CHEMICAL HERITAGE FOUNDATION

KATHRYN C. HACH-DARROW

Transcript of Interviews
Conducted by

Arnold Thackray and Arthur Daemmrich

at

Loveland, Colorado, and Seattle, Washington

on

20 July 2002, 2 October 2003, and 8 February 2004

(With Subsequent Corrections and Additions)

ACKNOWLEDGMENT

This oral history is one in a series initiated by the Chemical Heritage Foundation in honor of E. N. Brandt, an outstanding practitioner of oral history and a leader both in its methods and broader historical context. The series documents the personal perspectives of entrepreneurs, scientists, and managers who have made outstanding contributions to the growth of the American chemical industries during the twentieth century.

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Kathryn C. Hach-Darrow

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KATHRYN C. HACH-DARROW

1922	Born in Bucklin, Missouri, on 20 October

Education

1941-1944	Iowa State University
1998	Doctor of Laws (honorary), Northwood University
2004	Doctor of Humane Letters (honorary), Colorado State University

Professional Experience

	Hach Chemical Company
1947-1968	Co-Founder and Partner
1968-1978	Vice President
1978-1980	President and Chief Operating Officer
	Hach Company
1980-1988	President and Chief Operating Officer
1988-1999	Chairman of the Board and Chief Executive Officer

Honors

First woman director of the American Water Works Association
First woman to serve as director of the First National Bank, Loveland, Colorado
Member, Board of Directors, Colorado Crystal Corporation
Member, The Ninety-Nines, Inc., International Organization of Women Pilots

1957	George Fuller Award (shared with Clifford C. Hach), American Water Works Association
1982	Founding member, The Committee of 200
1992	Outstanding Business Leader Award, Northwood University
1993	Outstanding Business Woman of the Year, Colorado Women's Chamber of Commerce
1998	Distinguished Service Award, College of Liberal Arts, Iowa State University
2000	Inducted into the Colorado Business Hall of Fame
2000	Establishment of the Kathryn Hach Scholarship for Women, Northwood University
2003	Pittcon Heritage Award, Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy and the Chemical Heritage Foundation

ABSTRACT

Kathryn C. Hach-Darrow begins the interview* with anecdotes of Clifford C. Hach as a young, inquisitive child growing up on a farm and the effects of the Great Depression on the Hach family. Despite financial difficulties, the Hach family encouraged Clifford to attend Iowa State University where he met his future wife, Kathryn Carter. Similar to Clifford Hach, Hach-Darrow grew up on a farm during the Great Depression, but spent much of her early childhood riding in and flying her father's Eagle Rock biplane. Raising turkeys in order to finance her college education, Hach-Darrow decided to pursue home economics at Iowa State. Clifford and Kathryn were married in June 1943 after a yearlong courtship. Hach-Darrow discusses the responsibilities of raising their three children—Mary, Bruce, and Paul—maintaining a steady income, and developing a company.

In 1947 Clifford and Kathryn started the Hach Chemical and Oxygen Company, which eventually became Hach Company, one of the most innovative, influential, and well-known companies in the world. Hach-Darrow relays her thoughts on and her memories of the key events surrounding the start of the company, the creation of the Hach Model 5B Hardness Test Kit, the decision to enter the water testing market, the incorporation of the company in 1951, and the importance and need for instrumentation. Moreover, Hach-Darrow discusses the company's initial public offering in 1968, innovation, the company's international pursuits, Bruce J. Hach's involvement with the company, and the importance of quality control and customer service standards. Throughout the interview, Bruce Hach appends his memories and reflections of Clifford Hach as a father, an entrepreneur, and an innovator.

Hach-Darrow concludes the interview by recounting the effect of Clifford's death on his family and the Hach Company in the early 1990s. In 1999, Hach-Darrow sold the company to Danaher Corporation. Along with her family and other dedicated workers, Hach-Darrow now focuses her efforts on the Hach Scientific Foundation, known for its support of chemical education in the form of scholarships. Hach-Darrow is also an avid supporter of female entrepreneurship and was one of the founding members of The Committee of 200.

** This oral history also records the recollections of Bruce J. Hach, son of Kathryn and Clifford Hach, as he was present during all interview sessions.*

INTERVIEWERS

Arnold Thackray is President of the Chemical Heritage Foundation. He majored in the physical sciences before turning to the history of science, receiving a Ph.D. from Cambridge University in 1966. He has held appointments at Oxford, Cambridge, Harvard, the Institute for Advanced Study, the Center for Advanced Study in the Behavioral Sciences, and the Hebrew University of Jerusalem. In 1983 he received the Dexter Award from the American Chemical Society for outstanding contributions to the history of chemistry. He served on the faculty of the University of Pennsylvania for more than a quarter of a century. There, he was the founding

chairman of the Department of History and Sociology of Science, where he is the Joseph Priestley Professor Emeritus.

Arthur Daemmrich is a policy analyst at the Chemical Heritage Foundation in Philadelphia. He holds a Ph.D. in Science and Technology Studies from Cornell University and has published on biotechnology policy and politics, the sociology of medicine, and pharmaceutical drug regulation. In his research, he brings long-range perspectives to bear on the analysis of globalization, risk, health, and environmental policy. Daemmrich has held fellowships from the Social Science Research Council/Berlin Program for Advanced German and European Studies, and the Kennedy School of Government at Harvard University.

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INTERVIEWERS: **Arnold Thackray and Arthur Daemmrich**

LOCATIONS: **Loveland, Colorado, and Seattle, Washington**

DATES: **20 July 2002, 20 October 2003, and 8 February 2004**

HACH-DARROW: Let me begin with what I know about Clifford's [C. Hach] childhood. He was a difficult child, according to what his mother [Sophia Kiesel-Hach] told me. By the age of fifteen, his family had given up on him for a number of reasons. Cliff was a very absent-minded child. He always had his mind on other things. Once, amidst the [Great] Depression, he left the farm gate open, the cows got out and got into the food, foraged, floundered, and died. That was a terrible disaster for his family. However, that was just one thing.

Very early on, Cliff had a serious interest in electrical engineering. He built his own ham radio set and taught himself Morse code. When he was fifteen, he came online with his ham radio system. Somewhere in there, the family began to realize Cliff was not just an ordinary boy, but that there was something quite special about him.

THACKRAY: Please, go a little further back, if you would.

HACH-DARROW: Clifford's father [Charlie Hach] ran a hardware store and Cliff loved to go around that hardware store and examine the tools. The store was where Cliff hung out as a little boy. That store was in the little town of Clutier, Iowa, which is where Clifford was born on 20 October 1919. Clifford had an older sister, two younger sisters, and a younger brother, who later got a Ph.D. in chemistry from Iowa State [University]. The family life was very much part of the little town of Clutier. When the Depression came, the Hach family lost their store. Charlie Hach cashed in whatever he could and bought a farm in Marshall County [Iowa]. It was on that farm that Clifford grew up, and built his radio set. Later he blew out the side of the garage, also. That happened during an experiment when Cliff came home from college—I'll say more about that later.

THACKRAY: Clifford was the eldest boy in a farm and practical family.

BRUCE J. HACH: A lot of my information is from Cliff's brothers and sisters, my aunts and uncles, who have thoughts on this. His father, Charlie Hach, was second generation Czechoslovakian in the United States. There was quite a group of Czech farmers in central Iowa, and boy, that particular group was deeply self-reliant. There were no hired hands, nor

were there any other outside services. Charlie was typical. The family did absolutely everything themselves. I have always felt that had a certain degree of influence on Hach Company because later Hach became extraordinarily vertically integrated.

Cliff's inherent technical curiosity grew up in the wrong direction. As a child, he disassembled things and took things apart. The problem was the reassembly. [laughter] Only in the last ten years or so has one of his younger sisters, Mildred [Hach], told me one revealing story. After the Depression lessened, the family purchased one of the first big vacuum tube radios in a floor-mounted, wooden cabinet. His parents came home to find that Clifford had taken it apart. He had all of the vacuum tubes in order on the floor, but of course, the radio never worked again! [laughter]

THACKRAY: You mentioned the Czech community; was it a church-based community?

HACH-DARROW: Yes, it was. It was Catholic, but the family had broken from the Catholic Church and so again, some of this independence—

B. HACH: To be a Protestant Czechoslovakian, I think, was fairly rare.

HACH-DARROW: No, no, that all came about because Cliff's mother was German. Kiesel was her maiden name and she was of German and Lutheran decent. That was probably partial cause of their break with the Catholic Church.

THACKRAY: Did Clifford attend public school?

HACH-DARROW: Yes. I can assure you, there were no private schools. It was a big deal just to go to school. While he was living on the farm, he graduated from Green Mountain High School—a small, rural high school. Green Mountain had a population of one hundred people. The children all went to that one school. Of course, there was no chemistry in that school, but there was physics. It's interesting to note, Cliff repeated the third grade. So he was one year older than most of his class in high school. He was bright enough. He just was not automatically interested in everything the teacher taught. Another very important point is that when Cliff graduated from high school he refused to wear a cap and gown, because he thought that graduating from high school was not a major enough accomplishment in one's life to warrant such attire. So he wore a business suit; [laughter] he said it was in order not to attract attention to himself! [laughter] You can imagine how that worked out!

As he began to distinguish himself, Cliff prepared for a physics exam for high school students at the University of Iowa. He and a girl were chosen to go from Green Mountain to

take the exam. Now Cliff was a very modest man and he never was one to be boastful. But he always said, "You know, she had better grades than I did in high school, but," he continued, "I swamped her." [laughter]

B. HACH: His parents, Charlie and Sophia, didn't have a formal education, correct?

HACH-DARROW: No. They were literate, but they came from an impoverished background. However, Cliff's mother, Sophia Kiesel-Hach, understood the importance of education. While she didn't have any herself, she read, was certainly self-educated, and was a great promoter of reading. There was no radio before Cliff's ham set and there were no newspapers. There was nothing but the corn growing. It was pretty tough living.

THACKRAY: Was Clifford encouraged to go to college?

HACH-DARROW: I believe that he was encouraged to go, but you also have to understand, it was a terrible stress on his family to put that kind of money together. His mother said that she kept being approached by other women in the Green Mountain area wanting to know, "When is Clifford coming back to the farm?" Many students came to Iowa State unprepared for how tough it was, so they dropped out and went back to the farm life. This was called the back-to-the-farm movement.

In contrast, Clifford was doing pretty well. Then, he heard a lecture at the end of his second year in electrical engineering by Dr. [Orlando R.] Sweeney, head of the department of chemical engineering, and with that he dropped electrical engineering and switched majors. He went to the admissions office, had himself reenrolled in chemical engineering, and went home and told his folks what he had done. They were mortified. Then when Clifford got into chemical engineering, he realized that really wasn't what he wanted. What he really loved was straight chemistry. Very soon, he enrolled in analytical chemistry under Dr. Harvey [C.] Diehl [Jr.], head of the analytical chemistry department. Dr. Diehl realized that this boy was exceptional, and picked him up and gave him a job in his laboratory. So finally, Clifford was able to make it on his own financially, and the family no longer had to support him.

THACKRAY: How many years elapsed between enrollment and Clifford's graduation?

HACH-DARROW: Nine years. He started college in 1938, and received his degree in 1947.

Clifford actually received a deferment, during the war [World War II]. He had signed up for the [United States] Navy, but Dr. Diehl went to bat for him, or wanted him as a part of his team. He was just a great analytical chemist. Even though an undergraduate, Cliff was assigned

with Charles Neher, a graduate chemist, the purification of thorium. The university brought in many chemists who had bachelor's degrees, and gave them assignments.

B. HACH: Here's my take on this, because this has always been a little confusing. Once the war started, the Midwestern land grant schools turned out to be major research centers for the war effort. Iowa State was one of seven schools that provided support services for Los Alamos [National Laboratory]. The main focus was some pretty exotic research on the purification of thorium. There was also some work on metallurgy—a couple of rare earths were discovered. There was also related work on metallurgy and the metal casings for the bomb. Then there were all kinds of individual grants for other war-related projects. Grants were assigned to a professor, and he had the authority to pick whomever—even an undergrad—to serve as a technician or as a researcher in his lab. Because of the priority of the war effort, these "researchers and technicians" dropped out of college and worked on these projects full-time. In exchange, they received a draft deferment. Clifford became one of them, having been chosen by Harvey Diehl. That work lasted for the entire duration of the war. Many of his projects were not directly related to the Manhattan Project. One project concerned carbon dioxide [CO_2] generation, in connection with an effort being made by the Navy to find a way to package carbon dioxide for fire extinguishers.

HACH-DARROW: You're exactly right. That project was connected with Walter Kidde & Company [Inc., formerly Kidde Manufacturing Company, Inc.]. Clifford's research focused on the continuous generation of carbon dioxide on shipboard to fight fires. There were various early experiments leading to a compound that was an oxygen carrier. This compound became very powdery and, because of its oxygen-generating capability, was prone to cause explosions—this was when Clifford blew out the side of his family's garage in Green Mountain, Iowa. He was trying to develop a transportation system for this oxygen-carrying compound. The idea was to go from oxygen [O] to CO_2 to put out a fire. Out of all of this research came an invention of Clifford's that he was able to patent for the generation of CO_2 (1). The Walter Kidde Company was in the fire-fighting business, so they paid Clifford fifteen thousand dollars, which was a whale of a lot of money for two kids with no money at all.

THACKRAY: What year was that?

HACH-DARROW: About 1945.

THACKRAY: That must have been a huge vindication!

HACH-DARROW: It was. There never would have been a Hach Chemical Company if we hadn't had that fifteen thousand dollars because Cliff and I did not have anything when we were married in 1943.

B. HACH: When you have a strong pool of eminent scientists under the sense of urgency of World War II with a broad base of research projects and undergrads serving as research assistants, then one by-product is that the undergrads receive an enormously powerful informal education. As an undergraduate, you're really getting something done, even if you're not getting academic credit for it because of the war. The war effort provided an enormous informal chemical training that wouldn't have taken place in peacetime. Clifford was side-by-side with high-level people on these research projects. He probably learned more from this informal work than through traditional, formal education. The best chemists gave their best efforts. The other thing that is intriguing is that these people didn't receive any more pay than their standard faculty salary. There was an enormous flow of science research through the entire nation at extremely modest expenditure.

During World War II, there was another group that got a tremendous number of deferments: machinists. There was a tremendous lack of tool and die makers. In the industrial expansion that the war necessitated, you can imagine how much tooling was required. Thus, tool and die makers and the high-end machinist also received deferments.

DAEMMRICH: Kitty, we want to know about you as well. Please tell us about your childhood experiences.

HACH-DARROW: I was born in Bucklin, Missouri, on 20 October 1922—that's one of the first things that attracted me to Clifford, he was born on 20 October also [in 1919]. My father was a Ford [Motor Company] dealer in the little town of Bucklin. He made nice money in my early childhood, because the economy was good. He loved to fly airplanes, and in 1928, he purchased an Eagle Rock biplane. I fell in love with airplanes at that moment and would cry to go in that plane with my dad. That was the beginning of my interest in aviation. We'll come back to that later on.

B. HACH: Kitty's a Carter, a relatively prominent family in Virginia.

HACH-DARROW: My maiden name was Kathryn Louise Carter. I had an aunt, Lola Carter Rowell, who, in her elderly years, didn't quite have everything all together. She was in an elevator one time and said to a man in the elevator, "I'm a Carter, don't you know!" [laughter]

Anyway, the Depression wiped out my father. He was one of the people on whom Ford unloaded a lot of Model As. The V8 was coming and he didn't have to take bankruptcy, but it

wiped him out. So he cashed in his insurance and bought a farm in Triplett, Missouri. We were wheat farmers, so my growing up was on a Missouri farm. When we first moved in, we did not have electricity or indoor plumbing. It was sparse living. We didn't have many advantages, but there were some other things that were good about it.

My mother had been a schoolteacher and was very anxious that I go to college. I graduated from the little high school in Triplett. There were forty-eight of us in four classes. My class had twelve students, and we were the largest class that had ever graduated out of Triplett at that time. The class that followed mine had seven students. It was meager. We didn't even have a library. We didn't have anything.

THACKRAY: Did you have brothers or sisters?

HACH-DARROW: No, I am an only child. My folks were about forty when I was born and I'm not sure whether they were happy about that or whether it was a surprise. [laughter]

DAEMMRICH: How typical was it for a car salesman in Missouri to buy and fly an airplane?

HACH-DARROW: That was quite unusual. The period of 1926, 1927, 1928, was a good time to be in the automobile business because there were no trade-ins. People had money and they paid cash for a car. Everybody wanted to have a Ford Model T, so he did quite well. Then the Depression completely wiped him out. We moved to the farm in about 1933, and the plane was sold.

I raised turkeys in order to pay for college. I made seven hundred dollars, which was enough money for my tuition. I received a scholarship, and went to a small girls' school in Columbia, Missouri, called Christian College [now Columbia College], which was sponsored by the Christian Church. My mother was a great believer in the Christian Church. I did well there and I made Phi Beta Kappa, so that was a nice period.

Then I transferred to Iowa State—let me pause here and say, for a girl, at that time, there were three things one could do. One could be a nurse, a teacher, or a secretary. I really liked science even though I didn't have any real exposure to it. I wanted to be a nurse, and I wanted to go to the University of Missouri for nursing. My father said, "Nice girls are not nurses!" [laughter] He was very adamant that his nice girl was not going to be a nurse.

I didn't want to be a secretary. I knew that wasn't for me. That left being a teacher. On the farm, we were greatly impressed by a woman who was a graduate home economist that helped with canning and other household activities—she was a home demonstration agent, a home economist by training. The home demonstration agent was based in the extension arm of the department of agriculture at the University of Missouri. She came out of Keytesville,

Missouri, and traveled around and helped farm women. She could help with sewing, with canning, and with many other things. My mother was so impressed with this woman that it was determined that I would become a home economics teacher.

DAEMMRICH: Kitty, please tell me a bit more about the turkeys that you raised.

HACH-DARROW: There was a turkey processing plant in Brunswick, Missouri. Raising turkeys was a full-time job. I shepherded the turkeys around. I had two bamboo poles I used to guide where the turkeys could waddle, but the darned things would fly up in the air and get on the neighbor's watering tank. Our neighbor was quick to call my mother, and say, "Tell Kathryn that her turkeys are on my watering tank!" Of course, I had to get over there, get my poles going, and get the turkeys back over to our property. I didn't want to break their wings and prevent them from flying, because then your turkeys were graded down during sale. I didn't want that because I was trying to get as much money as I could.

We sold the turkeys for the Thanksgiving market. My mother and father had to finish them up, but I took them from the little fuzzy stage all the way up to adulthood. As they got bigger, I took them through the wheat field to clean up the wheat. I shepherded them around all over the farm in order to feed them, to make as much money as I could. My only investment was the initial layout for the little turkeys.

THACKRAY: CEO [chief executive officer] and entrepreneur at an early age! [laughter] Why Iowa State?

HACH-DARROW: It was my understanding that Iowa State was the best school for home economics. When I went to school, tuition cost forty-five dollars a quarter.

B. HACH: In my lifetime, as a little bitty boy, the roads from central Missouri to Iowa State contained patches where there was only gravel. The distance was no more than 200 or 300 miles, but there were no interstate highways so it was tough to go back and forth.

THACKRAY: This was in 1941?

HACH-DARROW: Yes. I was at Iowa State for two or so years during which time, I met Clifford Hach.

I attended the Christian Church group meetings for college students in Ames and Cliff attended those same meetings. One time the group had a party for all the college kids, and the

entertainment was one Clifford Hach with science experiments. He had a whole series of things he did with dry ice. I remember his clock reaction; he told us what time this cloudy precipitate would go perfectly clear—everybody was watching—and bingo! It did! Man, I was impressed with this guy. [laugher] It was at one of these Christian Church parties that I said something about my birthday being tomorrow, and he replied, "Gee, mine is too." Cliff had flowers delivered to me the very next day. I realized then that was the beginning of a nice relationship.

One question you will ask is the origin of my interest in business and entrepreneurship. I would say that with my turkeys and so forth, I was already really interested. Let me pause to say that my Grandma Lu [Louisa McMillian Brown], my mother's mother, was the first woman to have a driver's license in Chariton County [Missouri]. She drove her own Buick and she was the first woman I ever knew who invested in the stock market, in AT&T [Company]. She made a lot of money! [laughter] Her husband died when he was forty-one or forty-two. She had 400 acres and raised eight children. She was a CEO! That was my Grandmother Brown, and that's where the Louise in my name comes from, Kathryn Louise. So business was something that I was always interested in.

Going back, I had a date with Clifford Hach. He came up to the door and had a nice little package all wrapped up for me. I thought, "It's a box of candy." He gave me the package, I opened it up, and there was a book for me to read by Dr. Otto Eisenschiml, *Without Fame*: *The Romance of a Profession* (2). Cliff said, "I want you to read this because we're going to build a chemical company." His ambition was already very clear, even back in those days.

I don't have the book anymore. Dr. Eisenschiml referred a great deal to his wife in the book, because she was much more than just a wife. She was his business partner.

THACKRAY: Was this before you were married?

HACH-DARROW: Yes. This was on a date.

B. HACH: Not your very first date!

HACH-DARROW: No, but things were developing! [laughter]

B. HACH: Was this post-Pearl Harbor or pre-Pearl Harbor?

HACH-DARROW: This was post-Pearl Harbor, because Clifford had a little bit of money by then. He was being paid because he was part of the Ames Lab staff working with the Manhattan

Project. I haven't said it previously, but Cliff and Chuck's work was part of the Manhattan Project.

THACKRAY: Can we focus on chronology? Clifford met Harvey Diehl when?

HACH-DARROW: About 1940. The war hadn't started. I started college in 1940 and transferred to Iowa State in the fall of 1941. I was there from 1941 through 1944.

THACKRAY: You met Clifford in your first year at Iowa State?

HACH-DARROW: Yes, when I met him, he was already into chemistry. We dated that next year, and were married on 4 June 1943, at the end of my junior year. I never went back after that. Clifford hadn't graduated either, at that stage.

THACKRAY: When you first met, he was already connected with Harvey Diehl?

HACH-DARROW: Yes, the connection to Harvey Diehl led to the work on CO_2, and then came the Manhattan Project.

THACKRAY: In a certain sense, he already knew where he was going when you met, hence the book.

HACH-DARROW: Yes. The CO_2 did not work well enough. There were fires and explosions. Men were hospitalized. All kinds of things happened with the CO_2. The dust problem was something that they were never able to solve.

THACKRAY: The problem is: oxygen carriers are explosive! [laughter]

HACH-DARROW: That's right.

THACKRAY: Did you go home to get married?

HACH-DARROW: No. We were married at Iowa State. I took my last exam in economics on the morning of 4 June, got a B on it, [laughter] and we were married that afternoon at four o'clock. Then we came back to Ames, rented a little three-room apartment, and Clifford continued on with the Manhattan Project research. There was no money. Then a little girl [Mary Hach] came along, and I did not finish college, period.

THACKRAY: What did your families think of this?

HACH-DARROW: They were horrified, very unhappy. My mother did not like Clifford because she felt that he was a bad influence on me. [laughter]

THACKRAY: I presume he wasn't smoking and drinking. What was the nature of this bad influence?

HACH-DARROW: He didn't smoke and he didn't drink. That was never a problem.

THACKRAY: And you went to church together?

HACH-DARROW: Yes. We went to church and we were very active in the young peoples' group there. Her expression was, "He took away from Daddy and me the most precious thing we ever had."

THACKRAY: It might be that any man would have been disapproved of.

HACH-DARROW: I think that's right. No one was good enough for Kathryn in my mother's mind.

B. HACH: Did your parents perceive that Clifford's family came from a lower class? They were Czechoslovakian and German farmers, in Iowa. In contrast, Missouri is on the northern tip of the South, and farmers down there were a little bit more aristocratic. And, you're a Carter.

HACH-DARROW: Yes and my mother was British. The Browns.

B. HACH: You had a better lineage, I suppose.

HACH-DARROW: Yes. They felt they were classier people! [laughter]

THACKRAY: Did they come to the wedding?

HACH-DARROW: Yes, they came! It was a very simple wedding that we put on ourselves. Weddings today cost fifty thousand dollars or one hundred thousand dollars; our wedding was nothing like that. We had punch and cake in the church reception parlor afterwards.

THACKRAY: What did his parents think about your marriage?

HACH-DARROW: They never knew what to do with Clifford from the very beginning. I think they liked me, and I liked Mr. and Mrs. Hach. They were very fine, very genuine, hard-working people. I got along very well with them. Cliff used to tell the story that just before my mother passed away she said to him, "Cliff, as a son-in-law, you haven't been too bad." [laughter] But as Cliff said, "It took until she was ninety-one years old for her to say that!" [laughter]

B. HACH: I've always been intrigued that the two families, even though they had something in common, came from very, very different social and cultural environments. For example, up in Iowa, the Czech farmers were wearing bib overalls, even to church. They would actually have a shirt and tie, and then bib overalls on top of that.

HACH-DARROW: That's right. That was dressed up for them.

B. HACH: They did absolutely everything themselves. I remember once watching Clifford's father change a tractor tire with a pulley all by himself. He tipped the tractor up and changed the tire with the pulley off the branch of a tree. Kitty's parents were much more refined. Your father would wear a tie and suit coat to church and stay dressed up all-day on Sunday.

HACH-DARROW: My mother wore gloves to church and she and I always wore hats. Always.

THACKRAY: Did you see much of either family after you were married?

HACH-DARROW: My folks wanted to keep in touch, so we went back and forth, and I saw the people over at Marshalltown [Iowa] and I liked Cliff's brother and sisters. We got along just fine. I would say that we had a very normal, casual friendship. Nothing real big about it. I think it was adequate.

THACKRAY: Well, you were the crazy couple.

HACH-DARROW: Yes! [laughter] We were.

B. HACH: Kitty's father died in 1951, and her mother then remained a widow and lived until 1975. One thing that might have been a minor problem—I could almost see it now but I sure couldn't then—your mother just had no idea what a chemist was. Chemistry was so abstract. It is hard to gain a sense of confidence in something you just don't understand.

HACH-DARROW: You have to understand, we started our chemical company with a bunch of graduate students helping to construct a three-room building. Somebody somewhere said that Hach started in a garage. That really isn't true. Thanks to the fifteen thousand dollars, Clifford bought 1 acre of land for five hundred and forty dollars in a flood plain on the south side of Ames, Iowa. We built a three-room, cement block building, and that was the beginning of the Hach Chemical Company in 1947.

THACKRAY: Let's go more slowly, if we may, between 1943 and 1947. You married and dropped out of school. Cliff worked on various projects and ventures.

HACH-DARROW: I was doing some work too, trying to put food on the table. I worked in a clothing store. I ran a little catering service. I did everything I could to try to make money.

THACKRAY: What was the plan when you and Clifford first married?

HACH-DARROW: Today, I would tell you we did not have a business plan. We were just trying to keep everything together. We knew that the war would end, and we knew we had to get Cliff back into school. Now, there is one thing that I haven't mentioned: we moved. Walter Kidde wanted Clifford to go along with the CO_2 invention, so we lived in New Jersey for about a year.

THACKRAY: When was this?

HACH-DARROW: Bruce was born in New Jersey, so it would have been part of 1945 and part of 1946.

B. HACH: Was it a condition of the fifteen thousand-dollar award that you move to New Jersey? If you had not moved to New Jersey, would you still have gotten that money?

HACH-DARROW: I don't know the answer to that, Bruce. I'm inclined to say that it was. A lawyer by the name of Mr. Neville was involved. You see, there was a patent issued to Clifford and then sold by Cliff to Walter Kidde (3). Actually, Bruce, I really don't know what the details were. Nevertheless, we moved to New Jersey, and were there when you were born in May of 1946. Clifford was in a research group that did all of the start-up work at Walter Kidde. Once Cliff's work was completed, we moved back to Iowa because as we always said, "We've got to get Cliff's degree." You were four months old when we came back to Iowa, Bruce.

B. HACH: I can see the dilemma. You would have forfeited the Walter Kidde money unless you moved to New Jersey. If you waited another year or two, probably, they would have retracted the offer. It sounds as if there was a lot of conflict there.

THACKRAY: Kitty, you mentioned the birth of a little girl.

HACH-DARROW: Yes, Mary was born in 1944. And you were born in 1946, Bruce.

THACKRAY: Cliff's is a very interesting story of university-linked research leading to innovation and ultimately a start-up business.

HACH-DARROW: Yes, that's right. In addition, Clifford was working in New Jersey without a degree, when a second corporation also made clear that it wanted him—Ballantine Beer [P. Ballantine & Sons] offered him a very large increase in salary. We were in Clifton, New Jersey, and Ballantine Beer was also in north Jersey. How the offer came about, I don't know. I do know that it was a big step up financially from what he was earning at Walter Kidde. The money was enough to make us pause and think, but I said to him, "Clifford, if you go into a brewery, my mother will never ever speak to you again!" [laughter]

B. HACH: Kitty's mother was a member of WCTU [Woman's Christian Temperance Union].

HACH-DARROW: She prided herself in saying, "Wine has never touched my lips!" [laughter] She was a very opinionated gal! Actually, she was wonderful. She was smart. She was great.

THACKRAY: Did you enjoy New Jersey?

HACH-DARROW: No, I wanted to go back to the Midwest. As I said, the money at Ballantine was—wow, we'd never heard of that kind of money. It was enough that it gave us pause. I'd like to say that we had enough integrity or sense of what we really needed to do, that we didn't succumb to the money. I remember the discussions with Cliff: "You've got to get your degree." With that, we packed everything up—a little four-month-old guy, the Plymouth car—and drove back.

This was the fall of 1946. We came back by Missouri, saw my folks, and then headed up to Ames. Cliff started back to school that fall. Boy, I'll tell you, we lived on mighty little money because we received no support from my folks, and no support from Clifford's folks. We were out there on our own. We had a trailer, which Dr. Diehl let us put in his backyard. That's where we lived until Cliff graduated. This time he put on his cap and gown! [laughter]

THACKRAY: Simultaneously the business ideas were cooking.

HACH-DARROW: Absolutely. With the fifteen thousand dollars, because it was a one-time amount of money, the taxes were lower—boy, it was either 20 or 25 percent. There is a special provision in the IRS [Internal Revenue Service] code for inordinate circumstances, which lowers taxes. We really squeezed every penny out of that money because it was all that we had; we also knew the money would help to start our business. Just for the blocks in that three-room, cement block building, the bill was something like nine hundred dollars. For the contractor to lay the blocks, the bill was something like seventeen or nineteen hundred dollars. When the graduate students came and helped us put the roof on, we were ready!

We moved in the winter of 1947. We had a potbellied stove for heat that was in the middle room. Looking back on all of this is gut-wrenching. There wasn't even a bathroom in that building. It was in the flood plain, and, of course, we have pictures of when we flooded out! [laughter]

THACKRAY: That was your home and the office?

HACH-DARROW: No. We lived in a little three-room apartment in a building that Cliff was the maintenance person of. We only had to pay fifty-five dollars a month for rent because Cliff fired the furnace, kept the hot water going, and did some maintenance around the building.

The three-room, cement block structure was for the business. Our first action was to take the last of the Walter Kidde money, buy out Dr. Diehl's partner, a chemist, in the Standard Sample Company, which made student unknowns for college chemistry courses. We ran that and sold student unknowns.

Dr. Diehl and a Michigan chemistry professor, Fredericks, began the Standard Sample Company. As two college professors, Diehl and Fredericks recognized that there was a real need for chemistry professors to have preanalyzed, accurate, prepared samples with a code sheet, in order to take some of the burden off the teaching of quantitative analysis. The fact that Dr. Diehl was in Ames, Iowa, and Dr. Fredericks was in Detroit, Michigan, prevented their company from really growing. I believe that Dr. Fredericks was anxious to get out of the business, so Clifford was able to buy him out. Thus, Dr. Diehl and Clifford went into the standard sample business together.

THACKRAY: Was Dr. Diehl an active participant in the business after the buyout? Or was Clifford, as the junior partner, doing all the work?

HACH-DARROW: Absolutely. The analysis work was really what Clifford was doing. In the background, I was advertising, preparing the code sheets, and organizing the mailing lists.

THACKRAY: Collaborating with Diehl provided you with mailing lists. My sense is that this partnership was unbalanced and unhappy.

HACH-DARROW: Yes. Harvey Diehl was a very demanding and rather difficult person. He was a very bright man, and was prolific in his writings. However, as a business partner, Dr. Diehl was a difficult person to work with. There was even a falling out between Harvey and Clifford. In time, they made up and their relationship became friendly again.

THACKRAY: While you and Clifford were working with standard samples, water softening possibilities developed, and you began to develop that business as well. There was a simultaneous partnership with Harvey Diehl, and a new independent venture growing.

HACH-DARROW: That is correct. Our partnership with Harvey Diehl dissolved in due course via a buyout around 1949. I previously mentioned the fact that Clifford had made tetraphenylarsonium chloride and caused a bad fire. After that incident, Dr. Diehl really wanted

to separate himself from Clifford, so I believe that it was Dr. Diehl who asked to be bought out. A price was established, we took over the Standard Sample Company, and, of course, our fledgling water analysis business got started.

THACKRAY: Did the money for the buyout come out of the profits of the water and standard sample businesses or did the funds come from the sale of Clifford's patent?

HACH-DARROW: By that time, the patent sale money was gone. Therefore, our funds came from the growth of the company.

THACKRAY: Kitty, financial challenges plague every start-up venture. Would you talk about how Hach developed financially?

HACH-DARROW: First, I want to say that we bought the company three different times. Initially, we bought out Dr. Diehl's partner, Dr. Fredericks. The money for that buyout came from the fifteen thousand dollars from Cliff's patent, minus the taxes and the money that had already been spent. Those funds paid for half of the Standard Sample Company, and to get the Hach Chemical and Oxygen Company started. After that was done, a partnership with Dr. Diehl was established until Dr. Diehl felt that he wanted out of the company, so we decided to buy out Dr. Diehl. By that time, we really didn't have money, so Dr. Diehl was very patient with us, and allowed us to pay him with the earnings from our fledgling water analysis business.

THACKRAY: When were the agreement and payout arrangements with Harvey Diehl made?

HACH-DARROW: About 1949. Then the company began to show some signs of growth. Nevertheless, we were not earning <u>that</u> kind of money. We had the vision; we thought we could see what was out there, but we were out of money. Then another chemistry professor from Iowa State, Dr. Charles Goetz, who had industry experience, appeared.

Dr. Goetz came to Iowa State from the Kardex Corporation and was somewhat well-to-do. Dr. Goetz saw our company as an investment opportunity, so he agreed to loan us two thousand dollars, which we could not have gotten elsewhere. Dr. Goetz saw that Clifford was an innovative person and that we were two people who were willing to work hard. I'd like to think that he saw us as honest people. In turn for the two thousand dollars Dr. Goetz loaned us, he received 50 percent of the company, and we <u>still</u> had to payback the two thousand dollars. That money was a godsend. We could not have gotten the money from anywhere else, so we accepted Dr. Goetz's terms.

As the company grew, it became time to buy out Dr. Goetz. The arrangement was worked out through Mr. Arthur Lucht, the president of the Union Story Trust and Savings Bank. The bank did not loan us the money to buy out Dr. Goetz, instead Mr. Lucht acted as mediator and saw to it that we made payments on time. In fact, Mr. Lucht did very well for Dr. Goetz, because he invested the payments in General Electric [Company] stock. It worked out very nicely for Dr. Goetz, and it also freed us up. That was the foundation of the Hach Chemical Company as a freestanding entity.

THACKRAY: When did Dr. Goetz loan you and Clifford the two thousand dollars?

HACH-DARROW: That was about 1950 or 1951. We made the agreement to buy out Dr. Goetz in 1962.

THACKRAY: With two young children, that two thousand dollars had to cover various necessities.

HACH-DARROW: Yes, but we also relied on Cliff's salary. I did not receive a salary until several years later.

THACKRAY: What did Clifford's salary consist of at that early stage?

HACH-DARROW: It was about fifty dollars a week or something like that. By that time, we had put an addition onto the first three rooms of the plant so that there was enough space for a little apartment. In all fairness to my mother and father, I must say that my parents gave us some money—they didn't loan us the money because there was no way we could have paid it back—to finish that addition and to make it into a two-bedroom apartment. That was the beginning of our living in the plant in 1951.

THACKRAY: This was also another economical device.

HACH-DARROW: Indeed. It meant we could work every night and weekends! [laughter] And that's exactly what we did.

THACKRAY: The buyout of Dr. Goetz's half of the company was for how much?

HACH-DARROW: Our sales were near three hundred and fifty thousand dollars by that time. How much Cliff paid, I do not know. I think it was somewhere around three hundred and fifty thousand dollars—kind of like a dollar of sales for a dollar of buyout.

THACKRAY: Dr. Goetz was incredibly well rewarded for <u>your</u> hard work.

HACH-DARROW: Dr. Goetz might not have felt so, as the success of the company really came after the buyout. For what he put into it, he was more than adequately paid.

THACKRAY: Kitty, having Dr. Goetz as a financial backer was obviously difficult and painful in some ways. Were there positive aspects of that experience?

HACH-DARROW: That's a very fine question. Dr. Goetz was a disciplinarian. We held board meetings with Dr. Frederick Duke, a friend of Dr. Goetz, Clifford, Dr. Goetz, and myself every Monday night. We went through the orders we received, the orders we shipped, the bank balance, and the accounts receivable balance. We had a complete review every Monday night of everything that went on in the company. I have no doubt that that financial discipline was a part of what carried over after the process of buying out Dr. Goetz was complete. At the end of every day, we knew exactly how many orders had been entered, what the total dollar volume was, what had been shipped, and where we stood. That carried through the entire time that we were with the company, up until we sold it in 1999.

Furthermore, we always shared that information with everyone. We put it up on the wall so that all of the employees—even when there were just ten employees—knew where we stood with regard to what came in, what shipped out, and what remained to be shipped. I give Dr. Goetz the credit for starting that discipline, which we learned at his feet.

THACKRAY: What moral would you like to impart to someone contemplating a start-up business?

HACH-DARROW: Today, money is so much easier to come by. It would be very hard to start a chemical company today. Finding a location would be extremely difficult since society's mentality is "not in my backyard." I see venture capitalists and how they work and I realize that we could have made more money. Perhaps we could have grown much faster, and much larger. However, in those early days, we were not "business trained." We learned on the job. We did the best we could with the money that was available, and the experience we had.

THACKRAY: When the company began to generate positive cash flow, did the territory of acquisitions ever appeal to you? My sense is that the company grew via internal growth—yours is a very remarkable and self-contained story.

HACH-DARROW: That is correct. To use terminology that we hear today, it was all organic growth. Our acquisition mentality had not matured by that time. Actually, we had our hands full financing our own internal growth. We were smart enough to know that our plate was full.

THACKRAY: Let's go back to the start of the business, and to the making of standard samples.

B. HACH: The samples were mostly inorganics with spiked or seeded samples, which we converted to an answer sheet. The student, in quantitative analysis for example, would try to make a determination of the amount of iron or if there was manganese present—there were about three, four, or five different inorganics that were mixed into some type of a powder.

HACH-DARROW: We had a full set of steel samples. We had boxes that had five rows of five, so that there were twenty-five samples in a box, and then we provided—to the professor—the code sheet. All the professor had to do was compare the code sheet with the student's results. We provided samples for college-level quantitative analysis.

We ran that for two years. The first year, sales were about six thousand dollars. Sales not profit. The next year it was fifty-five hundred dollars. I said, "Cliff, we're going in the wrong direction. This is not a business. We need something else. " That's when Dr. Diehl contacted Clifford and said that Dr. [Frederick C.] Bersworth had sent him this product called Versene, the trade name he gave EDTA, ethylenediaminetetraacetic acid.

B. HACH: The standard samples provided a linkage. I can't imagine what would have happened without that linkage, because you would have had no other income.

HACH-DARROW: You're exactly right, Bruce. Little by little, in the third room back, Clifford got used benches from somewhere. He built a lab back there, so the chemistry started to flow out of that very crude building.

DAEMMRICH: From those first two years, walk us through a typical day. Clifford got up early, fired up the furnace in the apartment building you lived in, headed into the three-room, cinder block, research lab and building.

HACH-DARROW: Yes. Cliff and I were there from day one, but so were the children. I started doing the advertising. The standard samples were sold by direct mail, with the aid of a mimeograph machine. I had a list of all the colleges that taught analytical chemistry—we did our best to get the names of the heads of the analytical chemistry departments—and then we developed a letter and a fly sheet, which were all mimeographed. We mailed those out and by golly, we starting receiving orders.

The three-room building was rectangular and 45 feet long, so each room then was 15 feet square. The front room was our shipping department. We had a scale and a one-ton Ford pickup truck. That Ford was both the company and the family vehicle.

B. HACH: How many customers did you have?

HACH-DARROW: I don't know. I do remember the amount of money—six thousand dollars was our total sales the first year, and fifty-five hundred the second year. I was very distressed about that. I thought, boy, here we go again. We put all that work into this, and this was not the way to go. We never received a single complaint from the college professors using our analysis products. That says something about Clifford's ability as an analytical chemist. I handled all the mail and I answered the telephone, so if there were complaints, I would have known. In wondering about the future, we talked about going into organic analysis among other things.

As I mentioned, the front room was the shipping department, and Clifford made up all the materials. He used a ball mill to make up the sample, roll it, and so forth. Then he put the sample into a gallon jar, and marked the jar as to exactly what it contained.

THACKRAY: You didn't abandon that business. You just wanted something more.

HACH-DARROW: Yes, once we got into water analysis, we continued to make samples, for perhaps as long as another five years. The samples were already there and paid for, and the professors continued to order. Samples were bread-and-butter items. We continued to make samples until they became a nuisance.

THACKRAY: Was there time left over for anything else? We've heard that Clifford was inclined to think that seven days were for working!

HACH-DARROW: Absolutely. I did all the typing for the labels and the code sheets. Then we mailed the letters to sell the products and so forth. I took Sundays off, but Cliff did not. He

used to pride himself in his hardness test paper—he always said that he made that invention on New Year's Day. He never wanted to take a vacation.

THACKRAY: With a small business, raising your children must have been difficult.

HACH-DARROW: That's right. The kids were always around the plant as little ones. I remember the day that Mary turned a bottle of acid over on herself. She was in the sand pile in the back of the plant. The bottle had just a small amount of acid in it that ran out and onto her leg. She yelled. We got her in a tub and soaked her with water. She still has a scar from that. There were bound to be some accidents along the way.

DAEMMRICH: Throughout, Cliff must have stayed in touch with certain people because Diehl didn't appear unexpectedly, did he?

HACH-DARROW: Harvey Diehl was a very difficult person—an irrational man in many ways. It seemed like almost everybody at one time or another broke up with Dr. Diehl and the same happened with Clifford. Then, later on, they got back together. Harvey used to joke about how they broke up and then got back together again.

B. HACH: Quantitative analysis was a huge part of the chemical core curriculum. It was very rigorous. Harvey also produced a couple textbooks. The students in the 1930s and 1940s would start quantitative analysis classes by building some of their own test equipment, and then from there, operate it. This was a big part of analytical chemistry. It's my opinion that Harvey saw certain characteristics in Cliff—he saw him as a good candidate to improve simplified quantitative analysis methods. He obviously gave him some support, and he did discover the article on the Eriochrome Black T dye, which put an end to titration. He saw something in Cliff that he didn't see in his other students.

HACH-DARROW: There was one other thing: a fire. Cliff was making tetraphenylarsonium chloride and a fire started during the addition of sodium. Moreover, someone called the local fire department. In those days, fighting chemical fires was not something that firefighters trained to deal with, so they sprayed water on it. That only made things worse. The water damaged numerous graduate student records.

THACKRAY: When was this?

HACH-DARROW: This happened near Cliff's graduation in 1947.

THACKRAY: Did that sour relationships?

HACH-DARROW: It was an embarrassment for Dr. Diehl. Maybe Dr. Diehl saw it as a good time to free himself from Clifford.

Cliff was in the process of starting a chemical and oxygen company. We got rid of the oxygen part very quickly, and became Hach Chemical Company. College professors with a business leaning are not always pleasing to academia. This whole thing was complex. There wasn't just one big blow. There were a series of little things.

THACKRAY: So Harvey Diehl's withdrawal was gradual. Student unknowns were going through its second year, and were not the answer. You mentioned Hach Chemical and Oxygen. Talk about the groping for a way forward, if you will.

HACH-DARROW: The answer lay in EDTA. Dr. Bersworth said, "By the way, it softens water." It chelated calcium and magnesium. Clifford researched it and realized, "Here is a product to move us away from the old soap test. This will be a really good test for hardness in water." That was the beginning.

B. HACH: This dye, Eriochrome Black T, along with EDTA, marked the first time that a precise colorimetric endpoint could be established in a titration. Eriochrome Black T turned out to be very unstable. Clifford stabilized it. That was the start of our test kit [Model 5B Hardness Test Kit in 1949]. All one had to do was count the number of drops equivalent to the parts per million, watch the color as it changed from red to blue, and bingo. That had never been done before. Putting all these things together was his talent. It wasn't necessarily always invention. It was the combination of configuration, reformulation, restructuring, and stabilization. Stabilization was really almost the basis of the business. Cliff would take an unstable reagent, stabilize it, and then get it to the point where he could premanufacture and prepackage it.

HACH-DARROW: All of that later led to the powders.

First, there's one more thing I want to say. Clifford's early interest in chemistry were fluids and water quality. The hardness test grew in importance because of something else that was also developing: home water softeners. Salesmen were out selling them. In the early days, they went out with the soap test, to try to show the housewife that a curd develops and so forth. You made up a standard solution of soap. Then in an Erlenmeyer flask, you took 15 milliliters of water, added soap solution a milliliter at a time, stoppered it, and shook. As long as you

didn't have suds, you kept adding more of the standardized soap solution. You kept doing that until you had suds that stood. You can imagine what kind of a test that was. [laughter]

Housewives needed a water softener. This industry was very important to the growth of Hach because we were the only people that had a good test, and business was great. The home water softener business became a big business. This was where we really got our break, because we made Cliff's hardness test into the 5B Test Kit. It was in a little box, and it was cheap. We sold those like crazy. We were in the water analysis business with that. We went from five thousand dollars in one year to fifteen thousand dollars the next year. We tripled in sales in 1950.

B. HACH: This was truly a titration, so it looked elegant. Suddenly you simply took a tiny thimble of water and counted the drops until the water turned from red to blue. It's a titrant. The number of drops told you how many parts per million you had.

THACKRAY: This was Clifford's patent on EDTA?[1]

B. HACH: The EDTA abstract was written by Dr. [Gerold] Schwarzenbach, a Swiss chemist and a professor from the University of Zurich. He just threw his research in the public domain. It was originally published in German.[2] It was floating around Iowa State, and somebody picked it up in the German literature. Harvey Diehl reviewed it and gave it to Cliff, who began to play with it, and then suddenly discovered the endpoints.

HACH-DARROW: It was exciting. We were advertising. Hach obviously got people who were so much better than I was, but I started things like a mailing list with the names of the customers. Cataloguing of the numbers had to be developed because there were all these different products, and some of the early, early beginnings of inventory control. All of this was then developed by others who were much better at it. However, the initial pioneering was a role that I filled.

THACKRAY: The student unknowns were not doing very well. Harvey Diehl had come along and EDTA was there. But the Hach Chemical and Oxygen Company was already a concept, a name. The "Oxygen" initially was added because of previous experience and the hope to do something with it, is that right?

HACH-DARROW: That's right. Nothing developed, so the "Oxygen" was dropped.

[1] Information on patent is unavailable.
[2] Information on Gerold Schwarzenbach's article is unavailable.

THACKRAY: The first thought about where to market the test for water hardness was home water softeners?

HACH-DARROW: It was through the Lindsey Company. We didn't go to the individual salesmen. A salesman came down to see us from Fort Dodge, Iowa, and said he needed this test, and that he was the Lindsey salesman there. From that, we made contact with the company. We never really dealt with individual salesmen. We dealt with the company.

Our largest customer was the Lindsey Company out of St. Paul, Minnesota. That was a very reputable company. We knew Mr. and Mrs. Lindsey and their son Lynn. We supplied Lindsey, and we supplied Culligan [Water Conditioning, Inc.]. I'm sure you recognize that name. We also supplied Sears-Roebuck [and Co.]; we were on our way then. That was a very big breakthrough for us. Iron analysis became important in Iowa because they've got that doggone iron in the water. From there on it was one thing after another. Clifford was absolutely in his glory. This was a wonderful time for him.

All of this was developing at the same time, though, as something else was going on. Clifford was sharp, and he realized, "Hey, it isn't just the salesmen that are analyzing water. The municipal water treatment plants are analyzing water, and they're still using that old soap method." That was when we got a one dollar and twenty-five cent Rand McNally Atlas, took down the names of all the cities in the United States, and sent advertising on the hardness test to municipal water treatment facilities—Attention: Chief Chemist, Chicago, Illinois. We didn't have any addresses—initially we sent it to all the cities with a population above sixty thousand. Later on, we went down to thirty thousand. We finally went down to five thousand. We started mailing out information for a test kit that cost five dollars and forty-five cents. There was a quart of titrant, a pint of buffer, and 4 ounces of the Eriochrome Black T indicator. That was five dollars and forty-five cents.

On the first mailing, we got a ten-percent response. We never did that again. On the first day we got thirteen orders, and wow! That was our entrée into drinking water. From there, Hach got into the *Standard Methods* [*for the Examination of Water and Wastewater*] APHA [American Public Health Association] book (4).

The very first mailings were just mimeographed sheets of paper with procedures on how to carry out a test and the list of the chemicals necessary and their prices. Later on, we developed catalogs. Again, the catalogs carried the procedure. We found this to be a useful technique for promoting our form of chemistry. As the company grew and a variety of catalogs became available, we started producing catalogs for the various industries. Thus, we had a catalog for municipal water treatment, for waste treatment, for users of boiler make-up water, and so on.

With the creation of industry-specific catalogs, we needed to generate industry-specific mailing lists. Initially, we mailed every catalog to everyone on the mailing list—soon that was no longer practical. We then began to put the mailing list into categories. In time, our mailing list grew to encompass a quarter of a million names, with each in a specific category. For example, there was a catalog for the fish farmer. The farming of fish became very popular as people in the United States became more health conscious. The fish farmers became very good customers. Water is everywhere!

Interestingly, the Ralston Purina Company, one of our customers, manufactured what was called trout chow. It was believed that if one raised trout using the proper water temperature and oxygenation, and did not overfeed the fish, then one could produce a pound of flesh for a pound of food—the most efficient production of fish, at that time.

Eventually, each of our products had a special catalog, made for a special niche, which was generated from a special mailing list.

THACKRAY: That takes us right back to the farm girl raising turkeys. [laughter]

HACH-DARROW: Right! [laughter]

THACKRAY: When did Hach become involved with the fish farmer?

HACH-DARROW: We entered that terrain in the late 1970s or early 1980s. And, of course, that industry has grown tremendously now.

We became involved in that territory because of our concern for the quality of the water that farm fish were being raised in. Since the water was housed on farms, it became possible for it to be monitored effectively for the first time.

THACKRAY: How was an idea like that developed?

HACH-DARROW: That idea actually came from field salesmen. The idea initially revolved around the raising of catfish in the South. The catfish farmers realized that there was a problem with their water, so they called on the salesmen. When the salesmen brought the idea to us, Cliff ran with it.

THACKRAY: This is a good example of Hach's ability to innovate and generate new clientele.

HACH-DARROW: Absolutely. We were the one to come to, because we had chemistry test kits and the expertise.

THACKRAY: Did Clifford respond to requests directly?

HACH-DARROW: That was his forte.

THACKRAY: Going back to your mailing lists, who wrote the copy?

HACH-DARROW: At the start, I wrote the copy. However, as the company grew, we created an advertising department. Eventually, we hired graduate chemists to write copy. You have to understand, I was becoming busier with each passing day. Advertising was there from the beginning. We hired formally educated staff in the late 1970s and early 1980s. In due course, we even had our own photography department.

THACKRAY: What were the contents of your mailing in the 1950s and 1960s?

HACH-DARROW: We became famous for our color cards, which on one side displayed a four-color reproduction of a test set. Whether the set was in a box or not, or only included glassware, Erlenmeyer flasks, or whatever—it was on the color card. On the other side of the card was a brief description of the set and its price. That was what we mailed out. We had dozens of those cards. Every time we developed a new test, we put out a new color card. The photography used for the initial cards was done by a photographer in Ames, Iowa. It was quite simple. We took our equipment to the photographer, set it up, and the photographer worked his magic with the lights and the camera. At the outset, all of the images were in black and white. Later on, of course, the images were in color. As our mailing list grew, we became a good customer of the color card industry, which, at that time, was only working with hotels and resorts. We had a wonderfully cooperative color card manufacturer. We were ordering thousands of cards at a time. We weren't up to a quarter of a million by any means, but we were ordering thousands. The price was right. Once we received the cards, we affixed the postage, and out they went.

THACKRAY: When you say, "we took our equipment to the photographer," were you the "we?"

HACH-DARROW: Initially I was. Cliff laid out what he wanted done. I cannot remember if Clifford ever went to the photographer.

THACKRAY: Who approved the design of the cards?

HACH-DARROW: I don't want to take all the credit for that. Actually, the photographer was quite good. He had an artistic eye. I have to give credit to the photographer.

THACKRAY: How was the mailing list kept up to date as you reached the thousand-name mark?

HACH-DARROW: In the beginning, we housed the addresses on an old addressograph-multigraph machine. Well, of course, along came the computer, so it wasn't long until all that machinery was antiquated. Eventually, we purchased an IBM 632, which allowed us to computerize our mailing lists.

Every time we received a new customer, we added their name to the list. Did we buy mailing lists? I believe that we did once or twice. We found them to be quite inaccurate. And of course, as I mentioned earlier, we sorted the addresses into categories. We used specific advertisements for each specific segment, so we didn't duplicate advertising costs. We really became quite sophisticated at that.

DAEMMRICH: As the business developed, you were busy! How did you fill all those orders?

B. HACH: Clifford was incredibly comfortable with chemistry. He loved chemistry and chemistry apparatus. It was nothing for him to go out and buy huge ceramic vats, build scaffolding, put the vats and Pfaudler kettles up on the top, and start mixing chemistries and so forth. That just came naturally. I can see how that would really encumber a lot of people. In his mind, that was production chemistry and he was ready to roll.

HACH-DARROW: The first Pfaudler kettle is still in Building 4, as we called it.

Bruce, do you remember the first employee, Victor Geibelstein, a high school dropout? Victor was an absolute genius with his hands, and he did a lot of the physical work of scaling up.

THACKRAY: He was hired when?

HACH-DARROW: About 1949.

THACKRAY: Up until that moment, you and Clifford were doing it with just the two of you?

HACH-DARROW: That's right. Then it was just the three of us for quite a while. Little by little, people started being added until there were four or five of us. It was a long, slow process.

In 1950, we had sales of fifteen thousand dollars. The next year it was forty-five thousand dollars. Of course, we never had that percentage growth again.

B. HACH: This was the first time premanufactured reagents were being made and designed, so the whole concept of manufacturing was considered of extraordinary importance. Without internal manufacturing, there was no business. Clifford probably spent as much time thinking about how to manufacture the product as he did on how to develop it. Manufacturing was taken very seriously.

HACH-DARROW: Let me talk about Clifford getting into *Standard Methods* (5). Clifford had already demonstrated that he had the ability to simplify analytical procedures. In due course, he really got crosswise with the *Standard Methods for Examination of Water* of the American Public Health Association. Those methods are put together by a bunch of college professors, who run on a committee basis, using classical chemistry. Here was this guy wanting to simplify everything—they didn't like him, and he was not popular with the APHA. There were things said like, "A Hach procedure is quick and dirty." It just blew Clifford's mind that the way they came up with the standard was to mail samples around, and then average what everybody found. When you looked at a graph, my word, the findings were all over the place. Averaging really wasn't right. All of that led Clifford to develop spiking. We later sold that product. Gradually, the animosity died off.

THACKRAY: Explain spiking.

HACH-DARROW: You would spike a sample with a one part per million or two parts per million, whatever. You ran a test before, and then ran a test afterward. If you got a two spiking, then the first analysis was right.

THACKRAY: You'd stumbled into a big territory.

HACH-DARROW: That's right. We would take one method at a time and advertise. We took alkalinity, and, of course, iron, fluoride, phosphorus, and phosphate.

B. HACH: There's a big range of standard methods for different detection technologies. This was primarily the adaptation of colorimetric methods to measure for a specific inorganic in water. It was the American Water Works Association [AWWA] that simply went to the ASTM [American Society for Testing and Materials] method and said that's the standard. There's a great big book on how to run a water plant, the AWWA standard method (6). Most water works simply subscribed to the standard methods, in which the tester made their own reagents. A company premanufacturing a reagent really hadn't been approved in the late 1940s.

HACH-DARROW: We won simply because it was better chemistry. Most water treatment plants couldn't afford a graduate chemist to make up reagents. As a result, their reagents weren't as good as ours. Then we got into prepackaging and the development of powder chemistry because Cliff realized solutions, generally, were unstable, but powders were stable. With powders, he was able, for instance, to take a phosphate test that took five solutions and turn it all into one powder. The water treatment guys bought it. They didn't care what the AWWA said.

THACKRAY: Help me on the chronology a little.

HACH-DARROW: EDTA really took off in 1950. The next thing to be put out there was iron with 2, 2 bipyridine. Soon, both were going to the water softener people and the water works. Next came chlorine, and by 1957, Hach was up to about forty parameters. Pictures from AWWA shows in that era show the Hach Booth stating that Hach can test about forty different parameters.

B. HACH: I think it took about seven years to get up to forty. Those forty parameters were also available in different configurations. You could take two parameters, like iron and phosphate, or phosphate and hardness, and put them in different test kit configurations. It became a Hach hallmark to expand the parameters and then mix reagents based upon application requirements. Nobody else had forty parameters in 1957.

THACKRAY: This was still with solutions in 1957?

HACH-DARROW: No, the powders were coming along. One of the first powders was actually UniVer, which was a universal hardness indicator that was based on Eriochrome Black

T. UniVer had stabilizers in it. All you had to have was a titrant and that one indicator. Even the buffer was in it. Clifford was good that way. Our powders were loose fill in their own little containers. From that, we went to the powders in individual powder pillows, a single-unit, premeasured dose. Soon we had those for almost everything. Last year they made two hundred million of those pillows. Since each one is a premanufactured, single-unit dose, you just clip it off, drop it into the sample, and bingo.

DAEMMRICH: You had forty parameters, but you were still running your business out of a three-room building?

HACH-DARROW: No! [laughter] We were still in the flood plain, but we built a building on the back that was two stories in 1958 or 1959. We called it Building 2. R&D [research and development] was upstairs, the shipping department was downstairs, and inventory and storage were downstairs as well.

THACKRAY: Weren't you living in one of these buildings?

HACH-DARROW: Yes, we had an apartment in Building 2. Originally, we had an apartment in Building 1.

THACKRAY: Building 1 was expanded twice?

B. HACH: In the 1950s, Hach would almost discontinue work in the plant for a couple of weeks, in order to build a room. There was a whole series of one-room additions every year through the 1950s.

HACH-DARROW: In those days, you could do those things. There weren't all the permits, like there are today. Clifford used to have an expression that we had eleven additions and no plan. That was a joke he used to make.

There were five or six small additions, and then finally Building 2 was built. We never borrowed money. We saved. Whenever we had the money, we would make another addition. We were flooded two times. The company was growing, and it became obvious: we've got to do something. By that time, things were coming along. We hit a million dollars in sales on 11 November 1966, so that gives you a marker—it may have been Armistice Day, but we worked! I had a three-layer cake made, and went up to the Ames stationary shop and bought a one and six zeros in black plastic to put up one million dollars on the wall. We had a party with cake and coffee before everybody went home.

THACKRAY: You've described the hiring of your first employee, who was a production person. When was another chemist hired?

HACH-DARROW: Quentin Bowers was hired in 1953 or 1954. We were still in the three rooms, because I remember that Quentin worked in the back with Clifford.

THACKRAY: You were the marketing department. When did you hire help?

HACH-DARROW: We had to go to the bank every day and process the orders. We had to makeup packing slips. In those days, we didn't have all the forms that we do now. You put the carbon paper in and you made a packing slip and an invoice. I had a young lady who helped me, and, little by little, the office began to grow too.

THACKRAY: When did you and Clifford begin to go out on visits and when did you start to go to trade shows?

HACH-DARROW: Early on. In about 1954, we started going to shows.

THACKRAY: What happened to the children when you traveled?

HACH-DARROW: Well, we had Mrs. [Lillian] Christian. The kids went to junior church, and Bruce called Mrs. Christian "Mrs. Junior." [laughter] Mrs. Christian was with us for years. She drove her own car and came down. We didn't have live-in assistance, I can assure you.

B. HACH: I don't think we moved out of Building 1 until 1960. I was in eighth grade.

HACH-DARROW: I kept after Clifford. I wanted a real house, so we moved out. When Building 2 was built, he said, "I want to move back into the plant." [laughter] That was in 1967. The building was 3,300 square feet. Actually, we had a lovely apartment up there. It may have still been in the plant, but it was nice.

B. HACH: I graduated high school in 1965, and Mary was in college when we were in that building. She was two years ahead of me, so that had to be 1966.

THACKRAY: Did you move into another house eventually?

HACH-DARROW: The next house was on Ashmore Street. We were moving uptown. Then we had a nicer house out at the university.

B. HACH: You lived there about four years.

HACH-DARROW: Yes. I think that was in 1970.

THACKRAY: There are many wonderful aspects of this story—a start-up company, and you living in the plant for twenty-five years!

HACH-DARROW: That's right! [laughter] Clifford was totally happy. He was never really happy except in the lab—but being a typical woman, I wanted a <u>real</u> house!

THACKRAY: Ridiculous!

HACH-DARROW: That's right! Ridiculous! [laughter]

THACKRAY: What about the structure of the company? Did you incorporate?

HACH-DARROW: We incorporated in 1951, just a standard incorporation. That was the year we had forty-five thousand dollars in sales. In 1950, we had fifteen thousand dollars, and the next year we tripled to forty-five thousand dollars, and we figured, all right, now is the time we need to become incorporated. We were starting to learn some things about the business world.

THACKRAY: Who was the CEO during this period?

HACH-DARROW: Cliff would have been the CEO, but we didn't use the term CEO in those days. He was the president and I was the vice president.

THACKRAY: Did you have a board of directors?

HACH-DARROW: No, the board of directors came when we went public. The private company really was a paper organization.

There's a name I'm going to bring up again, Art Lucht. He was the president of the Union Story Trust and Savings Bank and a personal friend. He was a member of the board, but he played another role that's going to shock you. [laughter] This story shows, in some respects, post-Depression frugality. Not just Hach, but the entire Iowa farm culture was so incredibly conservative. They ended up almost doing damage to the company.

B. HACH: I have one little thing I want to bring up before we leave the 1950s. We've established that 1950 had the first titration test for hardness, and then the expansion to upwards of thirty-five different parameters, some of which were titrations. Some, though, were visual color comparisons [colorimetric], where there would be a standard made in a glass tube. The tube was heat-sealed at the top so you could carry it around with your ten standards, make your sample, hold them up to the light, and compare. Then came—and I think this is a milestone—the little electronic photometer [DC-DR]. [Displays the photometer] For these forty parameters, the calibration curve could be programmed into a paper meter scale—the chemical reagents were still mostly liquid at this time. The interference or the wavelength was set by the glass interference filter, so now at this point, you had an electronic measurement by a photometer, with the calibration curve precalibrated and the wavelength automatically set, and the reagent already manufactured. You took the sample bottle, dropped it in, and then hit the button and you got your parts per million. This was done by Clifford in 1955, and there was nobody else in the world doing it at that particular time.

You could also change cards and the color filter. So eventually all forty parameters could be put into a box. It's called the DC-DR, direct current/direct read photometer.

THACKRAY: That must have been in development for a while. You don't simply make that overnight.

B. HACH: Yes. Somewhere during the early 1950s to 1955 this instrument was developed. We sold it for one hundred and twenty-five dollars in 1955.

THACKRAY: This was a big-ticket item and a little different.

HACH-DARROW: Yes, but we sold it to the same people. It was an immediate success. There have been about five generations, and Hach has now sold three hundred thousand of these

units. I think we've now surpassed Bausch & Lomb [Inc.]. In the current models, all of the calibration curves are programmed in electronically and you just hit buttons.

THACKRAY: This was diversifying the business. It shows Clifford's electrical engineering background. It's interesting he had the confidence to create that instrument.

B. HACH: Clifford had electrical engineering knowledge, but he was always deeply chemically driven. The chemistry was still doing the majority of the work, and the photometer was doing the least amount of work possible. It was still the same parameters. It was still drinking water; it was still the water management people, but now they had an instrument.

THACKRAY: That also complicated the life of the company, didn't it, in the sense that now you had an instrument that had to be manufactured?

HACH-DARROW: That's right. We were starting an instrument division. It was no longer just chemistry. Also, this was when we were going to move into Colorado, when we had to start adding microprocessor engineers and the like, which we couldn't get in Iowa.

THACKRAY: The first instrument [DC-DR] was made in 1955. At what rate were other instruments added?

HACH-DARROW: After the photometer, along came pH meters, conductivity meters, and meters for chemical oxygen demand [COD]. We really got into instruments pretty heavily going into the 1960s.

B. HACH: I think the next one after the photometer was the turbidimeter. The 1860 Lab Turb [turbidimeter] started in 1965.

THACKRAY: Which came about how?

HACH-DARROW: The superintendent of the Elizabethtown Water Company came up to us—I remember standing in the booth at American Water Works Association in 1958 with Cliff when that gentleman came up. He said, "You know, Cliff, what you've got to do is to get us a device that can determine turbidity in order to control our filter runs." A little later, the EPA [Environmental Protection Agency] jumped on that too, because they proved that turbidity was suspended solids. Within suspended solids, there can be little, tiny, living microbes, so the

higher the turbidity level, the greater the chance there'll be some type of disease-bearing pathogen.

This gentleman suggested: if you can make a photometer, maybe you can make a portable turbidimeter that could give a precise measurement of the turbidity in water. That gets into physics and light scatter. It's really not much in the way of chemistry, other than the calibration. In 1957, we came up with the first simplified tabletop turbidimeter [the continuous reading turbidimeter, CR].

THACKRAY: Did Clifford develop that?

HACH-DARROW: Yes. He was a very mechanical man. Clifford, coming off a farm, worked a lot with his hands, so he really was skilled mechanically. His real interest was electronics. He majored in EE [electrical engineering], so there was the electronics. He actually had a mixture of electronics and mechanics.

By this time, we were pretty well entrenched with the municipal water treatment industry. We were renegades, you know, because we weren't classic. Everything we did was entrepreneurial. We had a lot of following, and our mailing list kept growing and growing. In direct mail, we started out with those water softeners, then we got into the municipal water treatment business, then we got into the waste treatment analysis, and then we got into industry. Any industry that was big enough to have water treatment problems became our customer. A little later on, once the EPA came, the effluents coming out from a plant had to be analyzed.

I want to pause here and mention boiler analysis. Laundries and hospitals became customers because they had to keep analyzing the make-up water that went into their boilers. Then along came Betz Laboratories [Inc.] and Nalco [Chemical Company] that sold to all these people. We manufactured for Nalco; we manufactured for Betz. All this was growth. It was little by little, but it kept going. We didn't care whether we were renegades. We just plowed on.

DAEMMRICH: When you developed the photometer and then the turbidimeter, you didn't really have any competition. When you started producing a pH meter, there were other established companies.

HACH-DARROW: We were competing with companies like Beckman [Instruments, Inc.]. We never had 80 percent of the market or anything like that. But it was worth doing for us because people bought from one source.

B. HACH: For Cliff everything always revolved around a fundamental invention. A flow through junction was something that Cliff invented in pH that nobody else had, so we had a little niche. Certainly, in the electrochemical field, we were not major market players.

HACH-DARROW: That was another thing. With boiler water came conductivity. Conductivity and pH were strong sellers for that industry. We haven't mentioned it, but conductivity was another thing that we had.

THACKRAY: The George Fuller Award, what is that? What did it signify for Hach in 1957?

HACH-DARROW: That is an award of the American Water Works Association for contributions to the municipal water industry.

The award to Hach was very controversial. We were supported by Harris Seidel, superintendent of the water treatment plant in Ames, Iowa. Many people from the old school in the American Water Works Association felt we should not have received the George Fuller Award, but by golly, we got it. That award had never been given to a couple before us.

B. HACH: One other thing I want to add. In talking about the 1950s and the growth of the company, another important element was that even though you had to buy from us directly, we also encouraged the customers, if they had any problems, to contact us. Kitty established an environment where we were extraordinarily friendly, extraordinarily compliant, and we gave an extraordinarily high-level warranty. If anything went wrong—if you sent it back—we gave you a replacement without any questions. It created a sense of community. If you were testing with Hach methods, you were part of a friendly little club with a lot of support and a lot of reinforcement. Our employees were treated the same way. That had a big impact on the support staff and it also had a big impact on tolerance. That environment was very critical, and it established a good base in the 1950s.

HACH-DARROW: Yes, the support system was very important. Clifford had a reputation for being dedicated, almost emotional. To the customer, that reputation suggested there was a lot of zeal behind our undertakings.

DAEMMRICH: Where did your newly hired staff come from?

HACH-DARROW: Some of them came from Iowa State and University of Iowa. This was pragmatic, hands-on chemistry; Clifford intentionally made available these jobs for bachelor degree people. Hach was not a classic academic institution. It had almost no Ph.D.'s, but many

bachelor people. In fact, there was even a bit of a profile for the company: bachelor's degree, Midwestern, sometimes modest background, or even a small town rural background. These people were very comfortable in a company of about one hundred people. They were people who didn't go on to graduate school, but worked hard. It was a dedicated group of people, and we had a wonderful family atmosphere. Once we got into electronic assembly, we had a lot of single girls, single mothers, and if somebody had something go wrong, I tell you, everybody rallied behind them. We had a family atmosphere that even to this day I feel terribly proud of.

B. HACH: There were high levels of cooperation in informal systems. Systems development took place in the 1970s and 1980s, maybe even the 1990s, when things got to be highly structured. Up to that point, many of our systems required a lot of informed cooperation to make them work.

HACH-DARROW: At this moment, I want to tell Roger Haas' story. The company was very remarkable for our familial environment. Back when AIDS [acquired immunodeficiency syndrome] was not such a well-known disease, Roger Haas was a programmer at Hach. It used to be said that he was the best programmer this company ever had. Everybody liked Roger. Roger contracted AIDS. It was obvious he wasn't going to make it. People rallied around him and sent him invitations to the company picnic. At that time, he was so slim he had to bring a cushion to sit on. There was a wonderful, wonderful tolerance here. It was a beautiful thing. That wasn't at a time when everybody was as tolerant as they are today. That was something that was genuine. Of course, Roger passed on. He was a fine employee.

THACKRAY: Into the early 1960s, the company was growing quite strongly. Clifford was focused to the chemistry seven days a week.

How did you create that familial atmosphere within the company?

HACH-DARROW: We had company picnics, but I think it was just something that was inherent in the company. We were always there, and the kids were in the company. Well, Bruce was. We were on the floor all the time. There was nothing stuffy about the company. Everybody was accessible. There was no reserve parking for the president. It was egalitarian.

B. HACH: Any organization essentially mirrors the personalities of those at the top who often, even subliminally, recruit people who are going to fit in well with that environment. I think that's something we were pretty good at. We brought nice, good people in. It never seemed like we had a foul ball or anything like that. We didn't have stealing in the plant. It was a wonderful place to work, really.

THACKRAY: Who did the hiring? Was it the two of you?

HACH-DARROW: Clifford was lousy at hiring. What he wanted to do was to sell you on the company. He never wanted to find out about you. [laughter] I realized Cliff was no good at hiring because all he wanted to do was sell the company. [laughter] That was not his forte.

THACKRAY: So you were the key person?

HACH-DARROW: I did a lot of it. However, Clifford hired the technical people. We also knew many people at the Christian Church and, little by little, we hired quite a few of them. They all worked out. Some of them had relatives. Some Norwegians had even come down from Roland and Story City, Iowa. Gee, they all worked hard. Just good people.

THACKRAY: Somewhere in there you had to start setting up payroll systems, human resources, and the like. Did that happen slowly through the 1950s?

B. HACH: I think it happened slowly. That was one good thing. We grew so slowly—it took twenty years to get to a million, but it provided time to build those systems.

HACH-DARROW: Janie Neal was a high school graduate and was one of the smartest women I have ever known. She had taken some bookkeeping courses. When Janie came, she upgraded us to better systems.

B. HACH: Pretty early on we had IBM punch cards for daily order entry with the IBM card file systems. When was that—early 1960s?

HACH-DARROW: We had one of those early IBM 632s, for invoicing, that Mabel Woodward ran. In our way, we were really quite progressive. The orders came in, they were punched in, typed up at night, and rolled up into purchase orders, which went out to the shipping department through a vacuum tube. Then accounts receivable sent out the bills. All those people just adapted to it. The girls came to me one time and said, "Hey, everybody's got to have an electric typewriter," and by golly, everybody got electric typewriters. I think we were really pretty progressive that way. When we got the first IBM machine, from then on, we were IBM-oriented. We started computerizing pretty early in the plant.

THACKRAY: How many employees did you have by 1966 when you hit the million-dollar sales mark, roughly?

HACH-DARROW: Fifty or so.

THACKRAY: Bruce, as a teenager, were you doing things around the plant?

B. HACH: Yes, I was. In fact, that seemed to be mandated for me. When I was about ten or twelve I made powder pillows. I even did some standard sample packaging. I also worked on the pH meter, in the summer time. I was a summer employee well below the age of sixteen. I was also stationed in the shipping department for a number of years.

THACKRAY: This wasn't true with the other children?

B. HACH: Mary never did any of that. My brother Paul [Hach] was six years younger me, so his situation was a little different.

HACH-DARROW: We sent Paul away to private school.

B. HACH: It was a little bit of a different time, I think. In the 1950s and 1960s, self-employed people often brought their kids in at a very young age. I've read a couple of books and noticed that happened a lot back then. I did a lot of the manual work that was not very complicated. A lot of the work was essentially unskilled. A lot of chemical bottling was manual—you'd just go to these great big vats, make up reagents, and with a little stopcock fill up four-ounce bottles. You'd just sit there all day.

THACKRAY: And then you went off to college—

B. HACH: Went off to college and majored in liberal arts. I was a history major.

THACKRAY: You weren't told to go into chemistry?

B. HACH: I wasn't a very good student. I think Clifford was so absorbed—I tell you, teaching and mentoring was not his strength.

HACH-DARROW: Family life really wasn't his strength either.

B. HACH: I look back and say that was a lost opportunity, because I was interested, but I was young and immature, and I wasn't getting much instruction. Many kids, young teens, don't necessarily want to do what their parents do. I wish I had had a little bit more instruction at the time, because at that point I was working at the company. Then, ultimately, I graduated.

DAEMMRICH: Where did you go to college?

B. HACH: Drake University. I graduated in 1970. At that time, we had seventy-five or one hundred employees. Kitty offered me a job in human resources. I served that role fairly well as a liaison between the employees and the purpose of the company. That seemed to be a comfortable fit.

HACH-DARROW: Bruce made a real contribution there. Up until this point, the mission of the company and those kinds of thoughts had been missing. Obviously, we didn't have any formal business background. We didn't think about business plans; we were just charging ahead. It was, "each day, try and make a little bit of profit and salt it away and don't touch it until we got enough accumulated to build the next room." I almost should apologize that we didn't think further ahead—but we didn't have the time. When Bruce came on board, he had a different background, and he brought a lot of thinking about—"Hey, where are we going? What is our mission? What are we thinking about down the road?" It was very helpful and needed.

The employees liked him. So we never had union troubles or anything like that. Nobody wanted to be unionized. The employees had too good of a deal. I'm now going to interject something else. Almost eight years ago, when I married Don [Donald] Darrow, Don flew his plane to see me, and said, "This place is a country club." [laughter] He continued, "You should see what it's like at American Airlines!" [laughter] At Hach, the ice cream was free and the coffee was free. The doughnuts were free after ten o'clock. You couldn't spend more than a dollar and a half on a hot meal in the cafeteria! [laughter]

THACKRAY: Kitty, please tell me more about your children.

HACH-DARROW: Mary, our oldest child, was born in 1944. She was a lovely girl who enjoyed playing the violin and was an excellent student. Mary graduated from Drake University. She has a great entrepreneurial spirit—she and her husband [Charles R. Gibbs] built the Village Mall in Pacific City, Oregon. Her husband is an organic chemist. Mary and Charlie

have three children. Their middle son [David L. Gibbs], a graduate of Reed College, is a practicing analytical chemist for an international importing/exporting company. Their oldest son [Timothy Gibbs], an industrial designer, married a Portland State [University] French teacher. Their youngest daughter [Rebecca N. Gibbs] is currently a senior in college majoring in industrial design.

Bruce, our middle child, has three children. Heather [K. Hach], the oldest, is the writer of the Disney [Company] film *Freaky Friday* and *The Governor's Wife*, which is still in production (7). Bryce [J. Hach] is in graduate school at Carnegie Mellon [University] studying non-profit management. Haley [A. Hach] just finished her master's degree at Portland in literary publishing. Muriel [F. Hach], Bruce's wife, is the person who makes sure that everything that needs to be done is done. She is highly organized. Muriel works in philanthropy, but her background is in art. Bruce is the full-time managing director of the Hach Scientific Foundation. He is completely dedicated to scholarships for chemistry students and scholarships for people who want to teach chemistry. We also have four scholarships for chemical engineers.

Our youngest, Paul, was an instrument designer at Hach until his retirement. Like his sister and brother, Paul is a graduate of Drake University. Paul's degree is in business administration, but he is like his father in that he is an excellent mechanical designer. Paul married Amy [K. Hach] and, like his siblings, has three children. Their oldest, Ethan [K. Hach], has been accepted at Embry-Riddle [University] and intends to become an airline pilot. Then Paul has two smaller children, Hunter [C. Hach] and Miss. Gracie [Grace K. Hach], who are an absolute joy.

DAEMMRICH: Tell us more about Arthur Lucht. What was his role in the company? What were you doing with banks?

HACH-DARROW: When we lived out on Ashmore Street, he was our neighbor, and his was the bank that we banked at. We had a bad flood—we were on South Duff [Street], the university was northwest of us, the town was directly north of us, and then out toward the northeast of us was a hill area that was undeveloped. Later on, the National Animal Disease Center was built in that area. We decided we'd better buy some land for another addition because we were down in a flood plain. By this time, the city said, "No more building down there, Hach." So, all right, we bought 10 acres on Dayton Avenue. Then we hired an architect and started what was then called Building 3.

It was going to be for instrument manufacturing. We realized that we were really running out of space down on Duff Street, in the flood plain. So we bought that land and got the design for the building. Well boy, we didn't have <u>that</u> kind of money. This was big money now, you know, we were not building one room.

THACKRAY: What year was this?

HACH-DARROW: That was in 1967. We decided that we needed to borrow some money. Art Lucht was advising us on things financial, and he knew that we were going to go to Des Moines to see if we could borrow money for building. That rascal went and contacted the bankers down there and said, "If Cliff and Kitty Hach come down to borrow money, don't loan it to them." Of course, we didn't know this. We went to one bank, Bankers Trust I think. It was very strange. We laid out all our financials showing that we were debt free, we were profitable, and we were clean as a whistle. But this guy said, "Well, well, money's pretty tight, and blah, blah, blah." It just didn't sound right to us. We came home and then somebody said, "Well, you know a pretty progressive bank is the Valley Trust." So we packed up and went to Valley Trust. And by golly, another guy said, "Well, you know, your friend Arthur Lucht told us not to loan you any money. But," he continued, "you know, I looked at this, and see you need it." [laughter]

We borrowed about six hundred thousand dollars. We had to clear the land, and lay the foundation. You had to do that, in those days; you had to have the land cleared before you could borrow money. We had the foundation in, and then we borrowed the money.

Then along came 1968 and our exhibit in Chicago at the Instrument Society of America show. Along came a guy by the name of Barney Cunningham from Blunt, Ellis & Simmons. This was at a time when IPOs [initial public offerings] were popular, and the joke was, "Anybody who's anybody is going public." Barney Cunningham talked us into it. He said, "I could raise a bunch of money for you guys." So we went public in 1968 and paid off that loan.

DAEMMRICH: What was Arthur Lucht's fear?

HACH-DARROW: I don't know. The only thing I could say is that he was very conservative. He took the attitude, "You're doing just fine. You're making money. Why do this?" He didn't realize that we were just grinding away.

THACKRAY: One thing we haven't talked about is how you priced your products in the marketplace. In most of the areas you didn't have competition. How did you know what the market could bear?

HACH-DARROW: We had pretty good cost analysis, and—I'm embarrassed to tell you this—we charged our accurate cost, times five. It was pretty simple, but it worked. It was not excessive, and yet it was very profitable. We used a times five factor of the basic cost.

THACKRAY: Which wasn't really your complete cost?

HACH-DARROW: At that time, we thought it was. We figured out the chemicals, we figured out the bottle price, and we figured out the labor cost. EBIDA [earnings before interest, depreciation, and amortization] was not something that we knew about in those days. [laughter]

B. HACH: One of the real failures was the whole State of Iowa. It was a different time, and Iowa had a quirky personality. That's less true today. Back in the 1950s and 1960s, there was a popular political movement in Iowa called "land use." Thinking of Iowa as the most fertile farmland in the world, Iowans wanted to minimize any type of development that would take farmland out of production. This was a very strong central theme written into the Iowa culture. Instead, the State of Iowa should have been desperate to develop a company that was actually going to employ its chemists, because Iowa's chemists were graduating from the local universities and leaving the state due to the lack of local jobs. The State of Iowa failed in that respect, in not allowing its financial institutions to make sure that this company got whatever it wanted and stayed there. They would never do that today, but back then, there was a bit of an anti-industrial movement protesting that Iowa's rich, black loam should not be covered by factories.

THACKRAY: Hach was doing its start-up at the very time that Silicon Valley was starting up. Chemists were very central to that start-up, and Stanford University was loving them to death! [laughter]

HACH-DARROW: There wasn't any love in Iowa. That may have only happened in the Midwest. There were many towns, like Ames, that did not support industry.

Cliff and I went to a Chamber of Commerce meeting in Ames, Iowa, one time; Keith Rushing was the president. I remember that Keith got up and made a speech stating, "Here in Ames we like all the industry we have, but we don't want any more brown bags." I wanted to walk out. When I don't like something that's being said, I simply get up and walk out. I was so angry that the Chamber of Commerce would say a thing like that.

DAEMMRICH: In 1968 there was conversation about going public. What was Clifford's reaction?

HACH-DARROW: I think he saw it as a way out of debt. We had a lawyer, Bob [Robert O.] Case, by this time. Bob was getting to the place where he was saying, "Look, you've got estate matters. You have never taken any money out of the company," which we hadn't; our salaries were very modest. Everything was just poured back in. Bob Case stated, "If I were you, I'd go

public and then I'd run." What he meant was that he wanted acquisitions, and we weren't very good at that kind of stuff!

THACKRAY: Before 1968, had there been any concept of stock options or something equivalent for employees?

HACH-DARROW: No. There were no stock options. It was very egalitarian. The company seemed to have a sense of direction and that created a certain motivating sense. It wouldn't last forever, but it was pretty effective in the 1950s and 1960s. People had to be on board, and they saw themselves as having a better promotion opportunity because the company was growing. There was very little pressure, I think, for material stock options and so forth. The company was growing so fast that there were actually times when it passed people by. It wasn't that there weren't opportunities. It was growing rapidly.

B. HACH: Iowans are agrarian. It was essentially an insecure group, so work gave a sense of community.

THACKRAY: The harvest was guaranteed! [laughter] Going public was a huge transition. Please talk about the difference it made.

HACH-DARROW: All of a sudden, we were in a glass house! All of a sudden, we had quarterly reports! If we felt we were getting sophisticated before, man. It was after that that we really started.

The board consisted of Barney Cunningham, who was an investment banker, Fred [Fredrick] Leydig, a patent attorney, and Bob Case, the attorney. Art Lucht, the banker, Cliff, and I were also on the board. That was it. Barney Cunningham only wanted to sell us off. We told him that he would not stand for reelection. Now, this was a time when we were beginning to grow up pretty fast, you know. We had to say, "You do not get to stand for reelection on this board." Barney only had dollar signs in his eyes.

B. HACH: The investment community embraced public offerings of small companies back then. Today they wouldn't at all. Today, you could have a billion dollars and should not go public.

Back then, there was a lot of encouragement to go public. Iowa had many public offerings that did very well, and they were small companies. That was a different era, the tail end of a different era. There's no question, we were really small—we had only one million, six hundred and eighty thousand dollars in sales.

HACH-DARROW: We came on at thirteen dollars a share and closed at twenty-one dollars that night on the NASDAQ. We offered about 25 percent of the shares.

B. HACH: What was your percentage? You certainly had over 50 percent.

HACH-DARROW: It was more like 75 percent. Of course, Cliff had the big percentage of that, and I had the lesser. He took the title of chairman of the board, initially. Before long, I became chairman of the board because Cliff said, "Look, you prepare everything. You get it all ready. This is not me. I don't even want it." That's just so Cliff. The documents say I became chairmen in 1988, and that may have been right, formally. Informally, I did all the contact with the board and made up the agenda long before 1988.

B. HACH: The company had extraordinarily honest accounting. In fact, we paid bills within seven days. [laughter] Our chemistry-based activity had a high gross margin, so the company was pretty profitable. There was nothing to hide, so that helped a little bit. The books were about as clean and honest as accounting books could ever be. That was helpful.

THACKRAY: Am I correct in thinking that, even before going public, you and Cliff were really co-CEOs?

HACH-DARROW: Yes. Wouldn't you agree, Bruce?

B. HACH: I agree. Clifford had an inherent, innate, intuitive sense of chemistry and how to reconfigure chemical tests. I've heard people say it was almost psychic, what he could do. But he was not a manager of systems, and he was not a business manager, or a manager of people. He didn't even want it—it was not his forte. On the other hand, he could visualize all this stuff. He had his talents, but running the company and managing systems wasn't one of them. Also, while he could make up new reagents in his laboratory in a way that was so incredibly creative, transferring that knowledge to mass production and taking time to understand the processes in between didn't interest him. The old adage is: we all have our strengths. Research not running the company was his.

DAEMMRICH: Kitty, did you get involved in the translation to mass production or was your interest more with the sales and marketing?

HACH-DARROW: I was the sales and marketing person. I really was the front office person. I was very much aware of what was going on in production, but the real scaling up was done by others.

DAEMMRICH: Of course, everyone knew that you had the inside track to Clifford.

HACH-DARROW: Yes. That's called pillow talk.

DAEMMRICH: When employees had ideas that they thought might be good, or were having problems with Clifford, would they come to you and say, "Can you give me some advice? Can you help me out?"

B. HACH: I'd say so. Our problem was never a lack of good ideas. I think the problem was so many of the ideas just had a limited market potential. There were a lot more products than there were high-growth markets or high-volume markets.

Cliff certainly had boundaries, but if employees were in direct conflict with Cliff, I think they knew it wasn't going to do any good to come to Kitty. On the whole, it was a pretty harmonious firm.

THACKRAY: As things began to grow, Clifford became more and more immersed in R&D. Is that correct?

HACH-DARROW: Absolutely. He <u>was</u> R&D from the very beginning. We've talked about the 1950s so much, because they were so important. Another unique distinction of that time was that, in the 1940s and 1950s, he really put in his time at the drinking water plants and the waste treatment plants—physically visiting the sites and finding out exactly what they needed. That was a classic case of applications marketing. Clifford would take all the parameters we were developing, and reconfigure them or stretch their ranges to meet exactly what was needed. He was really good at that. He even used to have an expression: if you're going to be in a town longer than two hours, you have enough time to go to the drinking water plant—and he was always welcomed, because hardly anybody else went to the drinking water plants. By the 1980s and 1990s, he no longer had that almost "magic touch" to be able to figure out exactly what was needed to simplify customer procedures. The business opportunities had changed. He attempted to modify some of these same tests for agricultural, soil, and food production uses. But it wasn't as successful.

In water, we were the first to provide these necessary tests, and we were recognized as dedicated to the industry. We were typecast and stereotyped as a supplier of water management

systems. Anything else we tried already had other suppliers. Since we were a smaller, outside effort, we were never accepted. I know we were never accepted in food, because, "Hach is very good in drinking water." Food analysis already had other companies who were providing that service, so we never had the distinction or exclusivity.

Coming back to the water field, I would use a slightly different term for Clifford. He was director of innovation. He really wasn't director of R&D because once you got into research and development that was a part of the scaling up. He said, "my lab," and he had people in his lab. Others would say, "We would get Clifford's ideas and then we had to scale up." Scaling up, boy, was hard lots of times. R&D really became central; it was transferred over to these other labs. Cliff had the luxury of just being involved in the innovation, and then the other boys had to do the grunt work to get it all up and running.

THACKRAY: What was the drive for a move to food and agriculture? Had Clifford innovated all he could innovate in the water territory?

HACH-DARROW: Cliff said, "Gosh, if we can do this in water analysis, we can do it in soil analysis." Cliff was the driver for going into soil analysis. Well, boy! It turned out that soil analysis was a whole other bucket of worms. We gave soil analysis quite a try. Actually, nobody really does soil analysis well.

B. HACH: I always thought Clifford's interest in soil analysis grew out of his own agricultural background. He'd done water for thirty or forty years, and he'd become a little exhausted with it. There were still many other things to go to in water analysis, but the next things were integrated systems, SCADA [supervisory control and data acquisition] systems and complicated particle counting, and some deeply computerized integrated processes. I don't think that appealed to him quite as much.

HACH-DARROW: No, it didn't. He was not computer literate. He was uncomfortable with computers transferring from R&D to manufacturing. It was all computerized by the 1980s. He said to me, "I can't invent anymore." That really grieved me because I could see that he was hurt. He was honest enough to say this to me, though he probably wouldn't say it to others. This was not long before he died.

B. HACH: His idea of quantitative analysis was manual. Even though there was automatic instrumentation, he thought it should still be a human being doing the test and getting test results. He wanted to have an operator look at the screen and actually see what the readout was. Integrating computer-driven, automated systems didn't appeal to him. His thought was—and in some of the stuff, he was half-right—"the drinking water system is already an integrated flowing system that requires the most minimal amount of human labor. Two or three people can

run a drinking water plant. Gosh, if that's all it takes, why do you have to automate everything?" [laughter]

His idea was that a person would be responsible for doing the test, and perhaps walk to a remote site and test different points, and so forth. This was not the way things were going, thanks to the Emerson Electrics of the world. They had massive SCAET [supervisory control and electronic technology] systems that were totally integrated. If one parameter jumped up a little bit, a valve would shut, or another reagent would be rejected, and so forth. This mega-industry approach didn't appeal to him very much.

HACH-DARROW: Clifford, as you can see, was a very complex man. He was very proud and he was very competitive, and he wanted growth. Yet I think that what came with the growth, as Bruce has described here, really didn't give him the satisfaction that he would have liked and that he got from the earlier, smaller days when everything was a struggle. The word "earlier" is key; it was exciting. Some of this later growth got to be more drudge.

THACKRAY: What was your own orientation to those different phases, Kitty?

HACH-DARROW: In some ways, I could share Clifford's feelings. In the early days, I got more into the financial end of it, and that too was exciting. On the other hand, I realized that as time went on and information technology developed, and I looked at all those whirling computers—even though I had my own little computer—it was another world back there, with the programming and all that went on. I realized that, all right, I couldn't make a contribution to this. I have to accept what other people tell me. I guess, we were more fortunate than what we've been seeing on TV [television], because we had people who were honest. [laughter]

THACKRAY: That helps in the long term! [laughter]

HACH-DARROW: And we didn't ask for anything dishonest.

DAEMMRICH: Let's go back to 1970. Your company had gone public. How many employees did you have?

B. HACH: A lot of growth took place just after 1970—I think in 1970 we still only had about four, five, six million dollars in sales. The economy was fairly good. We had about four hundred people, something like that. The stock was doing well. Those first couple of years were pretty good. We had a very stable customer base and were a very parochial business that

always remained relatively steady; a non-cyclical business, so the stock really never took a wild dive.

HACH-DARROW: We did a number of stock splits in order to try to get a greater volume of activity. That really didn't work. At the time that we went with Danaher [Corporation], we were in a slump from a stock price standpoint—small caps were no longer important and we were a small cap. Our stock stagnated at twelve and a P/E [price-earnings ratio] of eighteen to twenty. We had a pretty good P/E, but we could not budge off of that twelve. There were stockholders contacting me on a weekly basis asking, "What are you going to do about this stock price?"

B. HACH: From the mid-1970s all the way on, the stock was constant. It wasn't growing very much, so it became a source of some discomfort because people began to realize as time went on that the market we served was a relatively small, niche market.

THACKRAY: Sales were growing, weren't they?

B. HACH: Single digit. In the 1980s and 1990s, we grew 6 to 9 percent every year. There were a lot of people who thought that was just disastrous. It was a sore point for me.

HACH-DARROW: When the boom came, the bubble of the 1990s, boy, we looked like nothing. Yet we were always very profitable.

B. HACH: Very profitable, very stable, and coming out with better products all the time.

Gosh, the final version of the DREL [direct-reading environmental laboratory] became the DR/4000. We even private-labeled it for Beckman. Beckman admitted they could not make what they called a low-end, five thousand-dollar UV-vis [ultraviolet-visible] spectrophotometer better than we could. We still make the Beckman unit today with the Beckman name on it.

We were constantly under pressure for double-digit growth. "Why can't you grow at 15 percent, 20 percent, and so forth?" People weren't content that Hach remained a market share leader. What's so horrible about that?

HACH-DARROW: That's right. We made 15 percent after taxes, but the dot-com boom in the late 1990s crucified us.

THACKRAY: May we go on to talk about going overseas?

HACH-DARROW: By 1970, we were feeling pretty foxy in the U.S. and beginning to think that we should do something about international sales. Therefore, we built a plant in Namur, Belgium, in the Walloon area, the southern part of Belgium. We opened that plant in May of 1971. It was a good move. Our international sales, at that time, were only about 25 percent of total sales, but that soon got to be 40 percent. Namur became a shipping point, and soon we had dealers in all the European countries and Africa. The Saudi Arabian dealer was a big dealer for us. We did quite well. We did advertising in foreign languages; there were some things we did in as many as eleven languages.

THACKRAY: In the 1970s and 1980s, there you and Clifford were at the top. Were there many people reporting to Clifford? From going public through to the sale in 1999, the company was large enough and complex enough that it needed a *de facto* CEO. Were you that person?

HACH-DARROW: Yes, that would be right. Nevertheless, I can't do it all. There were others who were very much involved. We had Paul Goltz, who handled South America. Another fellow handled the Far East, so that became another group with its own reporting structure.

THACKRAY: I don't know too many CEOs of technology companies in the United States who remain CEO for thirty years. [laughter] I certainly think you're the only woman in the category.

HACH-DARROW: That's true. There weren't many.

THACKRAY: Through that thirty-year span, when the economy changed in various ways, Hach was also changing.

HACH-DARROW: There were many changes. Putting together organizational charts became a lot more important. We were very good in the budgeting area. It was through budgeting that we exercised discipline—there were sales targets to be met, and there were earnings to be made. We had good accounting. The department heads knew where they stood in all of these areas. We knew what we were looking for. We knew our plans and we followed them.

We had a boardroom. There were meetings in there all of the time, and the senior officers met regularly. Often we ate together. It was really informal, but we had excellent communication. People knew what was going on. There were no secrets at Hach. We used to

say that as a little expression. There was no point in having a secret around there because it was going to get out. When you have good communication, you know what's going on.

THACKRAY: The decision to go overseas, how did that come to pass?

HACH-DARROW: A young man by the name of Claus Weidner, a German who came to us from one of our dealers in South America, started to develop more and more sales. We then realized that if we were really going to serve the dealers, we had to have inventory closer to them. Trying to ship by air, which was very expensive, or by container, which was very cheap but very slow, didn't really work. There was quite an analysis made and we concluded, "All right, let's do it." We figured out what size building we needed, we put up the money to build it, and put the inventory inside. One of the men from the Ames plant by the name of Dan [Daniel] Gerber, a senior vice president of chemistry, went over and ran that plant.

DAEMMRICH: Was the marketing in Europe different? Were you still sending letters to every municipal water company?

HACH-DARROW: No. We tried some direct mail and found that didn't work in Europe. I was sure that we could make it work, but I was completely wrong.

B. HACH: Europe is old-fashioned, more wedded to an antiquated direct sales concept. They actually had people who became manufacturer's reps [representatives] for a specific discipline. There were people who were manufacturer's reps in the area of drinking water and wastewater. They were pretty good. They were often engineers, who understood exactly how the operation worked and knew all the local country's regulations. They would also sell other things. They'd sell hardware, pipes, filter beds, and so forth. They would sometimes take on a Hach account, and then represent the virtues of our product in their system. What they wanted was exclusivity for an entire country. They were essentially engineers advocating where Hach fit into the system. America didn't really have anything quite like that. In Europe that was the way you did business. They bought our products at a twenty- to thirty-percent discount, maybe forty-percent. The negative was they resold it at a very high price. It provided a low barrier of entry to get into those markets. Later we inventoried a lot of items in Europe, so customers could buy them directly, and so forth.

DAEMMRICH: The EPA was created in 1970 and the Clean Water Act dates to 1972 (8). What impact did that have on your business?

B. HACH: It was very mixed. We had many tests already in the system that, once the EPA was authorized, they liked. They liked our chlorine systems. We took advantage of the positive side: the early need for certification. We got the portable turbidimeter approved, as well as a chlorine system and DPD [diethyl phenylene diamine] systems. Twenty-two parameters got quick approval.

From that point on, the EPA was uncertain as to exactly how far to go with certification, what it should be, and the potential competitive impacts or ramifications of certification. Certification after that became much, much slower, and policy gyrated back and forth. It became a question for us: how much effort and money do we put in to a certification attempt? We decided that what we provided were inherent, necessary, intrinsic tests, and we backed away from putting too much effort into certification. We tried to provide the tests that were needed. We didn't chase EPA certification for the sake of business or exclusivity. Whether we were right or wrong, it turned out well.

HACH-DARROW: That's right. As the EPA grew, it became more bureaucratic, and much more difficult to get people to make a decision. Working with the EPA was frustrating.

B. HACH: We couldn't run a business on EPA certification, expect to get exclusive rights and keep non-certified people out. In some respects, we got the best of both worlds. We got certification, but we didn't allow the EPA to dictate our strategy or our direction.

We were back to being independent again. Many customers said, "All right, we're going to run the EPA classic method for reporting purposes, but, to run the plant, we're going to run it with Hach." Some tests required standard methods for reporting purposes, but may only had to be done once a month or even once a quarter. Not too bad.

I don't think our customers changed their habits significantly. Nobody was quite sure exactly what the best way to administer water regulation was. We tried not to be obstinate or impolite. We actually served on some committees and took advantage of that. Any committee we were invited to join, we did. We decided, essentially, that EPA certification was not the end goal for us.

HACH-DARROW: We never lost sight of our goal: simplification of the procedures. That was our mission. That really served us very well, and even though we didn't cover all the classical chemistry, it was a pretty good way to run a plant. Clifford had an expression: "You can run a Hach test if you can read." Now, I've got it to the place where you can run a Hach test if you aren't blind.

B. HACH: You could almost run our tests even if you couldn't speak English, because the pictures would carry you through. When you bought a DREL, if it had forty tests, all forty instructions came with the product.

HACH-DARROW: Our early catalogs had the procedure and then the price for the reagents down at the bottom. That was one of our marketing techniques.

DAEMMRICH: Would you visit customers and teach them how to use equipment?

B. HACH: The intent was that the procedure be self-explanatory, so that users could do it on their own. That was the thought. We'd mail you the product and you would do it on your own, because it's right in front of you. Actually, we developed our own Hach Technical Training Center as time went on. People came out for two- or three-day seminars where they would go through procedures systematically. A lot of customers really liked that. We did that at our expense, essentially. They paid their own transportation, but we charged almost no tuition fee.

Thousands of people went through that program. There were drinking water managers and wastewater managers who went through our program. We had a section for chemistry teachers. I've forgotten the number of thousands who went through that program. We tried to hit the issue of instruction on two levels. One, you should be able to do it yourself. Two, the little training center was available, too. The beauty was that both of those levels contributed to institutionalizing the test in standard operating procedures. We found ourselves getting written into the standard operating procedures of the drinking water plants. The procedures stated something like, "Take Hach chlorine test kit out and measure this filter every four hours." Business was hard to lose at that point.

HACH-DARROW: Actually, Danaher closed down the Hach Technical Training Center and then started it back up. They found out that we didn't do everything wrong!

DAEMMRICH: Part of what happened as a result of EPA regulations in the 1970s was that industry came under more regulation. Did you begin to sell products to the Dows [Dow Chemical Company] and DuPonts [E.I. DuPont de Nemours and Company, Inc.] of the world for them to do effluent control? That's a very different market from municipal water companies.

B. HACH: Yes, that's right. Some of that territory was highly specialized. We were never very engaged in the water conditioning business and so forth, but we did manufacture COD tests. We offered the classic BOD [biological oxygen demand], carbonaceous biological oxygen demand [CBOD], and TOC [total organic carbon]. We had major market share in those

products. To be able to premanufacture the reagent, take it and put in the sample, digest it for two hours, and then go straight to a precalibrated DREL test was another significant invention. From that point on, a company could structure their treatment system by relating the oxygen demand to the amount of organic material in the waste. We did pretty well with that.

HACH-DARROW: DuPont used to advertise that their effluent into the Brandywine [River] was better than what they took in.

I want to reemphasize that in the industrial end, we served every single supplier of water treatment chemicals. And of course, there was a lot of industry that they served. We didn't get into each one of the multitude of individual plants, but the Betz salesman did, the Nalco salesman did, the ChemTreat [Inc.] salesman did, and the Olin [Corporation] treatment salesman did. We got into a very unusual situation. That business was 100 percent Hach. We knew—and everybody was very quiet about it—what every specialist chemical treatment supplier was doing. As a consequence, we knew individual market shares—we knew who was the biggest, because there was no one else but Hach making the products they utilized.

B. HACH: This business involved some special formulations. The supplies had many treatment chemistries for corrosion inhibitors, and we supplied formulations that matched their treatment. For instance, Nalco gave us their formulas. They said, "Now, we want you to manufacture for us," and we responded, "Gee whiz, we can improve on these a whole lot!" [laughter] Well, they were not the specialists. We were.

THACKRAY: Kitty, please talk about moving to Loveland.

HACH-DARROW: In 1970, our instruments were getting old-fashioned and it was obvious that we had to get up-to-date. We needed electrical engineers who were microprocessor current, but we couldn't get them to come to Ames. Where were they? Well, they were in Silicon Valley, they were out on Route 128, or they were in towns around Texas Instruments [Inc.] in Dallas. Say, "Ames, Iowa," to those guys. We actually hired a search firm to try to find us electrical engineers. We paid them and they tried. They concluded, "You are the toughest client we have ever had, because we can't get anybody to come out to Iowa." I think all electrical engineers that came out of Iowa State, left the state. Iowa State did not realize that 92 percent of all the engineers that they trained left the state. The remaining 8 percent were the agricultural guys who went over to John Deere [Deere & Company]. It was obvious that we weren't going to pull this off in Ames.

Because of my interest in aircraft, I bought the FBO [fixed base operation] at Fort Collins in Loveland. It was a financial failure for a number of reasons. But, we went out there and looked at the FBO, and boy! We were like, "Hey, wait a minute! This is a pretty nice place." Hewlett Packard [Inc., HP] was there. IBM was there. Western Electric was there.

National Cash Register [Company] was there. HP had four plants and employed about ten thousand people. This was the place to be!

B. HACH: In the 1970s, Hewlett Packard and Texas Instruments were probably the role models in electronics manufacturing. They had a massive infrastructure of circuit board makers, etched and drilled board makers, and integrated circuit makers. None of that existed in Iowa.

HACH-DARROW: That's right. We came out here and bought 10 acres of ground at the airport. That's where the plant is today. We were going to move instrumentation out here. Hiring out here was no problem at all.

B. HACH: We kept Ames; and Ames still makes all the chemistry. However, all the instrumentation was done here. R&D also came here. Corporate headquarters moved here in 1977.

Listen to how old-fashioned this is by today's standards. We did this with the stated goal that we would offer anybody in Iowa a job out here if they wanted to come, and a job back there if they wanted to stay. We said we'd try to make it a corporate goal that no one lost their job against their will. In today's world, that would be laughed at! It became a noble cause, and, in the end, Ames ended up with about two extra people. About one hundred families moved out here. We used the opposite approach to shutting down and firing everybody and it worked pretty well.

Colorado actually has a lot of electronics—it was ranked seventh or eighth in the country for electronics technology. This is a good area.

HACH-DARROW: The people who moved out here at that time got a great deal, because housing was lower priced, so they could sell in Iowa, come out here, and buy a bigger house—whee! They were happy, and it's a nice place to live.

Would we do it again? The answer is: absolutely, only even earlier. Iowa is agriculture. Now, there is a resurgence of the Midwest and talk of things turning around. At the same time, you have to live life as it's going right now. So, yes, it made a big difference in the company. We took a bump in earnings, but we came back very quickly. We were public at the time, so we knew that bump. But we never had a year that wasn't a profitable year. Even with the move.

B. HACH: We were still doing 15 percent pre-tax profits. Danaher is peaking a little higher, but we racked up 15 percent pre-tax profits and 8 or 9 percent after-tax profits. We were making money.

THACKRAY: Kitty, can you talk more about aviation for a moment, because it features in the company in some way, and we left you several years ago [laughter] falling in love with airplanes at the age of six.

HACH-DARROW: From the beginning, I just loved airplanes and always wanted to learn to fly. Finally, we reached a point in 1953 that we had enough money and I could start taking flying lessons. Cliff said, "Go do it. Get it out of your system." So I did. I got a license in 1954. We bought a little airplane and started using it in some business flying to call on customers. We even tried to go to an American Water Works convention, but the weather was too much, so we had to stop in Huntington, West Virginia. That is the long way of saying we have had airplanes involved with the company. The company didn't buy them. We owned the airplanes so that we never had a problem with the IRS.

We have always had an airplane from 1954 forward. At the time of the move to Colorado, I had a Cessna 310 and Hach started using that quite extensively. I sold it to the company and then the company traded it in for a larger Cessna Twin. From then on, we started moving up into King Airs. At the very end, we had Citations. I got a Citation rating, and I had a Citation, which we used in the company. We logged about six hundred hours a year flying because we went back and forth between the Ames plant and the Loveland plant on an average of twice a week.

We really felt this was very important in keeping the plants together. We had two pilots. We never had an accident. We never had any difficulty at all. We ran an absolutely flawless operation. We had a mechanic. We had very little down time. I know that there were sometimes when the air was rough, but people had great confidence. In fact, if they could go with Kosta [Konstantine] and Jim [James Hall], that was the way. They didn't want to go on the airlines because all we had to do was walk across the street and get in the airplane.

THACKRAY: Who logged the six hundred hours in a year?

HACH-DARROW: The company did about four hundred hours. I did about two hundred hours.

THACKRAY: Would you and Clifford be together all the time, most of the time, or what?

HACH-DARROW: I don't want to answer that! Cliff and I flew together all the time. He would sit in the back, I would fly the airplane, and then maybe he'd come up at the time of the approach and sit down with me. Cliff got a license and got up to eighty hours, but he said, "This isn't for me. I don't care about it. You can just go on." I was the luckiest girl in the world

when it came to flying, because, generally, there was a fight over who got the left seat, but we had no problems at all. I got the left seat. [laughter] Cliff didn't care. But he liked to fly. We flew a lot.

THACKRAY: Did this continue over the years: going to Ames, going to meetings, and visiting customers?

HACH-DARROW: Yes. I have logged seven thousand hours. Probably my flying days are drawing to a close—I have some macular degeneration, especially of my left eye, so I think that I'm not going to be able to continue to pass my physical. Otherwise, I'm in pretty good shape.

THACKRAY: What did Clifford do on a flight, typically?

HACH-DARROW: Paperwork! He always had things with him. Especially in the Citation and in the King Air—well, I had two C90 King Airs and one Citation; the company had three B200s and two Citations. I've had a total of twenty-three airplanes. My present husband says that I have helped the used market greatly! [laughter]

In the back section of the plane, there were two rows, club seating, one this way, and one the other way. [Gesticulating] There were little tables that came out. Cliff would pull out the little table and work. He'd sit in the back and that was it. We did a lot of flying that way. [laughter] It was a lot of fun.

THACKRAY: That's pretty neat.

Coming back into the corporation, Bruce, you came into the company in the human resources territory. Is that where you stayed or did you move around the company?

B. HACH: I stayed in that until 1988. I became president in 1988. I was COO [chief operating officer] from 1988 on.

HACH-DARROW: Bruce may be too modest to say this, but he became deeply involved in quality control [QC] . He became our quality control guru.

B. HACH: During the 1970s and 1980s, the Demming principles were well accepted in Japan and advanced Japan's manufacturing technique and reliability. I really started to study that. A lot of our products were niche products, low volume. I just didn't think we had the inherent

reliability that we should. I got behind this business of process control and variation management, the statistics of it—it turns out it's a good management tool. A lot of it deals with systems integration and the Hach personality seemed to like it. It seemed to fit in well with our inherent culture. I really got behind that and did all kinds of charting and graphing and comparing lead times and vendors—the whole nine yards. I really enjoyed that.

HACH-DARROW: Bruce, by this time, was president and COO of the company. With his love of quality control, Hach became a leader in quality control. Hach even supported the organization of the ASQC, American Society for Quality Control.

B. HACH: We also got our ISO [International Organization for Standardization] ratings. We rallied around ISO for two or three years. That took us to full ISO certification. There were really two areas. One was ISO for consistency of process; the other was the absolute verification of output. Much of American industry was going through a quality movement at that time. We were following Motorola's [Inc.] Sigma program, so we weren't the only ones. It was a good role for me. It worked well.

HACH-DARROW: We had two or three women in the plant like Patty [Patricia] Lamphers, who really got into this. Also, these QC people had meetings, and thus had an influence on everybody about quality control. Bruce was very strong in the leadership of this.

DAEMMRICH: For a company that's been very innovative and has been very quick to take products to market, by adding layers of quality control and process, some of your employees had to feel stymied. How did you work around that?

B. HACH: The classic answer is that in a Demming-driven world, a lot of the processes would be administered by the persons themselves, with an emphasis away from inspection. We were trying to get away from third-party analysis. We were really trying to encourage everybody to do the measurement themselves. The better the system, the more self-generated and self-measured it is—you actually teach each employee the mathematics to take their measurements to a higher and higher level. In an ultimate world that should take layers away and take inspection away. In fact, I got so ingrained in this, I'm having a hard time with Homeland Security! [laughter] Exactly what we're trying to get away from is people sitting around who don't add value. That was the whole idea. Everybody who did something was actually contributing to the improved essence of productivity. A QC inspector with his caliper, his measuring, really doesn't contributing anything. But this was easier said than done. We still had layers of management, but, ideally, we tried to strip them away, not add them on.

One thing is inescapable: the more the volume, the better the systems work. The less the volume, the more you constantly compromise, and we did have a few awfully low volume

products. You can't do a control chart if you're going to build two a month, you know. I think we had a good sense of trying to be reasonable. We tried to do everything—that was the goal. Everything you did added value or added sustenance. We tried to strip out things that didn't make a contribution. It helped the company; it was a good rallying point. We tried to publish defect rates and measure defect rates month-to-month. We tried to make problems visible. You raise the visibility level and make sure that everybody could see what potentially could go wrong and have a chance to fix it.

I have one other thing I want to add. We have one other product family that we haven't talked about in-depth. The DREL came along in 1960, but before that we also had process instruments that could take a sample measurement at a point and run a test. That, I think, goes back into the 1950s.

These were capillary, gravity-fed instruments. Say you were measuring chlorine at some early stage at a drinking water plant. A drinking water plant can be imagined as a river flowing. One would take a sample at different points and then give measurements at those particular points. You can see how this could easily be integrated into a control panel. Clifford wanted to make these instruments at very low prices. The chlorine analyzer, which goes back to the late 1950s, was only three or four hundred dollars wasn't it?

HACH-DARROW: Yes. I think it started out at two hundred and ninety-five dollars, something like that.

Even today, Hach owns silica analysis in the steam generation and big boiler systems. Nobody matches us in that. It's no longer capillary flow. It's pumps.

B. HACH: It's a very important measurement in the production of integrated circuits. You have to have ultra-pure water. Clifford, had more excitement or passion about process instruments. He saw that process instruments, when perfected, could give a continuous readout.

HACH-DARROW: "We will have the perfect process instrument when we make the perfect pump." How many times did I hear that?

B. HACH: We almost got to process turbidity. We sold up to twenty thousand. Our customers there were Intel [Corporation] and others.

Process instruments also started in the mid-1950s. That rounds it out. The other thing I want to mention about Hach's chemical orientation: there was chemistry within chemistry. On some of the visual wheels, the little color continuous wheels, there'd be a visual color comparison of the sample, and then there was a color measurement scale that was graduated.

There was actually a specific polymer chemistry to be able to formulate that graduation on the color circle. We did that, too. We got into chemistry to support chemistry. In the case of turbidity, the most difficult thing was the recalibration of a product. That was done with Formazin. We reformulated Formazin to StablCal, which became the world standard. There was a lot of ancillary chemistry that wasn't part of a regular test.

THACKRAY: Kitty, you became CEO, Bruce became president, and Clifford died not long afterwards in 1990. Can you talk about that sequence and what you knew about his health?

HACH-DARROW: Clifford always managed his health with chemistry. He said there were three ways to treat everything: electrical, mechanical, and chemical. He always selected chemical. [laughter]

Cliff's mother had high blood pressure, and Cliff had high blood pressure. In effect, the Navy turned him down because of that. They said that they would take him, but later. I think getting a deferment to go with Ames Laboratory was relatively easy because of his health. He fought high blood pressure all his life and took all the medication that his doctors recommended.

We had worked a show in New York the day before his death. We came back home and walked into the plant. In Colorado, we have bentonite soil, which shifts, so our building had shifted. There was some damage. Cliff, as we were coming into the building, commented on how the maintenance people had repaired the movement damage and how nicely the boys had done it. We went up the stairs to the second floor, turned to go down the hall where he would go off toward his lab, when he said to me, "I don't feel right."

At the end of February, Cliff had slipped on black ice and was diagnosed with two hairline fractures in ribs 9 and 10. He was miserable. I asked, "Is it your ribs?" His last statement was, "No, it's not my ribs." With that, he went down and it was over. Just like that. I yelled to Bruce, "Call 911!" We had CPR [cardiopulmonary resuscitation] experts in the plant. They were there immediately. They did everything. We were only ten minutes from the hospital, so the paramedics were there in no time but they said it was over. There was nothing that could be done. He was gone.

We later found out that perhaps he had some symptoms and didn't communicate the symptoms to us. I did not know he had symptoms. We knew he had high blood pressure. I think he knew that he had some blockage.

Talking about belief in chemistry, let me tell you an anecdote. Cliff really wanted to get his cholesterol to the lowest possible level but was having a difficult time doing so. He ate a clean diet, even as a kid. He always ate fish and never ate beef, which I thought was quite strange. How you could pass up a good steak in favor of a Northern Pike! [laughter] Cliff decided he was going to lower his cholesterol no matter what. Chemistry could solve it. He decided to take niacin and lethicin and totally bypass the FDA [Food and Drug Administration].

He ate bowls of oatmeal that he loaded up with lethicin. Then he'd put on a layer of bananas, and then, on top of that, nicotannic acid right from his lab—unfiltered, raw niacin. He ate that. Wow!

He knew he was in serious trouble, I think, at that time. The doctor said at the autopsy that it was obvious he had had either two or three heart attacks, but nobody knew it, which was very sad. That way, Cliff was very close-mouthed.

THACKRAY: What difference did Cliff's death make on the operation of the company?

HACH-DARROW: I'm going to speak for myself, and also speak a little bit about R&D. Things didn't change for me. I continued on. It happened at 7:30 in the morning. After the shock was over, I came into the plant at about two o'clock that afternoon. I thought, first of all, this was what Cliff would want. This thing has to go on. "Just because I died, this doesn't mean anything stops." I don't think I got very much done, but I came back to the plant to see the people and so forth. My work just went on.

R&D suffered, they really missed his innovations and his innovative ideas, his comments, and the fact he was always there. I think that hurt them. Bruce blossomed because all of a sudden there was work to be done and leadership to be shown. Our work was more important than ever because we had lost our kingpin, but we had to carry on. Bruce stepped forward.

B. HACH: It became a matter of prioritization, trying to decide what we could and could not do. Clifford always had a hand in that. Because he was the founder, his voice was the first voice. With him gone, there became an awful lot more negotiation on prioritization. A series of steering committees developed, which became complicated because one had to look at potential, fit, and the continuity of a new product. The things we came up with, the DR/800, DR/4000, and the Sension were negotiated on a more democratic prioritization basis than before. That was the difference. That wasn't always smooth either. There were people whose projects were not approved, so they would pout about it and so forth. In the past, Cliff would say no—that was easier to take rather than being turned down by a committee. There was certainly no question about the mission of the company. That didn't change a bit. If anything, it became more clarified, almost defensively, out of fear that we'd forget. The simplification of quantitative analysis was the mission. It was one of those things. Life does go on.

THACKRAY: The 1990s was a strange era. Can we go back to share holder pressures, and the ultimate decision to sell in 1999?

HACH-DARROW: We were a small cap and small caps were not considered high enough tech. Many people did not appreciate the sophistication of the chemistry in a Hach system. It was quick and easy, and therefore, they missed the point. People felt we weren't sufficiently high tech. I always resented that, because I felt that we were really quite sophisticated. Nonetheless, we certainly weren't glamorous.

There was complaining that we couldn't get off the price of twelve dollars for our stock. It was so disappointing. Our earnings were good, our sales were quite good, and we'd announced and nothing happened. There was a pressure on us.

Mary, our oldest, was not involved with the company. I knew that Mary and her husband really wanted very much to have some of their inheritance, and they reminded me that they were getting older and they were not getting it. I realized that we had to address the issue. Then along came Danaher. George [M.] Sherman was the president, and boy, he really made a pitch to me.

THACKRAY: Did Danaher come directly to you?

HACH-DARROW: I dealt directly with George Sherman, the CEO and president. He made a pretty good offer, and promised that the company would run on. I was naïve enough to accept that, but I really think that George Sherman would have kept his word.

B. HACH: There might have been a little internal shake-up after Danaher purchased us under George's plan. Instead, there was a silent management shift at Danaher. George Sherman resigned. George's young lieutenant, who he had promoted, and the two primary owners took over. These people did not represent the principles that George talked to me about. George said that what he really wanted were middle-sized companies that had a solid niche, good market share, and were profitable, but were having a hard time sustaining growth and a high stock price. He said, "We'll pull the companies together, keep you intact; you'll have a broader sales distribution base and you'll be part of a larger organization, so you don't have to worry about the stock price." He already owned four water companies including the largest in Europe, although we had a larger line-up. He pulled together seven or eight companies to have a consortium of first-class companies in different forms of water monitoring. In many respects, it was not an unreasonable model, especially for companies that were already public, could not afford to go private, and were running out of options.

HACH-DARROW: We know of a company right now, Teledyne Isco [Inc.], in Lincoln, Nebraska. They're hovering at nine. A profitable, nice little company that just can't break out of nine.

B. HACH: What we negotiated for hasn't quite worked out. It does concern me that the management now is not nearly as scientifically based as we would like to see. We had the culture of a private company. We had the physical environment, structure, and the management of a private company though we were public. All the SEC [Securities and Exchange Commission] rules and IRS rules on what you could do with your assets made everything so difficult. It was almost impossible to unbundle any of the ownership as a publicly held firm. Either you have to be a billion-dollar company or be private. It's almost the worst of all worlds, to be publicly held and middle-sized. We were boxed in on almost every avenue. We had single-digit growth. The dot-com boom and that big stock rise in the late 1990s were killing us.

HACH-DARROW: There's one other thing that we haven't really touched. I want to talk about Dan [Daniel J.] Terra. Dan Terra was president of the Lawter Chemical Company. We didn't know it, but the day we went public, Dan owned 9 percent of Hach. He loved Hach and wanted to acquire us. Consequently, he kept buying and buying stock, until finally we had virtually no float, because Dan was locked in on his and, man, he wasn't going to give up. There was Grandma Kitty, who also wasn't going to give up, with this little bitty amount of stock down here that didn't amount to very much that was the so-called float. That was the situation that we were in with Dan. Dan had no intention of giving up. He tried four times with bear hugs to take over Hach. He died and his company was sold. You know, I can't even remember who bought Lawter. I think it was Eastman Chemical [Company], the spun-off, chemical division of Eastman Kodak [Company].

THACKRAY: So there was evidence that somebody might like to acquire Hach.

HACH-DARROW: Yes, Dan was always there. Dan was an albatross around my neck! Cliff wouldn't deal with him. Cliff couldn't stand him. It was always up to me to deal with Dan.

THACKRAY: Hach has a very remarkable fifty-year story of individual perseverance, tenacity, entrepreneurship, and vision.

HACH-DARROW: You can call it "Iowa Stubborn!" [laughter]

B. HACH: I think almost all of the various principles that we've ever worked with and developed are going to remain there. There will be a much greater integration of automatic control systems and SCADA systems. With the process instrument of today, they're still going to be measuring chlorine, maybe 12 points along, but it will be electronically connected to a controller and be able to do automatic responses and the like. More automation, more computer generated actuations and adjustments, but I see the basic principles that we were doing staying together. You'd agree with that, wouldn't you?

HACH-DARROW: I would.

B. HACH: If we'd been private and, say, in the mid-1970s we really wanted to get into integrating SCADA systems, we would have gone in a slightly different direction that might have been successful. But we didn't. I think the Hach name is going to survive. As we mentioned, two hundred million powder pillows are being produced a year. Those are individual tests. Our trade name is still powerful. I don't see that fading very much.

HACH-DARROW: I want to touch on the Hach Scientific Foundation. The Foundation was started in 1982. At that time, Cliff and I supported it with one hundred and forty thousand dollars a year. We had a little scholarship program [now termed the Clifford C. Hach Memorial Scholarship]. Because we also had a plant in Wyoming at that time, we offered the scholarship just to Wyoming, Colorado, and Iowa students. We ran as many as seven or eight students a year. We were doing the selecting, and we actually took the airplane, flew around, and met some of the candidates. I said, "Hey, Cliff, we can't keep doing this!" Larry [Lawrence M.] Liggett, who got his Ph.D. under Dr. Diehl—Larry was even part of our wedding party—and who had already retired from his company, was asked, "Would you take over?" He replied, "I'd be thrilled to." We had a very modest amount of money, but, of course, we paid all his expenses. He loved it. He made a newsletter and he wrote to all the kids and kept everybody up to date. Larry did a magnificent job. He graduated one hundred and four, and then we had, what, eight ahead of that that we had run, so that was one hundred and twelve graduates.

These days, I write to Larry [H. Lawrence] Culp, Jr., president of Danaher, to keep him informed on how we're doing with the Hach Scientific Foundation. I have an ulterior motive, because I want him to understand that we are promoting chemistry under the Hach name, and that we already have one hundred and twelve graduates. The Hach Scholarship gives out five thousand dollars a year, so it's not a nickel-and-dime scholarship. When the Foundation is fully funded, it will have thirty-five million dollars and we should have about one hundred students running. This is going to be one of the premier chemical scholarships in the United States.

B. HACH: If we can find them and if they're interested, we're also trying to give priority and preference to people who want to teach chemistry. We've been doing that for about two years now. We're hoping to appeal to a sense of chemistry national service. We'll provide you with your tuition, if you teach for a couple years, and then migrate into a chemical profession. We know we can't recruit forty-year teachers anymore. That program is going well.

It doesn't appear that the chemical industry is massively committed to scholarships. Universities have around fifty scholarships for one hundred undergrads. They'll seldom have more than three, four, or five scholarships for a chemistry undergrad; 95 percent appear to have no support at all. The field of chemistry is important to support, so I'm a little confused by

those numbers. A couple schools—the best, the most prolific producers in the country of chemistry teachers—Purdue [University] is one, Texas A&M [University] is another—don't even have chemistry education scholarships. Nobody is giving scholarships for chemistry education. Why?

HACH-DARROW: I console myself with this reflection. Obviously with some of the negative things we've said about Danaher, sometimes I think, gosh, we made a mistake in selling the company. Then I realize, no, we really didn't, because we're going to take that money and we're going to make a more important contribution. Danaher is going to keep the company running. They're not going to let it collapse. Meanwhile, we can make a more important contribution to young people and to the future of this country.

THACKRAY: It's very analogous to the Beckman experience. The company continues, but no longer possesses the flair that it once had. The money has come out in the [Arnold and Mabel] Beckman Foundation and science and young scientists are benefiting from it and will do so in perpetuity.

Right now, how many scholars are there in your program?

HACH-DARROW: There are about forty-five under scholarship right now. We also have eight Ph.D. candidates at [University of] Wyoming. Cliff liked the Wyoming department of chemistry. He said, "They're doing real chemistry up there." Analytical and hands-on. The students get four years—actually five or six. If they want to get a teaching certificate or want to get a master's in teaching, we'll allow that, too. We're ultimately going to get East Coast representatives. We don't have one yet, but we're flirting with Virginia Tech [Virginia Polytechnic Institute and State University]. We don't have anybody yet on the East Coast in metro areas. Catholic University [of America] apparently produces many chemistry teachers. Someday we're going to have one or two in the east.

THACKRAY: Bruce, as the president of the Foundation, what fraction of your time does the Foundation take?

B. HACH: Since I'm not working at Hach, I work with the Foundation every day. This is a full-time job. I wish the stock market wasn't going down, because I used to say I didn't need to have a salary. Ultimately, there are just three of us that do this. Unfortunately, we lost Annette [Geiselman]. She resigned. She was having some personal issues that needed immediate attention and she needed to step away for a while.

THACKRAY: Kitty, please talk about women entrepreneurs.

HACH-DARROW: I am what is called a founding member of The Committee of 200, which consists of entrepreneurial women. You have to be either a president or a CEO of a company to join. When I went in, one only had to have sales of five million dollars. The minimum is now fifty million dollars. They really upped that. [laughter] There are many entrepreneurial women out there doing some pretty remarkable things.

You've heard about the glass ceiling. That's the kind of thing I never experienced. Larry told me that of those who had applied for the scholarship, we had been running around 40 percent women. In his last class, 56 percent were women, young girls. That is also being seen now on a national level.

I think back to my friendship with Mary [L.] Good. That friendship goes back a long time ago. I'm sure Mary won't remember me anymore, but we had nice associations at the ACS [American Chemical Society] some time back. I think that there are going to be a lot of Mary Goods. We're bright, we're capable, we're going to be well educated, so I don't worry about glass ceilings. I think this kind of thing takes care of itself on an individual basis. I think it's going to be good.

THACKRAY: What would you say are the key contributions of Hach Company?

B. HACH: The key was that the simplification of colorimetric procedures required a premanufactured reagent. That meant trusting the reagent to be made by a third party—in this case, the Hach Company—to such a high-quality standard that it absolutely could meet all possible scientific criteria. What the company did was this blending. It provided the layman a chance to be able to do the tests, which would be required in water management. Hach never intended to discredit the integrity of chemistry or dissuade a person from exploring the academic chemistry discipline. We walked both lines: we provided lay technology in a sophisticated way, which continues to honor chemistry going forward. We were the first company that brought it to that level. There are other companies at that level today, but we were one of the first.

HACH-DARROW: That's very good: simplification of procedures and trusting the third party with the premeasured, premanufactured reagents. There's one other thing we can add: powder technology was pioneered by Hach. No one really has picked up much of that. There's been some tableting and so forth. Blending and stabilizing the reagents, that was really a core Hach technology.

THACKRAY: It's a very impressive story that deserves to be much better known. It's interesting that Clifford Hach, like Arnold [O.] Beckman, came from a Midwestern farming background and was first-generation to college in his family.

B. HACH: CHF [Chemical Heritage Foundation] published a whole book on Beckman (9).

We interfaced with Beckman on the resale of the DR/4000. That was the most sophisticated group of people I've ever dealt with. They were superb, so I'm a big fan of Beckman.

Arnold Beckman took electrochemistry and sought to take it out to the field, and Clifford Hach did the same thing by simplifying analytical chemistry. Beckman got to a billion dollars, and Hach got to one hundred and fifty million dollars. We were both doing very much the same thing. Clifford Hach represented the integrity and power of chemistry every bit as much as Arnold Beckman.

[END OF INTERVIEW]

NOTES

1. Clifford Hach, "Composition for Producing Carbon Dioxide from Hydrogen and Carbon Containing Compounds, and the Process for Producing the Same," U.S. Patent # 2,492,986. Issued 3 January 1950.

2. Otto Eisenschiml, *Without Fame: The Romance of a Profession* (Chicago; New York: Alliance Book Corporation, 1942).

3. See Note 1.

4. See for example:
Lenore S. Clesceri, Arnold E. Greenberg, and Andrew D. Eaton, ed., *Standard Methods for the Examination of Water and Wastewater*, 20th ed. (Washington, D.C.: The American Public Health Association, the American Water Works Association, and the Water Environment Federation, 1998).

5. See Note 4.

6. See Note 4.

7. *Freaky Friday*. Burbank: Buena Vista Pictures, 2003. Filmstrip

8. *Federal Water Pollution Control Act* [commonly referred to as *The Clean Water Act*], 33rd Cong. (18 October 1972), 1251-1376.

9. Arnold Thackray and Minor Myers, jr., *Arnold O. Beckman: One Hundred Years of Excellence* (Philadelphia: Chemical Heritage Foundation, 2000).

APPENDIX

I: The experiences of Kathryn C. Hach-Darrow presented through photographs

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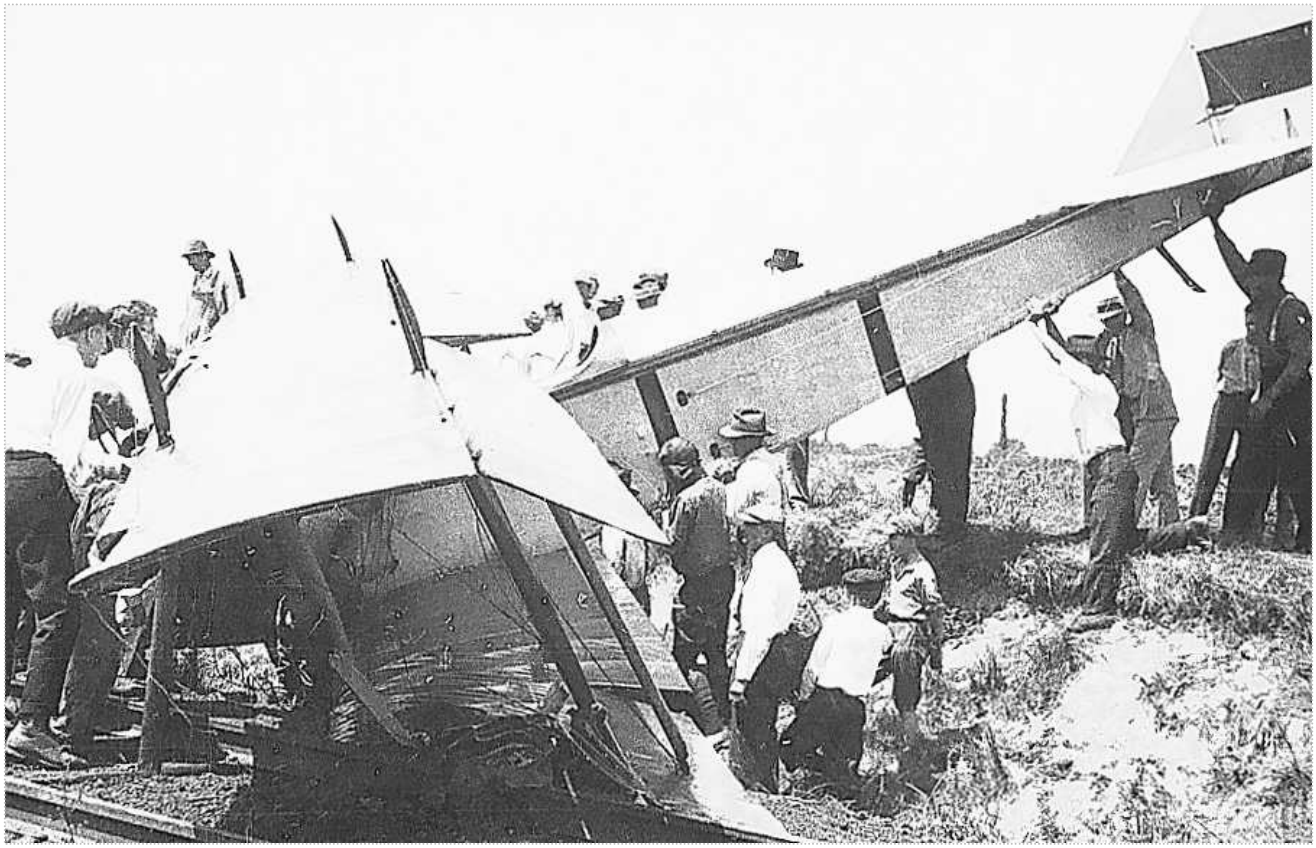
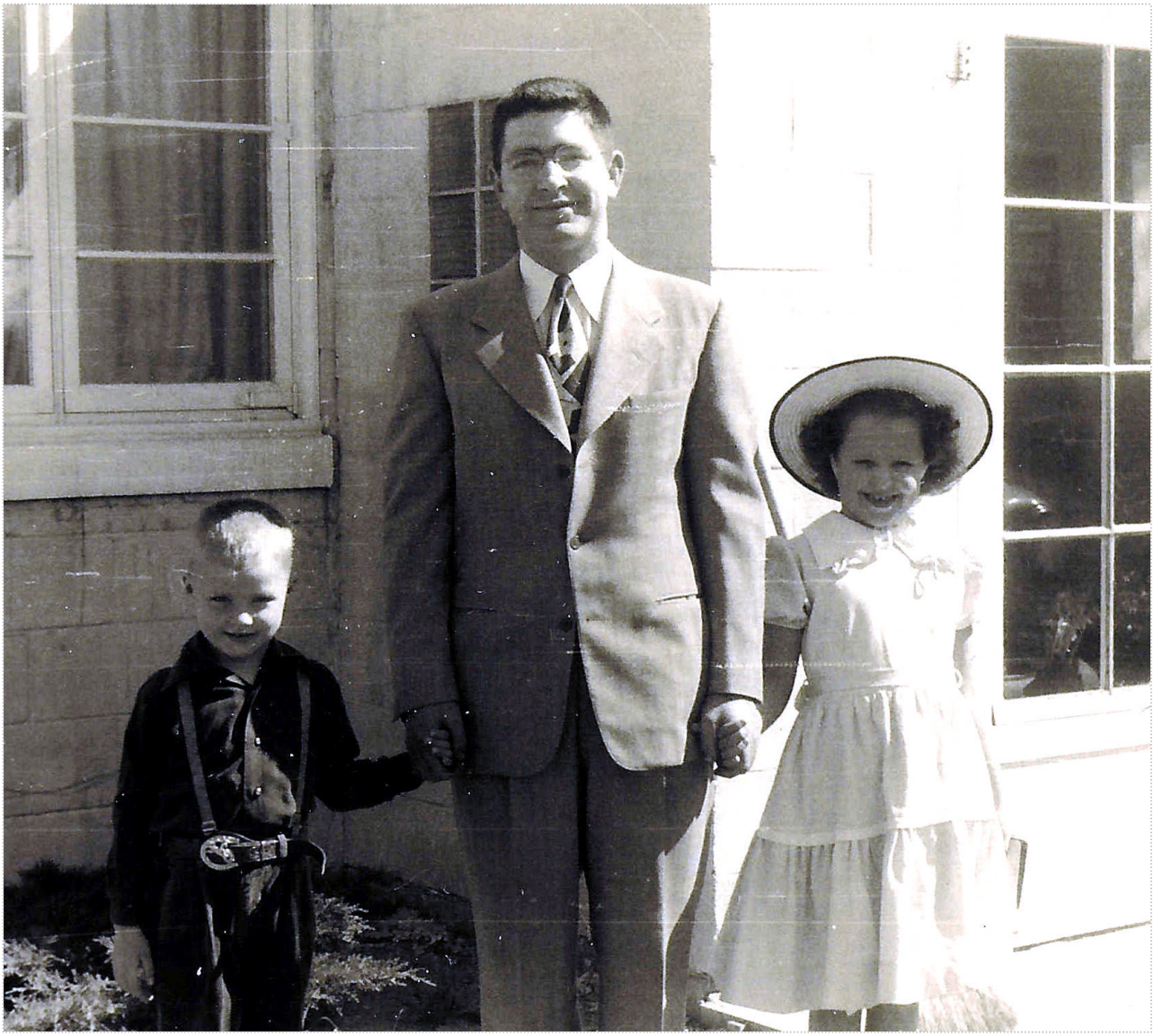
The experiences of Kathryn C. Hach-Darrow presented through photographs

FAMILY



Wreckage of father's Jenny after he overshot a runway and landed on railroad tracks, Bucklin, Missouri, 1917.

Kitty was always ready for a lesson in her father's Eagle Rock, 1927.
(Kitty poses in a helmet and goggles with her aunt and cousins.)



Bruce, Clifford, and Mary pose for a snapshot on Easter Sunday, 1952.

Hach Family Portrait, 1958.
(l. to r.: Clifford, Paul, Mary, Kitty, and Bruce)

Kitty and Donald Darrow in their Citation Jet, 1995.

Kitty flying her Beechcraft Bonanza.

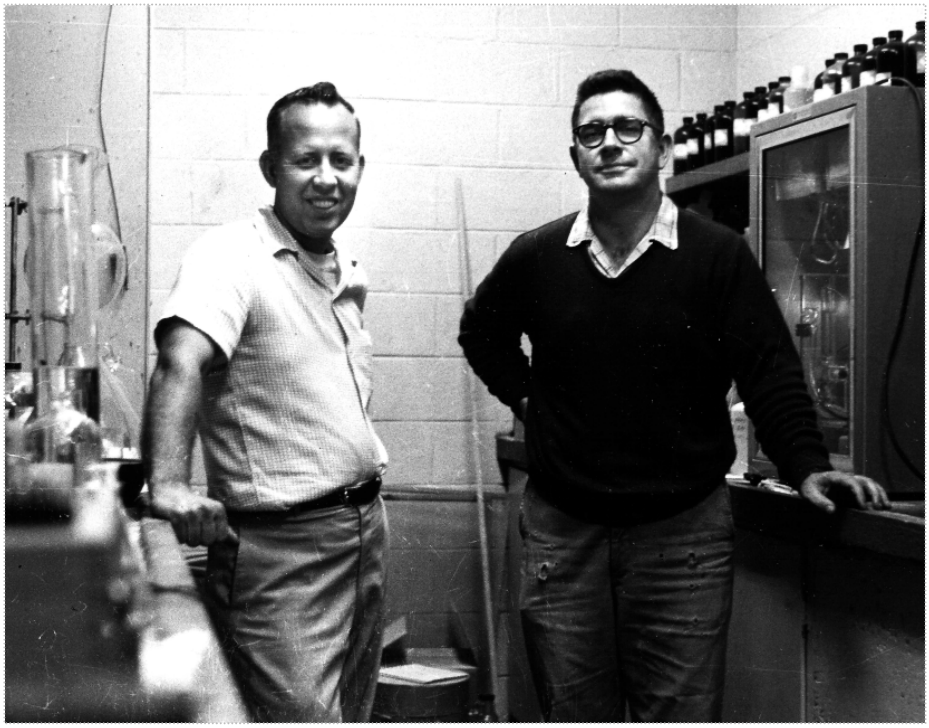
The experiences of Kathryn C. Hach-Darrow presented through photographs

HACH COMPANY THROUGH THE YEARS

Hach Chemical Company, Building 1, 1951.

Model 5-C Water Hardness Tester, mahogany block, 1952.

Clifford demonstrates the Sulfate Test, 1955.



Clifford and Stanley Anderson in the Ames plant, 1955.

Soft Water Operators Convention, Chicago, Illinois, 1956.

American Water Works Association Convention, Atlantic City, New Jersey, 1957.
(l. to r.: unknown man, Clifford, Louis Haase, Kitty, Steve Davies, unknown man)

Model 2B Water Hardness Tester, oak case, 1958.

Hach Technical Center, 1959.

Hach Chemical Company, 1960.

Hach Chemical Company, Buildings 1 and 2, 1965.

Clifford and Kitty celebrate a business milestone, 1966.

Clifford working on the DR/3000 spectrophotometer, 1985.

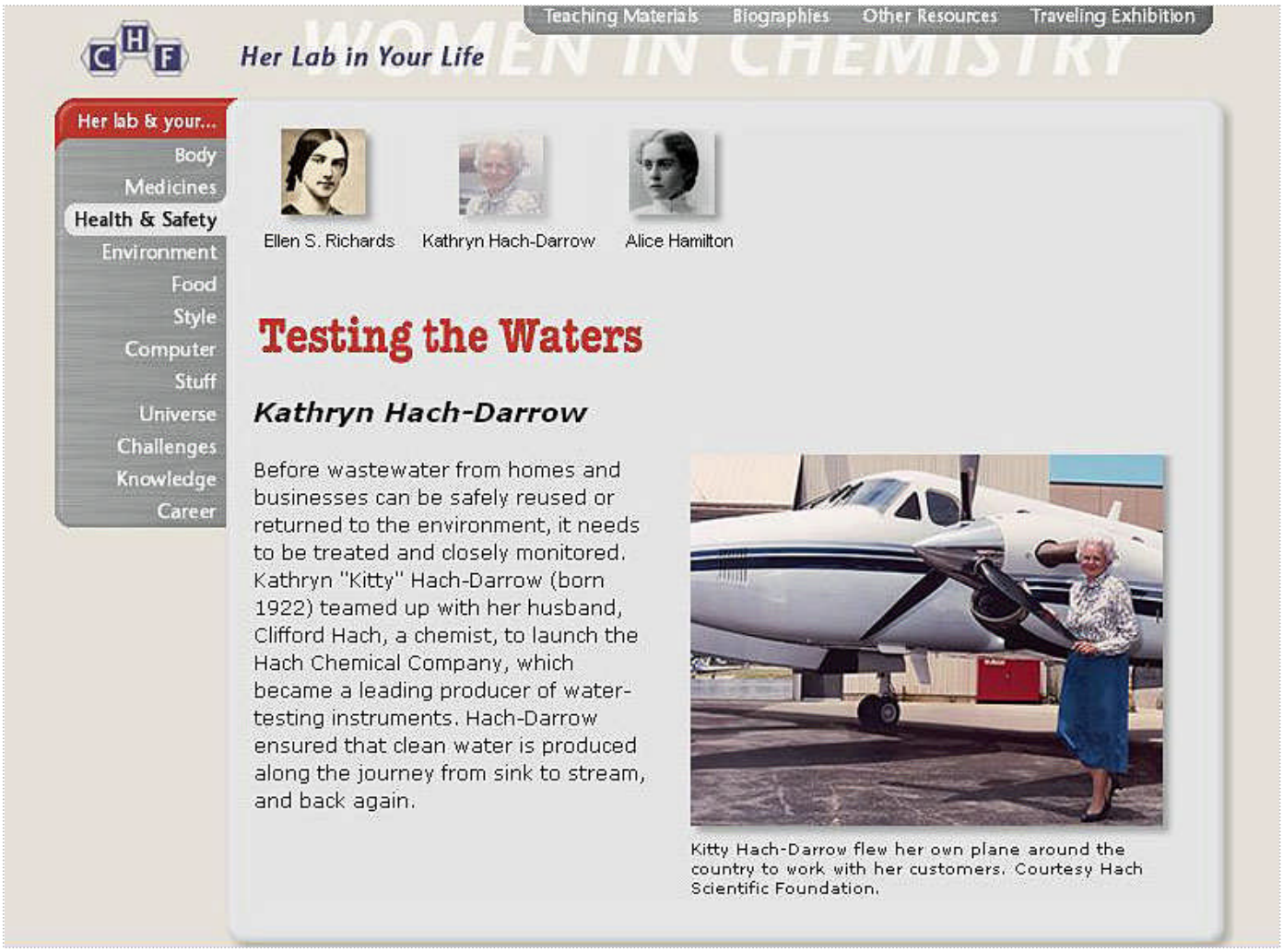
Clifford and Kitty pose for a promotional photograph, 1986.

Lecturing at a business conference, 1987.

Hach Company, Loveland plant, 1992.

Kitty graces the cover of *Colorado Business*, May 1995.

Holding the Pittcon Heritage Award with Arnold Thackray, 2003.



Except from *Her Lab in Your Life: Women in Chemistry*, Chemical Heritage Foundation, 2004.

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1. Clifford C. Hach, “Composition for Producing Carbon Dioxide from Hydrogen and Carbon Containing Compounds, and the Process for Producing the Same,” U.S. Patent # 2,492,986. Issued 3 January 1950.
2. ———, “Composition for Analysis of Iron,” U.S. Patent # 3,095,382. Issued 25 June 1963.
3. ———, “Method for Removing Rust from Water Softeners,” U.S. Patent # 3,139,401. Issued 30 June 1964.
4. ———, “Stain and Rust Removing Composition,” U.S. Patent # 3,183,191. Issued 11 May 1965.
5. ———, “Analyzer Mixing Apparatus,” U.S. Patent # 3,185,447. Issued 25 May 1965.
6. ———, “Apparatus for Automatic Analyzing,” U.S. Patent # 3,186,799. Issued 1 June 1965.
7. ———, “Apparatus for Automatic Analyzing,” U.S. Patent # 3,284,164. Issued 8 November 1966.
8. ———, “Automatic Continuous Analyzer,” U.S. Patent # 3,294,490. Issued 27 December 1966.
9. ———, “Turbidimeter for Sensing the Turbidity of a Continuously Flowing Sample,” U.S. Patent # 3,306,157. Issued 28 February 1967.
10. ———, “Extended Range Turbidimeter,” U.S. Patent # 3,309,956. Issued 21 March 1967.
11. ———, “Test Papers, Methods for Carrying Out Chemical Analyses and Methods for Making the Test Papers,” U.S. Patent # 3,510,263. Issued 5 May 1970.
12. ———, “Color Wheel for Color Comparators,” U.S. Patent # 3,520,626. Issued 14 July 1970.
13. ———, “Radiation Sensitive Dual Beam Turbidimeter,” U.S. Patent # 3,528,750. Issued 15 September 1970.
14. ———, “Method and Means for Detecting Coliform Bacteria in Water,” U.S. Patent # 3,553,082. Issued 5 January 1971.
15. ———, “Turbidimeter Using a Pressurized Fluid Container,” U.S. Patent # 3,564,262. Issued 16 February 1971.
16. ———, “Iron Analysis Reagent Formulation,” U.S. Patent # 3,709,662. Issued 9 January 1973.
17. ———, “Weight Loss Spring Balance,” U.S. Patent # 3,718,198. Issued 27 February 1973.

18. ———, “Method of Making Comparator Color Wheels,” U.S. Patent # 3,764,646. Issued 9 October 1973.

19. ———, “Automatic Analyzer,” U.S. Patent # 3,773,423. Issued 20 November 1973.

20. ———, “Method and Apparatus for Eliminating Air During Fluid Turbidity Measurement,” U.S. Patent # 3,849,002. Issued 19 November 1974.

21. ———, “Disposable Weight Burette and Method for Carrying Out Titrimetric Analyses,” U.S. Patent # 3,905,768. Issued 16 September 1975.

22. ———, “Methods and Apparatus for Automatically Analyzing Fluids,” U.S. Patent # 3,953,136. Issued 27 April 1976.

23. ———, “Carbon Nitrogen Test System,” U.S. Patent # 4,025,309. Issued 24 May 1977.

24. Clifford C. Hach and Michael D. Buck, “Method and Apparatus for Sampling Impure Water,” U.S. Patent # 4,053,282. Issued 11 October 1977.

25. Clifford C. Hach, “Digital Titration Device,” U.S. Patent # 4,086,062. Issued 25 April 1978.

26. Clifford C. Hach and Wayne P. Zemke, “Mechanical Strainer,” U.S. Patent # 4,177,148. Issued 4 December 1979.

27. Clifford C. Hach and Michael D. Buck, “Slurry Pipet,” U.S. Patent # 4,197,746. Issued 15 April 1980.

28. Clifford C. Hach, “Conductivity Probe for Viscous Liquids,” U.S. Patent # 4,220,921. Issued 2 September 1980.

29. ———, “Continuous pH Meter,” U.S. Patent # 4,288,308. Issued 8 September 1981.

30. ———, “Digestion Process,” U.S. Patent # 4,645,745. Issued 24 February 1987.

31. ———, “Digestion Process,” U.S. Patent # 4,645,746. Issued 24 February 1987.

32. Clifford C. Hach and John G. Wasson, “System and Method for Quantitative Analysis of a Solution,” U.S. Patent # 4,645,992. Issued 12 September 1989.

33. Clifford C. Hach and Keith M. Gawlik, “Programmable Fertilizer Application System,” U.S. Patent # 4,878,614. Issued 7 November 1989.

34. Clifford C. Hach and Keith M. Gawlik, “Programmable Chemical Application System,” U.S. Patent # 4,993,634. Issued 19 February 1991.

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