CHEMICAL HERITAGE FOUNDATION

HELEN MURRAY FREE

Transcript of an Interview
Conducted by

James J. Bohning

at

Elkhart, Indiana

on

14 December, 1998

(With Subsequent Corrections and Additions)

Helen M. Free

CHEMICAL HERITAGE FOUNDATION
Oral History Program
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HELEN MURRAY FREE

1923 Born in Pittsburgh, Pennsylvania on 20 February

Education

1944 B.S., chemistry, The College of Wooster
1978 M.A., management, Central Michigan University

Professional Experience

Miles Laboratories, Inc.
1944-1946 Control Chemist
1946-1959 Research Chemist, Biochemistry Section, Miles-Ames Research Laboratory
1959-1964 Associate Research Biochemistry and Group Leader, Ames Research Laboratory
1964-1966 Ames Product Development Laboratory
1966-1969 Ames Technical Services
1969-1974 New Products Manager, Chemical, Medical or Clinical Test Systems, Ames Growth and Development
1974-1976 Manager, Microbiological Test Systems
1976-1978 Director, Specialty Test Systems, Ames Company
1978-1979 Director Clinical Laboratory Reagents, Research Products Division
1979-1982 Director, Marketing Services

Miles, Inc./Bayer Diagnostics
1982-present Professional Relations Consultant

Indiana University at South Bend
1977-present Adjunct Faculty

Honors

1967 Honor Scroll Award, Chicago Chapter, American Institute of Chemists
1976 Professional Achievement Award, American Society for Medical Technology
1977 Ames Company Honoree, YWCA Honors Luncheon #1
1978 Bellringer's Award, Elkhart United Fund
1978 Honorary Member, Iota Sigma Pi

1980 Distinguished Alumni Award, The College of Wooster
1980 Garvan Medal for Distinguished Service to Chemistry, American Chemical Society
1981 Silver Bowl Award, Elkhart YWCA Honors for Professions
1981 Service Award, St. Joseph Valley Section, American Chemical Society
1983 Mosher Award, Santa Clara Valley Section, American Chemical Society
1986 Al Dietz Service Award, Chicago Section, American Association for Clinical Chemistry, Inc.
1986 Medical Economics Forty-Year Award
1991 Diploma of Honor, Association of Clinical Scientists
1992 Woman of the Year, Business and Profession Division, St. Joseph County YWCA
1992 Sigma Delta Epsilon, Honorary Member
1992 Hall of Excellence Award, Ohio Foundation of Independent Colleges
1992 Honorary Doctorate of Science, The College of Wooster
1993 Honorary Doctorate of Science, Central Michigan University
1994 Laboratory Public Service National Leadership Award, Washington G-2 Reports
1995 Helen M. Free Award in Public Outreach, American Chemical Society
1995 Alumna of the Year Award, Poland, OH Schools
1996 Engineering and Science Hall of Fame Induction
1996 Kirby Foundation Award

ABSTRACT

Helen Free begins the interview with a discussion of her family and childhood years growing up in Ohio. Free attended Poland Seminary High School in Ohio. There, she was greatly influenced by her English teacher and intended to become an English and Latin teacher. In September 1941, Free entered the College of Wooster. After the attack on Pearl Harbor in December of the same year, many young men either joined or were drafted into the armed forces, leaving academics behind. As a result, Free's housemother encouraged female students to pursue careers in science. Without reservation, Free switched her major and received her B.S. in chemistry in 1944. After graduation, Free immediately began working as a control chemist with Miles Laboratories. In 1946, she moved into the new biochemistry department at Miles, where she worked for her future husband, Alfred Free. She first researched assays of antibiotics before moving to dry reagent test systems. Working with tablets, Free helped develop tests to detect abnormal levels of bilirubin, glucose, ketone, and protein in urine. Later, Free worked with her husband to move the tests from tablets to strips, introducing Clinistix® in 1956. Several other testing strips were developed and added to the market, including Uristix®, Ketostix®, Dextrostox®, Labstix®, and a still-current product, Multistix®. When Bayer Corporation acquired Miles Laboratories, Free stayed with the company, moving into the Growth and Development Department, then becoming Director of Specialty Test Systems. Free formally retired in 1982, but continues to work as a consultant for Bayer Corporation's Diagnostics Division. Free served as the president of the American Chemical Society in 1993 and continues to be involved with the organization. Free is also affiliated with the American Association for Clinical Chemistry, Inc. and remains personally involved in several chemistry awareness programs, including the International Chemistry Celebration, National Chemistry Week, National Science and Technology Week, the National Chemical Historical Landmark Program, and Medical Laboratory Week. Free concludes the interview with a discussion of her children and thoughts on the National Registry in Clinical Chemistry.

INTERVIEWER

James J. Bohning is currently Visiting Research Scientist at Lehigh University. He has served as Professor of Chemistry Emeritus at Wilkes University, where he was a faculty member from 1959 to 1990. He served there as chemistry department chair from 1970 to 1986 and environmental science department chair from 1987 to 1990. He was chair of the American Chemical Society's Division of the History of Chemistry in 1986, received the Division's outstanding paper award in 1989, and presented more than twenty-five papers before the Division at national meetings of the Society. He has written for the American Chemical Society News Service, and he has been on the advisory committee of the Society's National Historic Chemical Landmarks committee since its inception in 1992. He developed the oral history program of the Chemical Heritage Foundation beginning in 1985, and was the Foundation's Director of Oral History from 1990 to 1995.

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INTERVIEWER: James J. Bohning

LOCATION: Bayer Corporation, Diagnostics Division
Elkhart, Indiana

DATE: 14 December 1998

BOHNING: I know you were born in Pittsburgh on the 20th of February 1923. Could you tell me something about your parents, James [S.] and Daisy [P.] Murray?

FREE: Sure. My father was a salesman for the Pittsburgh Coal Company, and I don't know what he was doing in Pittsburgh, but maybe that's where he started. When I knew him, he was in Youngstown, Ohio because we moved away from Pittsburgh when I was about three, as I've been told. He had an eighth grade education, that's all, but he moved up to be sales manager of the Youngstown office. I remember when I was a kid, I used to go around with him on his rounds to all the coal dealers, because this was back when they had coal-fired furnaces and you'd have a coal bin in the basement, and you'd shovel that coal in and take the clinkers out, and all that jazz. But my dad didn't sell to homes. He sold to the dealers who then sold to homes. He was a wholesale dealer in coal, I guess. I'd go around with him on his rounds, and he was an absolute teetotaler and never swore in his life, I don't think. Real wonderful guy. All these other rough people were a little different. But he handled them all right. He was very prissy about the thing, and they all loved him. I remember one coal dealer's name was Alfonso Scarazzo, and I can't remember whether he was in Canton, Ohio or someplace in West Virginia or someplace around that area, and he thought the sun rose and set on my dad. It was great.

My mother was Daisy Piper and I don't know much about her. She died when I was six of the influenza epidemic in 1929, and I remember but one thing about her. She could play the piano and she was teaching me. I couldn't have been more than five, I guess. But she was teaching me to play the piano and I would play one piece, and she'd say, "Oh, you've done that so well." I said, "Well, I just look at those little numbers and it tells me what finger to put down." She got so mad because she had thought I was reading <u>music</u>! But that's really the only thing I remember of her.

BOHNING: Do you have any brothers or sisters?

FREE: I have one brother, three years younger than I, Robert Earl Murray. He's now in Joplin, Missouri, retired. He was on the City Council there for a long time, but he was in the retail business with women's clothing in various stores. His last position was with Newman's, who

then was bought out by Federated Stores. I remember when Al [Alfred H. Free] and I were first married, we used to go back and forth to Pittsburgh to visit relatives, and Bob lived in Athens, Ohio, and we'd stop there. He, being in the retail business, would tell me about the latest fashions. I remember one time he gave me an emerald green satin cocktail dress which I think I wore once. [laughter] But it was great. He's terrific.

BOHNING: Your mother died, then, about the time the Depression came. What effect did that have on your family?

FREE: Yes. Well, it had a big effect because my dad was the one of many brothers and sisters who had a steady job, and my Uncle Arch [Murray], who was the oldest boy of the family, came and lived with us because he got a job with the steel company there in Youngstown when we lived there. My dad had a car, and a lot of people didn't. I didn't realize that then, but that was fine.

BOHNING: I guess people still needed to use coal to heat their homes.

FREE: That's right. His was kind of a secure position, I think. But my Uncle Arch came and lived with us while he worked, and I know my dad sent money to help all the other brothers and sisters he had. He had several. I don't know if I remember them all. There was Uncle Arch and Uncle Babe—he was the young one, Eddie [Edward Murray]. Uncle Bill [William Murray], and my dad. Those were the boys. There was my Aunt Agnes [Maxwell], my Aunt Janet [Leake, then Mesta], and my Aunt Margaret [Murray]. I guess there were three.

BOHNING: Now, did you have your elementary school education there in Youngstown?

FREE: In Youngstown, yes, until fifth grade. But I remember when I was in fifth grade, I got my glasses. Things came easy to me. I got straight A's all the way. When we went to have my eyes examined, I don't know how they discovered I had poor eyes, but we did, and I was so pleased because I got to sit in the front row—I couldn't see—until my glasses came in. I was proud of that fact. You know, they didn't call people—or maybe they did call me—"Four-Eyes." I don't know, but I was just so excited that I could really see. I hadn't known I couldn't before that. Then one of the things I remember about the school in Youngstown—it was Garfield Elementary School, and it was two or three blocks away, so of course we walked to school. The music teacher was Miss Elder, and she had red hair and a temper to match. We would have to stand up and recite, you know, "This is the key of something or other," and "A is found wherever it was found." I don't remember any of that stuff, but boy, we had to know it when Miss Elder taught us music.

Then we moved to Poland, Ohio, which is a little suburb of Youngstown, a little village. I guess it must have been when I was in sixth grade, or maybe seventh grade, but we went to Poland Union School, which was a consolidated school there in the middle of nowhere, near Youngstown. Again, it was easy for me at school. I remember I went to high school at Poland Seminary High School, which used to be a seminary for young ladies, before they turned it into a high school where everybody had to go to school.

BOHNING: But it was a public school.

FREE: It was a public school, yes. I got straight As, but so did Doris Dean in my class, and so they pulled me aside, and they said, "Now, you have everything you always wanted." Of course, I didn't, you know. But my dad could afford to send me to college and stuff, and so they didn't say, "Is it okay?" They said, "We're going to make Doris Dean the Valedictorian and you the Salutatorian." I didn't think it was very fair, but what could I do about it? [laughter] There were fifty in my graduating class.

BOHNING: Were there any teachers that had an influence on you?

FREE: Oh yes. Miss Johnson, my English teacher. She was kind of a portly lady, and one summer she went way for the summer and came back in the fall—she was slim, beautiful, just wonderful. All the boys, the basketball boys, "How many do you think, John?" "How many do you think, Roy?" [laughter] She really made a big impression on me because that's what I was going to be when I went off to college, to Wooster [The College of Wooster]. I was going to be a Latin and English schoolteacher.

BOHNING: Did you have any exposure to science at the high school?

FREE: Sure. I took chemistry and physics. Hugh [T.] McDonald was our chemistry teacher, and he went to the College of Wooster. I didn't know that at the time, but he was a Wooster alumnus. When I got to college, as I say, I was going to teach Latin and English. So that was in September of 1941, and in December all the fellows left to join up in the Armed Forces after Pearl Harbor. So, the housemother—and when I tell this to students now, "House-mother?" [laughter]—was sitting at the dinner table with us one evening and said, "You know, girls, we're going to have to get some of you girls into science because the men are all signing up, leaving the campus, and we're going to need some scientists." She turned to me and said, "Helen, you're taking chemistry, aren't you?" I said, "Yeah." "You like it?" "Yeah." "Your grades good?" "Yeah." "Did you ever think—why don't you switch?" "Okay!" Just like that! I think that was the most terrific thing that ever happened because I certainly wouldn't have

done the things I've done in my lifetime had I been a Latin and English teacher in some little high school somewhere.

BOHNING: College of Wooster—well, first of all, why did you go there? Just because it was close by?

FREE: I didn't visit any other college campuses, but I went to a church camp one summer and it was held at Wooster, and it was such a great place, I said, "I'm going to go to college here." Just like that. It's funny how decisions are made for you sometimes.

BOHNING: Now, if I remember correctly, the College of Wooster is an old school. It's been there for some time.

FREE: Oh, yes.

BOHNING: What was it like when you arrived on campus?

FREE: Well, to me, it was a wonderful, glorious, huge campus, but it was really a small one. I think they had probably a thousand students at the time, maybe less than that because there weren't so many men left on campus. We stayed at Hoover Cottage (which was a really old dorm), on the fourth floor of Hoover Cottage, where you walked up the stairs. It's since been torn down and they have a few more new buildings. The college is a Presbyterian school, and it's a wonderful site. "Queenly College on the Hill" is what the old Wooster Love Song used to sing. In fact, I was upset because many years after we left, they just rewrote that whole alma mater song. Do the colleges do that often?

BOHNING: I don't know.

FREE: I was so angry, because we used to sing the Wooster Love Song, and it was [sung] "To Wooster U"—of course, it wasn't a university. [laughter] That's one of the reasons why I think it was rewritten.

BOHNING: Were there any other women who changed like you did because the housemother suggested they needed more women, more people in science?

FREE: I don't know whether they changed or not. There were several women in my college class who majored in chemistry. The McClaren twins, Mary and Martha, from Youngstown, and I roomed with Martha my first year. I thought it was kind of silly that they put me with somebody next to my hometown. I thought I'd get somebody from California or Minnesota, or somewhere far away. But they were from nearby, they both majored in chemistry, but whether they started careers in chemistry or not, I don't remember. A couple of others—Lois Scott [Cook] was another one. She was from Dayton, and she actually taught at Wright State University for a long time before she retired. We still keep in touch because she runs a girls' camp at Wooster in the summer—the B-WISER Camp (sponsored by Buckeye Women In Science, Engineering and Research!).

BOHNING: What was the chemistry curriculum like?

FREE: Well, we had general chemistry as freshmen; and we had qualitative and quantitative chemistry for the next year. We had organic chemistry. And that's all.

BOHNING: No physical chemistry?

FREE: No. I didn't even <u>hear</u> about physical chemistry back then. Of course, there wasn't biochemistry. Oh, there may have been. There probably was at that time in the universities, but certainly not at Wooster. Then you had physics, calculus, and all the math, as well. But it was a liberal arts school, so they gave you history—I hated history. We had Miss [Aileen] Dunham, who made you memorize dates, and that was blah! I'm sorry I didn't pay much attention because I still have no concept of what was going on in this part of the world while something was happening over there. But I just didn't like it.

BOHNING: What kind of laboratory facilities did they have?

FREE: Well, we had good old Severance Hall—it was renovated in the 1960s because it hadn't ever been renovated before. So you know what it was like in the 1940s. Then just these last few years, they put on a campaign to re-do it again, and re-do it again is not redundant! [laughter]

BOHNING: The whole time you were at Wooster, the war was going on.

FREE: Right.

BOHNING: You said most of the men had left.

FREE: Yes. If men were going to be physicians or ministers, they could stay at Wooster. But otherwise, they hurried and joined what they wanted to so they wouldn't get drafted into the Army. Many of them did anyway. We had some men because we had a V-6 Training Program. Was that the Air Force V-6 Training Program? They were there. I went through in three years. I went for the two summers in between those three years straight so that I was only there on campus for three full years. The V-6 guys were there in the summers, and so of course they were in seventh heaven. All these coeds! [laughter]

BOHNING: As you were getting ready to graduate—well, let me ask something else first. You said your father could afford to send you. I was going to ask you how you financed your education.

FREE: Yes, he paid for it. He said, "We owe you your college education." He died ten years ago, and, of course, I got all his records and things, and I have a little notebook that says he sent fifty dollars a semester to Wooster to pay for my college education. Can you imagine that? I won, when I was a freshman, the William Z. Bennett Prize in Chemistry—given to the one with the highest grade in chemistry—and that was fifty dollars. That was <u>huge</u> then! [laughter]

BOHNING: Yes, absolutely. What about the professors at Wooster? Did they have any influence on you?

FREE: They sure did. Roy Grady was the chairman, the head of the Department of Chemistry, and under him was John Chittum, who became head of the department when Roy retired. Then there was a young guy there, Bill [William] Kiefer.

BOHNING: Sure.

FREE: So he taught me for one year—one semester. I don't remember what it was. But when I was chosen to be one of the honored alumni for Wooster, John Chittum was very ill at that time and couldn't give the speech, but Bill Kiefer did. He said, "You know, I was looking back at the records, and I didn't know Helen very well, but I did okay. I gave her an A!" [laughter]

BOHNING: They were the three in the department?

FREE: Yes. The only three.

BOHNING: What were you thinking about doing once you graduated?

FREE: Now, when I talk to kids on campus, you know, we discuss, "What's your career path going to be?" Back then, we went out and got a job. [laughter] That was it. Actually, Roy Grady was a good friend of Arnold Brown, who was head of personnel here at Miles [Laboratories, Inc.], and he got me an interview for the Quality Control Lab here at Miles. I also applied for a research fellowship at the Carnegie Mellon Institute. Because all my aunts and uncles lived around the Pittsburgh area, I thought that would be kind of neat. Then I had one other interview with Koppers Company in Orrville, Ohio. I don't remember much about my interviews, but that one I knew was not for me the minute I went in. They said, "Well, your job is going to be to test the creosote that we dip the fence posts in for the farms." I thought, "Well, that's not really my idea of the kind of a job I wanted." [laughter] But I took the train out here to Elkhart and met Lloyd [T.] Johnson, who was the head of the Control Laboratory at that time. My interview was during the war, and I was all crammed in with three or four men in this little-bitsy car, and they were going off to lunch. (They didn't take me to lunch.) They dropped me off at the "Y" [YWCA] and went on to this "Friday Club." The Friday Club is still in existence, as it has been for fifty-six years. We just had our 56th Anniversary—I say "we" because Al, my husband, is a member of the Friday Club. There are no women! [laughter] Still no women members. Lloyd reminds me every once in a while, and I remind him every once in a while, about riding around with three or four other Friday Club members on that interview day.

BOHNING: What did they tell you you'd be doing here?

FREE: Well, they showed me the control laboratory and said I'd be testing the ingredients for the vitamins. They had just started making vitamin tablets. Alka-Seltzer® was what they made here then. Of course, I'd listened to all the Alka-Seltzer® radio programs—*One Man's Family*, the *Quiz Kids*, and the *Barn Dance*, and all those good things. So I kind of knew about Miles Laboratories. So I went back home; they offered me a job, and I kept waiting to hear from Carnegie Mellon. I thought, "Well, I'd like to get into research instead of quality control, where it's routine." Carnegie Mellon didn't call me, so I said, "Sure, I'll come out to Elkhart," and I came out. I graduated on, I think, 31 May, and started the first of June. I went practically from Wooster right out here. Then two or three weeks later I heard that they had this fellowship available, but it was too late by then. But that's okay. Again, it's funny how decisions are made for you sometimes.

BOHNING: Let me ask a couple background questions. How old was Miles Laboratories at the time? You said they had just started making Alka-Seltzer®?

FREE: No. They had made Alka-Seltzer® for a long time, but they had just started making vitamins.

BOHNING: All right.

FREE: Actually we developed in the Control Lab the assay procedures for the different vitamins. I remember developing a method for doing Vitamin B_6. Lloyd had come up and said, "Now, this is the method, and can you adapt it to whatever this is?" I tried, and it was kind of neat. It was kind of like being a detective.

BOHNING: What was the Ames Company relationship? That's another thing I wasn't clear on.

FREE: Ames—actually it was called Effervescent Products at that time—was called the "ethical" or prescription branch of this medicinal production company. They had products like Alka-Vess, with prescription amounts of aspirin, and I can't remember some of the other ones. But they were take-off products of Alka-Seltzer®. They may have had another ingredient in for a cold or for a cough or something like that, but they were just beefed-up Alka-Seltzer®. That was the ethical line. Salici-Vess was another one. It probably had twice as much aspirin in it, or something. I don't know. It was a very small arm of Miles. Then they changed the name later on to Ames Company. I can get you a book (1) that gives you all the dates and things like that, when these things happened. The Ames Company was named for Walter Ames Compton because he was one of the executives at that time. During those years—actually in 1946, Al came to join the company—I'd been in the control lab for a couple of years at that time, and I kept bugging my boss about "I want to do research." The only researcher they had was Maurice Milligan. Dr. Milligan was head of a group of four or five people who were organic chemists, and they were trying to synthesize some marvelous new medicinal drug. I didn't particularly care for organic chemistry, and they didn't particularly care to hire me. So I never got to do research before 1946.

Well, in 1946 Al came out and at that time, they were expanding the research facilities here at Miles Laboratories. They called it the Miles-Ames Research Laboratory. They had Maurice Milligan doing the organic chemistry, and then they brought in a Dr. Otis Fancher to take over the organic chemistry. They brought in Dr. "Dutch" [Leonard B.] Schweiger to do the bacteriology. It wasn't microbiology yet. Bacteriology. They brought Al in from Cleveland; he'd been teaching at the medical school at Western Reserve [University] (this was before it was Case Western Reserve.) They brought him in to start a biochemistry research group. So they

said, “Okay, if you want to interview for this position in biochemistry, go over and see Al Free.” So, I went over and he hired me, and two years later, I married the boss, which was one of the smartest moves I’ve made.

BOHNING: I was going to say, it wasn’t long after he came that you were married!

FREE: No!

BOHNING: I had 1947. Is that right?

FREE: That’s right.

BOHNING: So you got into doing some research then.

FREE: Right.

BOHNING: What did you do?

FREE: I found out that research was just as routine as quality control was. [laughter] But instead of doing Alka-Seltzer® and free salicylics or vitamins or whatever, I did bilirubins all day long, day in and day out. But it was kind of neat because we were also hoping that they’d get this wonderful, marvelous, new thing to replace the sulfonamides. Penicillin had been discovered, and so we were looking for a great antibiotic. There was a woman named Helen Ketchum, who worked for Dr. Schweiger. Actually, she’d been here before, but she was in Dr. Schweiger’s group, and she had discovered what we called “17-B,” which showed antibiotic properties. Now, Al not only taught at Western Reserve, but also worked for the Benvenue Laboratories in Cleveland. He moonlit there! What they did there was to make lyophilized (dried) blood plasma for the armed forces. They became one of the six companies that were hired in the U.S. to commercialize penicillin. So they were doing tests on penicillin, freeze-drying penicillin, and then sending it over as the antibiotic to give in the field hospitals, intravenously. In fact, he and one of his associates, Barbara [E. Biro], were the first ones to determine that you could take penicillin orally, and still have it not be destroyed as it was metabolized in the body. They’d do these penicillin assays, with these little metal cylinders that they would place on a petri dish that had been inoculated with staph or some kind of organism. Then they’d fill these little cylinders with dilutions of antibiotic broth they were testing, in ten-fold differences, and measure the diameter of the circles where the bugs didn’t grow. That was how they actually assayed for penicillin. So Al and his assistant Barbara decided they would

take some penicillin orally. This was absolutely illegal. They weren't supposed to do this because all the penicillin had to go to the armed forces, and they had to account for everything. But they would take the leftover stuff from the assays and they drank it and then tested their urine and found it was just as good an antibiotic coming out as it was going in. So they published this paper in *Science,* which was pretty impressive (2).

BOHNING: What year was that?

FREE: That was probably in 1944 or 1945. I've got a copy of it someplace I can get for you. But the other thing that was neat about that was that he could use this penicillin type assay and assay the 17-B that Helen Ketchum had, so we became the assay part of that group. We found that it was just another strain of penicillin, which was a sad thing for everybody because we thought we'd found this wonderful antibiotic. But with this, I remember—Ernie [Ernest C.] Adams, who worked for Al then, said, "You can't really say it's penicillin, but if it walks like a duck, and looks like a duck, and quacks like a duck, maybe it's a duck." [laughter]

[END OF TAPE, SIDE 1]

BOHNING: I want to follow the development of the dry reagent test systems, and yet follow the changes you've made here at the company at the same time, and the changes in the company. I'm not sure if we can merge it all together or not. So, the company was making something called Clinitest®, is that correct?

FREE: Right. This was a test that was devised by Dr. Compton and a friend of his in New York, Jonas Kamlet. Ordinarily, in those days, the lab did a Benedict's qualitative test to see if you were a diabetic. You'd have a solution of cupric sulfate, tartaric acid, and alkali. Cupric ions, in the presence of heat, and strong alkali can be reduced by any kind of reducing substance to cuprous ions. So the color changes from blue to orange or red. You'd heat this little bit of Benedict's solution and a few drops of urine in a test tube over a Bunsen burner—it would shoot out and hit the wall sometimes—and watch the color change. If it remained blue, there was no glucose in the urine. So what Dr. Compton and Jonas Kamlet did was to devise a system where you could make Clinitest® tablets containing cupric sulfate, sodium hydroxide, citric acid, and—because it came from Miles—a little bit of carbonate to make it fizz. They would tablet this in a low humidity room with an old-fashioned, one-tablet-at-a-time tableting machine. Then all you had to do was take a little bit of dilute urine in a test tube about a couple inches high, take fifteen drops of urine, and add a Clinitest® tablet to it, and watch the color change. We had color blocks from blue to green to brown to orange. Depending on the extent of reduction, you could measure the differences in color. That's the first diagnostic test that there was; and it was the first diagnostic test made anywhere, made specifically for use in the diagnosis of disease. Up until that time, they'd used regular old quantitative procedures with spectrophotometers, and

just adapted general analytical methods for testing urine and blood. Well, this was the first one designed for use by physicians or in hospital labs.

BOHNING: That was before you came.

FREE: That was in 1941 or 1942, that's right. I didn't ever do the testing in the laboratory, but I've got a little anecdote about that. Peggy [Margaret] Fitzsimmons was one of the technicians there. There were about five or six technicians who were under the control of Mr. Lloyd Johnson, who was a bachelor's-degree chemist. Elmer Degner was a bachelor's-degree chemist, Lucille Trautman was one, and I was one. There were four of us managers or exempt employees, and the rest were technicians. They did most of the testing under the supervision of the graduate chemists. Well, Peggy Fitzsimmons was a kind of leader in the thing. She was one who was in charge of doing the testing on Clinitest® and they actually—bless their hearts—they actually used urine for testing instead of water or something. (You know, most people used water standards.) Well, by golly, they actually tested urine. They used to get it from Otis, one of the people out in the manufacturing plant who was a good guy. They knew he was not diabetic, and anyway, he was their urine provider. So they would use his urine as the standard and add a certain amount of glucose to see if they got the right colors, which was fine. Well, one day, Peggy got it into her head that she would like to pull something fancy on them. So I had told her that, heck, back in the old days, they used to taste urine to see if it was sweet. So she made up this series of glucose solutions using tea. So the technicians were all standing around and she said, "Now, Helen says all you have to do is to drink it to taste it to see if it's sweet." I said, "Yeah, like this." So I dipped my finger in it, you know, and tasted it. "Gasp!" They all were shocked! [laughter] They didn't realize that she had substituted tea for Otis' urine in that case. But it was kind of funny.

Anyway, it worked well. This was the qualitative test that they had with fifteen drops of urine. Well, they modified that to get a more quantitative answer and what they used to do would be to take ten drops of water, five drops of urine, and then add the tablet, and they'd get better color matches. But the tablet gave—and Benedict's would do the same thing—what they called a "pass-through" reaction. The color changes would change to orange and then red, and there'd be so much more sugar if it was 4 or 5 percent sugar that it would keep on reacting. It would resolve some of the cuprous ions and make it turn around to a brown color, the color that indicated 1 percent on the color chart. So if you didn't watch it while it boiled so you could see the pass-through kind of color change, you'd miss it, and call the result 1 percent when it was really much more than that. So Al and Cookie, Marian [C.] Cook (now Mrs. Don Fetter), in the lab devised what they called the "two-drop method," where they only used two drops of urine. We had a different range of color chart, which would detect amounts of glucose up to 5 percent rather than stopping at 2 percent like the original did. You didn't have to worry about the pass-through until you had 10 percent glucose.

Al said, "You know, the second test they use on diabetics is a ketone test." So we developed a test called Acetest®, based on the same principle as the liquid test. It's a

nitroprusside test, and with nitroprusside and alkali and ketones you get this beautiful purple color. So they developed a tablet with those particular ingredients. We used ammonium sulfate for the alkali and sodium nitroprusside, and if you put a drop of urine on the tablet, it would turn purple. So it was neat. That product was never advertised much. It was available, sales grew, and they still sell it, after fifty-some years.

BOHNING: I'm trying to see what the impetus was back in the early 1940s to go to a tablet form. Why did they decide to end up putting something in a tablet form?

FREE: Because they made tablets here. I mean, they made Alka-Seltzer® tablets. They were used to making products that had to be done under low humidity because they contained bicarbonate and citric acid. If you get a little bit of moisture in there it ruins the whole thing—it won't fizz! So, the whole manufacturing area was very low humidity.

BOHNING: All right.

FREE: They used that same technology to make the Clinitest® tablets. The formulation was like lye. It had all this sodium hydroxide in it, and they didn't have all those stringent laws back in those days. Clinitest® bottles actually had the poison skull-and-crossbones symbol on the label.

BOHNING: Well, that raises another question: Did you have to get any kind of government approval for this?

FREE: Of course not. I didn't know there was such a thing as government regulations then. There could have been, but not for me in the lab.

BOHNING: As you've indicated, that had quite an impact, because now you could do that test almost anywhere. A doctor could do it in his office.

FREE: Yes. In fact, it was designed for the laboratory and for doctors' offices, and it wasn't until much later that they actually said, "You know, this is simple enough, the diabetics can do their own testing." We were very fortunate. I don't know about fortunate, but there was a gentleman, Dr. John Mirza, who was here as an organic chemist and was here with the Sumner Chemicals Division. His wife, Mary Ellen, was a severe diabetic. She was diagnosed when she was just a child. When she went to college, she used to take an alcohol lamp and an old tablespoon and do Benedict's solution to test her urine. So she was kind of like our guinea pig.

With each of these improvements, and each of these additions, she was there to try it out from a diabetic point of view. This was long before there were such things as clinical trials that you had to go through. [laughter]

BOHNING: You were then in the biochemistry section for some time and that's when the Clinistix® developed. When you first moved over, when you worked with Al, were you still doing quality control work?

FREE: No, this was in research. We were developing Acetest® and we were also developing the bilirubin test—Ictotest®.

BOHNING: That one I don't remember. I don't have that one down.

FREE: Ictotest®. That's still the standard—most sensitive test there is, this crude old thing. Bilirubin appears in urine only if you have hepatitis or some other kind of liver damage—not a blockage—but liver damage. At that time, there were orphanages and group homes where you would have severe epidemics of hepatitis. To detect bilirubin in urine was an oxidative reaction and they used all kind of reagents, liquid reagents.

BOHNING: What was the driving force behind how you selected what you were going to do next? Was it always directed towards diabetes?

FREE: No. Al was the driving force. While we were in biochemistry, as I say, we were the assay people for the people looking for antibiotics in the bacteriology department. But we still had the organic chemists synthesizing stuff all over the place and trying to get that wonderful new drug. We had people in the physiology department—I didn't tell you about the physiology department, which was under Dr. Lathan [A.] Crandall, who was head of the Miles Research Lab, and his department was physiology. He was an M.D. The people in the physiology department finally got Dr. R. K. S. [Robert Kho-Seng] Lim, "Bobby" Lim, who was the Surgeon General for Chiang Kai-shek's army at one time. He came in to work under Dr. Crandall as head of the physiology department. He had produced a whole series of articles and book chapters on the physiology of the brain, and he was trying to figure out what pain was all about and how these things that worked against pain worked. His department was working with the organic chemists and trying to synthesize some kind of a tranquilizer. That's about the same time that Miltown® and Equanil® came out. So they had one they called Nostyn®, which was not strong enough to be called a tranquilizer so they called it a "calmative." [laughter] Anyway, it never did fly very far and very fast, but that was stuff that they were working on. The bacteriology department was working on making the yield better for the fermentation process used to produce citric acid. We were the second-biggest producer of citric acid, next to Pfizer,

in the country. In fact, we were the biggest one with deep-tank fermentation. I don't know if you noticed the big tanks that are out in the background here on this campus, but those tanks—there was one, then two, then four—I don't know, there are probably twenty tanks now, and that was deep-tank fermentation to produce citric acid. Before it was known as molecular biology or molecular engineering, we were having these bugs produce citric acid and calling it fermentation.

So that left us with—what do we do? Since we were biochemists, I mean, since we were in the biochemistry section, we thought, "Well, anything that belongs to assays that are useful in the clinical lab, we should be involved with," and our job was to make it as convenient as possible. For instance, one of the products that we invented was this Ictotest®. This was to detect hepatitis at an early stage, before an unknown carrier could contaminate and spread the disease through a whole bunch of people living in the same area. At that time it was orphanages and things like that. So they were oxidative reactions. There was a Fouchet's reagent that was an iron kind of reaction that turned green, and then we had Dr. Fancher in the organic section who synthesized a couple of diazo-salts for us. That worked beautifully. We had this diazo-reaction where bilirubin would couple with a diazo-salt and give a nice pink or red or orange kind of color. So that was the basis of the Ictotest® tablet. In order to concentrate the bilirubin so you wouldn't have a weak dilution like you had in a test tube test, we had an asbestos mat, or later on some other kind of cellulose mat, that adsorbed the bilirubin. As you put five drops of urine on this little square mat, the urine would soak through and the bilirubin would adsorb to the surface. That gave you a big concentrated area, so you put a little diazo tablet on, added a couple of drops of water, and we had carbonate in there so it fizzed over the edge and gave a little ring of purple or reddish color if the bilirubin was present. So it still is one of the most sensitive procedures for detecting bilirubin. Again, that was for hepatitis because that was endemic at the time. We followed the pattern of "what disease should we detect next?"

Of course, the second thing most often tested for analyte in urine, other than the glucose and ketones for diabetes, is protein for kidney damage. Again, we were working with tablets. There are certain kinds of indicators that give a Sørensen error. [Søren] Sørensen, way back when, discovered this protein error where these indicators would give a pH color change, without a change in pH, if there happened to be protein present. So, you couldn't use this certain bunch of indicators if you were doing anything like testing for protein in something that had to do with body fluid. You couldn't use the pH change in serum, because there was all that protein to interfere. So we turned it around and used that. First of all, we had a tablet test, Albutest®, and again it was a cellulose tablet. It was kind of a fiber tablet with this protein error indicator in it. You'd put a few drops of urine on this tablet, and the urine would sink through, and it was buffered at an acid pH so that if you got an alkaline pH color change from yellow to blue, you'd know that was protein, because you knew the pH was not the color changer. That was fine, but again, it was a tablet test. This was when we first discovered, at least in our minds, the process called "metamerism." That is, some special kinds of color dyes under a fluorescent light are much different than they are under incandescent light. People couldn't do this test unless they had an incandescent light bulb because it wouldn't work under fluorescent light. So about that time is when we came out with the glucose/oxidase test for glucose. This is because we bought the Takamine Laboratories in Clifton, New Jersey, where they made all kinds of

enzymes. One of them was glucose-oxidase, and Al said, "Well, we ought to use our sister division to utilize some of their products, and maybe we can get a test that's specific for glucose." Because with Clinitest® and the other reduction tests, any kind of reducing substance in the urine will give you a color change, not just glucose. There are a lot of drugs that are metabolized into glucuronides, which are strong reducing agents, and so that gave you a "false positive for glucose." Glucose/oxidase and glucose in the present of air will form two end products: hydrogen peroxide and gluconolactone, or gluconic acid. So we had teams set up. Some teams were going to test for peroxide. We were going to test for pH change—to me, it was simple to test the pH to see if the pH became lower. Then that would mean more glucose there. Well, the peroxide team won, because they'd have peroxidase as also a reagent to react with peroxide, and then get a chromogen color change. We used benzidine first, because we didn't know anything about carcinogenicity. I remember, we used to pipette benzidine and benzene, and we never got cancer! None of us ever got cancer. I don't know of anybody that worked in those labs that got cancer. We're all cancer-phobic now.

Anyway, we used this particular system for Clinistix®, we called it a double sequential enzymatic reaction—glucose/oxidase and peroxidase. At about that time, we put it on paper strips. We used to just cut filter paper and dip it into a solution and hang it in the oven to dry, and then dip it in urine and watch the color change if there happened to be glucose in the urine. Then it got to be a little more refined, and I've got a couple of pictures that are out there. There's a picture history out there, which I'll show you, that shows how we had this. When we were in the research lab, we did the research, we did the development, we did the beginning manufacturing. We had to devise tunnel dryers. The people in the development lab did a great job in producing a huge tunnel dryer that would allow mass production of drying these reagent strips. We used to have a card about half the size of an 8.5 x 11-inch paper and we would cut it with a scissors and dip it into this solution and then let it dry. We'd have these cards put in a rack that had slats on two metal rods through the holes in the slats. We would put them here, slap another slat up against it, put another reagent card in there, slap another slat against it, and then tighten those clamps, and then we had this rack of cards that would stick up. Then we'd dip that into a big pan of reagent and send it through the dryer.

BOHNING: It was very labor-intensive.

FREE: Absolutely labor-intensive. Sure. But that's the way the first productions were made. So by that time we were putting different analytical tests in reagent strips. Of course, glucose was the first one and protein was the second.

BOHNING: Could I back up a little bit?

FREE: Sure.

BOHNING: Still back before you went to strips, you moved from all of these different tablet products, and of course, that had to go into some kind of production. You just indicated that you were sort of involved in getting production started. What was the attitude of the company towards A: research, then B: facilitating your discovery, and then putting it out as a product?

FREE: They were all still looking for that wonder drug. We were kind of the stepsisters. As it turned out, Ames never did have a wonder drug, but they sure went hog wild on diagnostics, and that's all Al's fault. [laughter] He was the one that pushed the diagnostics.

BOHNING: So the support was there from the upper levels of the company in terms of keeping your group going?

FREE: Well, since Dr. Compton first invented Clinitest®, yes, we kept it going. Besides, we produced these products in a snap. I mean, it didn't take five years the way it does now to go through all the machinations one has to go through. We produced Acetest® in a hurry; we produced Ictotest® in a hurry. We had Albutest®, and then we got the reagent strips. This was such a novel thing that, as I say, we made our own manufacturing equipment in the Miles machine shop!

BOHNING: What kind of competition did you have prior to getting into the strip part?

FREE: None.

BOHNING: You were it?

FREE: Yes. The competition we had for glucose, Clinistix®, was with TesTape® from Lilly Company [Eli Lilly and Company]. Lilly, of course, is the big insulin producer. In 1954, I think, but I can also give you a better date on that—1954, or 1956, Al and Jack Comer from Lilly both gave papers (3) at the ACS [American Chemical Society] meeting on the same glucose/oxidase kind of test. They used formic acid instead of citric acid the way we did. I suppose we both had the same indicators. I don't remember. But it ended up, we cross-licensed each other because nobody could figure out who was first on the block. Then we just expanded and they quit.

BOHNING: The two groups were working independent of each other?

FREE: Absolutely.

BOHNING: Until the time of the ACS meeting,

FREE: We didn't know. And they didn't know. At least, I suppose they didn't know, anyway.

BOHNING: There are a lot of examples of that in the history of science.

FREE: Oh, yes.

BOHNING: That's an interesting one.

[END OF TAPE, SIDE 2]

BOHNING: What was the reason for moving from tablets to strips?

FREE: I think, again, it was Al who said, "You know, we ought to be able to make this easier and even more convenient than tablets, so no one would have to wash out test tubes and mess around with droppers. So maybe what we could do would be to do it on paper." Because we had just done Ictotest®, where we collected the urine on a filter mat and adsorbed to the surface and actually did the reaction on the surface. So maybe if you impregnate the paper with this reagent and put a drop of urine on it, you'd have it; and it worked. We got a blue color. So, I guess, he said, "Well, instead of doing it that way, we could get rid of the dropper if we just dipped the paper into the urine." That's what started it.

BOHNING: That really was quite a change. I was going to ask what the impact was on that, then, in terms of people you were selling these products to.

FREE: Oh! They said, "This new-fangled stuff! I don't want it. The way grandfather did it, I'll do it the same way!" Med techs would say, "These new-fangled things!" The College of American Pathologists was beginning to produce a quality-control system for laboratories. In fact, quality control for industry, I think began in the clinical laboratories with Dr. Bill [F. William] Sunderman's paper (4) in 1947. [William P.] Belk and Sunderman had this seminal paper in 1947 where they gave some known hemoglobin solutions to different laboratories and

got a wide variety of answers. They first started the idea of having quality control, having knowns, running controls and unknowns, and that's what started all that. With this attention to the fact that it was important to have a good accurate answer all the time, and tests being much more precise than they ever needed to be for some of these conditions, the med techs were saying, "These new-fangled tests—how do I know they're giving the right answer?" The College of American Pathologists had accepted Clinitest® as the way to do urine sugars. So when the "new-fangled" dipsticks came out, they said, "Of course you may use Clinistix®, but we have to confirm it with Clinitest®," which is a much less sensitive kind of test! I mean, they just did it backwards, the whole thing. It took a while before it became acceptable.

BOHNING: That's interesting because I would expect it would be just the reverse of that. That making something simpler for somebody to use would be more acceptable.

FREE: Yes.

BOHNING: The quality control aspect, then—

FREE: That was part of it. But also the "not invented here" kind of thing, because clinical methods were developed by the people in the laboratories to use on their own hospital's specimens. Also, I think another reason is that they were sensitive to their own jobs. This was the beginning of the time when automation came to clinical labs. People said, "You know, pretty soon they can hire high-school kids to come in and I won't have a job." Of course, it didn't turn out to be that way, but that was the feeling and that was the fear. I expect that this had something to do with those dyed-in-the-wool med techs. I remember, "How do you know this is right?" Then the protein test, of course; the reagent strips, with this protein error indicator as the color changer are buffered at pH 2; if the buffer is not there, any pH above 4 (which urine always is) would give a color change. The colors are very difficult to match. The yellow for the negative is not really yellow. It's greenish-yellow. It's difficult to know whether it's greenish-yellow or yellowish-green to get that first change in color blocks. So these med techs would say, "I never get a negative with this test. If I dip it and put it on a white background, it's always green." You're not supposed to do it that way! You're supposed to hold it against the color chart, good lighting, proper timing, and all. We'd say, "Do you match it against the colors?" "Oh, I memorized those colors. I don't need the color chart!" Or, I'll never forget—(we were the technical services people then, too, because we got all the calls)—we'd say, "Well, do you just dip it in briefly and drag it across the urine container to wipe off the last excess urine and match it?" And the answer was: "Oh, no, I swished it around to get that last little bit of protein out of the urine." She was washing the buffer out of the strip, and of course it was going to turn green! They all had their own techniques. Sometimes, to save money, they would cut the reagent strip lengthwise to have reagent areas only one fifth of an inch wide!

BOHNING: In order to promote this, did you need to go out and do it or did you train other people?

FREE: No. We had a sales force. Remember, we were selling Salici-Vess® and Alka-Vess® to physicians, and so this became the detail force that sold the diagnostics, as well; it was the same company. We had marketing people that didn't believe, too. Tom [Thomas C.] Black, from England, was our vice president of marketing when we thought, "Well, as long as people do glucose and protein urine testing on everybody that comes along, let's put the two tests on the same strip." One turned from red to purplish blue, and the other turned from yellow to green. Tom said, "Oh no! They'll get them mixed up!" How are you going to get them mixed up? [laughter] Then, that's when we first discovered that if "Suzie Schlonk in Podunk" can get a wrong answer, she will. She'll find a way! [laughter] But we finally persuaded Tom that it would be better, easier, and they could make a lot more money by putting the two on a strip.

BOHNING: In that video (5) that you sent me, you demonstrated how you originally started putting the two on one strip. That must have been not easy. I mean, it was very time-consuming.

FREE: Yes. Actually, we had a syringe full of this ethyl cellulose, which was the dividing substance. Of course, when we first decided to put two on a strip, we had no concept of how to keep them from reacting with each other. So that's when the ethyl cellulose was used as a barrier between the reagents. Because, about that time, we had used ethyl cellulose to coat the glucose reagent strips for blood glucose, to keep the red cells and the protein from interfering with the color reaction underneath the cellulose layer. We would put a drop of blood on the reagent, and then wash it off with water, and then match it to the color chart. So that ethyl cellulose protected the reagent from being stained by hemoglobin.

BOHNING: Clinistix® was the first one that was introduced in 1956.

FREE: That's right.

BOHNING: If I have my dates correct. Now, I have a whole list of others that followed. Albustix® was the next one?

FREE: Yes.

BOHNING: Do you know what year that was?

FREE: 1957.

BOHNING: Ketostix®?

FREE: Yes, that was 1957, too. That was a neat one—I forgot to do that one when I was doing the film. As I told you, the nitroprusside reaction is what they still use for ketones, and that has to be very alkaline. Nitroprusside is a gorgeous ruby red color solution when you dissolve it. When you put alkali in it, it turns green, so you can't just put all the reagent together and dip strips into it. So the guys were pretty sharp with this. They put ammonium sulfate, which was the alkaline component of Ketostix®, in an aqueous solution and put it through the dryer, and then they dissolved the nitroprusside in an organic solvent and dipped them again and they dried real fast; it just evaporated. So that was the way they figured out how to put these two incompatible things on the same reagent and still keep them stable. It was very clever, a very neat way to do it. So this two-dip modification was used in many of the other compositions, as well.

BOHNING: Uristix®?

FREE: That's the glucose and protein, yes.

BOHNING: I'm looking at a number of different names here. Diastix®. Is that the first one with the two reagents or not?

FREE: No, it was second. Uristix® came first. Then Diastix®. If we can put glucose and protein on the same strip, we can put glucose and ketone together, and the diabetic only has to dip one strip. But clinicians were still under the impression (and it was probably a valid one) that you don't do ketone testing unless you excrete a lot of glucose. Then you're testing for impending ketoacidosis and you can't have just urine ketones if you're a diabetic. If you're on the Atkins Diet, where you eat nothing but fat and protein and lose weight, you metabolize your body fat into ketone bodies. It's a ketogenic diet. So they used Ketostix® to make sure the diet was working. We sold a lot of Ketostix® to people who were Atkins Diet followers. When he first published—that must have been forty years ago or thirty years ago, anyway.

Keto-Diastix® wasn't a very good seller, and so it was discontinued.

BOHNING: Dextrostix®. Now we're up to about 1963. I'm not sure of the timeframe but you said you have something that we can use to sort that all out.

FREE: Yes. Maybe I should tell you about Dextrotest® first.

BOHNING: Yes. I did have that.

FREE: That was an earlier one, right. Dextrotest® was a modification of Clinitest®. Back in those days, whenever you analyzed any blood, you made a protein-free filtrate first. Well, we had—you probably don't have Bumintest® on your list, but the old-fashioned way of testing for protein was a turbidimetric test with sulfosalicylic acid. Well, these Bumintest® tablets were nothing but sulfosalicylic acid with a little fizzy carbonate added to it. It was just an easy way to make a 5 percent sulfosalicylic acid solution. It sold like hot cakes, and all they had to do previously was weight out sulfosal but—by golly, the modern way was to buy your ready-made stuff and dissolve the tablets. So we thought, well, what we can do is de-proteinize blood with sulfosal, make a filtrate, and then react that filtrate with a modified Clinitest®, with a much lower level of cupric sulfate so that you'd get low, normal, and high values, like 100, 150, and 250 ma/Dl. So we had especially designed these little filter-top tubes, which were cute, little things. I still have some around someplace. They were like the Clinitest® tube design, about that same size, except they had a flared funnel top and a one-mL mark. We had little filter paper circles that we put in there. In another tube, we would mix sulfosalicylic acid solution (from a modified Bumintest tablet) with blood and collect the filtrate into the tube I just described. When the filtrate reached the mark, you removed the filter paper and the rest of the glop and added a little cupric-sulfate tablet to that filtrate and it gave a reducing substance kind of test for blood glucose. Well, that was just a little less complicated than doing it in a regular lab so it never flew very far, but it <u>was</u> a way to conveniently measure blood glucose without an external heat source. Of course, then we adapted the urine glucose sticks to the Dextrostix® for blood glucose.

BOHNING: This must have been an incredibly busy time. Well, we're looking at something like ten years, not even ten years. From 1956 to 1963.

FREE: Isn't it amazing?

BOHNING: How many different products did you introduce?

FREE: We had about five or six, because the third one to be added was Combistix®, and it had glucose, protein, and pH, because labs always measured pH. That was pretty neat, too. We

took methyl red and bromphenol blue and mixed the indicators so that you got wonderful color differentiation. It was orange at pH 5, pH 6 was yellow, pH 7 was light green, pH 8 was dark green, and pH 9 was dark blue. With those two indicators it made a great wide span of colors. That's great, except for people who are color-blind. If you have different shades of the same color, people see them because it's gray to them, apparently. But if they're different colors, then they have a more difficult time. Apparently it worked for enough people that it was okay.

BOHNING: Not only was it busy, but it must have been exciting for you and for Al to be able to do all that you accomplished.

FREE: Oh, we had wonderful people. We had Chauncey [O.] Rupe in the lab. He and [Ingrid] Metzler came out with Phenistix® to detect phenylketonuria. Because about that time, Sir Archibald Garrod had described four inborn errors of metabolism—genetic disorders—that if detected early enough, especially with phenylketonuria and galactosemia, you can prevent the kids from becoming mentally retarded if you treat them soon enough. So Phenistix® is a simple ferric chloride on a paper, and it will turn sort of a gray-green-blue color with phenylpyruvic acid, which is the intermediary metabolite of phenylalanine. That's as far as these kids can take that metabolism. Their phenylalanine hydroxylase is missing from their livers or the enzyme is inactive for some reason. If you detect these people before they're a month or two old, after they've ingested protein so they have enough time to <u>form</u> phenylpyruvic acid, if they're going to, you can just take phenylalanine out of their diet and they'll not become mentally retarded. I have a slide that I use of a Sue Ellen Cross. We had a wonderful County Commissioner of Health at that time, Dr. Paul Martin, and he and Al worked together to send Phenistix® home with the mothers of all the kids in our Goshen or Elkhart hospitals. Mothers tested their own babies. Just press this reagent strip against a wet diaper and you get the color of phenylpyruvic acid. We have a lot of Amish people in the surrounding counties as well as Elkhart County. Sue Ellen Cross was born in a hospital about this time. Her older sister had died at the age of twelve and she was just a baby the whole time. Her mother had to change her diapers, feed her, and whatever because she was a phenylketonuric. So with our reagent strips, Dr. Martin found Sue Ellen was also phenylketonuric. We used to do her blood phenylalanine all through her growing up. These kids apparently will develop an alternate pathway to metabolize phenylalanine as they grow older so that you can gradually keep adding proteins to their diet and they still will not become mentally deficient. So when Paul Martin retired, Sue Ellen was about sixteen or seventeen at that time, and she gave him his gold watch and was there at the banquet to say how he saved her from a life of mental retardation and early death.

BOHNING: That's very impressive.

FREE: It was really great.

BOHNING: In making these products, one of the things you had to provide was color charts. That must have been something in itself, to print and produce good color charts on a large scale.

FREE: Oh, absolutely. In South Bend, Mossberg Printing Company developed their techniques for color printing as we developed our need for them. We had something called the "Color Harmony Manual," which was like a paint-chip catalog. These were octagonal in shape with a little tab at the end where you slid them into a slotted page. There'd be a page with this color in the center and then different shades going to paler, and different shades going to darker, and all the chips in between. We chose the closest match to the Color Harmony Manual—a reproducible manual that print shops had. Mossberg came up with wonderful color charts. I remember Acetest® charts were printed with a procedure that makes little dots. Instead of pure color, like a paint, it's a bunch of little dots that were printed, and with enough magnification you could see those little dots. Later on, technology improved and they actually would color with different inks rather than different amounts of dots. But Mossberg was wonderful. We'd run back and forth to South Bend. "This color chart doesn't work as well as it should." They'd fix it so it did. We said our urine products are "quality controlled" with a color chart. The color chart was the standard, because they came out the same all the time. People would say, "Well, how can you control a single unitized test?" That's still a difficult thing. With unitized tests, you test a whole bunch from a batch, you can't possibly unitize control because once you've used it, it's ruined. You can't do it unless you split it in half and people did that, too. They thought they'd save money so they'd cut it in two and make two very narrow strips, a tenth of an inch wide.

BOHNING: What was the size of the strip? Like a litmus paper or something?

FREE: It was one-fifth by one-fifth inch square.

During these times there are different formulations that were improvements on prior formulations so that the manufacturing was changing all the time to better and better products. About the time of Labstix®, which was five tests on a strip, the manufacturing people decided they didn't like to apply reagents between two water impervious barriers on felt paper. So they decided to go to reels of one-fifth-inch wide reagent ribbons, and they had these reels about a couple of feet in diameter. There was a Mylar reel about 6 inches wide, and that was the matrix to attach reagent ribbons. Then they had double-sticky tape a fifth of an inch wide, and so they would peel off one side of the tape and put it through so that the reagent would stick. Then as it got to the end of the line, they'd peel off the other side so it would stick to the Mylar. Eventually, they'd have several reagent reels for multiple reagent strips. It was an impressive manufacturing system, and they're always improving it.

BOHNING: So Labstix® was five?

FREE: Yes.

BOHNING: You went all the way up to ten, you said?

FREE: Yes.

BOHNING: What did you put on ten?

FREE: Here's a sample.

[STRIP SAMPLE HERE]

BOHNING: That's very impressive. This is a current product?

FREE: Isn't that neat? Yes. That's a current product.

BOHNING: I'm amazed that in all of this time—we're talking forty-some years here of development—that these strips are still as popular.

FREE: Urine reagent strips are the backbone of the Diagnostics Division.

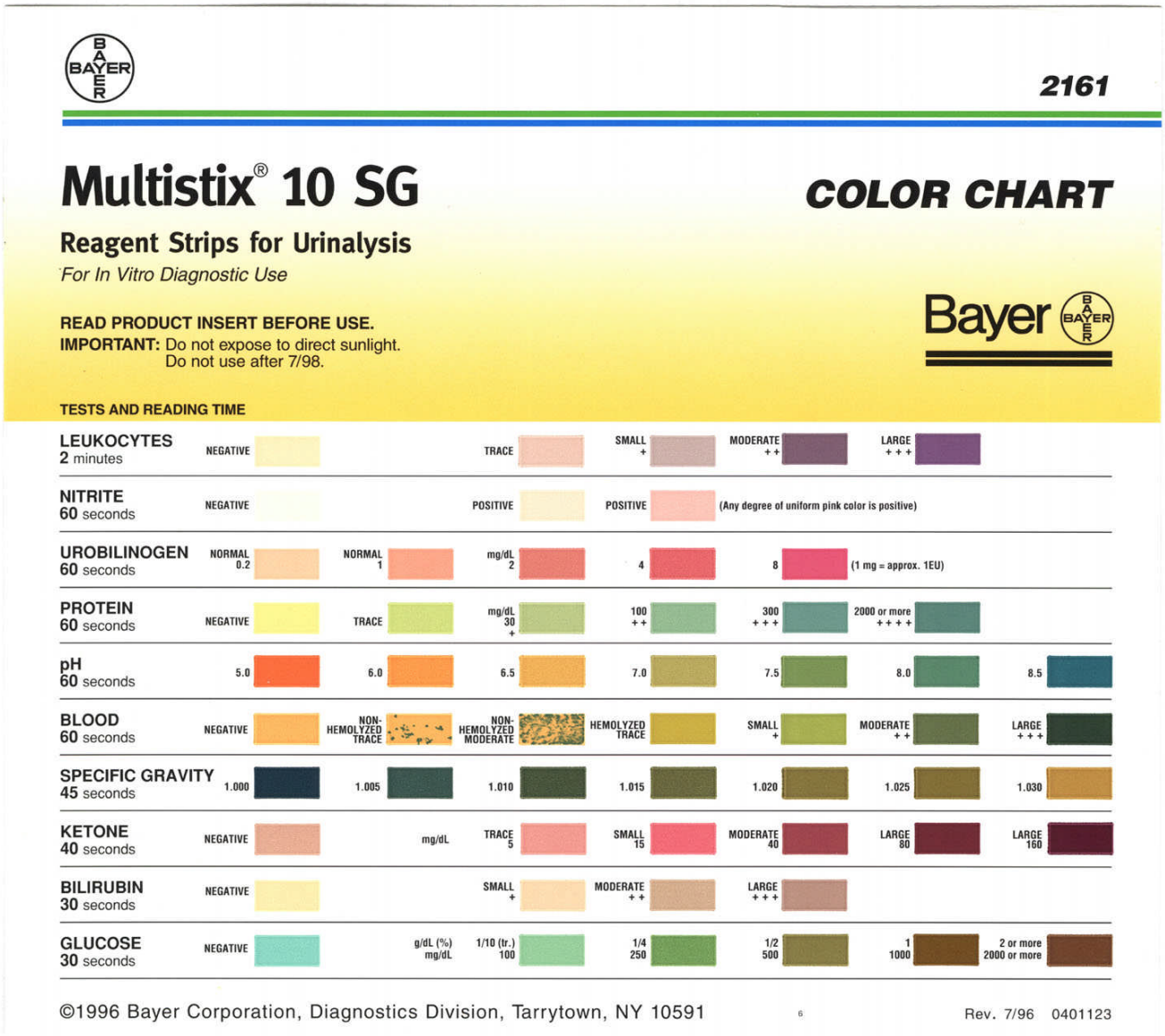
BOHNING: Yes. We need to actually put some of these right in the transcript. If I can have these? Just so that we can visually show what we're talking about.

FREE: Sure. You can have them. They're outdated anyway. They expired February 1998. Those colors are going to change. They're exposed to light. They are packaged in a black, plastic bottle, hermetically sealed, with a desiccant inside to keep them dry. This was another problem. Whenever we added a new reagent to those strips, we had to make sure that it didn't volatilize and cause one of the other reagents to change composition or to change color. We have to make sure that one reagent doesn't wash down on the rest. The way to do the test is to dip it into the urine specimen and drag it across the container so you don't have any drop of urine left on the strip. Then you match each reagent to its color chart. Each one is matched at a special time; first glucose, then bilirubin, then ketone, then specific gravity, then blood, then pH,

then protein, then urobilinogen, then nitrite, and the last is leukocyte esterase. But pH and protein are next to each other; the protein reagent is buffered at pH 2. So if you have an alkaline urine and don't get that last little drop off, and it runs down, it'll wash the acid protein reagent right onto the pH and change it to an acid color (yellow) from an alkaline color (green or blue). So people say, "How come I get this green color, but it's got a yellow stripe in it?" Well, that's where the urine ran down over the reagent—"pH runover," we called it.

BOHNING: Do you think there might be a chance of getting some of those labels to put in the transcript?

FREE: Oh, yes. Sure.



BOHNING: How did your position in the company change with all of these discoveries going on?

FREE: Well, once upon a time, there was a man who was the Vice President of Research and he said, "You know, buried in this Personnel Practices book, it says husbands and wives can't report to one another." So, he made me transfer to the development lab. I worked in the development lab for several years with John Rebar: development scales up the products from the research lab, and transfers them to production. But then our very good friend Charlie [Charles V.] Owens [Jr.] became President of the company and he said, "That's ridiculous." So I got to come back, and worked with Al when he became VP of Technical and Government Services. [laughter]

BOHNING: The Ames name still exists, or did that go with Bayer?

FREE: It went with Bayer. It used to say "Ames" on all the reagent strips, and it used to have our logo and all that, but when Bayer bought the North American Bayer Aspirin trademark from Sterling [Winthrop]—well, from [Eastman] Kodak; no, actually from SmithKline Beecham—then everything became Bayer. Bayer was worldwide. Bayer bought Miles in 1976. But when Bayer bought us, it was particularly because we had a good name in the pharmaceuticals, even though they were over-the-counter pharmaceuticals, and also because Bayer had no diagnostic products. So they bought us and said there'll always be a Miles and there'll always be an Ames. Then in 1992, I think, they said, "We own Miles lock, stock, and barrel, and we're never going to get the Bayer name back in North America, so what we're going to do is change all of North America, all our sites to Miles Incorporated, including MOBAY. Monsanto and Bayer had MOBAY in Pittsburgh, a huge manufacturer of polyurethanes and other plastics and coatings. So everything changed to Miles, Incorporated. I remember I was in Texas giving a talk for the American Chemical Society in Houston, and the people from Baytown—we have a big Bayer plant in Baytown—said, "Will you come over the tell us what the heck Miles, Incorporated is now that we're Miles?" So I had a good time talking to the Baytown group.

[END OF TAPE, SIDE 3]

FREE: Three or four years later, Kodak, who owned Sterling Winthrop over-the-counter products, decided they would concentrate on cameras and film. So they got rid of their over-the-counter products by selling them to SmithKline Beecham, and they sold their diagnostics to Sanofi [Pharmaceuticals, Inc.]. Bayer in Germany was going to Kodak and everybody else who had owned Sterling Winthrop, saying, "What would it take to buy the Bayer Aspirin trademark in North America?" Nobody wanted to sell. So when Kodak sold Bayer Aspirin to SmithKline Beecham in England, then Bayer crossed the channel with their one billion-dollar check in hand

and bought their North American Bayer cross, Bayer trademark, and Bayer name. So it's now Bayer/Bayer all over the world. In fact, Helge Wehmeier, who is the chief honcho in Pittsburgh, wrote us all a letter saying, "We're going to pronounce B-A-Y-E-R the way the locals pronounce it." They weren't about to try to train everybody in the U.S. to say B-E-I-E-R. [laughter] So we're "Bayer," but when we go to the rest of the world, we're "Beier."

BOHNING: I was curious about it. I'm glad you mentioned that, because I was curious about the two pronunciations.

FREE: When we were bought by Bayer, many of us took German lessons. I never did get to use mine, although I did visit Bayer in Leverkusen one time. We actually had Gerhard Stigler, who was a professor of German at St. Mary's, come to Elkhart, and we took classes. I'm very bad at vocabulary, and "dies" and "ders" and "dases" and all that. So I had to give a talk about Den Pflussen and I'd say "Die pflussen," and he'd say, "It's die, not der. Or das, not die." I'd say, "Oh, come on. Won't they just say, 'Doesn't she have a charming American accent?'" He said, "No, Helen. That's not what they'll say!" [laughter]

BOHNING: Somewhere along the line, you managed to get a degree in management from Central Michigan [University].

FREE: Yes, that was part of the time I was in Growth and Development. After I'd come back to Technical Services with Al, I took a job with Jim [James A.] Murphy in the Growth and Development department as New Products Manager. This was a system whereby the New Products manager from Growth and Development—there were three or four of us—would take a project development team who had representatives from Research and Development, Quality Assurance, Manufacturing, Marketing, Medical, and Finance—all forming a team, because Charlie Owens said, "New Product Development is a company-wide thing, not just one department." We in Growth and Development held these Project Team meetings. During that time, the American Society for Medical Technology, who had core groups in various parts of the United States, had a process where you could get an M.A. in Management or in Education. We would collect the thirty hours or thirty-two hours for our master's degree by going to Harrisburg, Pennsylvania for a week and getting this two-hour class done; or we'd go to Denver, Colorado for a long weekend, Thursday through Monday and get an hour or two hours. It was a great way to get a master's degree while employed full-time because the others in the class were all healthcare-oriented people. They were nurses, med techs, or sometimes physicians, and it was a neat way to get a master's degree.

BOHNING: How did you feel about moving into the Growth and Development area, after having been in research all that time?

FREE: Actually, I think they got me from Technical Services, and I thought several times about it because Technical Services was my favorite kind of place. We used all our knowledge that had developed during the years in research and development. We had to answer the questions and all the correspondence, but we also got to train the salespeople on using any new products, and refreshing the District Sales Managers on old products. That was just like being a teacher in a laboratory and it was fun. It was great. The position in Growth and Development, was a promotion, so I took it. But Technical Services was terrific. My favorite bunch. We also used to have urinalysis workshops that we would provide for physician office workers or laboratory people in clinical labs or for medical students. Again, it was a combination of teaching and doing and it had a lot of lab stuff connected with it. I remember once upon a time we had a wonderful Chinese lady, Johan Cheuk, working in our lab with us, in Tech Services, and we held division manager refresher courses. We had about ten or twelve divisions; I think there are about thirty divisions now. Anyway, division sales managers would come into Elkhart for a week or two for these refresher classes, both from a marketing perspective and from our technical part. We used all the products and had a variety of the urines made up to contain various analytes, and they were doing lab tests on these. But anyway, one of the guys was Charlie [Charles] Santari, a little, Italian guy from New York—and he was wonderful—told a story like nobody else could tell stories. He tells this story on himself: we were doing bilirubin tests that day, and Johan had his section of the lab, and he said, "Johan, I need some Harrison strip tests." She said, "Okay. I'll get them for you." She went off and forgot about him. She came by again and he said, "Johan, I said I needed some Harrison strip tests." She says, "I gave them to you." He says, "No, you didn't. See, I don't have any." She says, "Well, I gave them to somebody. You all look alike to me!" [laughter] We just can't feature—this is short little Charlie, and a tall guy next to him. [laughter] But that was a wonderful story! "You all look alike to me!"

BOHNING: At one point you were also the Director of Specialty Test Systems. I'm not sure what that means.

FREE: Well, I'm not sure what it was, either. It was an effort that didn't go very far. This was also under Jim Murphy as Growth and Development Vice President. There were some special kinds of tests that we had that were not marketable through the detail men because it cost too much to sell them. So we were trying to figure out a mail order or some way to market these few tests. Many of them were neonatal test strips. We had several of these. We had the Galactostix®. It was like Clinistix® for glucose, but it was for the sugar, galactose. Ordinarily what people in hospitals do—they still do—is they'll do Clinitest® and Clinistix® on the same urine from a baby, and if they get a positive Clinitest® and negative Clinistix®, they know it's not glucose, but there's some reducing substance there. One out of five hundred thousand times it's galactose, but again, taking lactose away from that baby and feeding him soy milk will prevent the mental retardation, early death, and liver damage that occurs with galactosemics. We couldn't talk most labs into using it routinely so we could make it a routine product. There was another test for Hurler's Syndrome. That's a kind of mental retardation that's detected by

the excretion of chrondroitin sulfate products. It was an azure-blue, impregnated square of filter paper that turned pink when you put a drop of urine on it if there was some kind of chrondroitin product there. There was another one called Fecatest® for occult blood in stools. Without collecting a stool sample and having a mess to test, you just leave the stool in the toilet bowl, and drop this fizzy, Alka-Seltzer®-type tablet in. The fizzing would release the blood from the specimen, and then you'd drop in an envelope or another tablet that contained oxidative chromogen that would turn blue in the presence of blood. It's the second half of that double sequential enzymatic reaction, because blood acts like a peroxidase. Without collecting a stool sample you could test for occult blood, which is a good screening test for bladder cancer and urinary tract cancer, kidney cancer. They said, "Helen, why don't you try to sell these few low-volume products? Do market plans and all." But we eventually decided it wasn't worth even putting just my time in those products.

BOHNING: There was something else that came out, probably a little earlier than the time frame we're at now. But that was the reflectance meter.

FREE: We had an engineering department that said, "You know, if you make these tests consistent enough, we can take these color reactions and measure intensity of color by reflectance spectroscopy." Instead of measuring the intensity of color by passing light through a solution, reflectance spectroscopy measures intensity of a solid surface by measuring reflected light. The instrument directs a beam of light on the reagent strip, and depending on the intensity of color, a little or a lot of light would be reflected onto a photo cell. Reflected light measured would be inversely proportional to the intensity of color, and therefore to the amount of the analyte. This should give a more accurate, more quantitative blood sugar value. The blood-sugar tests are matched against color blocks with 100 or 200 mg. differences up at the top part of the range. Tom [Anton H.] Clemens and his crew developed this meter, about 5 inches by 9 inches by 2 inches, with a lithium battery in it. You would put a Dextrostix® strip in after you had reacted it with a drop of blood and washed it off, and take a reading from the galvanometric scale. If the reading was too high, you'd turn to the next galvanometer scale to get an accurate number. That was the first meter for using reagent strips with reflectance spectroscopy. Then it was developed into Dextrometer®, which was about a fourth that size, and now it's Glucometer® or Glucometer-3®, or Elite®, or Encore®, or Dex®. They all have different names, and they're all getting smaller and smaller and smaller. The newest one is called "Dex" for dextrose. It is an ergonomically created device. Previous meters are rectangular and somewhat bulky things and they read reagent strips. This one has a disk with reagents for ten tests in a wheel pattern. A single reagent will slide partly out of the meter, and by capillary action, will take a tiny amount of blood from a fingertip puncture and display the glucose concentration on the display window without the need for timing or removal of blood from a strip. A lot of times, diabetics will say, "I want to throw that meter against the wall, because I don't want to know that my blood sugar is 297," or whatever it is. But you like to use this one. Bayer spent thirteen million dollars building a manufacturing facility in Mishawaka, Indiana, to make Dex®.

BOHNING: What did the original ones cost? Was this meant for someone to do at home? This was still in the lab setting?

FREE: Oh, no. Lab or a physician's office, yes. Or at the bedside sometimes in the hospital. I have no idea what they cost.

BOHNING: It sounds like they would be expensive.

FREE: It was a lab instrument. Yes.

BOHNING: At least the original ones must have been.

FREE: Yes. Then they got to be working on batteries, and now they're throwaway instruments. When the instrument batteries die, you just throw it away and get a new one. They cost maybe fifty bucks now, but most of the time they give them away, so you buy the products that fit. It was in the early 1980s when all our patents ran out, so Boehringer Mannheim [Biochemicals] came out with a multiple, just like ours. Except they had leukocyte esterase on theirs, and leukocyte esterase in urine is an indication that there's some kind of kidney or bacterial infection, because the white cells are gathered where the white cells secrete the esterase into the urine. But about that time we came out with a specific gravity, so again, we cross-licensed, and we allowed them to use our specific gravity, if they let us use their leukocyte esterase. Al and I worked, and the people in the lab later worked for years trying to get a colormetric specific gravity.

BOHNING: I was going to say, that's not an obvious one.

FREE: Yes, and we'd say, "We know how to do this." The two biggest contributors to the density of urine are sodium chloride and urea. So we'd say, "Urea and urease form ammonia. You can use the color pH indicator." But ion exchange of sodium chloride replaces sodium with hydrogen to form an acid, so they neutralize each other. [laughter] So the people that came after us were smarter than we, and they said, "You don't have to worry about urea. All you need to do is measure the ionic concentration and it follows specific gravity closely enough without urea, so that you can measure within five specific gravity points, .005, and that's good enough." So they use a polyelectrolyte, replace with hydrogen ions, and measure the color that develops with bromthymol blue, which is fantastic! Katie [Katharine] Johnson did that before she retired.

BOHNING: After the specialty test systems, you were the Director of Clinical Laboratory Reagents.

FREE: This is when I was on my way out. They asked me to transfer to the Research Products Division. The Research Products Division was another group that missed the boat, because they had one of the first series of specific enzymes that break up DNA [deoxyriboneucleic acid]. What kind of enzymes? The name escapes me. Everybody knows what they are, but I can't think of them. Transcription enzymes?

BOHNING: Oh, transcriptase.

FREE: Yes. We had a bunch of them, and we never sold them to the right people at the right time, because other people came and got into the market earlier. Well, this was the Research Products Division, and we had a variety of biochemicals—a whole catalog full of products. They made them down in Kankakee, Illinois. One of the mainstays was serum-protein fractions. Fraction 4, Fraction 5, and Fraction 8, and just plain albumin, either bovine albumin or human serum albumin, which were reagents for many different kinds of things in a clinical lab. Then they had another product called "cholesterol concentrate," which they got when they were fractionating for serum albumin. They extracted the cholesterol concentrate out of bovine blood. So they asked me if I'd go over and start a new clinical products line and figure out how to get their products into the clinical lab, because there were still some people in clinical labs who liked to make their own reagents. I thought the cholesterol concentrate was wonderful as a cholesterol control. About that time people started not making their own reagents, and I wasn't very effective in that job. So when they eliminated my job, I took early retirement when they offered it to me. They sold most of the Research Products Division off about that same time. They kept the blood fractionation group going in Kankakee, and I just read on the bulletin board that they sold that a couple weeks ago. This was the Pentex [Protein] group. This particular group was started by two women who were chemists who worked for Armour [Pharmaceuticals]—you know, Armour is in Kankakee—and they said, "Heck, we can fractionate blood fractions just as well on our own as we can at Armour." So they started Pentex. It was these two women and three other people. Their lawyer and two other people each contributed one-fifth of the funding and they started Pentex Protein. Miles bought Pentex from this group. Trudy Dickinson and Jean Thomas were the two women. Jean was marketing director and that's whom I worked for. Trudy Dickinson was the President of this little company, Pentex, in Kankakee. So they were put into the Diagnostics Group and they didn't fit very well into that group and so they sold part of it off. So I retired in 1982, and I've come back every year as a consultant to the Diagnostics Division ever since. [laughter]

BOHNING: I was going to ask, since you still list yourself as a professional relations consultant, what arrangements you had with the company.

FREE: Well, Al calls himself the Senior Scientific Consultant, and they ask us both questions about the different kinds of things in diagnostics that can be answered from the Dark Ages part. I call myself a Professional Relations Consultant. I chose that title when they said, "What do you want us to call you?" Because I'm so deeply involved with the American Chemical Society, the American Association for Clinical Chemistry [AACC], the Association of Clinical Scientists, and Medical Technology groups, I go around and give speeches at all these places and advertise. So I figured "Professional Relations" sounded like I'd be a goodwill ambassador.

BOHNING: I want to talk about some of those activities, too, especially the American Chemical Society. Did Al stay in the research group after you left?

FREE: Oh, no. He was out of the research group before I left. I was still one of those product development people when he retired. He retired not from research but from being Vice President of Technical Services—Technical Services and Scientific Relations. So he had all the "Good Manufacturing Practices," and all the other legal things that he worried about with lawyers. He did a lot of the defense on the patents, as well, when they were challenged by Boehringer or somebody, or when we challenged Boehringer.

BOHNING: As all of this developed, what kind of competition did you have?

FREE: At the beginning we had the glucose competition from Lilly, which faded away pretty fast, because they felt that they were not in the diagnostics business. Lilly is still known for insulin and drugs. Then about the time our patents began to run out, Boehringer Mannheim in Germany came out with very similar products. Theirs are called Chemstrips. They had just the same kind of stuff we did. They made theirs a little differently and they had a web that they covered theirs with that did something special, and they were strong competitors.

BOHNING: I'm going to ask you a question I've asked other people, and I have to be careful how I phrase it. One of the things I've noticed in talking to a number of different scientists is that if they develop something for a company that's a good money maker, the scientists don't often share in the fruits of that labor as the CEOs.

FREE: Of course not. At least I didn't when I worked in the research lab, and Al didn't when he came to work. It was said that what we develop on company time in the company lab belongs to the company. That's what they're hiring us for. For a long time, when Al was director of research, and I don't know how long it lasted after that, we could spend 20 percent of our time working on what we wanted to, as long as it fit the company policy and mission that were established. We had a lot of stuff that was fun to work on. Some of them developed into

products. Most did not. But a lot of them were new uses for old products. We used to have exhibits, scientific exhibits at the Federation meeting, that were shown in a special part of the exhibit area. It was separate. Scientific exhibits were better than all those commercial exhibits. We had a whole slew of new uses for old products. For instance, Clinistix® is a very sensitive detector of glucose. So if you're drilling for oil, you sometimes pour a bunch of water in, and how much water is there, how much oil is there? We figured if you dumped a bunch of glucose in and then pumped it back up, you could tell by the glucose concentration about how much water was there. That was a new use for that. It never went very far. They also used to detect glucose in cutting fluids of metal working companies. Because the bugs would chew up the oil and whatever they used in oiling the cutting fluids, and you could tell by the amount of glucose how much contamination you had and how much oil was disappearing and not doing its job. There were all kinds of things like that we had projects for. We used to do animal work. I remember, we used to squeeze rats at the Federation meeting to get a drop of urine and detect glucose of a diabetic rat, or protein, or whatever, using experimental reagents. Or we could slice the tip of the tail off and get a drop of blood to measure their blood analytes with experimental strips. Because these were really well designed to use just a little bit of specimen, and they were very sensitive so they were very useful in small-animal testing.

[END OF TAPE, SIDE 4]

BOHNING: You've been involved, especially recently, with organizations for women in science. You started out at a time when women weren't in science as much. You've already explained your fascinating story about how you got into science. I want to ask if you have any comments to make about your experiences and how you can use those experiences to help women today in science.

FREE: Well, it's kind of different because, as I said, I got into science because there weren't any men available to go into science. So then after I was in, it was no problem whatsoever. People asked, "Well, did you ever face sexual harassment or anything like that?" I said, "Either it never happened, or I was too dumb to recognize it if it did." I think back then, you know, people were used to having men pat you on the shoulder and slap you on the rear as you went by, and it didn't make any difference. If it bothered you, you said, "Don't do that," and they didn't do that. I don't know that I ever heard the term until many years after I started working, but it wasn't a big thing. It was a man's world, sure, but I felt worse about being married to the boss and working for the boss, because I thought maybe I'd get some anti-stuff there, but the people around me were very grand. Of course, Al bent over backwards not to show partiality. I tell people, I worked for a company—where my husband was my boss—that made tests that were done on blood, urine, tears, spinal fluid, and stools, and I got all the shitty experiments to do! [laughter] Because I <u>did</u> work on the tests for occult blood in stool. Other people did, too, but, that's the story. Again, I don't read people very well, so if they were angry with me, I didn't notice. Which is probably a good thing!

BOHNING: Do you feel that throughout your career at Miles—I guess I can call it Miles—that you were treated fairly by the people you worked for and the company?

FREE: Oh, absolutely.

BOHNING: Were there a number of other women here at the time, too? You've mentioned a number of names.

FREE: Yes, there were. I don't suppose we ever had a group that had more women than men in it, but there were significant numbers of women who were graduate degree people who worked in the labs. Yes. Nobody ever became a vice president. I kept thinking, I knew I'd never get to be president, but I thought maybe I'd get to be vice president some time, but I never did. In fact, when Al retired in the Technical Services, as Vice President of Technical Services, and they appointed his successor, who was his assistant, Brad Hager, I kept saying, "Well, did you ever consider me for that job?" They said, "Yes, but you don't have a Ph.D. and you can't sign Ph.D. after your name when you write those letters from Technical Services." At least that was the excuse they gave me, anyway. It was a perfectly valid excuse to have. Perfectly valid reason. Al still keeps saying, "You ought to go back and get a Ph.D." But there's no reason to anymore!

BOHNING: Had you thought early on about doing that?

FREE: Yes. It never crossed my mind when I graduated from college. My dad kept saying, "Don't you want to be a doctor?" He wanted to brag about his daughter the doctor. No! I just wanted to be a chemist.

BOHNING: Now, you're active, I guess, still today in a number of programs that involve women. You were at least involved in the Association for Women in Science Mentoring Program.

FREE: I didn't do very much on that, though. They wanted me to be part of the investigator committee and I didn't have time to do that. So I just was a kind of advisor and I didn't do a very good job at that. But they have developed a very good mentoring program, women mentoring women. I was on the Advisory Committee for the group at Dartmouth College. Dartmouth has the WISP [Women in Science Project] program. I met with them a couple of times. They had some good people on that committee. They had Millie [Mildred S.] Dresselhaus, the physicist from MIT [Massachusetts Institute of Technology], and they had Mae

[C.] Jemison, the astronaut. She's the astronaut that now is the spokesperson for Bayer in the U.S. She comes around. She's been here to one of these sites. She does a good job with kids. I mean, she's a woman, she's black, she's a physician, she's an astronaut, and you just can't beat that credibility. She came to visit one of our fourth-grade schools with a lot of black kids, saying, oh, she's an astronaut and all that, and she starts out by asking the kids, "Well, what kind of chemistry did you use today?" She gets them first thing in the morning. They say, "Chemistry? We don't use it." "Well, didn't you brush your teeth? Didn't you take a bath?" [laughter] And right there, she's got them—right where chemistry meets their everyday life.

BOHNING: Well, maybe at this point we could talk about your experiences with the American Chemical Society. You were president of the Society in 1993, if I have my dates correct.

FREE: Yes. That's correct.

BOHNING: You, of course, before that had been active at all kinds of different levels within the Society. Why did you want to become president of the ACS?

FREE: It just kind of fell into my lap. I never dreamed of being president of the American Chemical Society. It was not in my list of things I wanted. In fact, I don't think I ever really planned any of these moves. It isn't as though you say, "These are my goals," because it just happened along the line. I happened to be at the right place at the right time. One of the things that I had done was to be active in my local American Chemical Society section, which was, back in those days, centered at the University of Notre Dame, where most of the professors kind of said, "Well, we'll let those Miles Laboratory scientists join." We were the second-class bunch. If I wanted to be secretary, that's fine, I could be secretary as long as I wanted to because that was a lot of work. In fact, Milton Burton, who was a radiation chemist there, used to say, first of all when they built the new rad lab, he said, "They're debating whether to call it 'Milton's Hilton' or 'Burton's Sher[a]ton.'" [laughter] But he made kind of—maybe this was harassment, I don't know—but he used to say, "Helen, I don't recognize you if you're not pregnant!" [laughter] Because during my pregnancies was the time I was the secretary of the local section. They figured I'd been secretary for so long a time, I had done that job, so maybe I deserved to move on up to be chairman. Then once you move up to be chairman, you get to be councilor, and then you get to go to all the national meetings. I actually followed Dr. Ernest [L.] Eliel, who was a professor at Notre Dame at that time. He was secretary and then I became secretary. He was elected to the chairmanship; I was elected to the chairmanship. He became councilor. When he went to the University of North Carolina, I became the councilor. He became president of the ACS; I became president of the ACS. So I said, "What are you going to do next now, Ernie? President of the U.S.?" It just happened that I followed in those same footsteps during that time.

When you're a member of Council, they ask what kind of committees you want to be on because there are about forty-five different committees of the Council that are made up of only councilors. You can't be on those committees unless you're a councilor. I was on the Women Chemists Committee, and I chaired that for several years, and was an advisor to them afterwards. I was interested in public relations. I guess that's been one of my goals, to get the whole world to understand that they can't get along without chemistry, and that they shouldn't think of chemistry as the polluter and the bad stuff that happens, but think of all the wonderful things that chemistry has given them to make their daily lives better. Otis Fancher, who used to be head of the Miles Organic Chemistry Section, when we visited him in Arizona after he retired and we'd retired, said he thinks that people are healthier, wealthier, better organized, and have more convenient lives, all because of chemistry. But if it weren't for chemistry, none of those things would have happened. The idea of having people on the street recognize chemistry for the good stuff it does is public outreach. So I wanted to be on the public relations committee. You don't have to be a councilor to be on the public relations committee, but I chaired it when I was on the Council anyway. We actually had Dick [Richard] Moore, who was the public relations person for some big company, and kind of a public relations person for the Chemists' Club, on our committee. But they wanted to do things in a more formal way, and I wanted to do it informally, just go talk to people, talk to your neighbor. As John [Kistler] Crum once said in a comment column (6) for American Chemical Society's *Chemical and Engineering News*, "If every one of our one hundred fifty thousand people (or one hundred thirty-five thousand—how ever many we had) talked to one person and told them and convinced them that chemistry was great, that would be half a million, and then if each of them—that would be a million. Pretty soon everybody would know." But it just doesn't work that way. It isn't that easy. I still think that talking to the people beside you on the airplane, talking to your neighbors, to the garden club, the Lions Club, the PTA, and people like that, about how great the contributions of chemistry have been, it would be an eye-opener. I always start my speeches to those people—I talked to Al's Lions Club one time. I said, "I'm a chemist and I'm sick and tired of being the one that's blamed for all the bad things that happen, when all the good things like medicine, and this, this, and that are also the results of chemistry." I guess I made them feel all ashamed. A couple of them came up and said, "I understand. You know, my wife's on this kind of medicine, and I know that's something chemical." [laughter]

I tell people that an easy way to do this is to write a letter to the editor when they do something good, bragging about chemistry. For instance, we're on the mainstream of Amtrak, it used to be New York Central, and all these freight trains are made up down at our Robert Young Yards, and they go both ways—hundreds of freight cars. Well, they had one car that was leaking hydrochloric acid. Instead of having a big panic and big headlines about "Big Hydrochloric Acid Spill," what they did was call the hazard team in. They found out it was hydrochloric, and they evacuated people two or three blocks away until they got it under control, they plugged the leak, they took care of the stuff that was spilled, and they did a great job. So you write to the mayor and you write a letter to the editor saying, "Isn't that terrific that they didn't cause this panic? They knew what to do because they asked chemists to help them overcome this and did a good job." So that's the kind of thing that we have to be more aware of and do more of. And we don't. There are so many things that <u>could</u> happen to make people

understand how important chemistry is that don't happen. But National Chemistry Week and the International Chemistry Celebration are going to take care of some of that, I hope.

BOHNING: One of the things that I've been struck by is, if you go into a bookstore and you go to the science section, you'll find books written for the general public by physicists, mathematicians, and biologists, but it's pretty hard to find one written by a chemist.

FREE: There's one that [Benjamin Klaus] Selinger from Australia wrote called *Chemistry in the Market Place* (7).

BOHNING: Yes.

FREE: But you're right. Maybe that's what I should do in my next retirement—write a book for the public.

BOHNING: Philip Ball wrote one, a former editor of *Nature*, but he didn't even want to use the word "chemistry." He called it *Engineering the Elements* (8) or something, but he sort of stayed away from the word "chemistry."

FREE: I know. Which defeats the purpose of getting chemistry out there so that people would know. Philip who?

BOHNING: Ball. I have a copy of the book. I think it's called *Engineering the Elements*. I'm not sure if that's one of the chapters or if that's the title of the book. He was a former editor of *Nature*, and actually the book isn't bad, but he tried to avoid the use of the word "chemistry."

FREE: [laughter] I think [Isaac] Asimov was a good chemist to have put chemistry before the public—of course, he did his in science fiction as well as strict chemistry.

BOHNING: I have a copy of his *Intelligent Man's Guide to Science* (9). I think that's what it's called. He wrote it many years ago. It's three volumes. It's very, very interesting. It was written specifically for the general public.

You indicated earlier, when we were talking about the ACS, that you said you sort of fell into the presidency. I wonder if you could elaborate on that a little?

FREE: Well, I was on the nomination-elections committee for a long time, and I knew the process and all that. They have a kind of unwritten system, whereby they alternate between an academician and an industrial chemist. These people are running against each other, not academic versus industrial person. Because if you did that, the academicians would win all the time because the industry people don't vote, although they are 60 percent of the membership. They're not the active governance kind of people. I guess one year all the industrialists on their list said "No," and they finally got to me. [laughter] But I had been on the Board of Directors, I was known to the people on the committees, and I was known to the people on the staff, and so I guess they put me on. So I said, "Who? Me? Okay!" It was a great experience. I ran against Hank [Henry F.] Whalen, who was another great guy. He's now the Vice President of Development for PQ Labs [PQ Corporation], a specialty chemical organization in Philadelphia. Our election ballot was a landmark event, because neither one of us has a Ph.D. Whoever would have won that election would have been the first non-Ph.D. to be president of the ACS. I didn't have my honorary degrees then, either. As soon as I got it, Justin Colatt, who was the secretary of the Society said, "Hey, I hear you got a Doctor of Science degree. Do you want to be called 'Doctor' now?" I said, "Well, I don't care. What difference does it make?" "Oh, a lot of difference! I'll put down 'Doctor.'" [laughter] I was kind of bragging before that I didn't have one.

BOHNING: I never thought about that. What kind of agenda did you set for yourself as the president of the Society?

FREE: I had four goals, one of which was the public outreach, the important one. One was to get more girls interested in chemistry. Another was to get more of the members active. I said, "During my time, in the three year track of president-elect, president, and immediate past-president, I want to have at least 10 percent of the members do something for the ACS. Do something besides go to meetings and read *Chemical and Engineering News*. Do something proactive." So this was when we started the Volunteers in Public Outreach Program, which I'm glad to say now has about eighteen thousand members, which is more than 10 percent. I kept saying, whenever I talked about it, "When you think of 10 percent of the members, that's not very much. That's not a big percentage of people who belong to a society who are really active in it." Yet it was a hard goal to reach because it was a large number of people. We're trying to get one hundred seventy-five thousand members by the year 2001. So far they're going to have one hundred sixty-five thousand by the end of next year, and one hundred seventy-five thousand at the end, I hope.

BOHNING: Is it true—and I heard this somewhere—that the membership of the ACS is only about half the chemists in the country?

FREE: I would expect that's right. Yes.

BOHNING: That always struck me as being amazing because you would think as a chemist, you'd at least want to be associated with a professional society of some kind.

FREE: Well, chemists, chemical engineers, and of course the engineers have the American Institute of Chemical Engineers—the AIChE. There are a lot of people who belong to both, but a lot of engineers prefer just the engineering society because they think of the ACS as that old, fuddy-duddy academic bunch, and the governance is mostly made up of that fuddy-duddy, old academic bunch.

BOHNING: You indicated this earlier and said that while the industrial people are the majority, they're still not active. Is there any reason why they're not active?

FREE: Well, a lot of them say they join just to put it on their resume. A lot of them say, "But my boss won't let me go to national meetings, unless I'm giving a paper. I can't give papers because I don't want to reveal the secrets." They have a lot of great excuses like that. That is changing. In fact, with the public outreach programs to the schools, a lot of the volunteers are more likely to be from industry because there are lots of industries that have recognized they should support that. For instance, Bayer has the Bayer Science Forum, which was the Miles Science Forum before Bayer bought us, which is a great group of volunteer scientists who get their bosses' permission to do this, and they go out once or twice a year to talk to a class. They've gone a step further and they have what is called an "Adopt a Scientist Program" where a class can say, "Yes, we want to adopt a scientist, and we want that scientist to come back every two weeks for the whole class year." They get to know this person, and the person gets to know the kids in the class, and they develop a good rapport and have a lot of fun teaching science at the same time. Then they have "Magic with Miles." We are a great source for judging science fairs. The Science Fair program in Elkhart is very good. Some of them start in kindergarten. I judged one little boy who was a kindergartner. His father was an engineer. He had this little rotating windmill that was run by solar power, and he had all these things he put together. He had a solar cell from a little calculator, and a light source, and he put all the connections, and he'd just stand there and watch that thing go around. [laughter] It was wonderful.

BOHNING: What about the International Chemistry Celebration? You certainly have been the driving force behind that.

FREE: Yes, but I think we started to drive too soon. [laughter] We were all real excited about it the first couple of years, and then we said, "It's not coming for five more years!" [laughter] So it really dragged for a while. Now it's picking up steam. It goes from this November to next

November's National Chemistry Week, and it's going to peak at National Science and Technology Week in April when the National Science Foundation is going to have a lot of stuff for science, chemistry, and engineering at their week. We've got these four really special projects that have really taken off. We have at the ACS the National Historic Chemical Landmark program, and we have about five of these international groups that we have this year. In fact, the first one was SmithKline Beecham's Tagamet, which was in England and in New York at roughly the same time. It's already been, so it's our first international. We have one coming up this week in India, which is to honor Raman spectroscopy in Calcutta and Bombay, and that's just India. We have one coming up—Ed [Edel] Wasserman, who is the 1999 president—it's his baby and he's got it in Heidelberg, where German chemist [Hermann] Staudinger was, and also in the U.S. at DuPont [E.I. de Nemours and Co., Inc.]. We had one lined up to do rayon, but we can't figure out where to do it in England, and so we're not going to do that one, probably. But we're thinking of penicillin in England and here. There's one coming up in France for [Antoine-Laurent] Lavoisier, and there's another one, which I can't think of. But those are the international ones because Ed Wasserman has called his presidency the International Chemical Enterprise Year. Then we have the Global Salute to Polymers, which is a local section-oriented project, or an outside-of-the-country chemical society-oriented project. They choose a polymer, and we give them a polymer plaque in which they can insert their parchment "dedicated to this polymer because of" whatever. Those are supposed to be community parties where the community gets involved with knowing how important this polymer, this chemical, is to their own economy. We have several polymer salutes that have been done already in the U.S. One at the University of Michigan. Ned [D.] Heindel has the first polymer in space; it came through a Lehigh [University] group. Some of those are being planned for a variety of places. We had a National Historic Chemical Landmark in Akron, about rubber, and it was great because it had the five rubber companies, and they just couldn't decide where to put the plaque so we've got one in each of the rubber companies, but the main one is at the University of Akron. So, we've got a bunch of landmarks and global salutes that are coming up. These projects have really taken off.

The other thing is the World of Color, which we call our "unifying event" for kids. The polymer salute is more for adults in the community. The project for kids is picking a plant, a leaf, a seed, a nut, a root, that's got color, and we're going to try to get the whole spectrum of colors that kids extract from plants. Then when they dye a swatch of material, they send it in and we're going to make a collage of that. But we're also going to have a series of experiments to do, like: What happens if you put vinegar on this dye? What happens if you wash it? What happens if you bleach it? What kind of properties does this dye that you found in your back yard have? The World of Color experiments are translated into, I think, twelve or fifteen different languages already. In the spring we're going to send these to whoever or wherever they want them in the whole world so they can start putting the colors that they have found on the global map that will be produced.

[END OF TAPE, SIDE 5]

FREE: Then the last one is something that we do all the time anyway and that is to develop a contact, a connection with somebody who works somewhere else in the world as a chemist. You can compare research, you can compare economies—this can be students who have gone to school here and gone back to their country, or they can be people from other countries who you have met at an international meeting. We're trying to get a lot of person-to-person contacts going and hopefully they'll last for a long, long time after the international year is over. We had a tough time trying to figure out a unifying event, like light-sticks around the world, where, you know, if they hold hands, you could have light-sticks around the world—fireworks. We still may do the fireworks, somehow. Something that you can record from a satellite somehow.

BOHNING: In addition to your activities at the ACS, you've also been involved with the Clinical Chemists, and I don't know that much about that organization, but could you tell me something about their activities there?

FREE: It's about one-tenth as big as the American Chemical Society, and these are people who work either in the diagnostic industry in their research labs, or are marketers or whatever, as well as those who work in clinical laboratories in a hospital or urgent care centers, or even physicians' offices. That group of people is the most regulated group of people in the world <u>because</u> it's so easy to control the lab in a hospital. As I say, the U.S. started quality control in the clinical laboratory. It has expanded to the nth degree. There's legislation called "The Clinical Laboratory Improvement Act of 1967" and then 1988. But those particular Acts were directed right at the laboratory, at the rules and the things that you could or could not do, and things that you had to do. They have clinical laboratory control specimens that they send out four times a year that any registered laboratory—and all laboratories have to be registered and have to test and report results. You can be registered as a lab that does waivered tests only, which are the easy-to-do ones; urinalysis is a waivered test. There are lots of borderline ones, which they don't know where to put. Then there are some, two grades of that higher-than-that regulation for those who do clinical chemistry blood tests. Then some others that do Pap smears and cytology that require even <u>more</u> kinds of legislation. The clinical chemistry group is the biggest, I think, of the clinical laboratory groups. The med techs stole our thunder because they are now called the American Society of Clinical Laboratory Scientists, and that's what the AACC should have changed their name to, because they're really laboratorians and not necessarily chemists. Someday the artificial designations of microbiologists, hematologists, chemists, those that look through microscopes: cytologists and coagulation scientists—they're all going to be laboratorians some day because they're doing a lot of cross-training. Besides that, the companies are producing instruments that are not necessarily dedicated to one of those special areas. They call their newspaper *Clinical Laboratory News* now instead of *Clinical Chemistry News*.

I tried to get them involved in public outreach; they have Medical Laboratory Week in April, and I said, "This is a good chance to get out and change the public's impression of what you do," because they always say, "Nobody knows who we are. We're back in the lab. Or they call us the 'vampires' because we're the ones that go out and draw blood." I did try to get them

to get involved with public outreach activities, and they are, to some extent, with this Medical Laboratory Week, but not nearly as sustained and as consistent and committed as the American Chemical Society has been.

BOHNING: Well, public outreach requires a commitment of time and energy as well as money.

FREE: Absolutely.

BOHNING: You sort of have to find the people who want to do it.

FREE: Yes, exactly.

BOHNING: That's another thing I might just mention here, that you can comment on because my experience has been that I've met a number of chemists who really aren't interested in dealing with the public or dealing with the perception of their profession at all.

FREE: No. They want to talk to each other, and they're great at talking to each other. When they do talk to anybody else, they use the same words, and it goes right over people's heads. This is true, I think, in more instances in the academic area than it is in the industrial area.

BOHNING: Well, industrial people, I think, are acclimated to—you know, they are selling a product.

FREE: Yes, stand up for your research.

BOHNING: You have to be able to communicate enough to convince others.

FREE: That's right. [laughter]

BOHNING: Whereas academic people really don't have to convince anybody else.

FREE: No. They're the experts and "If you don't take what I tell you as the truth, that's your problem, not mine."

BOHNING: I also wanted to talk to you about your family. I know that you have nine children, and I've forgotten the number of grandchildren, and one great-grandchild I think I saw somewhere.

FREE: Right!

BOHNING: One of the things that I'm curious about is how many of your children may have followed your and Al's footsteps to being scientists or not.

FREE: Would you believe hardly any! Al had three before I married him, so the three oldest are his. But they're mine now. Their mother has since died. His oldest son is a protein Ph.D. chemist, retired recently from Bristol Myers Squibb. Of our six, two of the girls, the oldest and the youngest, said that they wanted to go to medical school. So they got to organic chemistry and changed their minds. Both of them! Well, let me go through our six, and tell you what they are, because if I don't do it in order, I get them mixed up. Our oldest son is a 7th grade schoolteacher.

BOHNING: His name?

FREE: That's Eric [Free]. He teaches English, as a matter of fact, or "language arts" they call it now. Eric teaches 7th grade, and he's a big, two-hundred-and-some pounder, who also has coached football. Now he's coaching girls' volleyball and basketball. But having the coach teach language arts is really neat, instead of driver's ed or whatever they usually teach. So he's a good role model for 7th grade boys.

Our oldest daughter is Penny [Burke]. She's in Arizona and now is a Vice President of Human Resources for the Terros Corporation, which is a non-profit, mental-health agency. She's always been one that's gone out to save the world. She graduated from Miami University, Al's alma mater, with a major in English and art. Then she got a master's in creative arts therapy, and then she went to Atlanta University and got a Master of Social Work. She said, "I know what it's like to be a minority!" [laughter] Then she got an MBA after that. So she says, "I could have had a Ph.D. with all those master's degrees!" But the Terros Corporation is a group that goes out and works with the homeless and the street people. They do AIDS education, they do emergency calls, they work in the poorest, worst part of town, and luckily she just directs those people. She doesn't have to do any of that anymore. But that's Penny. She was one of the ones who was going to go to medical school.

Then I have Kurt [Free], who is a marketer and he's with the good, old mobile home/recreational-vehicle industry; Elkhart/Goshen is the center of the world for manufactured housing, RVs, and the industries they need to support this manufacturing. He works for a company that makes different parts and pieces that go into that kind of manufacture.

The next one is James Jacob [Free], better known as Jake, who, when he got to junior high school, had his brother Eric for a teacher, and he's the one who said, "I'd like to be called Jake, if you don't mind. Don't call me James." He dances to a different drummer. He has his own business, quote, called Creative Enterprises, and he designs parts for boats and RVs. He has a degree in fine arts from the industrial engineering department at Purdue [University]. He designs and makes things; he has a wonderfully aerodynamically designed cap for the back of a truck, which he has for his Volkswagen and he designed one for Al's Ford Ranger. Nobody else has since bought one! [laughter] But he's got the mold for it. Then he also does parts like running boards, dashboards, and propellers. He actually has a propeller that's called a variable prop propeller, or something like that. He's got a patent or two on a latch that's very difficult to open and easy to shut or something. He does the design of a bunch of things that he makes with glass fiber and epoxies and all that. He is big on human-powered vehicles like boats—he has human-powered (bicycle-type powered) hydrofoils he has "flown."

Bonnie [Free] is a lawyer. I mean, she has a law degree, but she works as a financial analyst for the Ayco Corporation in Dallas, Texas. She went to Southern Methodist [University] for college and for law school, and is a confirmed Texan. I ask, "Bonnie, what do you <u>do</u>?" She says, "Well, I help these executives from a bunch of different companies plan their retirement. I don't recommend any stocks or anything like that, but I give them the basics about financial planning and I teach classes like that." I say, "Bonnie, you're the one who overdrew your bank account every month for seven years! How can you do this?" She tells me, "It's different, Mom, when the numbers are bigger and it's somebody else's money!" [laughter]

Then Nina [Lovejoy] is the baby. She's Al's ninth. That's why she's called Nina. She was the marketing manager for the Sutter Corporation, which makes continuous passive motion devices. If you have arthroscopy on your knee, you put your leg in this gadget and it bends and straightens your leg. Well, they moved to Phoenix from San Diego, which is where she lives, and they wanted her to come, and she said, "I thought about it, but Dave wouldn't go." That's her husband. So she—for six months, she just had a baby that was a year old in June, and the year before last, for six months after that baby was born, from September through March of last year, she commuted with that baby back and forth between San Diego and Phoenix. She would leave San Diego on Monday night, go to her sister's in Phoenix and stay with Penny for three days, and on Thursday night, she would take the baby and go back to San Diego and spent Friday through Monday in San Diego. For six months she did that. They wanted her to keep doing it. First she said three months, and then she just agreed for three more, and they wanted her to keep doing it, and she said, "No, thank you. I'm not going to do that." So she has just accepted a job with Nova Corporation, which makes up polyacrylamide gel for electrophoresis, and she has a marketing position with them. I'm not sure what it is, but a week after she was hired, they sent her to Heidelberg, where they had just bought another German company, to

integrate their products with these products. She said, "Mom, I was reading everything I could about electrophoresis!" [laughter] But anyway, she's real happy, and she was the other one that was going to go to medical school. So both of them are kind of in the medical science field, but they're certainly not M.D.'s.

BOHNING: Well, I appreciate that. The reason I asked that question is that a number of people—of all the people I've interviewed, it's been very rare to find children who have gone into science.

FREE: I told Al. I said, "I think we made a mistake, because we bent over backwards to try not to influence them, and we bent over too far the other way, I think."

BOHNING: The one exception I can think of is Jerome and Isabella Karle. They have three daughters and all three daughters are scientists.

FREE: That's wonderful. That's great.

BOHNING: They're the only people I've talked to that I've found that. Well, we've talked about your activities with women's organizations, the ACS presidency, the Clinical Chemists. The National Registry in Clinical Chemistry—is that run by the Clinical Chemists or is that separate?

FREE: It's kind of run by a variety of different groups who contribute to its existence, and they're going to come up on hard times next year. The Registry is for those chemists who wish to take the examination and belong to the Registry because they've passed the test. First of all, the AACC is a branch off, a spin-off from the ACS. They used to be part of the ACS, and have their meetings on Friday afternoon where the last speaker would have the previous speaker and the moderator as his only audience on Friday afternoon! Anyway, they broke off and formed the AACC. The ACS, the AACC, the American Institute of Chemists, and there are two or three other smaller organizations who also donate a pittance of money to run this thing. The American Chemical Society has furnished them with an office, so they're the big contributor to it. As I say, NRCC does this examination for clinical chemists. A couple of years ago, they were asked to see what they could do about instituting a registry for analytical chemists, particularly those involved with environmental chemistry and also health officers from various industries. So they have both of those programs up and running now. They have a couple of other minor sponsors, but they're fishing around for money to keep going. They're doing pretty well at getting people to pay for their registration but it's a long hard haul.

BOHNING: Is this registration required anywhere?

FREE: No, it isn't. That's the problem. It'd be great if it were. It ought to be helpful. The environmental chemists that I talk to say, "You know, we have to fill out forms, and they have to be signed by a PE (a professional engineer)." So if we could get this to have as much credibility as that, it would be good for us chemists because we ought to be able to sign off on whatever these papers are. But it's not required, and so being a voluntary thing makes it a difficult thing to administer.

BOHNING: Well, I've sort of come to the end of my questions and I know you're coming to end of your voice. But is there anything that I haven't covered that you feel you'd like to discuss?

FREE: I brought this pen and pad in so I could write notes, and see if there was anything I wanted to say. All I did was copy the names of those two books down you gave me, and, say, I'm going to send you a Hall of Fame brochure. I don't know if you'd be interested in any slides or any materials that I have from the talk I gave at the Hall of Fame, which described some of the diagnostic things. You probably don't want visual aids.

BOHNING: Well, we've collected those in the past from people. If they're available, why, that would be nice.

FREE: Probably everything I had there is also on the videotape that you already have.

BOHNING: All right. I did look at the tape.

FREE: That was a fun thing to do.

BOHNING: Well, it was nice because you interspersed it with a number pictures of the buildings and those things. That's one of the reasons we don't videotape these interviews.

FREE: Because you have two talking heads, or whatever, right?

BOHNING: Exactly. You may remember the old ACS Eminent Chemists series.

FREE: I interviewed Rosalyn [Sussman] Yalow for that.

BOHNING: Oh, yes. But many of them were done in professional studios where people weren't relaxed—because I've watched them, and people seem more uptight or tense.

FREE: On camera, yes!

BOHNING: In all the times I've been doing this, we've not done any video interviews because there are usually visuals available, pictures of the people are available. We'd much rather get this kind of information that we've gotten today. Well, if there's nothing else you want to add at this point—

FREE: I was trying to think what else I could show you. We can go out and look at the display out there in the lobby. Again, I think that any pictures I have, or anything like that that I could have used, you wouldn't need anyway, because you've got the live stuff.

BOHNING: All right. Well, I appreciate your spending the time with me today and especially in view of the fact that you've barely recovered your voice and I probably helped to have you lose some of it again.

FREE: That's okay.

BOHNING: But I certainly appreciate your time and I enjoyed talking to you.

FREE: Well, I've enjoyed having you here. Thank you very much for coming, Jim.

BOHNING: It's my pleasure.

[END OF TAPE, SIDE 6]

[END OF INTERVIEW]

NOTES

1. William C. Cray, *Miles 1884-1984: A Centennial History* (Engelwood Cliffs, NJ: Prentice-Hall, Inc., 1984).

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