THE BECKMAN CENTER FOR THE HISTORY OF CHEMISTRY

RAY H. BOUNDY

Transcript of an Interview
conducted by

James J. Bohning

at

Higgins Lake, Michigan

on

21 August 1986

Ray H. Boundy

THE BECKMAN CENTER FOR THE HISTORY OF CHEMISTRY

Oral History Program

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(Revised 20 February 1989)

Chemical Heritage Foundation
Oral History Program
315 Chestnut Street
Philadelphia, Pennsylvania 19106

RAY H. BOUNDY

1903 Born in Brave, Pennsylvania on 10 January

Education

1924 B.S., chemistry, Grove City College
1926 B.S., chemical engineering, Case Institute of Technology
1930 M.S., chemical engineering, Case Institute of Technology

Professional Experience

Dow Chemical Company

1926-1930 Scientist, Physics Laboratory
1930-1942 Assistant Director, Physics Laboratory
1942-1950 Assistant to the President
1950-1968 Vice-President and Director of Research
1968- Consultant, Management of Research and Development

Honors

1947 Honorary Sc.D., Grove City College
1964 Medal, Industrial Research Institute
1965 Scroll Award, National Association of Manufacturers
1967 Member, National Academy of Engineering

ABSTRACT

Ray Boundy describes his family background in western Pennsylvania, his schooling and his college studies at Grove City College. He then studied chemical engineering at Case Institute of Technology where there was a strong interection with the Dow Chemical Company. Before Boundy had completed his degree at Case he had met Herbert Dow who offered a position in the Midland laboratories. Starting in the analytical laboratory, Ray Boundy moved to the productive physics group headed by John Grebe. After describing his involvement with early Dow projects, such as the seawater bromine process, sodium electrical conductors, electrolytic chlorine production and applications for ferric chloride, Boundy briefly reviews the work on styrene polymerization, monomer purity and wartime production. At the end of hostilities in the European sector Boundy joined one of the teams of experts sent over to assess the German chemical industry. Postwar, Boundy had responsibility for plastics at Dow before his promotion to research director. In conclusion, he reflects on the changing nature of research direction in the chemical industry.

INTERVIEWER

James J. Bohning holds the B.S., M.S., and Ph.D. degrees in chemistry, and has been a member of the chemistry faculty at Wilkes College since 1959. He was chair of the Chemistry Department for sixteen years, and was appointed chair of the Department of Earth and Environmental Sciences in 1988. He has been associated with the development and management of the oral history program at the Beckman Center since 1985, and was elected Chair of the Division of the History of Chemistry of the American Chemical Society for 1987.

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INTERVIEWER: James J. Bohning

LOCATION: Higgins Lake, Michigan

DATE: 21 August 1986

BOHNING: Dr. Boundy, you were born on 10 January 1903 in Brave, Pennsylvania. Can you tell me something about your parents, their names and their occupations?

BOUNDY: My father was second generation American and of English stock, therefore it wasn't too unusual that he was called George Washington Boundy. [laughter] My mother was Annette Cather.

BOHNING: What did your father do?

BOUNDY: My father was oil well worker who worked in the oil fields all through Pennsylvania and West Virginia for maybe 15 years, and then his father left him a farm in western Pennsylvania so the whole family moved there. Dad tried to make a go of the farm but he wasn't a farmer. The farm was too small; finally he failed completely and went back to the oil fields. He got to be a drilling contractor and finally he started drilling wells on his own, for gas primarily, and selling it to the big companies. Then he was injured in an automobile accident when he was taking me to school back in 1925 and he never did recover. He broke his back but he did have his interests in these oil wells so he managed quite well [financially].

BOHNING: Was he already past the farming stage at the time that you were growing up?

BOUNDY: About the middle of World War I, he moved back into West Virginia but we still stayed on the farm, and went to school from there. Then the farm failed and he started moving back into the oil and gas business. First as a driller, then as a contractor and finally as organizer of wells where he would sell a part interest in the well. He would own maybe half of it for the drilling and the contracting and so on. That's where he really established a little money.

BOHNING: Brave is a little town...

BOUNDY: It's a crossroads on the border between Pennsylvania and West Virginia; we lived there for about two years. I don't remember any of this. The very first thing I remember is when we had moved to Blacksville, West Virginia, which is only about 10 miles from Brave. My father had gone fishing, spearing, and had brought back quite a few fish. I was a wide-eyed two year old kid watching him. When he cleaned the fish there was a little fish inside the big fish, so I had my first lesson in ecology way back then -- how big fish eat little fish and so on. [laughter]

BOHNING: Where did you have your early schooling?

BOUNDY: This was all in western Pennsylvania. We lived in Pine Township, about three and a half miles from Grove City. I went to a little one-room school. In order to get into high school from a one-room school, you had to take an examination in seventh grade. I skipped the eighth grade and went to high school, also in Grove City, Pennsylvania. My brothers and I walked the three and half miles and back. Finally we had bicycles and we rode them back and forth.

BOHNING: Was the farm up there in Grove City?

BOUNDY: Yes, that was in Pine Township, three and a half miles from school. Right near this one-room school. Cranberry School in Pine Township.

BOHNING: Do you remember the name of the teacher you had? I guess you had the same person for all those grades?

BOUNDY: We had probably half a dozen teachers, who stayed for one or two years. Vella McCain was the one that I remember that probably had more influence on me than the others. I don't quite remember the other teachers. I enjoyed the one-room school -- to be able to sit and hear the eighth graders recite, and the seventh graders, and the sixth graders -- that was a real benefit to me. I enjoyed it and it was a great way to go to school.

BOHNING: You learned a great deal more than if you had just been...

BOUNDY: Very much more, very much more.

BOHNING: You say Vella McCain had an influence on you? In what

way do you remember her?

BOUNDY: Here's a good way to tell you how much. I made a mistake one day when she asked me a question and I answered "mother". That's what she was to me -- a second mother. She was there the longest too, two or three years.

BOHNING: I'm sure you didn't have any exposure to science at that time, did you?

BOUNDY: No, except up front near the teacher's desk, there was an encyclopedia, and if you had free time you were welcome to go up and pick out a book and sit at your desk and read it. So I did quite a bit of that. She had an encyclopedia and a set of books on the Civil War. Both of them I read from one end to the other.

BOHNING: When you got into high school, you skipped eighth grade. That would have been 1917. The First World War was just about over...

BOUNDY: My oldest brother enlisted in 1918, I think. He was just in for a short time and then the war was over.

BOHNING: What did you do in high school, did you get any exposure to science?

BOUNDY: I had chemistry and math and algebra. I took a commercial course in high school. I had typing and shorthand, and all that, bookkeeping, and all that sort of a thing.

BOHNING: Was there a reason for selecting the commercial course?

BOUNDY: Only that I thought I might use it. I didn't have any idea at that time of being a chemist or anything like that. However, about that time, my brother and I got interested in amateur radio and we had a Ford spark coil and a galena detector receiver set. I've often thought many times how many amateur radio specialists, or just hobbyists, there were at that time, and everyone of us had a galena or silicon detector; we were looking right at the transistor, right in the eye, and none of us fell for it.

BOHNING: Talking to Bill Goggin yesterday I learned that he was also involved in amateur radio at about the same time as you.

BOUNDY: My brother continued with it. He worked for the Storer Broadcasting Company for many, many years. But I didn't [go so far]. I did continue the hobby in Grove City College. At the time I finished high school, and for the first couple of years in college, I had taken a correspondence course from the National Radio Institute and had got my first class commercial operator's license, and had a job on a boat. That's what I was going to do after I finished college. My chemistry professor changed my mind; also a scholarship to Case changed my mind.

BOHNING: That's very interesting. Before we get to Grove City, were there any high school teachers that influenced you in any way?

BOUNDY: Not particularly. I can remember some I disliked, [laughter], but I don't remember any of them that influenced me. Maybe my chemistry professor, because I did like chemistry, and it was easy for me. He did recommend me to Pitt [University of Pittsburgh] as well as a couple of other schools and Grove City. Money was the big factor at that time and Grove City was close so that I really had no choice. I enjoyed it there and besides that they had the first commercial broadcasting company -- WSAJ. They made the first broadcast and my brother and I both worked in the physics department with the broadcasting station (WSAJ) and also the amateur radio session, which was 8YV. We both spent quite a bit of time, nights and weekends, running their sessions.

BOHNING: When did you decide to go to college? You took a commercial course so you probably didn't have college in mind when you started at Grove City high school?

BOUNDY: No, I didn't but I don't recall exactly why I decided to go to college. It just seemed to be the thing to do. My mother influenced me greatly. She was a very intelligent woman. She had taken algebra and a couple of science courses in high school and she encouraged all of us boys to really get down to study and be busy. She was the one who encouraged us to go to college, Dad didn't object but he didn't do the encouraging, like she did.

BOHNING: You said earlier that you were the third boy, did your other brothers go to Grove City ahead of you?

BOUNDY: The oldest one enlisted and he never went to college. There were five of us, after him and we all went to Grove City College. Our kid sister, who was four years younger than any of us, also went to Grove City College.

BOHNING: Do you remember what the costs were at that time?

BOUNDY: I don't remember exactly, but about $200.

BOHNING: Did you have a scholarship?

BOUNDY: Not to Grove City, but we lived at home. By then we had moved from the farm into Grove City itself, so when we went to college, we only had a mile to walk or ride our bicycles to the college.

BOHNING: You said you worked at the radio station. Did you have any other jobs to help support your expenses?

BOUNDY: Oh, yes. I had a summer job all through the last couple of years of high school. First as a roustabout and then as a tool dresser in the oil and gas fields with my dad. That was the first thing I did. Then I worked some evenings, and also one summer with the Bessemer Gas Company in Grove City. Also, I worked for the Brain Construction Company; we called them the Brain Destruction Company. They built houses, small factories and things like that. I worked every summer and earned money. With my scholarship that was all I needed to go to college, even to go to Case.

BOHNING: What courses did you first take when you started at Grove City? Did you start as a chemistry major?

BOUNDY: For the first two years there I just took their academic college course. I did have both chemistry and physics the first two years, and math.

BOHNING: Can you tell me something about the chemistry department when you were there?

BOUNDY: Otto J. Sieplein, a Case graduate, was head of the chemistry department. A man by the name of C. J. Hoyt, a wonderful teacher, taught physical chemistry when I was there. Later on he was head of the chemistry department. These two people both had a great deal to do with my liking chemistry and taking it up later on.

BOHNING: What did Sieplein teach?

BOUNDY: He taught organic chemistry and general chemistry and either qualitative or quantitative analysis. He also taught food chemistry, we had a course in food chemistry.

BOHNING: That's unusual.

BOUNDY: Yes, for a college that size, it was unusual.

BOHNING: Were they the only two chemistry department faculty at the time?

BOUNDY: Yes, only two.

BOHNING: What were their laboratory facilities like?

BOUNDY: They were downstairs in what was called the main administration building. Today they would be considered very unsafe and very primitive laboratories. But they had all the facilities; we had qualitative and quantitative analysis, an organic chemistry laboratory, a general chemistry laboratory and all those things. They were all in the basement of the general administration building.

BOHNING: Were there many other chemistry majors?

BOUNDY: I can think of four, and some of them were either one year ahead of me or one year behind me.

BOHNING: Do you remember how many students there were at Grove City at that time?

BOUNDY: About 600. Pretty close to that.

BOHNING: That would have been 1920-24.

BOUNDY: 1924. I finished at Grove City and was offered a scholarship [to Case], which really determined that I was going to take chemistry rather than radio!

BOHNING: You had indicated that you were going to be a radio operator on a ship, that was one thing you were looking at. Then

by your junior year, you really got to like chemistry. Were there other schools that you were looking at, or was it just that Case had given you a scholarship?

BOUNDY: Just that Case had given me a scholarship, and the head of the chemistry department at Grove City was a Case graduate, and he influenced me to go there too. I'm sure he had something to do with getting the scholarship also. I did not consider other schools very much.

BOHNING: Pittsburgh wasn't very far away, and so...

BOUNDY: No, Pittsburgh wasn't too far away. My brother, who was also interested in radio, did take electrical engineering at Carnegie Tech, as it was called at that time.

BOHNING: You entered Case in 1924. Did you get another bachelor's degree from Case?

BOUNDY: Yes. Chemistry at Grove City and chemical engineering at Case.

BOHNING: I see.

BOUNDY: Between the two schools, I had enough academic work to cover my master's degree, so I wrote a thesis on automatic control in the chemical industry. That was the thesis I wrote in 1930 to get my master's degree from Case.

BOHNING: You were already at Dow.

BOUNDY: Yes.

BOHNING: I wanted to talk about that, but let's go back to your early days at Case. Do you remember any of the faculty? Of course Veazey is a person you interacted with?

BOUNDY: Yes, and [A. W.] Smith. Dr. Smith was still teaching at that time, and besides Dr. Veazey, there was Dr. Prutton.

BOHNING: Both of whom eventually came to Dow.

BOUNDY: Yes, and they were very much tied into Dow and interested in Dow too, even when they were teaching. Dr. Smith was; his sons, I think there were two or three of them, started this oil substitute company in Cleveland. Can't think of the name of it right now.

BOHNING: What courses did you take and why did you move into chemical engineering? You said you got a degree in chemical engineering at Case.

BOUNDY: Primarily because of my teachers. At Case, chemical engineering was not the kind of a course you have today. You took all your chemistry courses in the chemistry department. You went to the electrical engineering department and took courses there, you went to the metallurgical department, and so on. You got a nice introduction to courses in different areas. The chemistry department really taught industrial chemistry.

BOHNING: What were their facilities like at the time you were there?

BOUNDY: They had quite good facilities, for that time and period. A chemical building with laboratories on several floors, kind of mixed in with the classrooms. Very good facilities, I would say.

BOHNING: The scholarship that you had, did you have to do anything for it? Did you have to do any student teaching?

BOUNDY: No, I didn't have to do anything for it. It was the Grasselli Chemical Company in Cleveland. Later it was [bought up by] Du Pont. I remember the Grasselli fellowship was $600.

BOHNING: That covered your...

BOUNDY: That covered my tuition, and part of my living expenses. [laughter]

BOHNING: Where did you stay while you were in Cleveland?

BOUNDY: I didn't belong to a fraternity there, so I didn't have a fraternity house. I did belong to the chemical fraternity, Alpha Chi Sigma, but I stayed in private boarding houses, usually with two or three others. There were well-known lodgings for students, within walking distance of the college.

BOHNING: Were there other Grove City students at Case while you were there?

BOUNDY: No. Another Grove City student followed me. He also had the same fellowship that I did. If I remember right, ahead of me was a Grove City man, Dr. Kendall was his name. He was several years ahead of me, probably five or six years ahead of me, but he also was from Grove City College and also had a scholarship at Case. Dr. Sieplein took care of the students he thought would make good chemists or chemical engineers.

BOHNING: You said you had enough academic work between what you had at Grove City and at Case to get a master's degree. The master's degree didn't come till 1930, when you were already at Dow.

BOUNDY: I should have told you about this while we were talking about Grove City. My doctor's degree is an honorary degree and is from Grove City College.

BOHNING: You came to Dow in 1926 and your master's degree is in 1930 and I wasn't clear how you got a degree while you were already out here at Dow.

BOUNDY: That was a conventional thing to do at Case, especially if you had gone four years to another school and had enough academic credits for a master's degree. You could work for a few years and write a thesis on work you were doing at your job. In my case, this was automatic control as that was what I was doing in the physics lab at Dow. This was quite a unusual route then.

BOHNING: I see. So you were actually using your industrial work as a topic for your thesis.

BOUNDY: That's right. The academic work was amassed because one had a total of six years at school.

BOHNING: That's very interesting. I hadn't realized that was possible. Did you have anyone at Dow who was acting as a coordinator with writing this thesis for Case?

BOUNDY: John Grebe, who ran the physics laboratory at Dow, was a Case graduate. In my junior year at Case, our chemistry professor, Dr. Veazey, explained the thesis of this young

physicist. He had evolved a method of detecting certain chemical elements by the time and the voltage required to liberate them from solution. He plotted these data on a chart to use as a method of chemical analysis. Dr. Veazey explained it to us and said that this might be a method for automatic control of some chemical processes. That's how I first heard about Grebe. In my senior year, Dr. Veazey had a note from H. H. Dow, asking for two athletic students, to lift and drop sandbags during a lecture he was going to give on the use of high-boiling, organic chemicals to improve the generation of power. Dr. Veazey picked Ormond Barstow because he was from Midland, and picked me because I was his friend and we were doing a thesis together. Neither one of us was particularly athletic, and we found we could not generate a horsepower for three minutes. We just couldn't do it by lifting sandbags, it wasn't possible. Two athletic football players might have been able to do it but we could not. We convinced Herbert Dow that half a horsepower would be satisfactory. [laughter] So we lifted and dropped sandbags during that period. We inadvertently demonstrated Newton's third law of motion. About the time we finished our demonstration, our ordeal I should say, the bellhop rushed into the room, this was in the Hollander Hotel in Cleveland, Ohio, and said, "You're knocking the plaster off the room below!" For every action there's an equal and opposite reaction! [laughter] Anyhow, that's how I got acquainted with Herbert Dow. I heard his lecture and I got to know him a little bit. In any event between Ormond and Dr. Veazey's influence I was offered a job at Dow Chemical [at that lecture] in Cleveland. Incidentally, of the four job offers that I had when I finished at Case, three were because of my radio hobby. These three were Westinghouse, RCA, and General Electric; as a chemist but because I was interested in radio. The only honest to God offer in the chemical industry was with the Dow Chemical Company. So naturally I took the job.

BOHNING: Had you been out searching for jobs when you were finishing up at Case? Were you actively looking for jobs or were the faculty pointing you towards...

BOUNDY: I was offered these four jobs and they just kind of came. The faculty must have had something to do with it because the job offers did come to me. I turned down the first three because it was not exactly what I wanted. I wanted to get into the chemical industry. Dow was the only chemical plant that offered me a job. That was 1926.

BOHNING: So you came to Midland in July 1926?

BOUNDY: That's right. Soon after I graduated.

BOHNING: What was your first assignment?

BOUNDY: I was in the main analytical laboratory. That was characteristic of the Dow Chemical Company too. Everybody went to the main analytical laboratory to start.

[END OF TAPE, SIDE 1]

BOUNDY: I was in the main analytical laboratory for about six months.

BOHNING: What kind of work were you doing there?

BOUNDY: Analytical work, primarily on magnesium alloys. One incident that might be interesting. While I was in the main analytical laboratory analyzing magnesium alloys, I had a bottle what was supposed to be sodium hydroxide. It was labeled, it had a Baker label on it and I don't know how it got contaminated. Anyhow, it turned out to be sodium cyanide rather than sodium hydroxide. I found that out in my work and in my analysis. I think that was when I was first noticed at the Dow Chemical Company; that I was somebody who was curious and was observant. Because I did find this out, did notice it, and didn't get myself killed. [laughter]

BOHNING: Do you remember the analytical procedures you were following? I read somewhere that you were analyzing six elements which took about a week?

BOUNDY: Yes. I don't remember what they all were but there was manganese in the magnesium, aluminum in the magnesium, iron; I don't remember what the others were. But there were about six different elements that we were analyzing for. I did other analytical work too, that the sample grabber would bring from the plant and we'd have to run them in the daytime and sometimes I worked nights. That was a hurry-up job. You had to do that right now because he had to call the plant back. I don't remember what the procedures were.

BOHNING: Can you tell me something about H. H. Dow? You didn't go through that student training program. That came after.

BOUNDY: No, that came afterward. Herbert Dow was a Case graduate, and he was interested in Case graduates. Early in the history of the Dow Chemical Company practically everybody he hired was from Case. It was very usual for him to do that. I can't think of how to describe him precisely. He was a very conservation-minded man. I remember one little story about him.

This was when Grebe was with him, Grebe told me this story. They were walking out of the hotel room in Cleveland. It was when John was with H. H. Dow and they were giving this talk on high-boiling organic compounds. John was behind H. H. Dow as they walked out of the room and John forgot to turn out the light. Dow turned around, switched off the light and then he gave John a five-minute lecture on the poor miners who had to hew the coal to make the power and here John was wasting it. He was a very, very conservation-minded individual.

He was perhaps almost as much interested in the generation of power as he was in chemistry. He was very much interested in it. Basically, the Dow Chemical Company, until a few years ago at least, has always been very power generation-minded. They generated their own power for their electrolytic processes. Well, here's another little story. The old bromine plant was right next to the main office. At that time Herbert Dow visited every plant in Midland every week. Once a week he'd get through all the units. This old bromine plant was right near the office so the manager, Glenn Cantwell, saw Herbert Dow come out and he knew he was going to go through his plant first. He didn't have time to arrange anything except he walked in to the lunchroom, which he knew Herbert Dow would have to come through to get to the rest of the plant, and all he had time to do was to arrange all of the lunch pails in a nice, regular manner. Sure enough, the next day Glenn Cantwell got a note from Dow complementing him on the fact that his lunchroom was in such good order and all the dinner pails were lined up in military fashion! [laughter]

He noticed things like that. I guess the important point I wanted to make was that he visited every laboratory and every plant at least once a week. It wasn't a big plant at that point, there were only 1500 employees, so it wasn't a huge plant. Nevertheless, he did get out to see it and he did know all of us. Another thing which he did which I think pointed out some of his character. We worked Saturday mornings; incidentally, we had a 45 hour week. With new employees, he would schedule a trip through the plant, and he would personally take all the new employees, which may have only been a handful, but he would take them all through the whole plant from one end to the other and explain what was going on, what was happening in every section, and he did this over and over again, Saturday after Saturday.

BOHNING: Sounds like the forerunner of that student training program.

BOUNDY: It was a forerunner, I'm glad you mentioned that. It was, it certainly was.

BOHNING: Did he take a personal interest in you? Did he talk to you about what you were doing, the analyses in the lab?

BOUNDY: He talked to me, but he talked to everybody, not to me anymore than anybody else. Dow always came in with a bunch of

ideas and he'd try them out on Grebe. Just another little story I think might be worth telling. Herbert Dow had lots of ideas, most of them good ideas, and he'd come and talk to John about them. One day Herbert Dow came in and I was sitting right close by, we were all crowded in one little room. He tried an idea out on John which I thought not up to Herbert Dow's usual standard of good ideas. Anyway, John was enthusiastic about it and he promised to look it up and think about it; that he'd call him and tell him what he thought about it. When Herbert Dow left I said to John, "What in the world made you so enthusiastic about this idea? It seemed impossible to me" He gave me a five minute lecture: "First of all, an idea is God's greatest gift to humanity. Without it we'd still be in the dark ages. Whenever you hear an idea, don't be negative about it, be positive. Tomorrow is soon enough to judge, so try to do it this way." I've remembered that all my life and I've tried to do that all my life. This was Grebe all over. If you want a profile of John Grebe, that is my introduction to him. Enthusiasm plus ideas; encouraging everybody to have ideas and not ever being negative about them at first hearing.

BOHNING: That's interesting. You were in that main lab for only a short time.

BOUNDY: Yes.

BOHNING: Did you know when you went to Dow that you'd end up in the physics lab?

BOUNDY: No. I had no idea.

BOHNING: When they offered you the job did they say what they had in mind for you?

BOUNDY: No, not at all. Grebe borrowed me for two days to help him take data on Dowtherm, which was a high boiling organic compound that was intended to improve electrical generation. He borrowed me for two days to help him take data. I didn't realize it then, but I'm sure now, that he did that to get to know me and to decide whether he wanted me in his group. The two days grew into two years, which grew into almost twenty and so forth. That's how I moved out from the main lab to John Grebe. I was the only one in the lab besides two lab assistants. John had already introduced two different automatic control or sensing devices. These technicians were supposed to go around each day and check these devices and to do that sort of thing. I was the first professional graduate to work with Grebe.

BOHNING: That occurred in 1926? I've forgotten when Grebe came to Dow but it wasn't much before...

BOUNDY: 1924.

BOHNING: When you were measuring those properties of Dowtherm, you said that Grebe had borrowed you. How long a project did that turn out to be? Was it just short term?

BOUNDY: It wasn't just short term. Actually, I took the data in the pilot plant. It was characteristic of Dow at that time to build and operate a pilot plant early in a development and then go back to the lab and work out any problems that turned up. I was given the job of measuring specific heats, at a whole bunch of different temperatures, the explosive limits, and few other things like that. This took me perhaps, most of the first year I worked for Grebe, 18 months at Dow. This also explains a little bit more about Herbert Dow. John Grebe was sent to Germany. When Grebe came to the United States, he came alone as an immigrant and worked for his uncle in Cleveland. During the period when...

[interruption by telephone call]

I was telling the story about Herbert Dow and John Grebe. Grebe had left his large family in Germany. About six months after I went to the physics lab, he took a leave of absence to visit his family in Germany and to arrange to bring them back to the United States. In the meantime, he left me with the problem of measuring the specific heat of Dowtherm [diphenyl oxide] in different temperature ranges. To do that I needed a couple of resistance thermometers, which we had ordered from Leeds and Northrup before John left. Herbert Dow called me about a week after John had left for Germany and said, "How are you coming along with your specific heat measurements?" He was that interested in things like that. I told him we had ordered the resistance thermometers about ten days ago but we hadn't heard from the suppliers. Herbert Dow said that ten days is much too long a wait for something like that. "You get on the phone and call them and find out when they're going to ship the order." Believe it or not, this was the first time I had ever had an occasion to use a long distance telephone. Remember, this is 1926. I went to the purchasing department and got permission to talk to Leeds and Northrup. I knew enough to do that. When Herbert Dow called first thing the next morning to find out what had happened, I was able to tell him they had been shipped and they were on their way, and we'd have them soon. He was that interested in everything that was going on.

BOHNING: That's amazing because in an operation that size...

BOUNDY: Yes, he had so much to do.

BOHNING: What kind of a person was Grebe to work for in the beginning when you started with him in the lab?

BOUNDY: Very easy. He gave you all kinds of "accountable" freedom, not freedom to go and waste your time, but what he called accountable freedom. With that, and if you were working on something of interest to the Dow Chemical Company, even though it was for something which might be good only in ten or twenty years time, he encouraged you. He just simply encouraged it enthusiastically. In order to encourage people to do more of it, he originated what he called the "idea card" system. Everybody in the lab had these cards; if you had an idea, no matter how wild it was, you filled in the card, you dated it, made it a record, and then, this is the most interesting thing, you posted it on the bulletin board, which he had made especially for this, for everybody to see, for everybody to make suggestions, to help you out, to improve it or do something with it. This was his idea card system and it's so characteristic of John Grebe.

BOHNING: I had not heard about that before, that's interesting.

BOUNDY: It's a very interesting thing and I don't know of any place else that it has ever been used either. It must have been but this was my only contact with it.

BOHNING: Would he follow up on those too? You didn't give them to him to post, you posted them directly on the board?

BOUNDY: Yes. Anybody who had an idea posted them directly on the board, without giving them to him. He would look at the board every day and see what was new and what was going on. He always encouraged ideas and if you were discouraged and you couldn't make something work, he had sixteen more ideas to try. He was so easy to talk to, and so enthusiastic about everything, that everybody talked with him, everybody in the lab liked him. I guess in some of the other labs it wasn't quite that way.

BOHNING: I was going to ask you whether you had any kind of regular meetings to discuss what you were doing.

BOUNDY: We did have regular meetings once a month. We had what Grebe called a seminar, where he encouraged everybody to come. Herbert Dow and Willard Dow used to come to some of these

meetings. We would review them in writing -- these were written reports at that time. Then, every other month we'd have oral reports, which were just exclusively for the lab personnel themselves, and they could exchange ideas and talk about them, make fun of them, or anything else they wanted to. The formal meetings every other month were for the plant production people and the other research heads and for Dr. Dow and Willard Dow if they wanted to come. But we did have these formal meetings as well as informal ones.

BOHNING: You did some early work on the distillation of tetraethyl lead?

BOUNDY: For Dr. Britton in the organic lab. He also borrowed me before John. He borrowed me for a few days to help him out on the distillation of tetraethyl lead, on which he was doing some work for Du Pont at that time. I was there busy at the desk running a distillation of tetraethyl lead which Dr. Britton had told me how to do -- how to set it up and everything. I was sitting right close to the distillation flask and Dr. Britton came along and said, "Well, this material has been known to explode, so maybe you'd better stand back a few feet." He hadn't walked fifteen feet away when boom! The whole thing went up and everybody in the lab had to evacuate. Nobody was hurt but white fumes filled the lab; of course, it was tetraethyl lead and was poisonous. Everybody got out of the lab and they had to stay out for half a day. The next day Dr. Britton sent me back to the main lab. [laughter] That was my experience as an organic chemist!

BOHNING: Was this a common way of doing that? They would come into the main lab and pull people out?

BOUNDY: I learned much later that that was a very common way but I did not realize it at the time.

BOHNING: And this is how they determined which ones they wanted to move into their new...

BOUNDY: Exactly. It was rather a good system.

BOHNING: When did you start working on bromine? I guess that was a little later, wasn't it?

BOUNDY: A little later but not very much. There weren't many in the lab, probably a dozen by that time. Sea water bromine.

BOHNING: Can you tell me something about your experiences with that?

BOUNDY: Yes. John Grebe came to me and said that Du Pont were very much interested in large quantities of bromine. At Dow we had already agreed to double the number of brine wells to produce bromine for tetraethyl lead, and for ethylene dibromide to use in ethyl fluid. At the same time, Du Pont knew and Dow also knew that they couldn't possibly get this much bromine from the brine wells; it was too expensive to do it that way. Du Pont was interested in making bromine from sea water and they had already devised a system which used aniline. They freed the bromine, added aniline to make tribromoaniline, which was an insoluble material, filtered it and either used it as an additive rather than ethylene dibromide or else used it as a source of bromine to make the dibromide. They had outfitted a ship which they called the "Good Ship Ethyl" and taken it out to the ocean. But it was an expensive process and the tribromoaniline was difficult to filter so the losses were very high, and the project was a failure. They came to Dow to ask about making bromine. H. H. Dow got interested right away in making it from sea water. Barstow's group in the Dow Chemical Company were responsible for the bromine work, but for some reason or another, they weren't able to free the bromine. It just didn't work. They got a little bromine and then it disappeared. So John Grebe came to me and said, "Look, what they're forgetting is that there's a little bit of alkalinity in the ocean. There's probably sodium carbonate or bicarbonate and you have to acidify this first before you can possibly free the bromine, otherwise it'll make sodium bromate and it won't be volatile." He said, "Run a titration curve on ocean water and see what it looks like." Sure enough, it had a pH of about 6, and when you titrated it with acid and then it went down to 3. John said, "Acidify it to a pH of 3 then chlorinate it and see if you can free the bromine." Well, sure enough, first you get a flash of iodine and then you get the bromine color. That's all there was to it and that was John's invention. The method of controlling the acidity and the method of controlling the subsequent chlorination, so you get good efficiency, was the contribution of the physics lab to the sea water bromine process.

BOHNING: Those were the controls that you used for your master's thesis?

BOUNDY: Actually, my master's thesis was on the theory of automatic control, starting with dampening control and anticipatory control and all those sorts of things. Grebe and Herbert Dow's interests at that time were very much along those lines.

BOHNING: How long did that take to work out? What period of time?

BOUNDY: Maybe three months. Then of course, after the plant was built, the physics lab people went down and worked in the plant, actually put in the control instruments and stayed there to operate them. Then, a little later in the sea water bromine process, a chap by the name of George Hooker came up with the conventional method. First you blow the bromine out with air, then you react it with sodium carbonate to make sodium bromide in another absorption tower. Then you introduce more chlorine to get the bromine concentrated. George Hooker came up with the idea of burning sulfur to SO_2, introducing that into the blowing-out air, which was very dilute in bromine, thus making a combination of sulfuric acid, which you could then recycle to acidify the sea water, and HBr, which was volatile. This would save one whole step in the process. This was also was a physics lab proposition and also we had physics lab people down when we had that built and started up. It was probably two or three years later, after the plant was a success.

BOHNING: Did you make any trips to the plant yourself?

BOUNDY: Yes, I spent altogether a month down in Wilmington, North Carolina, at different times, checking the automatic controls.

BOHNING: When was that plant built?

BOUNDY: I'd say 1932 or 1933.

BOHNING: What was your next project after that?

BOUNDY: Sodium for an electrical conductor. First of all, the Dow Chemical Company used sodium as a reducing agent in the production of indigo dye. The sodium was manufactured somewhere in the Niagara Falls area by an outside company and Dow bought it. The price went up and up to where Herbert Dow decided we could make it ourselves more economically than we could buy it. We designed and built a sodium cell using salt as electrolyte. But there's always a problem with the high temperature of the sodium cell. The sodium is free at the cathode, and then it redissolves into the salt mixture and you can never skim it off or get it out, so John's idea was to have the cathode just touch the bath, so that the temperature at the point where the sodium was produced was above the boiling point of sodium (1). We built a condenser above it and and we made perhaps a hundred pounds of sodium that way. But in the meantime, this company that was furnishing sodium heard about all of this and they lowered the price down to where it was no longer economical [for Dow Chemical to continue].

The next problem that got Herbert Dow interested was, "Why use all this good copper for electrical conductors when the ocean is full of sodium?" So we worked on a high amperage sodium conductor. The DC current was produced on one side of the river and the electric lines crossed a bridge for the chlorine cells that were operating on the other side of the river. He said, "Why don't we take a two-inch pipe and fill it with sodium and put it across the bridge and use this as an electrical conductor for high amperage current?" We did but we had all kinds of trouble with it, but nevertheless we filled about three thousand feet of two-inch pipe with sodium. We grounded it, filled it up and used that as an electrical conductor. The problems were many, mostly with getting good contact all the way through and filling the pipes. We were given good two-inch pipes but they had been used previously for brine. They were rusted a little bit, with residues of brine underneath, so when we tried to fill them with sodium, the sodium went whoof! and it would blow out the other end. We tried to fill forty-foot lengths at a time, and then we had of course the problem of connecting each section, and that was not easy either. Nevertheless, we were able to dry the pipes and then we were able to make it and install it and it operated for about two or three years. This was written up in the electrochemical society paper (2).

[END OF TAPE, SIDE 2]

BOHNING: What did you turn your attention to after that? I have a number of things here that you worked on. You became assistant director in 1930. How did that appointment occur?

BOUNDY: I guess it just grew like Topsy because I was the first one there. John liked me, we got along fine, and I was a very good listener. That's probably why John liked me the most, I could listen to his ideas and not get too impatient. Sometimes I did get impatient but I didn't show it. That was a team we had --Grebe and Boundy.

BOHNING: I have a list here of some other projects and I'm not sure of the order. Maybe you could just talk about them briefly. Were you involved in making acetylene?

BOUNDY: Only as an assistant lab director. Dr. Matheson was the one who was primarily interested in making acetylene. Larry Amos was trying to get the data necessary to decide whether acetylene or ethylene would be the future basic feedstock. It's interesting that, after all these years, when oil begins to get very expensive or peters out entirely, and the same thing starts to happen to coal, then maybe the acetylene method is going to be way. To use energy from the sun to make calcium carbide, ship calcium carbide anywhere in the world you need to, and use acetylene to make all the basic chemicals. This could well be

something that could happen somewhere in the far distant future, but it's at least a practical method of substituting wood and charcoal or coal for petroleum. And this is going to have to happen some day.

BOHNING: You instituted a training program for people in the Dowell Service. Was a technical training program?

BOUNDY: Yes, it was a technical training program.

BOHNING: Did you start that? There were courses given then, as I understand.

BOUNDY: Yes. Larry Amos had a lot to do with the courses. As John's assistant I was there and knew about it and helped out, but I don't think that I originated the idea. But Dowell was one of the things that the physics lab did early on that turned out to be very, very important.

BOHNING: Were you involved at all in that?

BOUNDY: I was involved in it but primarily as assistant director. It's interesting. Dr. Veazey, who was working summers at that time, argued that the way to get authority in the Dow Chemical Company was to just assume it. As far as I'm concerned he had assumed responsibility for being director of research. He called me in one day and said, "Well, now that you're assistant, one thing you need to be very careful of is not to discourage other people to have patents, that you should not get patents yourself. You should encourage other people even if you give them your ideas." So this is what I started to do about the time I became assistant director. It grew to the point where I just said, "Well, look, let's try this and let's try that." John had done that before, too. He didn't worry about patents. He got quite a few. I had 15 before this happened, and then after that I didn't get involved in patents. Except if it was clearly something that I was closely associated with or somebody else wanted my name on it, or something like that.

BOHNING: Do you have a list of those patents anywhere?

BOUNDY: I do, but not here and not in modern Midland either. The Dow Chemical Company would have a list. I must have it somewhere, but I....

BOHNING: If you're back in Midland and think of it, maybe you could send me a list of patents and papers and other publications?

BOUNDY: Yes. I had about 15 publications and 15 patents. That's about the way it was.

BOHNING: When you became assistant director then, did that mean that you were being more and more removed from actual participation in the laboratory work?

BOUNDY: Yes, it meant that, but at the same time it was such a small laboratory that I still did some laboratory work whilst I was an assistant director. Until I was transferred into the styrene program, I still did quite a bit of research work.

BOHNING: Larry Amos used ferric chloride for treating municipal waters and sewers? Did you work on that with him?

BOUNDY: Yes, I worked on that with him.

BOHNING: What was behind that?

BOUNDY: The primary reason for it was that chlorine is a difficult material to store, and yet you want your chlorine cells to operate continuously and uniformly 24 hours a day. If you don't have any other use for the chlorine, make ferric chloride by bubbling the chlorine through a solution with iron shavings. So then what do you do with the ferric chloride? This was one of the applications. And the other thing that Stoesser developed was a photographic etching, which was only a small use, but a good one. But the municipal precipitant -- coagulant I guess is what I should say -- was a big use for many years.

BOHNING: Was that used just in Midland or was it used....?

BOUNDY: No, eventually it was used widely. At the time, in Detroit, I'm sure, and it was used in Toronto because Larry and I had both made a trip to Toronto early in the development work to help them get set up to use ferric chloride. And they did use ferric chloride in Toronto at the municipal waste disposal plant.

BOHNING: Could you also tell me something about Sylvia Stoesser? Could you tell me something about when she joined the lab and some of her early work there?

BOUNDY: She joined the lab -- again, I think it was 1930, plus or minus a year -- because her husband was hired and he would not come unless she was also offered a job. So they found a place for her, and John Grebe was very happy to have her in the physics lab. Also -- this is a peculiar reason for hiring somebody -- but the physics lab which was outside the fence, right next to the main office, had no restroom for females, so she and a secretary went to the main office where they had facilities. That was another thing that had to be taken care of.

BOHNING: Did you talk to her at all before she was hired?

BOUNDY: I don't remember that I talked to her before. I think John talked to her and then we hired her. I don't remember either one of us having a formal interview with her. We must have had but I don't remember.

BOHNING: Now you said she was the first.

BOUNDY: She was the first female chemist in Dow Research anywhere, and certainly the first Ph.D. In our lab, she was the scientist of the group. Everybody went to her to try out their ideas and get help.

BOHNING: What kind of work did she do?

BOUNDY: She took over my work on the physical properties and heat stability of Dowtherm. That was probably one of her first jobs. Using ferric chloride as a photographic etchant was another one, and then the purity of styrene monomer. She was very much responsible for the total work on pure styrene monomer. How to do it and the inhibitors for distillation and for storage.

One of the really difficult problems with polystyrene was the fact that it etched and got foggy on the surface. She was the one who discovered that it was residual monomer and other volatile low molecular weight material. If you reduced that all the way down to one percent, then the material was commercially a good polymer. One of the stories is that Du Pont did a great deal of research work on this and they gave it up because it simply wouldn't last. Well here is a sample that is fifty years old and that is her work. [Boundy gives object to Bohning]

BOHNING: Did she make those for a number of people?

BOUNDY: Yes. You can see what she did. She used burned out electric light bulbs and she filled them with monomer. We made a

lot with magnesium crystals because they were so beautiful. Anybody who wanted preserve something; she made them in the hundreds for everybody in the lab and in the company. We used them for give-aways too.

BOHNING: That's the first one I've seen. You may have one of the few that remain.

BOUNDY: I suspect that this is one of the very few. In fact, I don't have very many papers but I have collected a lot of stuff like this.

BOHNING: That's fascinating.

BOUNDY: Stoesser stayed with the polystyrene purity program and that probably was her single biggest contribution, although she made many others including helping everybody else. She did quite a bit of work on Dowell. She did a lot of her early work on Dowell, different inhibitors, and that sort of thing. After about ten years she retired to raise a family.

BOHNING: But she did come back?

BOUNDY: She came back to edit the book on styrene (3). If she hadn't come back, we never would have had that book published.

BOHNING: That's interesting. I was just talking to Ray [Boyer] about that book this morning. He told me a little bit about how that originated. We're running a little ahead here but why don't we at least continue with the book. He said that he had put out five pamphlets -- technical bulletins -- on styrene and that Willard Dow was on the editorial board of the ACS Monographs. Willard took them to the editorial board and they became the nucleus of the book. How did you get involved? Did Willard Dow come to you about that?

BOUNDY: I talked to him about it. I was in Willard Dow's office. We talked at least once a month to review everything that was going on. But Willard Dow said, in words something like this, "During the war, we have given our competitors all of the information we have on styrene. How to make it, how to purify it and even a great deal of information on making a polymer from it, because of the rubber program. Now let's make this a real competitive race. Let's publish everything we know about it so everybody has it and we'll see who wins." I think it was one of the smart things he did because it didn't hurt Dow Chemical

Company at all. The competition was good for them. Ray Boyer had also talked with Willard Dow. But Willard was the one who gave us permission to publish it and who actually encouraged us. Willard Dow loved competition by anybody. He had two pilot plants and two different laboratories making the same thing by slightly different processes just to get the competition. So this was a natural thing for him to say.

BOHNING: Who was responsible for getting Sylvia back?

BOUNDY: Ray Boyer.

BOHNING: Let's come back to when the physics lab first started getting into styrene. When was that?

BOUNDY: The organic labs under Dr. E. C. Britton had done a small amount of work on making styrene from pure ethyl alcohol and benzene. You get an alcohol and then you dehydrate that to make styrene. This is a classical organic method of making styrene monomer. They had made a little polymer that way and they had got the same crazing that Du Pont had observed. Bobby Dreisbach, who worked in the physics lab, knew that Dow had benzene because they were making phenol from benzene and he knew that we were building a huge ethylene plant and were going to have excess ethylene. What Bobby did was to construct a kind of crossword puzzle in which on one axis he put down all of the things that might react with ethylene, and benzene was one of them. Then on the other axis he had ethylene. In each compartment he filled what might happen and what the product would be and whether it would be commercial. One of the products was ethyl benzene and that dehydrogenated into styrene. That's how styrene was started. Bobby made what we called the crossword puzzle and decided that this was the way to do it. Making ethyl benzene and dehydrogenating ethyl benzene was the cheapest way to make styrene. He was the one at Dow who really got it started, and Stoesser was the scientist who made it possible.

BOHNING: In 1942 you were asked to head the expansion of the styrene production...

BOUNDY: Yes. In about 1939, Willard Dow could see the war coming. He didn't like to have a lot of vice presidents. So he took three of us. Two of us, Dr. [George M.] Hebbard and myself, were from the physics lab and, together with Dr. Kendall, who was at that time running the ethylene plant, and made us his assistants, but not <u>assistant presidents</u>. He would delegate different responsibilities to us and once he had delegated something, we were on our own and we could just go and do it. Accountable freedom, again.

BOHNING: What was the state of styrene production in 1942 within the company?

BOUNDY: Let's go back to 1937. In 1937 Dow had built the first commercial plant. We were making a good grade of pure monomer. Simply using a ten gallon can for the polymerization vessel and carefully controlling the temperature over the period of he reaction. All we did then was to grind up the polystyrene and sell it to either Monsanto or Bakelite. That continued until the war started. I think it wasn't until 1942 that the rubber program was fully initiated.

BOHNING: What did Dow assign to you?

BOUNDY: As an assistant to the president I was told, "The styrene plants are your responsibility. Go do it." And that was it. We had a plant in Gary, Indiana that wasn't actually even started. We had Texas, Los Angeles, and Sarnia as well. I had the responsibility for getting those built and the initial operations -- not the operations after they started -- as well as training the personnel. Not only did we have all of these plants of our own but we also had a group of people from Koppers and from Monsanto who came in for training in the only commercial plant that was being operated in the United States, in Midland, Michigan. We built another plant in Midland at the same time. So we had five different plants. I made a circuit around all of them.

BOHNING: Did you select the sites or were they already chosen?

BOUNDY: Those sites were selected primarily by the Rubber Reserve Company in Washington D.C. It was a very well-run government organization. I still think they did a magnificent job.

BOHNING: Dow was under contract to build the plants they determined?

BOUNDY: Yes.

BOHNING: Who was your contact in Washington?

BOUNDY: John Livingston and right after him, Bradley Dewey. I think both of them were at one time or another presidents of the Rubber Reserve. Livingston, who was from Monsanto, was the one

who did the leg work. Bradley Dewey stayed primarily in Washington.

BOHNING: How did you set out when you were given this responsibility? It was quite an undertaking to get five different places operational.

BOUNDY: To tell you the truth, I don't know how I did it. [laughter] I had an awful lot of good help. It would be a good study in psychology for somebody today. We had sixty people in training at one time in Midland. Most of them were from Dow. At that time, the technical personnel were pretty much at the bottom of the barrel. Most of these kids were just an average group of technical employees. What happened to them and the responsibility that they were given all at once, and the fact that out of that sixty, came at least two presidents of companies, two to four vice presidents of companies, a lot of lab directors; well, it was just unbelievable that sixty people could contribute so much later. I think it was that, at an early age, they were pointed in the right direction and given an awful lot of accountable freedom.

BOHNING: Did you establish an organizational framework of people that worked under you?

BOUNDY: I had one assistant, John E. Mitchell, who was responsible for the training of all of the personnel and also the writing of the manuals for operations of the plants. He had a manual for the automatic controls and instrumentation, another manual for ethylene production, another one for ethyl benzene production, and another manual for styrene production. This was a terrific load off my mind. With the exception of the Midland plant, a company in Boston was given responsibility for the design and construction. They were able to do a great deal of a very difficult job. We sent engineers from our own engineering department out to Boston to help with the design. But Stone and Webster did do the design and the construction. Texas, the largest plant, is a good example. We built it in four different units, each unit small enough so that one manager could understand and see all of the piping. If anything went wrong, you only lost one-fourth of your plant rather than the whole plant. Today I'm sure the logical thing to do would be to build one huge ethylene plant and so forth. But we didn't. We built four with its own inventories, each one a separate unit, so that if sabotage or fire or anything shut down one unit, you would still have a chance to keep the others running. Also because it was easier for an operator to understand that kind of a plant.

BOHNING: How did you select the personnel that were running the plants? Where were they coming from?

BOUNDY: They were the sixty people that we hired. Most of them were new graduates. Out of those sixty people we hired, only three had any production experience. So you can see how responsibilities were given to these kids all at once. They were just pointed in the right direction but the plant was designed with the fact in mind that they were the kind of people who would be running the plants.

BOHNING: Did these sixty all come in at the same time then?

BOUNDY: They all came in the same year and they were all admitted at one time. J. E. Mitchell was responsible for the training as I mentioned.

BOHNING: Do you know if any of those training manuals still exist? Would the company have any?

BOUNDY: I'm sure they do and they would be very interesting but I don't know where to tell you to go to get them. But I do know where to start.

BOHNING: That would be great. They certainly would be very beneficial.

BOUNDY: I would like to see them again too.

BOHNING: To take people like that and to train them to run plants of that kind in such short order when time is of the essence.

BOUNDY: And those plants started up on schedule without a single lost-time accident. It's just unbelievable.

BOHNING: When was that? You started in 1942. When were they in production?

BOUNDY: In less than two years they were operating at design capacity. Today that would be an impossible job but at that time, it didn't seem to be. There is so much more red tape today that I don't know whether I could stand it. Government red tape, ecology red tape, everything.

BOHNING: I think everything is much more complicated than it was then.

BOUNDY: Oh, it is. And while we didn't have any accidents, neither did we consider safety like we do today. Here again, I think it was primarily if a youngster understands what is possible and what has to be done safely, he'll even operate potentially hazardous equipment in a safe way.

[END OF TAPE, SIDE 3]

BOHNING: When the war ended this changed things drastically in terms of the demand for styrene.

BOUNDY: I drifted right back into plastics and still was an assistant to Willard Dow. I organized the plastics department and here again, he gave me all kinds of accountable freedom. We moved out and built a new warehouse. In the warehouse we built our PTS [Plastics Technical Sales]. This was Bill Goggin's. That was in the same place. Everything that was connected with plastics was about two miles away from the main office. One time, somebody asked me how much autonomy does one need for a separate department and not be interfered with too much by the president and vice presidents. I said, "Oh, about two and one-half miles." [laughter] But it worked very well. We were pretty much left alone and to some extent the same system was used by the Dow Chemical Company to organize the chemical department and other departments of the company.

BOHNING: I wanted to talk a little more about how you organized that but there's one minor thing that I read about. During the war, Matheson gave a talk on the possibilities of splitting the atom, which was followed by a visit from the secret service.

BOUNDY: Yes. He had given that talk at an American Chemical Society meeting in which he pointed out the possibility of a nuclear bomb. Then one or two days later, we had the FBI in asking how in the world did Matheson know about it. Well, he knew about it because he was a darn good physicist.

BOHNING: Where did he get his information to put that talk together?

BOUNDY: Himself. He couldn't have gotten it anywhere else. He got his doctorate at the University of Michigan and went to school in London, Canada [University of Western Ontario]. He got the idea himself. What he knew about it and what he had read about it. The Germans had published quite a bit about the fact that it was possible. The German scientists, not the government.

BOHNING: That was interesting how quickly the government managed to find out about it.

BOUNDY: I should say so.

BOHNING: The main thing I wanted to talk about was your trip to Germany to investigate their synthetic war program. Could you tell me something about how that came about?

BOUNDY: This was under the supervision of the Army and it was called the Technical Service Corps. The idea was that it was organized primarily to follow the troops into Germany (right behind the troops -- even before peace was declared) and find out what German industry was like. What they made and how they made it and bring this back to the United States. In other words, bring back all of the technology that could be found. My own part of it was the synthetic rubber program. That involved styrene and polystyrene.

BOHNING: Who were the others in your group?

BOUNDY: Dr. Bill Goggin and Dr. Hirschkind, who was from the Dow western division laboratory in California.

BOHNING: Bill told me that they were looking at the plastics industry but he didn't pay much attention to rubber. I guess it was your group that was looking at rubber and they tried to separate the two.

BOUNDY: When we got to Germany we got all mixed up anyway. But he's right. That was it. I remember Leonard Hasche from Tennessee Eastman was one of the synthetic rubber people. I don't remember if there was anybody else or not. This didn't happen all the time, but the English also had a group there and often we went together. So we had English counterparts. We were called capon colonels. We were given a sort of synthetic colonel rating in the Army. If you were captured by the enemy this would give you the status of being an Army officer rather than being a civilian or a spy.

BOHNING: How were you selected to go on this team? Did it come out of Washington?

BOUNDY: Yes. I don't know any more about it other than it did come out of Washington in a letter to Dr. [Mark] Putnam.

BOHNING: When did you leave for Europe?

BOUNDY: I was in Washington waiting for six weeks. Peace was declared on the German front before I set out but the Japanese war continued. It was right in that period. It was probably May of 1945 when I got there. We flew across with Pan American.

BOHNING: A commercial plane?

BOUNDY: Well it was Pan American but it was entirely Army. We sat in the old bucket seats.

BOHNING: Where did you start when you got there? Did you go to England first?

BOUNDY: Yes. We were pretty thoroughly briefed there. Then we flew into Leipzig one time and Frankfurt a second time. We were under the supervision of the Army who furnished the jeep and the driver.

BOHNING: How long were you in Germany?

BOUNDY: About six weeks.

BOHNING: Can you tell me something about some of your experiences -- where you went, what you saw?

BOUNDY: The most interesting experience was in the Leipzig area because that's where the Russians came in. Our contacts with the Russians and how they acted even at that time was probably the most significant experience that we had. On one occasion there was a river that divided the Russian territory from the territory of the Western allies. We wanted to visit an ethyl cellulose plant across the river into the Russian territory. So we stopped at the Russian gates and asked them. They finally gave us permission to go in. I think Bill Goggin was along with me that time.

Anyway, we had just started to interview the manager of the plant when one of the group pulled out his notebook and started to write down notes. The Russians said that was it; to get in the jeep and go home. So we went in our jeep and went home. [laughter] It was all right to listen but you couldn't take any notes.

BOHNING: Were you generally accompanied by soldiers when you went into these areas?

BOUNDY: Only a driver who would be a private.

BOHNING: Where did you stay? Did the Army provide any...

BOUNDY: Yes. The Army told us where to go and usually it was a private home that the Army had taken over and had used for their officers. In many cases, there were Army officers at the same time that we were there.

BOHNING: How did you find the Germans that you interviewed? Were they cooperative?

BOUNDY: Very friendly and willing to tell anything that they knew. I guess they felt that it was to their benefit to do that. One of the ones we interviewed in Frankfurt had worked for Dewey & Almy in this country. He had gone to Germany and joined the Nazis but he was also willing to talk. And practically everybody that we spoke to could speak reasonably good English.

BOHNING: Did you speak German?

BOUNDY: Very little. I could read German pretty well but I couldn't speak it.

BOHNING: Did you find any surprises?

BOUNDY: No. A couple of times I got pretty nervous because I was in the middle of a plant, all by myself with nothing but the German workmen around me and I kept wondering what they were going to do to me, but they didn't do anything.

BOHNING: You were wearing a uniform?

BOUNDY: Yes. We couldn't carry arms but we were permitted to wear uniforms. We didn't have any sidebands or anything like that to show a rank.

BOHNING: How much damage had been done to the plants?

BOUNDY: There were two ways to look at it. In Leipzig, the Air Corps were investigating when we were there, evaluating the damage and the accuracy of the bombing. Primarily this is information that I got from them, not what I saw for myself, although I did see a little bit. The Air Corps were sure that they wouldn't hit anything more than three miles away from the target area.

The other part was in Ludwigshafen, which was one of the big IG Farben plants. We noticed that one whole section of the plant was just completely destroyed. It was gone. We asked what happened. They said it was an accident. A tank car of butadiene leaked over that whole side of the plant and then blew up. It did more damage than all of the American bombs, at least in that area.

BOHNING: What could you tell about their styrene production, let's say in comparison to what Dow was doing or what was happening in this country?

BOUNDY: It was amazing to me that two companies starting out with some basic information on what each was doing but from that time on had grown independently, should have such similar processes. It was just remarkable. It was almost the same process, except that different catalysts were used. That was another interesting thing about research. The Dow Chemical Company was responsible through Rubber Reserve for trying to find a better catalyst for dehydrogenating styrene. The oil companies were responsible for developing one for butadiene. It just so happened research at Dow had developed the best catalyst for butadiene, whilst Shell Chemical Company developed the best catalyst for styrene. Research aimed at different objectives and turning out to be just diametrically opposite. To this day, I think, the same catalysts are being used for those two processes. They may have been modified a bit, but I think they are essentially the same catalyst.

BOHNING: You didn't really have any information you could bring back that would really help Dow Chemical?

BOUNDY: Very little, either by Hirschkind, Goggin, or myself. In fact, I guess that everybody who was sent over there would conclude was that there was little that was of extreme value.

BOHNING: Did you write a report?

BOUNDY: Yes. Leonard Hasche and I wrote a combined report. There again, I don't have it but the company must. Washington D.C. must.

BOHNING: It would be nice to get a hold of that report.

BOUNDY: Yes, it would because it did tell you how to make styrene and while we didn't say so, it told how Americans made styrene too.

BOHNING: That's interesting because on Monday I was in Chicago talking with Ernest Volwiler, who was president of Abbott Laboratories. He had been in Europe at the same time investigating the pharmaceutical companies. So I had three people in this trip who were all involved with the same project.

BOUNDY: What was his name again?

BOHNING: Ernest Volwiler. He was president of the American Chemical Society in 1950.

BOUNDY: I don't think I met him over there.

BOHNING: He might have been there a little later.

BOUNDY: I met two people who were investigating nutrition; how the Germans managed to eat and stay healthy, but they weren't in the pharmaceutical area.

BOHNING: Let's come to after the war. You said you were still special assistant to the president after the styrene production stopped. This is when you organized the technical sales group. I'm not quite sure about your company title as this group evolved and what your role was.

BOUNDY: I moved out to this warehouse we built, which also had the technical service and development. Right behind it was the polystyrene production, essentially in the same building. Our flow was from the monomer right through to polymer and into the warehouse. My office was there. Other than that and being assistant to Willard Dow and responsible for the plastics development, that's about all there was. The head of the sales department was also in the same building and quite close to me. Production right behind us and sales, TS&D [Technical Service and Development] and manager of the plastics department, all in this one building.

Of course, we had to work with Texas and the monomer production there and all the other polymers -- the production of

Saran and that sort of thing. But it was all centralized in this one building.

BOHNING: Willard Dow had given you the responsibility to see that the styrene plants got into operation. When you came back from your European trip did he change the focus of your work? How did he approach that with you?

BOUNDY: As I remember, I assumed it. I must have told him and he agreed, which is the same thing as him telling me to do it. At Dow at that time, you could assume responsibility for practically anything. As long as Willard knew about it and agreed and you didn't make too many mistakes, you were okay.

BOHNING: Were you looking at creating an additional need for all of that styrene capability?

BOUNDY: Yes.

BOHNING: Is that how that whole program got started?

BOUNDY: That's how the polystyrene program got started. Actually it didn't turn out to be a very large excess of styrene because the synthetic rubber program went on and on; there's still a lot of synthetic rubber being made. As it turned out there wasn't nearly the surplus of styrene monomer that we had expected.

BOHNING: How did you go about setting all of this up? Can you describe some of the developments that occurred up through the time that you became research director. I'm not sure I have the titles correct here but you headed plastics sales.

BOUNDY: I headed the plastics department. It was a complicated sort of arrangement. The only thing that made it workable was that I was an assistant. The president of the company had delegated that responsibility to me; the head of plastic sales line responsibility was to the head of the sales department. So mine was a heavy dotted line. The same thing with research. Research was done all around the company but for plastics, I had a heavy dotted line for research and so on, to TS&D and sales. Well, TS&D was pretty much [John] VanHorn. He was part of our organization right there. They made a beautiful tie-in with research. No matter where it was, we had the in-between; between the customer and the research.

BOHNING: I found this paper that you and Goggin wrote (4). You became research director in 1950.

BOUNDY: I was vice president and then became research director.

BOHNING: What was your approach to managing research at Dow in 1950 and how did that title come into being? How did you acquire that position?

BOUNDY: Willard Dow had died. He was killed in a plane accident and Leland [Lee] Doan had taken over. Doan felt that he was not trained and as capable of directing research as Willard Dow had been. Doan decided that we needed a director of research and he is the one who appointed me.

I felt pretty much that the director of research should be responsible primarily for the record keeping and research accounting. I went into research accounting pretty heavily; the ability to say, "Well, this lab was effective and productive to this extent and the return investment in this lab was such and such." We had this all charted in my office with one person responsible for keeping the whole thing up to date and bringing in all of the records. We had lost time accidents, patent applications, issued patents, everything that you could think of charted, including return on investment of each lab and return on investment of total research. The amount of process and product improvement research, the percent of basic research, and customer application research.

I felt that it was my responsibility to know what was going on everywhere, to get around personally and visit each one of these labs at least twice a year and talk to the people there. Generally speaking, this was also part of the chart room. I had pictures so that if I was to visit the Western Laboratory, I had pictures of everybody working in that laboratory. It just helped me to get their names straight and know who they were a little bit better than I would had I walked in cold. Visiting first, but then keeping really good records of what was happening at every lab and the company as a whole. Having this information at hand so that if anybody criticized research I could bring them into the chart room and tell them what was going on and why.

Then we had a research advisory committee that met every six months. They were the heads of every laboratory in the company. I think at that time we had about thirty. They would come in and we would review everything that was going on. We didn't hold anything back. Whatever the labs showed on the charts we showed them, no matter what it was. One of the interesting things was that the most profitable laboratories, generally speaking, were the little labs that were out in the productions plants -- right out in the middle of production with the worst facilities. Previously, one would have thought that they would never have done it. But they were the ones who were the most profitable.

[END OF TAPE, SIDE 4]

BOHNING: How do you explain their success under less than ideal conditions?

BOUNDY: Closeness to production.

BOHNING: They could see the problems better.

BOUNDY: Yes. They see the problems and they work on the immediate problems. What I said is perhaps a little bit misleading because while their production and profit was better, the other labs were doing work which would show up in ten or fifteen or twenty years. These production labs were handling immediate problems. New products were another thing that we studied. We took them for ten years and then if they were not profitable in ten years, we would not credit them for research any longer. That sort of thing was probably all that we could do.

BOHNING: Did you still give your people this freedom or accountability that allowed them to work pretty much on their own.

BOUNDY: I tried to. What I did was to give it to the lab director. It might be interesting that I tried to study what was special about the Dow physics lab and why was it so successful in the pre-war years and if its success could be repeated. One of my conclusions has been that the head of that laboratory was the most technically uninhibited, the most enthusiastic, and the most unconventional man. Usually such people work down in the lab, the creative people stay in the lab and a business manager who looks over them and tries to guide them. Whereas Grebe managed the lab as a very enthusiastic, although an unconventional individual. Maybe that's one of the reasons it was so successful.

You know, today practically every laboratory is managed by a good businessman and you hope to get your creativity from down in the lab somewhere. I'm not so sure that that's where you get it.

BOHNING: When I talked to Ray Boyer I asked him about the changes he had seen at Dow over his career. He said the biggest present difficulty was the institution of fifty cash registers. When H. H. Dow had the company there was one cash register. One lab could help support another. Now you have fifty cash registers and it doesn't work that way. It tends to stifle needed creativity because people are working in very narrowly defined regions.

BOUNDY: That's a good point.

BOHNING: That was his term. Fifty cash registers instead of one. [laughter]

BOUNDY: That sounds like Ray Boyer.

BOHNING: Let me ask you that same question. Looking back now at your career at ow what were some of the more important changes that you saw?

BOUNDY: I'm speaking of research now. Red tape. All kinds. Governmental red tape. That can't help but slow down research. The emphasis on safety without spending additional money to ensure that things are done as quickly as before and done safely. Sure it's possible to operate a safe lab and do essentially nothing. To do things as in earlier times but do them safely, may mean doubling the capital investment. I think those are the big changes. Maybe that comes out to be the same as Ray Boyer's fifty cash registers too.

BOHNING: When you mentioned red tape, you especially identified the government. Has the company put a lot of red tape on research?

BOUNDY: Yes, the company has also. There are just so many restrictions.

BOHNING: Do you think that's due to the fact that there are fewer scientists at the upper level making those decisions? At least that's what I sense. If you look back over your career at Dow, there were more scientists who worked their way into management positions and positions of decision. I'm not sure that's the case today.

BOUNDY: It's not the case today. Most of the very top people are financial people today. That's a big difference. That may have a real influence too. But they should be able to understand that the director of research should be independent enough that he would carry on his program almost regardless of what he was told. He should assume responsibility.

BOHNING: When you were director of research, what kind of voice did you have in major decisions within the company?

BOUNDY: As a member of the board of directors and the vice president, I was responsible most of that time to the president of the company. I had all I needed and if I needed more, I could have had it. I think anybody could do the same thing if they just assumed that they had it.

BOHNING: You were there at a period when there was strong support for these kinds of programs.

BOUNDY: Yes.

BOHNING: And that came from Doan? Was Doan a strong supporter of research, following the mode of the Dows? Was he a technically oriented person?

BOUNDY: I'm not absolutely sure what his education was. He was the head of the sales department but he must have been technically oriented. He supported research just as much as anybody else. He probably left it more to me than Willard Dow did. Willard knew exactly what was going on all the time, everyday. And Willard Dow had the patience and the perseverance to spend a lot of research money during the Depression when some companies were cutting back and when other companies were failing to take advantage of the opportunity of good, cheap technical help. Willard Dow really went all out during that period of time.

BOHNING: The Depression did not affect Dow as much as it did many other places; it certainly wasn't a disastrous affect.

BOUNDY: In Midland, we hardly realized that there was a Depression If you look at the charts, you see that there was a Depression. Sales did go down some but they picked up very quickly. I think 1932 was the bottom for us and then after that, things improved. So we really didn't see it.

BOHNING: What would you attribute that to?

BOUNDY: I think the chemical industry as a whole was not hit as hard as the rest of the industry. The chemical industry was growing very quickly and I suspect that's also a reason.

BOHNING: Well, I have reached the end of my list of questions. Is there anything else that we haven't covered that you would like to add.

BOUNDY: I would like to point out that over my working lifetime, about one-third of it was spent in research, either as an assistant director, but still doing research with my own hands. Another third was in the business end of the company, production and selling plastics. The last third was in managing research. This is about the way it divided up. I would probably have never realized it without having the other opportunities, but I had the most fun and job satisfaction in the laboratory, and I wish I could convince other people that this is true. Right in the laboratory, doing research with my own hands, and having fun. And being given accountable freedom to go ahead and do what you felt was right. This was the most enjoyable period. But as I said, I probably never would have known that if I hadn't had the other opportunities.

BOHNING: What you have said is what I have heard from a number of the Dow people I have interviewed. You really had a good time. I find that very intriguing. Also, a great deal of company loyalty. The number of people who spent their entire careers with the company. They came in right out of school and spent their entire career with Dow. That really says something for the company during the time the company was developing.

BOUNDY: We did have fun then. Some things didn't seem like fun at the time, but they do now. [laughter]

BOHNING: Thank you very much for spending the time with me.

BOUNDY: Well, I've enjoyed every minute of it. I hope I haven't bored you.

BOHNING: Not at all. It's been very fascinating and I look forward to seeing your book on the history of the physics lab when that's available.

BOUNDY: My own wild guess is that that will be about a year, if we're lucky. I shall get you a copy when it's available.

BOHNING: That would be great. Thank you.

[END OF TAPE, SIDE 5]

NOTES

1. John J. Grebe and Ray H. Boundy, "Apparatus for Electrolysis of Fused Baths such as Production of Sodium from Sodium Chloride," U.S. Patent 1,839,756, issued 5 January 1932.

2. R. H. Boundy, "A 4000-Ampere Sodium Conductor," Transactions of the Electrochemical Society, 62 (1932): 1-10(preprint).

3. R. H. Boundy, R. F. Boyer and S. M. Stoesser (eds),Styrene: Its Polymers, Copolymers and Derivatives, (New York: Reinhold, 1952).

4. R. H. Boundy and W. C. Goggin, "Application Research in the Thermoplastics Industry," Chemical and Engineering News, 26 (1948): 1220-1222.

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