: What about Taiwan? I know we talked about Taiwan, but now just as a kind of wrap up, could you talk about how you're involved with Taiwan?

Kuh: Taiwan, of course, did extremely well in the late eighties and nineties in their industrial parks, universities, high tech development. I went there more often after Professor Y. T. Lee went there to become the president of the Academia Sinica. I was a member even before that, but I didn't go to many meetings. They have meetings every two years. After he became president I attended almost every meeting. Then most of the time I also went to Hsinchu, where the high tech industry is located.

Rubens: That's a region?

Kuh: That's a city. Both Tsinghua and Chiao Tung are in Hsinchu, together with the industrial park. I think I mentioned to you that I was appointed visiting chair at Tsinghua. It was supposed to be for three years. After one year I decided I didn't want to go there so often. Then I visited the Chiao Tung, because they always recognized me as an alumnus, even though I did not even graduate from Chiao Tung. They gave me an honorary degree and I gave lectures there several times.

Let me just conclude talking about the way Taiwan developed their high tech industry and their higher education. Now TSMC and United Microelectronics are the two major foundries that all countries depend on. I'm talking about Texas Instruments and others in Silicon Valley. I'm talking about Phillips in Europe. They use their foundry. Their high tech in microelectronics really came up. In the meantime, the universities came up too, but not to the extent like the top research universities here, but they provided many good students. For the longest time students came to study at Berkeley, but since the mid '80s there have been so many opportunities in Taiwan, that they stay in Taiwan to form start up companies. That's why the industrial park was so successful. Taiwan has this tradition of supporting higher education with a lot of money. They want to develop two or three research universities of international stature. This is what I mentioned to you before.

Regarding China, I just want to make a general statement. It's amazing how China developed from almost nothing in technology to its current status. Now you buy everything from China, high tech, low tech, consumer products, everything. The way they developed, I think we have to give major credit to Deng Xiaoping. He was an extremely capable and dynamic person with vision and leadership. Compared to Russia, China has done so much more.

Rubens: Russia, in '89-

Kuh: They decided to open up, but they haven't done anything at all. China started in the early eighties with planning, but mostly in the late eighties and nineties and they came up so quickly. It's amazing.

Rubens: Do you think they will be able to solve their social problems?

Kuh: Well, the government is starting to be more liberal. For that you have to give credit to President Jiang and the new president Hu. I think he has continued, even though there is a faction in the government which is more conservative. But I think he sees that China should continue to develop economically for foreseeable future.

Rubens: High tech and manufacturing has taken off in the cities.

Kuh: Also from the interior of China, people moved to the coast to earn some wages. The capable people moved around. They created a work force with low wages compared to outside, but their wages have come up too. So you can see the advancement.

Rubens: Progress.

Kuh: Progress, yes. I was really impressed.

Rubens: Perhaps it is trite to say, but it is simply amazing what you have seen and been a part of in your life.

Chapter X: Family Matters—The Next Generation

Rubens: What it is you would like to have noted about your family?

1-00:00:25
Kuh: I think that some factual information should be included, since we have the photograph in this volume. So, as you know, we have two sons, Tony and Ted, both went to Berkeley undergraduate and Tony got his PhD at Princeton. He's now a Professor in Electrical Engineering at University of Hawaii. And for a brief period he served also as the Chair of the department.

1-00:01:10
Rubens: He has how many children?

1-00:01:14
Kuh: He's married and his wife, Joan, got her PhD in genetics at Hawaii, and is a Post-Doc Fellow there.

1-00:01:31
Rubens: Did he meet her there?

1-00:01:31
Kuh: Yes. They have one boy, Matthew, who will be fourteen in July. He's a second year student in the Mid Pacific Institute, which is a private school. K-12. And I can say something about him first. He's a very good tennis player, maybe following me, but he's so much better. And he is good in music. He had quite a few years of piano lessons. When he was in London, he also picked up violin. He likes sports, so maybe he's spending too much time on sports instead of reading. I try to get him to do more reading.

1-00:02:37
Rubens: Is he interested in your background?

1-00:02:40
Kuh: He had a project in school and he tried to learn something about ancient Chinese history. The only thing we told him about was the first Emperor of China. But he hasn't asked about my family, so I don't know.

1-00:03:01
Rubens: And what about computers?

1-00:03:06
Kuh: Oh, he's so good at it. Sure.

1-00:03:08
Rubens: Do you talk computers, or the history of computers, with him at all?

1-00:03:11
Kuh: Sometimes he comes back and helps me a little bit.

1-00:03:15
Rubens: And does he know Chinese?

1-00:03:17
Kuh: Not really. No. And someday I hope he will go to China to see the place. Tony has been to China many times and he loves hiking; he has hiked to the top of Yellow Mountain. He hiked to the top of Fuji Mountain. And he thinks that's a great accomplishment. But since he had a problem with his eye, which affected his nerve, I don't think he can ever go further than that. Otherwise he would try, maybe the Himalayas.

1-00:04:06
Rubens: Tony was born when?

1-00:04:08
Kuh: Tony was born in 1958.

1-00:04:13
Rubens: Does his wife Joan teach or do research?

1-00:04:22
Kuh: She is a research assistant. Post-Doctorate research.

1-00:04:25
Rubens: Is there a particular field of genetics that she's in?

1-00:04:33
Kuh: She did research on fruit flies; I don't know the details.

1-00:04:38
Rubens: And Tony, is there a particular—

1-00:04:43
Kuh: Yes, he's in the area of so-called Neuronetworks, interconnected signal processing. So he's in a combined field. Neuronets was his PhD thesis.

1-00:05:07
Rubens: Did he share information with you while he was doing his PhD?

1-00:05:20
Kuh: He's open with me.

1-00:05:24
Rubens: So Ted was born when?

1-00:05:30
Kuh: Ted was born two years later in 1960. He got his MBA from the Wharton School in the University of Pennsylvania. He worked with a few companies, but he has been with the CitiGroup, maybe for the past ten or twelve years. He is a Managing Director in charge of Global Retail Sales. He's doing quite well.

1-00:06:07
Rubens: He lives where?

1-00:06:10
Kuh: He lives in London. He has been in London for the past seven years. He travels a lot. He works very, very hard, just like all the investment bankers. But he takes a lot of vacations. In Europe, people take longer vacations, but in his work area people take more because they work so hard. So we've been with them on vacation, which I will mention briefly in a minute. His wife is Christiana, she's a homemaker. But before that she worked in a publishing house in San Francisco.

1-00:07:00
Rubens: Where did he meet her?

1-00:07:00
Kuh: In New York. Ted worked in New York briefly, then came back to San Francisco, then went to London. They have two boys; Jason will be twelve years old in May, and Evan will be nine years old in April. (2007) Jason is a sixth grader at the American School in London. And Evan is a third grade student at the International School, South Bank in London. They both play violin and they both took trips to different cities in Europe to perform, including Prague, Dublin and Paris. And they also like sports; they play tennis, basketball, and soccer.

1-00:08:17
Rubens: Did you see any of those performances?

1-00:08:20
Kuh: No, I did not, but I went to their schools to listen to performances there. All three of them like mathematics. Of the trips we went on together, let me just mention, that we went to Tuscany twice, with the two families together. We went to Switzerland once. This summer we are going to the Dolomites to hike, in northern Italy near Austria. And we've also had three or four trips together in Hawaii to different islands.

1-00:09:13
Rubens: You mean all of you?

1-00:09:17
Kuh: Yes, altogether, that is the whole family traveling. And we really enjoy that. Especially if during the trip I have time to play chess with them. And they do some art work. And in the car sometimes, I give them math problems to work on. And they are pretty good; sometimes they answer right away. But the latest incident that really impressed me was with Jason. We talk on the phone frequently. And I asked him, "Can you tell me, if you add up one to one thousand, one, two, three, what would be the sum?" After two or three minutes, he came back with the right answer. I was amazed. He could have learned that before, but if not that's really amazing, because it's not that easy, you have to figure out how to do it.

1-00:10:21
Rubens: And the correct answer is?

1-00:10:26
Kuh: I cannot tell you right away. The trick is you have to add 1 to 1,000, add fifty times, and multiply by that. So he got it right away.

1-00:10:44
Rubens: Do they know Chinese?

1-00:10:46
Kuh: They are taking Chinese lessons. And the teacher comes once a week, but they don't take that too seriously. I think someday, they will be going to China, too. But I just wanted to mention that we, my wife and I and our two boys went to China, I know I mentioned that. And I think they appreciate the Chinese. So that will give their children encouragement, incentive for their children to learn.

1-00:11:28
Rubens: Does this boy, who lives in London, does he go to China for business?

1-00:11:36
Kuh: He has been to China, maybe two or three times for business, but each time just for one or two days. One time we met him in Shanghai. But Tony went there maybe four or five times to give lectures. So they are totally different. The three grandchildren are totally different in temper. Matthew is very quiet. Jason is so talkative. Evan is very nice, and knows what to say always. So we like all three of them.

1-00:12:18
Rubens: Jason and Evan have basically grown up in London. Have they been to the United States?

1-00:12:29
Kuh: Jason went to London when he was four years old. Evan was just a baby.

1-00:12:37
Rubens: Do they have an accent at all?

1-00:12:38
Kuh: They can have an accent if they want to, but they usually don't. But they come back every year.

1-00:12:49
Rubens: Her family must be back here too?

1-00:12:53
Kuh: Yes, her family is in New York. So they spend about two weeks with her family.

1-00:12:57
Rubens: Are the wives backgrounds' at all similar to the boys? Are they first generation American?

1-00:13:03
Kuh: No, Joan is American. Her ancestors were from Germany and Ireland. Christina was born in San Francisco, and I don't quite know her history.

1-00:13:30
Rubens: Was that ever an issue with you or your wife?

1-00:13:34
Kuh: No, no, not at all. So we are a very happy family. We really enjoy family get-togethers and trips. And this year, my son in London invited all of us to visit the Dolomites to celebrate my wife's birthday. So we expect a wonderful time. Tony went to London for a sabbatical year. So that year, we must have gone to London three times. Also, I spent on sabbatical at Imperial College which we discussed, so we got together with them then.

1-00:14:30
Rubens: He was there at the time?

1-00:14:34
Kuh: He was there maybe for a short trip, but not- I don't quite remember.

1-00:14:49
Rubens: Do you have any more trips planned to the Far East?

1-00:14:53
Kuh: Yes. I will be going to Taiwan to deliver a lecture at the end of this month.

1-00:15:00
Rubens: For the CITRIS Asian Research Symposium 2007, yes? I see the subject of your talk is on EDA, past, present and future, is that correct? Where literally will that be taking place?

1-00:15:19
Kuh: In Taipei, actually held at the National Taiwan University.

1-00:15:24
Rubens: How long will you be there?

1-00:15:28
Kuh: Just two days, three nights. Then the second day I go to Chiaotung University and Tsinghua University, since I know the presidents of both. That's a short trip.

1-00:15:47
Rubens: That is a short trip for you, compared to others you've had. You're not going to the mainland?

1-00:15:46
Kuh: No, no, no. But we do plan to go to Europe in June and plan to go to China in August.

1-00:15:59
Rubens: Oh, so you will go to China, in August?

1-00:16:03
Kuh: We hope so. That's a small research meeting that will be held in Shandong, where Confucius was born. That's one province I've never been to, so when they invited me and I said yes.

1-00:16:24
Rubens: And the invitation is at the behest of-?

1-00:16:27
Kuh: A research group co-sponsored by the National Science foundation here in the U.S. and the National Sciences Foundation there. It's usually a small group, maybe a dozen professors, maybe three dozen students. That's it. It's a workshop kind of thing on EDA. So that's about it. So the important thing is to add the names of the next generation and how they are doing.

1-00:17:13
Rubens: I think that will be a wonderful coda.

1-00:17:17

[End of Interview]

Curriculum Vitae—Ernest Kuh

EDUCATION

Shanghai Jiao Tong University, 1945-47.

B.S., Electrical Engineering, University of Michigan, 1949.

S.M., Electrical Engineering, Massachusetts Institute of Technology, 1950.

Ph.D., Electrical Engineering, Stanford University, 1952.

EMPLOYMENT

Member of Technical Staff, Bell Telephone Laboratories, Murray Hill, New Jersey (1952-56).

Lecturer, Newark College of Engineering (1955-56).

Associate Professor, University of California, Berkeley (1956-62).

Professor of Electrical Engineering, University of California, Berkeley (1962-1992).

Chair, Department of Electrical Engineering and Computer Sciences, University of California, Berkeley (1968-72).

Dean, College of Engineering, University of California, Berkeley (1973-80).

William S. Floyd Professor in Engineering, University of California, Berkeley (1990-present).

AFFILIATIONS

Member, Eta Kappa Nu.

Member, Tau Beta Pi.

Member, Sigma Xi.

Fellow, Institute of Electrical & Electronics Engineers.

Fellow, American Association for the Advancement of Science.

Member, American Society for Engineering Education.

Member, National Academy of Engineering

Member, Academia Sinica, Taiwan

Foreign Member, Chinese Academy of Sciences

UC COMMITTEES

Member, Academic Senate Committee on Budget and Interdepartmental Relations (1985-88).

Chair, Academic Senate Committee on Budget and Interdepartmental Relations (1988)

Member, UC Berkeley Chancellor Search Committee (1989).

Member, Academic Senate Committee on Committees (1992-94).

Member, UC Irvine Chancellor Search Committee (1993).

Member, Law School Review Committee (1991-93)

Member, Engineering Advisory Board, Univ. of Calif. at Davis (1987-1998).

Member, Advisory Committee, School of Engineering, University of California, Riverside (1995).

OTHER ACADEMIC COMMITTEES

Member, Scientific Advisory Board, Mills College (1975-80).

Member, Visiting Committee, Electrical Engineering and Computer Science Department, MIT (1985-1991).

Advisory Board Member, Alexander von Humboldt Foundation, Germany (1985-present).

Member, Advisory Council, School of Engineering, University of Southern California (1986-89).

Member, Board of Trustees, International Computer Science Institute, Berkeley, California. (1986-90).

Member, Advisory Council, Electrical Engineering Department, Princeton University, (1986-1998).

External Examiner, Electronic Engineering Department Hong Kong Polytechnic (1988-91).

Member, Board of Directors, The Faculty Club, University of California, Berkeley (1988-91).

Member, Doctoral Evaluation Project Coordinating Committee, State University New York (1990).

Member, Engineering Advisory Board, Hong Kong University of Science and Technology (1990-1996).

Member, Advisory Committee, Institute of Information Science, Academia Sinica, Taiwan (1994-1998).

Member, Advisory Commmitee, Microelectronics and Information Systems Research Center, National Chiao Tung University, Taiwan (1993).

Member, International Advisory Board, Department of Electrical Engineering, Hong Kong University (1994).

PROFESSIONAL COMMITTEES

President, IEEE Society of Circuits and Systems (1972).

Member, Board of Directors, Institute of Electrical & Electronics Engineers (1976-77).

Chair, IEEE Awards Board (1987); Member (1984-86).

Member, Panel on Applied Technology, National Bureau of Standards (1976-80).

Member, Committee on an Assessment of Quality-Related Characteristics of Research-Doctoral Programs in the United States, The Conference Board of Associated Research Councils (1980-81).

Member, Advisory Board on Engineering, National Science Foundation (1980-83).

Member, Committee on Scholarly Communication with People's Republic of China, National Academy of Sciences (1980-83).

Member, California Policy Seminar (1981-84).

Member, Committee on Engineering Education and Utilization of the Engineer, National Research Council (1982-85).

Chair, American Society for Engineering Education Benjamin Garver Lamme Award Committee (1994); Member (1983-present).

Member, Panel on Information, Communication, Computers and Control, National Academy of Engineering (1985-86).

Member, Nominating Committee, National Academy of Engineering, (1990)

Member, Nominating Committee, American Association for the Advancement of Science (1989-92).

Member, American Society for Engineering Education Centennial Recognitions Committee (1990-92).

Chair, IEEE CAS Society Ad hoc Committee on Long Range Planning (1991).

Chair, IEEE CAS Society Awards Subcommittee (1992); Member (1990-93).

Member-at-Large, Board on Assessment of National Institute of Standards and Technology, Department of Commerce (1992-95).

Chair, Engineering Section, American Association for the Advancement of Science (1994)

CORPORATE CONSULTING

Consultant, IBM Research Lab., San Jose, Ca. (1956-62).

Member, Advisory Board, General Motors Institute (1975-79).

Member, Board of Directors, Cadence Design Systems, San Jose, Ca. (1984-1991).

Chair, Scientific Advisory Committee, Cadence Design Systems (1988-1991).

Chair, Advisory Board, ArcSys (1993-1995).

EDITORSHIPS

Advisory Editor, *International Journal on Networks* (1975-2000).

Co-Editor-In-Chief, *International Journal of High Speed Electronics*, (1990-1993).

International Editorial Board Member, *Slaboproudy Obzor* (*Electronic Horizon*), (1990-1995).

Overseas Advisor, *IEICE Transactions on Communications, Electronics, Information, and Systems*, (1990-1993).

VISITING PROFESSORSHIPS

Imperial College, London (1962, 1982, 1990).

Technical University of Denmark (1963).

Kobe University (1969-70).

Osaka University (1969-70, 1977-78).

Technical University of Munich (1978, 1980, 1985).

Waseda University (1981).

HONORS

NSF Senior Postdoctoral Fellow, 1962.
Miller Research Professor, University of California, Berkeley, 1965-66.

National Electronics Conference Award, 1966.

Distinguished Alumnus Award, University of Michigan, 1970.

IEEE Guillemin-Cauer Award, 1973.

Chinese Institute of Engineers Achievement Award, 1975.

Elected to National Academy of Engineering, 1975.

Elected to Academia Sinica, 1976.

Alexander von Humboldt Senior Scientist Award, 1978.

Honorary Professor, Shanghai Jiao Tong University, 1979.

IEEE Education Medal, 1981.

ASEE Lamme Medal, 1981.

Japan Society of Promotion of Science Award, 1981, 1988.

British Science and Engineering Award, 1982 & 1990.

IEEE Centennial Medal, 1984.

Honorary Professor, Tsinghua University, 1985.

Honorary Professor, Tianjin University, 1985.

IEEE Circuits & Systems Society Award, 1988.

Elected member of the Berkeley Fellows, 1996.

Most Distinguished Chinese Scholar Award, Society of Hong Kong Scholars, 1990.

William S. Floyd, Jr. Professorship in Engineering, 1990-present.

Honorary Professor, University of Electronics Science and Technology, Chengdu, 1993.

Berkeley Citation, 1993.

Honorary Professor, Peking University, 1995.

Honorary Professor, Nanjing University of Science and Technology, 1995.

C&C Prize from the Japanese Foundation for C&C Promotion, 1996.

Doctor of Engineering, Honoris Causa, Hong Kong University of Science and Technology, 1997.

Phil Kaufman Award of the Electronic Design Automation Consortium, 1998.

Honorary Doctor of Engineering degree, National Chiao Tung University, Hsinchu, Taiwan, 1999.

IEEE CAS Society Golden Jubilee Award, 2000.

IEEE Millennium Medal, 2000.

PUBLICATIONS

Co-author of four books.

Author or co-author of over 200 papers in circuits, electronics, networks, systems, and computer-aided design.

Co-editor of two books.

Publications—Ernest Kuh

BOOKS

1. Kuh, E.S. and D.O. Pederson, *Principles of Circuit Synthesis,* McGraw-Hill, New York, 1959, 244 pages.

2. Kuh, E.S. and R.A. Rohrer, *Theory of Linear Active Networks,* Holden-Day, Inc., San Francisco, CA, 1967, 650 pages.

3. Desoer, C.A., and E.S. Kuh, *Basic Circuit Theory,* McGraw-Hill, New York, 1969, 876 pages. Italian translation, 1972. Chinese translation, 1972. Russian translation, 1976. Japanese translation, 1977. Portuguese translation, 1979. PRC translation, 1979.

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6. Hu, T.C., and E.S. Kuh, eds., *VLSI: Circuit Layout Theory and Techniques,* IEEE Press, October 1985.

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1950 - 1959

1. Kuh, E.S., "Potential Analog Network Synthesis for Arbitrary Loss Functions," *J. of Applied Physics,* vol. 24, no. 7, pp. 897-902, July 1953.

2. Kuh, E.S., "Parallel Ladder Realization of Transfer Admittance Functions," *Proc. of the Natl. Electronics Conf.,* vol. 10, pp. 198-206, October 1954.

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60. Tsukiyama, S., E.S. Kuh, and I. Shirakawa, "An Algorithm for Single-Row Routing with Prescribed Street Congestions," *IEEE Trans. on Circuits and Systems,* vol. CAS-27, no. 9, pp. 765-772, September 1980.

61. Tsukiyama, S., E.S. Kuh, and Isao Shirakawa, "On the Layering Problem of Multilayer PWB Wiring" *18th Design Automation Conference,* pp. 738-745, July 1981. [NSF]

62. Marek-Sadowska, M., and E.S. Kuh, "A New Approach to Routing of Two-Layer Printed Circuit Board," *International Jour. of Circuit Theory and Applications,* vol. 9, no. 3, pp. 331-341, July 1981. [NSF, JSEP, AFOSR, Humboldt]

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66. Tsukiyama, S., and E.S. Kuh, "Double-Row Planar Routing and Permutation Layout," *Networks,* pp. 287-316, 1982.

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BERKELEY, CALIFORNIA 94720

August 25, 1982
File No. 82-1410

Honorable Vice Premier Fang Yi
Chairman
Science Council
Beijing, People's Republic of China

Dear Vice Premier Fang:

I was indeed pleased to see you again during the reception given by Vice Chairman Deng Xiaoping at the People's Great Hall in Beijing early this month. Unfortunately, I did not have a chance to discuss some of my views in regard to science research and education in China with you. A number of key points I would like to bring to your attention are as follows:

1. Presently, basic scientific research in the P.R.C. is carried out mostly in the Academia Sinica. This is in contrast to the U.S., Japan, and most of the western nations where basic research is being done at major research universities. While I believe that it is important to maintain the strength of Academia Sinica, it is perhaps more crucial to greatly expand the research capabilities of major universities in China. As you know, basic research in science and technology depends heavily on the creative minds of young people. This can be witnessed by the success of such research in the western nations where a continuous flux of graduate students work with professors in leading research universities year after year. The Academia Sinica in China lacks this crucial element which I believe can only be provided by diverting research funding to major universities. Thus, what I am proposing is to gradually establish a number of leading research universities in China.

2. I have noticed that all universities in China attempt to keep their best graduates in their own institutions. However, this kind of in-breeding has a detrimental effect in the long run in that it limits the growth of an institution intellectually and professionally. If China wants to produce talented people and high-caliber universities, in-breeding must be curtailed.

3. It appears that the three major segments involved in research and development in China -- the Academia Sinica, the universities, and the industrial ministries -- are very much isolated and hardly communicate with one another. One group is usually not aware of what the others are doing. A typical example is in the development of integrated circuits and computers. With the very

continued../...

limited resources that that the country can invest in research and development, it is most important that close coordination be maintained among these three segments so that the better minds can work together and unnecessary waste is thereby eliminated. I would like to make a specific proposal in the area of integrated circuits and computers, perhaps the most needed high technology in China today. That is, to have a leading agency similar to the Japanese MITI (Ministry of International Trade and Industry) coordinate its research and development. In addition, the three segments should be encouraged to exchange personnel on a visiting basis from time to time. From our experiences at the University of California, visitors from industrial laboratories have made valuable contributions to our teaching and research activities. And for faculty members spending sabbatical leave at leading research laboratories in industry, the same climate of creative interaction prevails.

4. Within the Academia Sinica, applied research and basic engineering research are perhaps more important than basic scientific research. In my view the Academia Sinica should carry some responsibility in assisting industrial ministries for pilot developments. Take, for example, the Bell Laboratories in the United States, perhaps the most prestigious and successful research institution in the world. Its budget for fundamental research is less than 10%. The rest is devoted to applied research and basic engineering research. Furthermore, it works closely with Western Electric, the engineering and manufacturing arm of the giant telephone industry, ATT. The Academia Sinica and the Bell Laboratories resemble each other in many ways. Although the aim and interest of the Academia Sinica are much broader, I believe that lessons can be learned from the highly successful operation of the Bell Laboratories.

During the past ten years I have visited China a total of five times. While on each of my visits, I have noticed distinct improvements in science research and education; major changes in policy are necessary to face the challenge of the four modernizations. If China is to succeed by the end of the century in its aims, creative research and innovative development in science and technology are crucial. I believe that under the leadership of Vice Chairman Deng, a gradual, shifting policy can be designed to ensure strong industrial and economic development. It is in this connection that I offer my views and hope that you will consider some of them worthwhile for implementation.

Respectfully yours,

顧宇保

Ernest S. Kuh
Professor

cc: Dr. Lu Jai Xi, President
Academia Sinica

ESK/jva

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February 25, 1994
File No. 94-1057

President Zhou
Chinese Academy of Sciences
52 Sanlihe Road
100864 Beijing, China

Dear President Zhou:

Thank you for your letter of February 6th. I am somewhat familiar with the changes the Academy began to carry out in 1985 and am pleased to learn that some progress has been made. Nonetheless, I agree with you that it is time to reevaluate in order to plan for the future.

Although you proposed 11 questions for us to respond to, I would prefer to give you my random thoughts and recommendations based on my involvement in R&D policy in the United States, Japan, and Taiwan. I hope my comments will shed some light on the best course for the Academy and China. My expertise and these remarks are, of course, limited to high technology, especially electronics, computers, and communications. These areas are crucial to the economic development of any industrial nation.

United States

As you know, the Academies in the United States do not conduct any research, unlike the Chinese Academy of Science. Most basic research in the States is done at the hundred or so research universities. The federal government does spend money directly on research, for example through NIH, NIST, the National Laboratories, and some laboratories in DOD such as the Naval Research Lab. Of these, however, only NIH has made significant contributions.

Most of the research which has benefitted industry and developed the economy has been done by individual research labs. The leading labs are AT&T Bell Labs, IBM Yorktown Lab, Xerox PARC, GE Labs in Schenectady, and the Dupont Research Lab in Wilmington. As one who worked at Bell Labs I can say that the impact of the industrial research labs has been truly significant; they are mainly responsible for the success of industry in the United States since the end of World War II. There are several factors which have contributed to their success: first, the clarity of direction, mostly top-down, in terms of the company's needs; second, the enthusiasm in the ranks of the very good research staff working in a very good environment; third, the diversity

within the staff — scientists, engineers, technicians, and other support people working together; and fourth, perhaps most important, the substantial level of support.

Unfortunately, the situation has changed in recent years. Perhaps because of competition in the world-wide marketplace, most companies are down-sizing and de-emphasizing basic research. At AT&T Bell Labs, for example, 90 percent of the activities are now conducted in the AT&T business units. The same thing is happening at IBM. Yet fortunately for the U.S., high technology is still blossoming, mainly because of the spirit of entrepreneurship and the ease of getting venture funding. Thus in electronics, computers, and communications the United States is not only the leader but is gaining in its position.

Japan

Japan's Academy, like the United States', does not support research. Unlike the United States, however, research at the universities is not emphasized and is very spotty, depending on the field. Most research is conducted by the large multinational companies such as NEC, Hitachi, Toshiba, etc. As a result, the research is highly targeted and Japan has had great success in transforming it into products on the marketplace. There are several other factors contributing to Japan's success. First there is the national work ethic, and the pride each individual has in getting his work done in the best way he knows. Second is Japan's strength in manufacturing, from the automobile to the electronics industry. Manufacturers pay great attention to quality and take advantage of modern technology. Third, the top managers are mostly engineers who know the industry well.

Taiwan

The Academia Sinica, like China's Academy, has research laboratories which conduct fundamental research, but on a much smaller scale. Their emphasis so far has been on basic research. Taiwan has given higher education a very high priority — with a population of only 20 million it has half a dozen top research universities. It has produced many outstanding students and in recent years has attracted back many top students from the United States who were originally trained in Taiwan. The main reason for its recent success, however, is due simply to the excellent planning of the central government.

The establishment of the ITRI (Industrial Technology Research Institute) in the mid-seventies and the industrial park in Hsinchu is the source of Taiwan's current booming industry in high technology. I was there two weeks ago and learned that you had visited with a delegation a month before. I am sure that you are as impressed as I am with their success. I discovered on this trip that five new IC fab lines, each with the capability of producing 8-inch wafers and making 0.5 micron ICs, are now under construction. This will give Taiwan an opportunity to capture Asia's huge IC market outside Japan. The companies consist of people formerly with ITRI and those recently returned from such places as Bell Labs and IBM Yorktown Labs. The two universities, Chiao Tong and Tsing-Hua, have close ties with both ITRI and many of the companies in the industrial park. Taiwan's seems to be an ideal recipe for China to follow.

China

I do not know to what extent your Academy has changed since 1985; neither am I familiar with many of the companies affiliated with the Academy. My comments are thus based on a perhaps superficial understanding of the current situation. I believe that to make an impact on industry and the economy, research must be targeted. The two ministries directly involved are the Ministry of Posts and Telecommunications and the Ministry of Electronics. I understand that the former is planning to set up a research lab à la Bell Labs, perhaps due to the fact that there is not much work in communications within the Chinese Academy of Science. I am not aware of any research activities at the Ministry of Electronics, but know that within the Academy you do have laboratories ranging from semiconductors to computers. I understand there has not been much interaction between the Academy and the Ministry of Electronics.

If the government really wants to push high technology in electronics, computers, and communications, it is crucial that the Academy and the two Ministries collaborate closely. Perhaps it is not too late to enlarge the Ministry of Posts and Telecommunications' planned research lab to include electronics and computers. Such a lab would be very similar to ITRI of Taiwan. China already has a number of outstanding universities, so manpower is not a big problem. On the other hand, the current remuneration system makes it difficult for any government organization to attract top talent. I am not in a position to suggest changes in that direction; you will have to work through the top government officials to improve the situation.

Finally, I do believe that it is crucial for China to push high technology as hard as possible.Things are changing overnight — if you do not try to keep up you will essentially be moving backwards, which would mean a bleak future for China.

I hope the above will be of some use to you. I look forward to seeing you again either in China or at UC Berkeley. We certainly enjoyed your brief visit last fall.

With best personal regards,

Sincerely,

Ernest S. Kuh
William S. Floyd, Jr.
Professor Emeritus in Engineering

ESK:tms

Report of the Committee on Budget and Interdepartmental Relations

1987-88

According to Academic Senate Berkeley Division Bylaw 16, the Budget Committee "represents the Division in all matters relating to appointments and promotions, and makes recommendations to the Chancellor on appointments, promotions, salaries, and other matters related to the quality of the faculty." Indeed the Committee usually spends over 80 percent of its time conducting academic personnel reviews in year-round weekly meetings. As a matter of fact, on other UC campuses, similar committees are called Committees on Academic Personnel. In addition to academic personnel reviews, Berkeley's Budget Committee serves an important function in reviewing departmental faculty FTE proposals and many policy issues relating to faculty matters and quality of the academic program.

For example, a special issue which took up a considerable amount of time and effort this year was the problem of the grossly incompetent tenured faculty member generated by the recently initiated policy of mandatory reviews for all faculty otherwise unreviewed for five years. Our final report, which includes the background information, is given in Appendix I. The document has gone through several iterations: we have incorporated key suggestions from the Senate Committees on Policy, Academic Freedom, Privilege and Tenure, and Teaching, and from Vice Chancellor Roderic Park. A preliminary report was delivered by the Chair of the Budget Committee at the spring Academic Senate meeting. The present document was submitted to Chair Epstein of the Berkeley Division and will be discussed in the coming meetings of the Academic Senate.

The Chair of the Budget Committee serves as a member of the University Committee on Academic Personnel (UCAP). UCAP usually meets monthly during the academic year to discuss academic personnel policy for the UC system and reports to the Academic Council. During the past year UCAP discussed at length the issue of grossly incompetent tenured faculty. The Chair of the Budget Committee also serves as an ex officio member of the Berkeley Division Committee on Academic Planning and attends the Chancellor's monthly luncheon with the chairs of other major Senate committees. In addition, the Chair made a presentation to the Board of Regents with Chancellor Heyman and Dean Burnside on academic personnel review procedures.

In Table 1 a summary is given of the number of review cases in different categories for the past five years. Table 2 gives a summary of miscellaneous academic personnel reviews in addition to the ladder faculty cases given in Table 1. In total, 1242 cases were reviewed during the academic year.

The Budget Committee depends on Campus *ad hoc* committees to review tenure appointments and promotions. We continue to nominate three-member committees for all cases for promotion to full professor; we also nominate three person committees to review most cases of promotion to tenure and appointments to tenured positions except for two divisions of Letters and Sciences that have requested five-member committees for such cases.

Table 3 gives a summary of *ad hoc* committee service for the past five years. Committees are appointed by the Provosts from nominations by the Budget Committee. The deans of the colleges are informed of the preliminary committee composition and have an opportunity to comment. Following the recommendations of the Special Committee to Review Academic Personnel Procedures, the Provosts and the Budget Committee have tried hard in the past few years to reduce the processing time of academic personnel cases. Table 4 summarizes the processing time for cases reviewed in 1987-88. Compared to the past two years, the time has been somewhat reduced; it seems from our experience that it can be reduced further if the time taken to constitute the *ad hoc* committee is shortened. In this connection faculty members can cooperate. As of two years ago, faculty members who decline to serve on *ad hoc* committees are required to write a note to the Provosts giving reasons for their declination. Table 5 summarizes the *ad hoc* committee declinations and substitutions for the past year. The Budget Committee notes that there are far too many faculty members who decline because they are "too busy to serve."

During the academic year 87-88 a new salary step, Step VIII, was introduced to the Full Professor series. In the absence of clear and precise criteria, we have agreed that advancement to Step VIII should require at least the degree of fresh accomplishment requisite for advancement to Step VII.

In Table 6 we summarize the result of cases submitted by department chairs for advancement from Professor VII to Professor VIII and directly to Special Salary. It is seen that 29 of the 37 proposed for advancement to Step VIII were approved by the Administration and three of the 10 proposed for advancement directly to Special Salary were approved. Three cases are still pending completion of the review process or approval by the President's office, as required for cases in the Special Salary category. In addition, there are two cases of advancement to Step VIII in which the department chair recommended advancement lower than Step VIII. There are also four cases where advancement to Step VIII was approved instead of a departmentally recommended advancement to Special Salary.

The Budget Committee met with the Provosts to discuss their disagreements with Budget Committee recommendations. In many cases those disagreements were resolved after discussion. It should be pointed out that the Chancellor has the final decision on all cases below the Special Salary category. We are pleased to report that excluding the three cases for advancement to Special Salary still pending, the Chancellor agreed with the Budget Committee in all but three personnel actions during the past year. The Chancellor awarded immediate tenure in one case where the Budget Committee had recommended a re-review, in another approved a promotion to professor against the Committee's recommendation, and in a third awarded an appointee a higher Special Salary than the Committee had recommended.

As in the past, the departmental documentation of teaching evaluation submitted with personnel actions varied considerably from unit to unit. A number of cases were returned for more detailed evaluations of teaching. As we noted in our last year's report, the guideline document prepared by the Committee on Teaching ("Policy for the Evaluation of Teaching (for Advancement and Promotion)") has our full endorsement, as well as that of the cognizant Deans and Provosts, and has accordingly been distributed as official policy. We again urge officers in charge of assembling personnel cases to read this policy document carefully and to

implement its provisions.

The Berkeley campus has been at a more or less no-growth status for many years. In recent years, an average of 70 new faculty members have accepted appointments each year. During the past year the Budget Committee reviewed 106 appointment cases. Table 7 summarizes ladder rank appointments reviewed by the Budget Committee. Out of the 106 appointments, 80 candidates have accepted and 9 are still undecided. Sixteen (20 percent) of the 80 new faculty members are women. Sixteen (20 percent) are minorities, a slightly higher rate than in past years.

As mentioned before, the Budget Committee is concerned with the quality of the faculty and academic programs. While reviewing personnel cases and faculty FTE requests from department chairs, the Committee is in a position to observe problems in recruitment and retention of faculty in some departments. This year we compiled data for the past four years of the total appointments and acceptances and resignations and terminations for all departments. We noticed an exceptionally high rate of appointment declination in four units: Geology & Geophysics (five out of eight), Economics (six out of 15), Political Science (five out of 12*), and Business Administration (10 out of 40*). In addition, Economics had four separations due to resignation or termination, Political Science had five, and Business Administration had 15. The figures suggest that these units have had difficulty recruiting and retaining some of their better faculty. We have discussed this matter with the Provosts, Vice Chancellor Park, and Chancellor Heyman, and have suggested innovative steps in recruiting. We are pleased that they agree with our assessment and suggestions.

A program begun in 1982 of allocating so-called "target of opportunity" positions has worked well in bringing qualified minority and women faculty and in special situations, some top stars, to Berkeley. We have collected the data since 1982 for these appointments. We should point out that the number may not be totally reliable since until last year the target of opportunity positions were allocated somewhat unsystematically. Nontheless it is interesting to note that there have been 22 such appointments: nine women, eight minorities (three Blacks, three Hispanics, one Native American, and one Asian), and seven white males. The Chancellor intends to allocate more target of opportunity positions in the coming year; it is understood that such positions, once allocated, will not be taken away for 15 years. This will give departments a good opportunity for affirmative action and for bringing top unusual candidates to the campus. It also means that the Budget Committee should continue making a careful review of each target of opportunity position.

In 1983 the Administration and the Budget Committee agreed to review the FTE for Schools and Colleges in two-year cycles. A year ago, the Provosts and the Committee agreed to review the departmental FTE requests for the College of Letters and Sciences for the target years 1988-89 and 1989-90, and next year to carry out a two-year departmental review of the Professional Schools and Colleges. We also agreed to start the review at the end of the spring term. There are three distinct advantages to starting the review early. First, the Budget Committee review will play a more significant role in the Provosts' final decision on

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* Three of the 12 for Political Science are still undecided. Two of the 40 for Business Administration are still undecided.

FTE allocation. Second, the allocations could be released earlier to the departments, thus increasing their recruiting time. Third, new Budget Committee members, who start on July 1st, will not be responsible for the difficult task of reviewing the FTE requests immediately after joining the Committee. Unfortunately, some of the deans did not submit their requests on time. We hope that in the future the FTE reviews could be completed by July.

The Budget Committee has been consulted on various policy matters including the constant updating of the Academic Personnel Manual. An important issue which came up during the past year was leave for childbearing and childrearing. We are pleased that the new policy on this matter is more flexible in terms of the waiver and extension of service time toward the eight-year limit. We also gave advice on the use of the Adjunct Professor title on the Berkeley Campus, changes in the retirement system, compensation for University Professors, and other policy issues.

Other miscellaneous items in which we were consulted and gave advice include the appointments of deans and directors, the search committee membership for such appointments, nine-month versus 11-month appointments in the College of Natural Resources, the tenure review procedures in individual units, and the usual departmental five-year reviews and ORU reviews.

Chancellor Heyman and Vice Chancellor Park visited the Budget Committee and held additional discussions with the Chair. We were pleased with their openness in discussing problems and issues and their support of the Budget Committee's operations. In particular, the Committee has acquired new computing facilities; before long its operation will be more computerized. We are also pleased that they have cooperated with the reorganization and reclassification of the Budget Committee staff.

The Committee is delighted and privileged to have excellent staff support under the leadership of Betty Rancatore. Their knowledge, dedication, and hard work contributed a great deal to the smooth operation of the Committee during the past year.

Respectfully submitted,

Ernest Kuh, Chair
Iain Finnie
John Gerhart
Edward Halbach
Sanford Kadish
Shoshichi Kobayashi
Thomas Marschak
Hanna Pitkin
Ralph Rader
Kenneth Raymond

September 19, 1988

APPENDIX I

The Problem of the Grossly Incompetent Tenured Faculty Member: Recommended Policies and Procedures

1. The Background

Regular five-year review of all tenured faculty is stated Campus policy. Following three years of deliberations, the Universitywide Committee on Academic Personnel released, after their May 13, 1986 meeting, a "Statement on Scholarly and/or Creative Productivity of Tenured Faculty and Equivalent Ranks." In his directive of September 9, 1986, Vice Chancellor Roderic Park, calling attention to this statement, wrote:

> The Universitywide Committee on Academic Personnel has adopted a resolution urging that the personnel cases of tenured faculty members and those in equivalent positions (i.e. Research titles) should be considered at least once every five years. UCAP was principally concerned with "nonproductive" faculty, but there are additional reasons for implementing such a policy....
>
> ...Accordingly, beginning this academic year, the personnel cases of tenured faculty and equivalent ranks are to be considered at least every five years.

The most difficult issue that faced UCAP was determining what to do in cases in which a careful five-year review discloses a performance that is flagrantly below the standards of teaching and scholarship expected for University appointment. While UCAP did not deal in its final statement with the issue of negative advancement, in its deliberations it did so at length, and the absence of stated academic procedures in such cases was noted.

This report is an attempt to clarify substantive principles and to define procedures for policy that heretofore has been vague and rarely implemented. Present concern is with a very small fraction of nonproductive faculty who are flagrantly poor instructors. Initiation of the five-year review during 1986-87 revealed five cases of faculty whose performance appears grossly deficient according to the standards set forth below. There are also other cases that call for further examination: in 35 instances the chair initially provided no information as to the current activity of the faculty member under review, and in 28 others the faculty member declined to be reviewed, a problem to which we speak below (see p. 7). Thus, the full dimensions of the problem have yet to appear, and the problem is likely to become much more serious in the future if there is no mandatory retirement. Prudence would seem to dictate the early development

of appropriate policies for action in such instances that would on the one hand safeguard the rights of faculty members and on the other offer clear procedural guidelines for the personnel reviewing agencies of the Academic Senate and the administration.

It is stated policy, as indicated below, that demotion or loss of tenure can be warranted by nonperformance, and our aim here is to develop a detailed basis for action which might lead to loss of tenure in cases of gross incompetence.

The procedures and positive criteria now applied by University academic review and appraisal committees in advising on appointment or promotion in the professor series (APM 210-1) are in part described as follows:

> a. Purpose and Responsibility of the Review Committees
> The quality of the faculty of the University of California is maintained primarily through objective and thorough appraisal, by competent faculty members, of each candidate for appointment or promotion. Responsibility for this appraisal falls largely upon the review committees nominated by the Committee on Academic Personnel or equivalent Committee and appointed by the Chancellor or a designated representative. It is the duty of these committees to ascertain the present fitness of each candidate and the likelihood of the candidate's pursuing a productive career.

and

> d. Criteria for Appointment, Promotion, and Appraisal
> The review committee shall judge the candidate with respect to the proposed rank and duties, considering the record of the candidate's performance in (1) teaching, (2) research and other creative work, (3) professional activity, and (4) University and public service.
>
> ...Superior intellectual attainment, as evidenced both in teaching and in research or other creative achievement, is an indispensable qualification for appointment or promotion to tenure positions.
>
> The criteria set forth below are intended to serve as guides in judging the candidate, not to set boundaries to the elements of performance that may be considered.
>
> (1) Teaching - Effective teaching is an essential criterion to appointment or advancement. Under no circumstances will a tenure commitment be made unless there is clear

documentation of ability and diligence in the teaching role.

These criteria can be viewed as a threshold that tenure cases must meet or exceed in order to satisfy the standards of the University. We propose establishing an analogous but much lower threshold for initiating the review process for a tenure faculty personnel action which in extreme cases might lead to loss of tenure and dismissal. (We have decided not to recommend the possibility of demotion because it seems to us that the University cannot justify continuing in service faculty whose shortcomings in teaching are as severe as those covered by the criteria which we set forth below.)

2. A Proposed System

In this section we outline the principles, substantive and procedural, that we think should apply when a decision is made to use negative sanctions against a tenured professor who has become grossly incompetent. Regents' Standing Orders 103.9 and 103.10 note the possibility that a tenured appointment may be terminated, but only for "good cause." A provisional definition of "good cause" is developed and offered here.

A paragraph of "University Policy on Faculty Conduct and the Administration of Discipline," APM-015, distinguishes disciplinary action based on misconduct from action designed to deal with incompetence:

> Disciplinary action is to be distinguished from certain other administrative actions taken as the result, not of willful misconduct, but rather, for example, of disability or incompetence. The administration naturally bears the responsibility of assuring that the University's resources are used productively and appropriately. In meeting this responsibility, administrators must occasionally take actions which resemble certain disciplinary sanctions but which are actually of an entirely different character.
>
> These actions are subject to separate procedures with due process guarantees and should not be confused with disciplinary action with its implications of culpability and sanction.

Neither procedures nor specific standards of what might constitute "good cause" in cases of such "incompetence" have ever been articulated. Such rules must be carefully developed in a form that will safeguard tenure as an institutionalized protection of academic freedom and at the same time validate the privilege of tenure by seeking not to protect extreme incompetence. The procedures we recommend adhere to much of the

customary review procedure long in place in this University whereby, to the maximum degree consistent with the final authority of the administration, the faculty itself, through the Academic Senate and its agencies--including departments, ad hoc committees, and the Budget Committee--bears responsibility for the evaluation and reward of faculty performance.

a. The Governing Criteria

Following is a draft of a policy statement of criteria to be employed in defining cases of gross incompetence and to be applied at each stage in the procedures described subsequently:

> The normal consequence of a tenured professor's failure to meet expected levels of performance in teaching and scholarship is the denial of a merit increase or promotion. In some cases, however, the level of performance may be so far and so long below minimum levels of competence in both teaching and scholarship that termination may be in order.
>
> Failure to publish alone or inadequacy in teaching alone will not normally constitute performance below this minimum level of competence. But a faculty member
>
> (i) who has ceased (or virtually ceased) to engage in serious scholarship or creative activity for a substantial period of time, and who gives no satisfactory evidence of any likelihood of renewed productivity in the future; and
>
> (ii) whose teaching, as measured by the usual standards of intellectual and professional competence in university-level instruction, is so inadequate that it is a disservice to students to permit the faculty member to continue to teach, and who has failed to make earnest and conscientious efforts to improve his or her teaching, or, having made such efforts, has failed to bring the teaching up to minimal levels of acceptability, will, upon a proper finding, be subject to termination.

The references to "serious" scholarship or creative activity and to "usual standards" in teaching and "disservice to students" are meant to acknowledge that standards of judgment cannot be rigorously and universally defined for all fields, but must be applied according to the understanding and judgment of reviewers

expert in the teaching area. As applied to teaching, however, standards would certainly require judgment as to the degree of the faculty member's knowledge and current competence in the particular teaching field, intellectual cogency and clarity of presentations, diligence as a teacher, availability to students, and willingness and capacity to communicate effectively with them and to support their efforts to learn.

Although professional activity and University service are not included in the basic criteria, in close cases it would be appropriate to take account of worthwhile contributions in these areas.

b. Procedures for Identifying Problem Cases

The first task in applying the specified criteria is to devise a procedure for identifying problem cases and developing a possible negative recommendation. In our view any such recommendation should normally come from the departmental Chair, in consultation with the tenured faculty, after finding flagrant and chronic shortcomings during a five-year or other review; or the recommendation might be made by the Academic Senate's Budget Committee in the light of its evaluation of a Chair's report, in which case the recommendation would be referred back to the Chair for further investigation and comment. In either case the Chair would inform the faculty member of any recommendation and would explore with the faculty member the nature of the concerns and the possibility of improved performance.

c. Assistance to the Problem Professor

In its "Statement on Scholarly and/or Creative Productivity of Tenured Faculty and Equivalent Ranks," UCAP suggests that faculty whose scholarly work has fallen below acceptable standards should be offered appropriate counselling and assistance. It mentions the possibility of

> 1) encouragement by the Chair and/or Dean for increased scholarly and or creative productivity. This might include asking the candidate to develop a timetable for career development, articulating goals and objectives;
>
> 2) exploring other ways in which that individual can lead a productive academic life and be of service to the University;
>
> 3) initiating a "faculty renewal program," i.e., leave time to develop competence in other fields;
>
> 4) for those who remain nonproductive, increasing the incentive for early retirement, including increasing inducements to those who elect to continue past age 65.

UCAP does not directly consider the possibility of dismissal in such cases, and we agree that such action is inappropriate in response merely to a lack of research productivity. We feel strongly that such a lack, in the presence of adequate teaching, possibly supplemented by service, is adequately dealt with by denial of advancement; but where teaching is also flagrantly below standard, we believe, as indicated above, that dismissal is the remedy to be contemplated, in contrast to demotion, which would continue to subject students to the faculty member's gross incompetence. In such cases, however, a process of consultation and assistance such as UCAP has envisaged for research performance should be initiated and carried through by the Chair or other appropriate official, with special attention to teaching performance.

d. Departmental Progress Reports

The Chair would be obliged to report to superior reviewers the steps taken in each case in which the negative review process had been initiated. In the academic year following the start of the counselling and remedial assistance efforts, the Chair would be obliged to assess whether the faculty member has made satisfactory progress in improving his or her performance and to report the results to superior reviewers (the "first-year report"), with a copy to the faculty member. After reviewing this report, the Budget Committee might conclude that the faculty member's performance is now satisfactory. In that event, the matter would be closed. On the other hand, the Budget Committee might conclude that significant progress has been made but that more is needed. In this case, the procedure of consultation and advice would be continued for another year. It is also possible, however, that the Budget Committee would conclude from its review of the Chair's first-year report that the steps prescribed in part e., below, should be commenced.

e. Higher-Level Review

If the Budget Committee should conclude, from the first-year report or from subsequent departmental or other reports, that the efforts to improve the professor's teaching were not making sufficient progress and that termination proceedings should be considered, the matter would then move to the next step. A Special ad hoc Review Committee would be appointed to consider the record (including a statement from the faculty member, if obtainable, assessments by the Chair and Dean, and a preliminary finding from the Budget Committee), to assess the faculty member's performance with reference to scholarship or creative activity and with particular reference to teaching, and to recommend whether termination proceedings should be initiated or, if not, what further action might be taken. The Budget Committee would then consider the ad hoc committee report, make its own further evaluation, and prepare a recommendation and forward it to the Provost. If the Provost approves a negative

recommendation, a notice of tentative judgment would be sent, with a full summary of its basis, to the faculty member and the department Chair, either or both of whom might offer further commentary or rebuttal.

If the negative recommendation is subsequently maintained by both the Budget Committee and the Provost, the matter would come before the Chancellor, who, prior to taking action, would afford the faculty member an opportunity of hearing by the Chancellor or by the Chancellor's designate. Thereafter, if the Chancellor reaches a decision of termination, the case would be forwarded to the President and Regents for final action.

Nothing in this procedure would prejudice the rights of the faculty member to present a grievance to the Committee on Privilege and Tenure at any time that committee should choose to hear it.

In order for the recommended policy to be fairly and uniformly implemented, all chairs would be obliged to make a substantive report on the occasion of a faculty member's five-year review, with specific documentation of teaching and service in addition to a report on research activity.

Presentation of the 1998 Phil Kaufman Award to Professor Ernest S. Kuh

3rd November, 1998

Once more, it is both a pleasure and an honor to be selected to present the fifth annual Phil Kaufman Award to Professor Ernest Kuh of the University of California at Berkeley. Following four years at Bell Laboratories in Murray Hill, Ernie joined the faculty at Berkeley in 1956. As you may know, Ernie started his professional career, in both teaching and research, in the area of circuit theory. I know many of us used the popular text *Introduction to Circuit Theory*, by Charles Desoer and Ernest Kuh, as an undergraduate text. Ernie's work in network synthesis and approximation, and then system theory, continued until the late 1970's. His early work on piecewise linear modeling and simulation at the circuit level was an excellent example of rigorous theory applied in a practical way, although even he admits it was just too hard to beat SPICE at that time!

Many of Ernie's graduate students from those early years have made major contributions to electrical engineering. They include Professor Sanjit Mitra, now Chairman of Electrical Engineering at UC Santa Barbara, Professor Ibrahim Hajj at the University of Illinois at Urbana, and of course Dr. Ron Rohrer, another very successful contributor to EDA in both research and practice. As Ron recently told me, “Ernie has had a profound impact on me and on my career.” Ernie's former student Dr. Ming Chien founded First International Computer in Taiwan, now one of the largest PC motherboard manufacturers in the world.

In 1968 Ernie accepted the role of Chairman of the EECS Department and in 1974 he followed that assignment with a seven year term as Dean of the College of Engineering at Berkeley. If there was a Kaufman Award for service to academia, Ernie would certainly have won that as well. In his administrative roles, Ernie set our Department and our College on a new course in many areas, especially in its relationships with industry. On Ernie's watch, we were able to develop a much closer and more integrated relationship with the semiconductor and emerging EDA industries, leading to the Berkeley Industrial Liaison Program and culminating in the addition of an entire floor to the Electrical Engineering building in 1982, called the Berkeley CAD/CAM Center. Ernie certainly played a key role in the development of the CAD/CAM Center.

While Ernie has made very significant contributions in all of these areas, the reason we honor him here this evening is for his contributions, both directly and indirectly, to the EDA industry. It was during his term as an administrator that Ernie decided to change the direction of his research and move into a more applied field, in particular the physical design of circuits and systems. Such a radical change is not at all easy! Especially in the middle of one's career, not to mention moving from a theoretical basis to a very practical one, where you really do have to start almost from scratch, developing new relationships and learning the ins and outs of building software systems. A key insight for Ernie came when he was visiting his friend and well-known circuit and system theorist Brockway MacMillan at Bell Laboratories in 1975. He was introduced to a group working on the automation of PCB placement and routing and he realized how useful his understanding of graph theory might be when applied to these problems. So Ernie began the

transition by bringing his theoretical understanding to the physical design arena, initially with printed circuit boards and then to integrated circuits and systems. As Professor Alberto Sangiovanni-Vincentelli recalls: “When I first came to Berkeley in 1975 as a visitor in Ernie's group, he opened my mind to many interesting and new problems in layout that combined both theory and a practical implementation.”

Ernie's early work on one-dimensional pin assignment and the introduction of the interval graph was critical, not only in the PCB area but also to channel routing as well. His work with Yoshimura of NEC on extending these ideas by introducing the use of the vertical constraint graph and applying them to channel routing resulted in a classical paper in the field and the basis for much work that followed in the area. But Professor Kuh and his students continued and expanded their work in the area, bringing together a variety of different approaches and forming them into a coherent and consistent body, and then polishing the results from both a theoretical as well as a practical perspective until the system really made sense. Soon we were to hear of entire physical design systems like BBL, BEAR, and PROUD. In fact, Ernie's work on the PROUD system was one of the earliest practical applications of quadratic programming techniques to cell placement. With his student Dr. C. K. Cheng, now a faculty member at UC San Diego, Ernie pioneered the use of a resistive network analog for placement and for partitioning. His most recent contributions have been in the development of timing-driven physical design tools for Deep Submicron VLSI circuits, and for multichip modules, as well as the development of an accurate and efficient circuit and interconnect simulator. This research has also yielded software programs useful both in industry and in academia, including the zero-skew clock routing work with his student Dr. Rensong Tsay (now at IBM), the timing-driven placement work with Dr. Arvind Srinivasan, and the SWEC program, with Dr. Sheng Ling. More than any single contribution, I believe it is the tight and appropriate integration of timing simulation and analysis techniques with detailed layout that is the most significant part of the contribution here.

In the mid 1970's, Professor Kuh was invited to join the Board of Directors of the young EDA company ECAD. As Paul Huang, the principal technical founder of ECAD, told me, “We wanted to work with Professor Kuh because of his unquestionable personal integrity and because of the great respect he has in the research community throughout the world, but especially in Japan and the rest of Asia. He and his students had a very strong reputation for their research in physical design of integrated circuits at that time as well.” When ECAD merged with SDA Systems to form what became CADENCE Design Systems, Professor Kuh remained on the Board of the new company and formed the first CADENCE Scientific Advisory Board. As a member of the CADENCE SAB during that period, I can say from personal experience that it was a real pleasure for all of us on the board to work with Ernie. He made sure the company derived all that it could from its SAB!

Of course, Professor Kuh has won many major awards for his research and his teaching as you can see from his resume, including the 1996 C&C Prize in Japan and the IEEE Education Medal. But perhaps the most visible and long-lasting reward for his efforts lives on in the form of his many successful students. As well as those mentioned above, they include Ben Ting and Nan Ping Chen, both of whom worked for many years at Hughes, Chi Ping Hsu and J.T. Li, now at Avant!, and Michael Jackson of Motorola. To his credit, many of his doctoral students have chosen academic careers in the EDA area, including Tim Cheng at UC Santa Barbara, Massoud

Pedram at USC, and Wei Ming Dai at UC Santa Cruz. So, in summary, on behalf of Mrs. Kaufman, EDAC, and all present here tonight, I am both pleased and honored to be able to present the Phil Kaufman Award to Professor Ernest Kuh, another who has played a central role in creating the EDA industry, through his teaching and his research, but perhaps most importantly through the generations of students he has mentored and who have carried his ideals, his values, and his passion for excellence throughout the academic community and the EDA industry.

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