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CARROLL A. HOCHWALT

Transcript of an Interview
Conducted by

Jeffrey L. Sturchio and Arnold Thackray

in

Clayton, Missouri

on

12 July 1985

CENTER FOR HISTORY OF CHEMISTRY

Oral History Program

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ABSTRACT

Carroll A. Hochwalt begins with his early years in Dayton, Ohio, including his student days at the University of Dayton. This is followed by his work with Charles Kettering and Thomas Midgley Jr. at Dayton Metal Products, where Hochwalt was a significant contributor to the development of lead tetraethyl and other antiknock compounds. In the central portion of the interview Hochwalt focuses on the Hochwalt and Thomas Laboratories, its development into a large consulting research operation, the clients it served, and the products it developed. The interview concludes with Hochwalt's association with the Monsanto Company and his role in the company's research management.

INTERVIEWERS

Jeffrey L. Sturchio holds an A.B. in history from Princeton and a Ph.D. in the history and sociology of science from the University of Pennsylvania. He has had teaching appointments at the New Jersey Institute of Technology and Rutgers Univerisity, and a fellowshio at the Smithsonian's National Museum of American History. He is Associate Director of the Beckman Center for the History of Chemistry.

Arnold Thackray majored in the physical sciences before turning to the history of science, receiving a Ph.D. from Cambridge University in 1966. He has held appointments at Oxford, Cambridge, Harvard, the Institute for Advanced Study, the Center for Advanced Study in the Behavorial Sciences, and the Hebrew University of Jerusalem. In 1983 he received the Dexter Award from the American Chemical Society for outstanding contributions to the history of chemistry. He is Director of the Beckman Center for the History of Chemistry.

CARROLL A. HOCHWALT

1900 Born in Dayton, Ohio, on 29 April
1987 Died in St. Louis, Missouri on 23 May

Education

1922 B.Ch.E., University of Dayton
1935 D.Sc., University of Dayton

Professional Experience

1918-1920 Laboratory Assistant, Dayton Metal Products Company
1920-1924 Research Chemist, General Motors Corporation (Tetraethyl Lead Division)
1924-1925 Production Manager, Ethyl Gasoline Corporation
1926-1936 Vice President, Thomas and Hochwalt Laboratories
Monsanto Company
1936-1945 Associate Director, Central Research Department
1945-1948 Director, Central Research Department
1947-1964 Vice President of Research, Development, and Engineering
1948-1950 Coordinator, Research Developments and Patents
1949-1950 President, Chemstrand Corporation
St. Louis Research Council
1964-1967 Director
1967-1971 Vice Chairman of the Board
1965-1966 President, St. Louis Regional Industrial Development Corporation
1971-1973 Director, St. Louis Regional Commerce and Growth Association

Honors

1956 Midwest Award, American Chemical Society, St. Louis Section
1962 Honorary D.Sc. degree, Washington University
1963 Knight of Malta, Pope Paul VI
1964 Honorary D.Sc. degree, St. Louis University
1967 Distinguished Alumnus Award, University of Dayton
1969 Brotherhood Citation, National Conference of Christians and Jews (St. Louis)
1970 Cardinal Gibbons Award, Catholic University of America
1971 Society of Chemical Industry Medal, American Section

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INTERVIEWEE: Carroll A. Hochwalt

INTERVIEWERS: Jeffrey L. Sturchio and Arnold Thackray

LOCATION: Dr. Hochwalt's home, Clayton, Missouri

DATE: 12 July 1985

THACKRAY: Dr. Hochwalt, can you tell us about your parents and your family situation in your early years.

HOCHWALT: Yes, I would be delighted to. First, here is a picture of the four of us. There are four boys in the family, and my father and mother. I am the one on the left. My father was an author. He wrote quite a few books in a sporting field, dogs. They would go out all over the country and have trials in which dogs would contest by the searching for and finding of game birds, such as quail, pheasant and others of this type. My father was a reporter for two sports magazines. He covered these trials and became an expert, the outstanding man in this particular field. He knew more about sporting dogs, like pointers and setters, as anyone in the world. He had a contract not only to write reports for various newspapers but also for sporting magazines. Also, he authored about twenty-five books, mostly relating to dogs and field trials of dogs (1). He was an expert and the first, number one, in this field. He was also a prolific reader. When he died he had a library of about 3,500 books. He was a self-taught person. He developed this particular interest, and it became a publishing business for him. He also wrote some fiction, two or three books.

THACKRAY: Were these under his own name?

HOCHWALT: Yes, these were on other subjects, such as the Thirty Years War in Europe (2). He was a very able and a very intellectual person. He was interested in history, literature, and art. He was also a judge of field trials and dog bench shows, to determine the best dog in the breed. He traveled to England and France quite often to judge shows there. He was a very, very able person. It sounds boastful, since he was my father, but it's a fact. He didn't go through college, but I think in this case he accomplished very much without it.

THACKRAY: Was he a native of Dayton?

HOCHWALT: Yes. My ancestors came over from Germany in about 1870. They went to Baltimore and then Cleveland, Ohio and finally settled in Dayton.

THACKRAY: And your mother?

HOCHWALT: My mother was the same. She was born in Dayton, and her family originally came from Germany. I do not know when that occurred.

STURCHIO: Were you the oldest of the children?

HOCHWALT: I was the youngest of the four. My oldest brother died when he was about twenty-one, during the flu epidemic back in the First World War. My second brother was a businessman. My third brother was an M.D. in Dayton, an obstetrician.

THACKRAY: Where you outrageously spoiled as the youngest?

HOCHWALT: Not at all. At least I don't think so. [laughter] All of us went to what is now the University of Dayton. At that time, it was called St. Mary's Institute. They also ran a high school. I went to that high school, as my brothers did. I also went to St. Mary's Institute, which became the University of Dayton, while I was enrolled there in college. While I was in the high school the teachers would take us to the college section of the school. One day they took us through the laboratory. I saw a beautiful glass apparatus used to perform some experiments and I was so interested in it that I said, "That's the field I want to get into." So I decided to take up chemical engineering when I graduated from high school and I entered the college section of the St. Mary's Institute/University of Dayton to earn a degree in chemical engineering.

I was fortunate in having a college professor who was an inspirational teacher. He was an outstanding man, one who could imbue his students with the love of the subject. His name was [William] Wohlleben (3). He received his degree at the University of Fribourg in Switzerland. The University of Dayton was and is a Catholic school run by the Marianist Brothers, a religious order. After Wohlleben joined this Order, he was sent over there to take up chemistry, and he graduated from Fribourg. Eventually he became a professor of organic chemistry and Chairman of the Department of Chemistry at the University of Dayton. I owe a lot of what I may be to him. He was an outstanding man. He even helped us [Hochwalt and Charles A. Thomas] start our laboratory. We asked his advice on things and before we had furnished our first laboratory he turned one of the University laboratories over to us for our work on the fire extinguisher contract.

THACKRAY: One of the labs in the college?

HOCHWALT: Yes. We worked at and really developed that fire extinguisher in a laboratory in the University of Dayton, which Wohlleben had turned over to us with its equipment and chemicals. We occupied the laboratories vacated by Dayton Metal Products after General Motors moved them to Moraine City. We used their laboratory on the third floor of this building [See following page]. We really established and equipped it. Then in another year or two, we outgrew that and we moved our laboratory to Nicholas Road in Dayton. That's the group of buildings that you see in those pictures [See second page following]. We bought that land, expanded the number of laboratories and went into our own consulting work. It may be of interest to note that General Motors formed GM Research Corporation from Dayton Metal Products. While they were doing that, [Thomas] Midgley did work on synthetic rubber for GM in the Thomas and Hochwalt facilities on Ludlow Street.

THACKRAY: Let me take you back, if I may, into high school and college. Did you meet Professor Wohlleben when you were in college or high school?

HOCHWALT: It was when I moved into the college. We didn't have him in high school, but they did allow the high school students into various physics labs and chemical labs. That's where I decided that chemistry was the field I wanted to enter.

STURCHIO: You said that one of your older brothers had become a doctor and your father had a large library. Did it include science books?

HOCHWALT: No, it did not. His interest was principally in sports, literature and art. I have many of the books here. He was a typical self-made man. He died a comparatively young man, at 68 years. My mother lived to be 92.

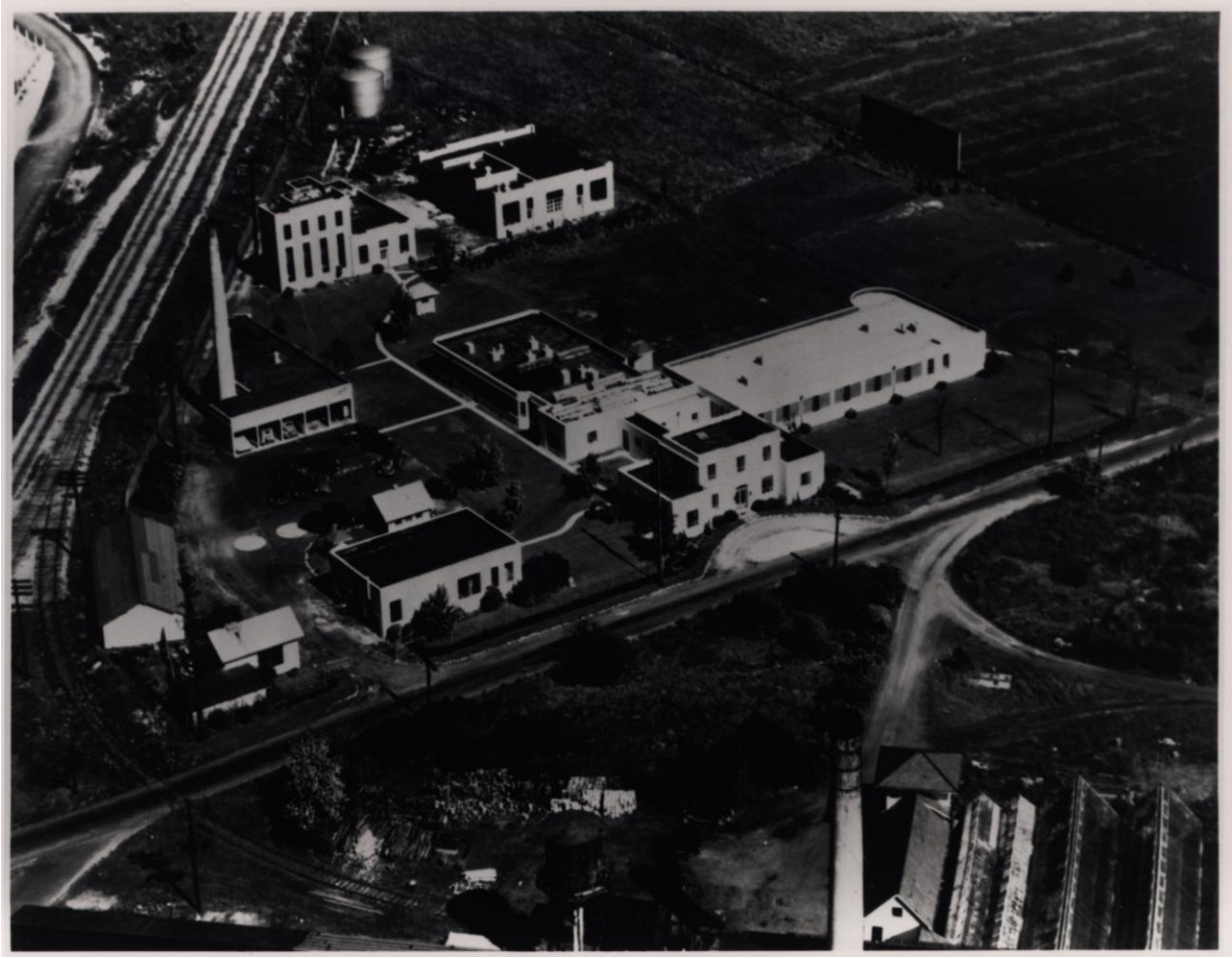
THACKRAY: How old were you when your father died?

HOCHWALT: I was 39.

THACKRAY: So, your awareness of and fascination with science really didn't come until you were into the beginning college days?

HOCHWALT: My interest began when I went through that laboratory in my last year of high school. The following semester I went into college.

University of Dayton



Nicholas Road

THACKRAY: There was never really any question that you would stay in Dayton? Your brothers had gone to St. Mary's Institute as well. Had that become a family tradition?

HOCHWALT: Not in any real sense. It just happened that we lived in Dayton and St. Mary's Institute/University of Dayton was there, and a good school. I lived in Dayton until 1949, when Monsanto asked me to move over here [St. Louis]. My family is still there, so my roots are really there, not here.

STURCHIO: Did you ever consider going into aeronautical engineering instead of chemical engineering, given that Dayton was such an important center for that?

HOCHWALT: Chemistry is my field. I knew that right away. I don't know why. There was something about it. And I think Wohlleben was the primary reason for it.

STURCHIO: What sort of things were you learning in formal courses in chemistry with Professor Wohlleben and others at that time?

HOCHWALT: Physical chemistry, organic.

STURCHIO: Do you recall any of the textbooks that impressed you at the time or any of the other things that you were reading?

HOCHWALT: I've got them downstairs. Let me get them. You bring up an interesting point. [Pause] This is a well-thumbed book.

STURCHIO: That's intriguing, that you still have your first organic chemistry text (4). What was the course like at that time? Was it mainly preparations?

HOCHWALT: It was a lot of theory and, of course, laboratory work. I also had an advantage, because Wohlleben asked me to give an organic course to the premeds when I was in my sophomore year. I did this for a couple of years, while I was a student.

THACKRAY: That was pretty unusual.

HOCHWALT: Yes. I knew chemistry. Also, I had another advantage, because I worked in Kettering's laboratory, the laboratory at Dayton Metal Products, in my college sophomore and junior year. So, I also had experience in that laboratory.

THACKRAY: How did you get in there?

HOCHWALT: Well, that was during the war, of course, and it so happened that one of my friend's classmates told me about it. He had found out that there was a position open for a laboratory assistant. He decided not to take it because he could make more money with the war companies that were also in Dayton. So, I went there immediately, and they gave it to me.

I was the luckiest guy in the world to have that background, working with Kettering and Midgley. Even though I was only a sophomore at that time, I knew a little chemistry, too. I worked on the pilot plants, and we can go into that later. I was in the laboratory with Boyd, and we'd synthesize different things. In those days, it wasn't so easy in the laboratory because the ordinary reagents that we needed were not available. You couldn't buy them from Eastman, or Kahlbaum, but, God damn it, you had to make them yourself. I got a terrific amount of experience while I was still in school as result of that work.

THACKRAY: You really decided at a very early stage that organic chemistry was your field.

HOCHWALT: I took chemical engineering, of course, but organic was a very important part. My degree is a bachelor's in chemical engineering. Later I did some work on fire extinguishers. Finding the metals was an outstanding discovery (5). It had a sort of catalytic effect on flames. The University of Dayton, even though it was after I had graduated, gave me a Ph.D. I turned a thesis (Catalytic Effect of Alkaline Earth Metals on Gasoline Fires) in to them, but this was after I had graduated (6).

THACKRAY: You must have been extraordinarily busy if, by your sophomore year, you were going to Dayton Metal Products. Was that in the daytime or in the evening?

HOCHWALT: That was a full time job in the summer. Whenever I had a day or two free, for some reason or another at the University, I would go to the laboratory. They wanted me any time I was available.

STURCHIO: Could you tell us about Dayton Metal Products at the time that you joined them? What were the facilities like? What kind of working atmosphere existed?

HOCHWALT: I don't know what the plant made, as a matter of fact. Probably some war materials. But they had this laboratory which was really a plaything of Kettering's. They were working on various things. Lead tetraethyl antiknock was the principal thing which they started (7). So my experience with them was the making of antiknock materials. I synthesized them and developed the methods. I was pretty handy in setting up equipment. Zinc ethyl was a bad compound. If you don't handle it right, it takes fire as soon as air hits it. You had to be a little active on that.

STURCHIO: Were there standard methods for dealing with that or did you have to develop new ways of handling it?

HOCHWALT: Well, the making of it was standard, of course. But we had to handle it, as an alkylating agent to make organometallic compounds, like lead tetraethyl, tin ethyl, antimony--a whole slew of them.

THACKRAY: You really got in on the ground floor at Dayton Metal Products?

HOCHWALT: That was during my summers while I was at college. Even during Christmas vacation I used to go down there and work for four or five days a week. That was during the war, and this matter of knock in the preignition of the engine became of great importance, because gasolines in those days either knocked or they didn't. Most of them knocked. Airplane engines knocked so badly, it would even break the pistons. I guess Midgley found out that benzene doesn't knock. And when you converted it to cyclohexane by hydrogenation the octane value was even higher. We developed a process for making cyclohexane for the Air Corp at this laboratory. We made 50 gallons or 100 gallons in a pilot plant, and I operated the pilot plant. Those were the early days, and it was not in any quantity, even though chemically it had the right molecular structure so that it didn't knock. Nevertheless, that wasn't the solution to the main problem of a knocking motor. The thought was to add something smaller than that, but not use it as a fuel in itself. That's when they got into the antiknock problem.

THACKRAY: How many people were in the lab at Dayton Metal Products?

HOCHWALT: As a whole, not too many. I don't think there were more than two dozen of us. They had a lot of people in a machine shop because they were playing with various types of engines. But so far as laboratory people were concerned, I would say there weren't more than a couple dozen of us. In this fuel section, there was only Midgley and Boyd and myself in those days, plus one or two helpers. When we had the cyclohexane pilot plant fired, we had two or three more helpers. We made that by hydrogenating benzene over a nickel catalyst in the presence of hydrogen, and that converted the benzene to cyclohexane.

STURCHIO: What kind of problems did you face when you had to scale up the laboratory process to make larger quantities in the pilot plant? That wasn't the sort of thing that one would learn out of Holleman's textbook.

HOCHWALT: Hell, no! We had to take a liquid like benzene and gasify it. We knew we had to put a catalyst with it. We did this in an eight foot tube, filled it with the catalyst (which was pumice impregnated with nickel) and passed vapors of benzene over it. It wasn't much of a job, and that converted it to cyclohexane (8).

STURCHIO: Where did you find out about the properties of catalysts and how did you choose that catalyst in particular? Did you go to the patent literature?

HOCHWALT: We knew that nickel was a catalyst in any hydrogenation--most of them used nickel, and some platinum or palladium. In this case, nickel was quite satisfactory.

THACKRAY: In defining what was going on in some strategic way, was Charles Kettering very much the central force?

HOCHWALT: He was an inspirational fellow. He was questioning everything. He always had better ways of doing things, and Kettering already had the experience of developing the automobile starter. But, of course, he didn't have any chemists around him in those days.

[END OF TAPE, SIDE 1]

THACKRAY: Let's slide into your full-time position with the company. Were you formally hired upon graduation?

HOCHWALT: Yes.

THACKRAY: But in fact you already had quite a track record with them?

HOCHWALT: Well, they knew who they wanted. I came out and they gave me a decent salary. I would have gone with them anyway, for that matter.

THACKRAY: That was in 1922?

HOCHWALT: I graduated in 1920. I turned full-time in June of 1920.

STURCHIO: Had you ever thought of going someplace else to work?

HOCHWALT: No, except my own laboratory. I only lasted until 1926, when we formed our own laboratory. So, I was with them full-time for six years. But, they eventually moved that laboratory to Detroit. Dayton Metal Products moved from that house on Ludlow Street down to the old Dayton Wright Airplane Company. They built enormous airplanes there during the war. It was located in Moraine City, which is a suburb of Dayton, Ohio. After the war, Dayton Metal Products moved the laboratories. General Motors Laboratories moved there in 1920. Then, of course, they moved out of Dayton entirely in 1926. It's all located in Detroit now.

THACKRAY: The organization became General Motors Research Corporation at about the moment you formally joined it?

HOCHWALT: It became General Motors Chemical Company. But it was a research organization, of which Kettering was the head. Midgley was the head of the fuels section.

THACKRAY: When you were formally hired, were you hired to work in that section?

HOCHWALT: Yes, I was hired by Midgley to work in the fuel section. That's when the antiknock work really became intense.

THACKRAY: Would you talk about the antiknock work that culminated in December 1921?

HOCHWALT: I carried on right after graduation in 1920 synthesizing various alkylated compounds that we tried as antiknocks.

THACKRAY: How many were working on this? You and Midgley and who else?

HOCHWALT: T. A. Boyd and about four others, including Jim Andrews and Russell Wells. I was the synthetic man for making the new products to try.

STURCHIO: Who tested these new products?

HOCHWALT: We had a test engine set up. We developed what is called the octane number, but we used a one cylinder motor to do it. It was just amazing. It would be knocking like hell and when you put in a little of the antiknock, just like that there was no knock at all, no noise. And you could measure the octane value. However, that came a little later when we put it in terms of octane value. It sounds complicated, but it really wasn't. I made them, and T. A. Boyd tested them (9). That's what it amounted to.

THACKRAY: What was Kettering's role in relation to this?

HOCHWALT: He was the inspiration, and he was the one who gave us the money to do it (10). He was a very sharp person. He didn't know any chemistry, and that's no reflection on him at all. He depended on us to supply that. He's the one who gave us the incentive and the inspiration to carry on, and assessed what it meant and the value of it to the world.

He had the foresight to see that antiknock was needed if the automotive industry was ever going to develop. The same is true with the starter. He put the female in the car. If you didn't have a starter, you wouldn't have as many automobiles. That's doing good for mankind. And at the same time, of course, and this is important, it increased the efficiency of the motor by having an antiknock so that you used motors from a fuel standpoint. You had a much more efficient operation of the car, because if you drove with a ping like that the engine wouldn't last very long. The greater the compression between the piston and the top of the engine, the higher the efficiency of fuel usage. Antiknock allowed you to do that.

THACKRAY: You were working on organometallics then. Was this a sort of searching, empirical procedure?

HOCHWALT: Absolutely, for a while. But then it developed. We finally predicted that lead would be the one. It came to the point where we could predict that any metal in a certain area in the periodic table had some antiknock effect. We proved that lead was the one that had the maximum effect. That was through the help of MIT, by the number of vacant spaces and all that sort of thing, so that we predicted lead could do it. But tetraethyl lead was difficult to make even though the compound was known. It was made by some German fifty or sixty years earlier. It was not an unknown compound, but the way we made it was different. Then we had to develop efficient ways, a low cost process. We started with ethyl iodide and zinc ethyl and ended up with ethyl chloride and sodium blend alloy, as the method of making lead tetraethyl (11).

STURCHIO: When you started out doing the testing, presumably you were just using a few cubic centimeters of tetraethyl lead. How large did you eventually start making batches by 1923?

HOCHWALT: Oh, we were making about a gallon at a time.

STURCHIO: That must have created some problems with lead poisoning.

HOCHWALT: It did. We all had lead poisoning. I had it. You could see the lines of lead in the bones, but it disappeared. It doesn't bother me now, but at the time it did. I used to get nauseated over food. I would go out for lunch, and then find that I couldn't eat when I got there. Midgley had it, too. This was just about the time I was to be married and General Motors gave me six weeks vacation just to get away from the lead. That was our honeymoon.

STURCHIO: Could you tell us about your wife? I believe that you were married in 1922. Was she also from the Dayton area?

HOCHWALT: Yes, her family was from the Dayton area. They were furniture manufacturers. Her father had a big factory in Dayton. It was a well-known family. We traveled in the same groups--dancing school and that sort of thing. She's quite a lady.

THACKRAY: She must have thought you were living a rather unusual life.

HOCHWALT: Yes. Well, I was a busy guy. I had objectives and I saw to it that I reached them.

THACKRAY: How would you characterize those objectives?

HOCHWALT: I wanted to be on my own and I knew, of course, that I wanted to successful financially. I was interested in new knowledge and new things. I had a great curiosity of things, and that's the reason why I really became a research chemist. I was interested in new areas and new fields. I just enjoyed having the freedom and liberty of a laboratory such as Ket's lab, and we provided that freedom and liberty out in our own laboratory. The men had a pretty free hand.

THACKRAY: Why did it seem so important to you to be on your own?

HOCHWALT: Just to prove that I could do it. Not that I had any doubts. I wanted to get married in 1922. It was after we found lead [tetraethyl] that we were able to get married, I mean with increases in salary and bonuses and so on. Financial success was a factor too, but it was really an exploration for new knowledge--sort of being a pioneer. I like that connotation.

STURCHIO: Did General Motors show its appreciation for the work that your group had done in late 1921? You mentioned bonuses and raises.

HOCHWALT: Yes, General Motors showed its appreciation. When we opened our laboratory, Thomas and Hochwalt Laboratories, General Motors did research for themselves under Midgley in our labs, and Thomas and Hochwalt also did projects for General Motors, as well as for other companies. General Motors gave us $150,000 a year for a few years to cover the costs of their men in our facilities. That really helped Charlie and me to get moving.

THACKRAY: If I understand correctly, it wasn't until after you had done the tetraethyl lead work that you first met Charlie Thomas.

HOCHWALT: Yes. We had had lead for about one and a half years. Charlie came in 1923.

THACKRAY: He joined the company then?

HOCHWALT: Yes. We hit it off together. We were kindred spirits.

THACKRAY: What was he hired to do?

HOCHWALT: He was hired to more or less do whatever was necessary to rid the engine of the lead residues from tetraethyl lead. The job they gave him was finding some agent that would prevent the deterioration of spark plugs and valves as a result of lead oxide forming on those parts. He found that bromides were useful. That was the beginning of the need for large quantities of bromine, and led to the extraction of bromine from sea water, by Dow and Ethyl.

THACKRAY: You and Charlie Thomas were naturally working together on cognate problems. Was there some personal chemistry as well?

HOCHWALT: Yes. We enjoyed things. He was ambitious. God knows I was. Even out of the laboratory, you can't stop thinking about things. That's when we came up with this fire extinguisher, as a result of my neighbor telling me that there was a need for it.

THACKRAY: When was the conversation with your neighbor about the need for the fire extinguisher?

HOCHWALT: Let me see. I have to watch my years here. You're asking me to remember things when I'm eighty years old. We formed our own lab in 1926. So it must have been in the latter part of 1925 or early 1926.

THACKRAY: Was going independent an idea that the two of you had which was then precipitated by General Motors' move and your desire to stay in Dayton?

HOCHWALT: We were ambitious. That was one thing. Secondly, we had confidence in ourselves, because of what both of us had accomplished at that time. We weren't afraid. We went out and got clients. Well, the clients really came to us. It wasn't any job to sell a well-known laboratory. When Monsanto took us over, we were the largest consulting laboratory in the country doing just research work. A. D. Little, of course, was larger, but that was mostly just testing work. We were the largest consulting laboratory.

THACKRAY: Who were your natural competitors? Was A. D. Little the principal one?

HOCHWALT: That was the principal one. I think Battelle had started at that time. Some were connected with universities. Of course, we had no connections with universities. We had the ideas ourselves.

THACKRAY: How did you finance and organize? You mentioned the subsidy from General Motors. Did you incorporate yourselves?

HOCHWALT: Oh, yes. We had three or four clients the first year and, with General Motors, we worked on aspects of synthetic rubber. But, of course, we weren't successful. We had the elements of it, styrene and butadiene, but that was a little ahead of its time (12).

THACKRAY: Was that a contract with General Motors in addition to your subsidy?

HOCHWALT: Yes, but it was a loose contract. By then the relationship was so good between us that a handshake would do it.

THACKRAY: This was with Kettering. He was the person in General Motors that you were in contact with?

HOCHWALT: Midgley was his representative in our laboratory. For instance, Midgley and Henne developed the freon refrigerant in the Thomas and Hochwalt Laboratory. Charlie and I had nothing to do with it. Midgley was doing it. We were doing other things. It was an interesting arrangement. We all got along fine and we all had a great admiration and respect for each other.

THACKRAY: In the early period, as you were starting, how many people did you have working for you?

HOCHWALT: Not many. We had a girl who came to us from General Motors as our secretary. We had two mechanics and about four chemists when we started. And Charlie and myself.

THACKRAY: Were these other chemists people who had been in the General Motors Research Department?

HOCHWALT: No. We got them from the University of Dayton. But then, we built up quickly after that. When Monsanto took us over in 1936, we had about eighty-five to ninety chemists and engineers, most of them Ph.D.s (13). We had quite a group. As I said, the subsidy helped, and also the Fyr-Fyter Company

royalties. Then we started getting other royalties, such as Morton Salt. We worked out a process to make ammonium bromide from their salt liquors (14). I don't know if they are still doing it or not.

STURCHIO: How did that come about?

HOCHWALT: From the ad in Fortune (15).

STURCHIO: Did you get other clients from that ad as well?

HOCHWALT: Yes. It cost us $3,000 to run that ad in 1934. It took a lot of thought on our part to do it and it was a smart move. It was the best way to get our name out. It only ran a short time. That's an original etching from the artist who made up the ad; I got it from him. [see following page.]

THACKRAY: Was there a natural division of labor between yourself and Charlie Thomas?

HOCHWALT: Charlie was really what you might call more of an outside man than I was. He did the contacting and selling, and I would be the inside man working on the developments. That's the way it ended up when Monsanto took us over. Charlie eventually became president and chairman. I continued in what I wanted to do, which was being in charge and responsible for all of the research, basic engineering, patents and development. I was the in-house man. But Charlie was not the out-house man! [laughter].

Charlie had a wonderful personality. He got along well with people. The characteristics of the two of us made a damn good blend, as far as I can figure it out. Plus we had a great respect for each other. Here's an interview with me a couple of weeks ago in Monsanto World News that shows about Charlie (16). Anyway, he became chairman of the board of Monsanto, for which I was very happy. I was doing what I wanted to do.

THACKRAY: He did quite a bit of traveling in this period.

HOCHWALT: Yes. He did more traveling than I did. At Monsanto, I did a lot of traveling with Edgar [M. Queeny].

THACKRAY: How did the coming of the Depression affect your business? It seems to have had a beneficial effect, but it must have been an anxious time.

HOCHWALT: We watched our pennies in those days. At one time it came to the point when Roosevelt closed the banks, we went out and got our payroll in a crap game. That's a silly thing, but nevertheless, it's a fact. We had a tough time, but it didn't last long. We got quite a few clients during that time.

THACKRAY: Can you explain that?

HOCHWALT: You mean, why they wanted to go to that expenditure during that period?

THACKRAY: Yes.

HOCHWALT: I think they were all getting disgusted and wanted to come up with new products. That was the principal reason. It was a good decision on their part, because we weren't cheap for consultation.

THACKRAY: Did you operate by charging so much a man-day of time?

HOCHWALT: No. We just charged them a lump sum. But, we did insist on this, that if we had patents developing, we would get some royalties off of it. Thus, we had a stake in everything that we developed, besides our regular research fee.

THACKRAY: Was that a usual arrangement? Would that also characterize Battelle and A. D. Little?

HOCHWALT: I don't know, but I don't think so. I think we were the only ones who had that, and they didn't want us to have it.

THACKRAY: It stood you in good stead with companies like Morton Salt?

HOCHWALT: Yes. And Fyr-Fyter. With Monsanto we didn't take royalties because we had so much work!

[END OF TAPE, SIDE 2]

THACKRAY: Before the tape started, you were talking about how the Monsanto connection developed. Could you go over that again?

HOCHWALT: We had contact with Monsanto through being customers of theirs for chlorosulfonic acid, phenyl chloride, and fluorobenzene. They had a man by the name of Watt, who was in development, and he maintained contacts with us because we were customers. As a result of that, Monsanto gave us some contracts (17). We worked with the Phosphorus Group and detergents. Well, the principal thing was detergents. We were working with polymers--styrene, butadiene, acrylonitrile--and general chemicals. And they gave us a contract particularly to be consultants in the general chemical field.

Then, when we were bought by the company, we went into detergents, agricultural chemicals, synthetic fibers--we sold that to the board. Of course, Charlie and I were on the board, too, after 1947. We developed sodium tripolyphosphate as a builder for detergents and also put them in the general chemicals we used to watch, such as plasticizers, oil additives, and new methods for making nylon intermediates. This was a pet of mine. We used acrylonitrile as a raw material for our Acrilan in Monsanto. I wanted to use it also to make nylon intermediates and we were successful in doing that through the hydrodimerization of acrylonitrile to make adipic acid and then hexamethylenediamine. Monsanto's using that today. These were new processes for the intermediates without going to the standard products such as butadiene, and so on.

THACKRAY: Let me take you back to Lynn Watt in the development of the Monsanto connection. Was he the key player in that period when Monsanto work was being funneled to the lab?

HOCHWALT: Yes, he was. He was a friend of ours and he was a good employee of Monsanto. He had the contact and I think what intrigued him was the fact that we were buying chemicals so long. The sales weren't very high. Chlorosulfonic acid, for instance--who in hell would use that except crazy nuts like us? Phenyl chloride--that was a big volume.

We made carbon remover for the Alemite Corporation. Our laboratory did, Thomas and Hochwalt. We developed that, patented it (18), and sold it to Alemite. We made it and put it up in cans. This is to remove carbon from automotive engines. Chrysler started using it. It was automatic. When you stopped your motor at night, and put it in the garage, you'd pull it on the last pull, and it would suck the can contents into the motor. You would let it stand overnight. The next morning, you would start up the motor and blow all the carbon out. This is before Ethyl became prevalent.

So, I think he was interested from that angle and then, seeing our record on that, they started giving us a lot of their orders. Sodium tripolyphosphate is a builder in synthetic detergents. We did that while we were still consulting with them. We developed a baking powder from calcium phosphate. That was our principal work for Monsanto. When we came into the company, then we opened up. The reason Edgar really bought us out was that he wanted to better the character of Monsanto's scientific reputation. At that time, it wasn't doing any really interesting new things. There were standard products. I think he wanted to better that, and he thought maybe acquiring us would help.

THACKRAY: When did you first meet Edgar Queeny?

HOCHWALT: Oh, I don't know. It was sometime in those intervening years. They bought us in 1936. It was between 1930 and 1936. That's about all I can say.

THACKRAY: Was the idea of the Monsanto purchase something that came quite suddenly, or had it been discussed for a number of years before?

HOCHWALT: No, it came quite suddenly. He came in and put it that way. As I said before, if you get so damned expensive, it would be cheaper to buy you out. He was a great guy, but that's the way he put it. Then, the negotiations started. They only lasted for about a month, and concluded on Easter Day of 1936.

STURCHIO: From what you just told us he said, obviously a large fraction of Monanto's outside research budget was going to Thomas and Hochwalt Laboratories. How much of your practice was Monsanto at that time?

HOCHWALT: About thirty percent.

STURCHIO: Did part of the negotiations consider what you were going to have to do with other clients at that time?

HOCHWALT: We had to give them up. I went around and explained it to our various clients. But, yes, we had to give them all up. onsanto was number one.

STURCHIO: How many clients did you have by that time?

HOCHWALT: We had about eleven, including Monsanto.

THACKRAY: Didn't the prospect of going back inside the corporation cause you some qualms? You said earlier you wanted to be independent, and Thomas and Hochwalt had been very independent.

HOCHWALT: Well, we worked pretty independently within Monsanto. I was in Dayton. Both of us were originally. Charlie moved to St. Louis in 1945 and I moved here in 1949. But, we were pretty independent, by God. If we wanted to do something, of course, we had to get the approval of the board and executive committee, but that wasn't a problem. By 1947 we were both on the executive committee and on the board. Charlie was on in 1945. I went on in 1947. If we wanted something done, damn it, we went to Edgar. He was very level-minded, and ambitious for the company. I think he wanted to better the scientific stature of the company. So he would listen to us. He would listen to these things. Monsanto had been going into synthetic fibers. I presented the problem to him and the statistics, and hell, just like that, God yes, go ahead. Things like that, I mean, would take place in that kind of atmosphere. Edgar and I used to go fishing a lot in Newfoundland. We transacted a lot of business up there.

THACKRAY: When was that?

HOCHWALT: That was in the 1940s and 1950s. Edgar and I traveled around Europe to meet all the chemical people there, the German outfits and so on. I was looking for new things, trying to broaden Monsanto in all respects. I was sort of the contact man with a lot of companies. I had friends all over Germany, France, and Italy. That's when we bought the Italian company, Montecatini Edison. It then became Montedison, which is the largest chemical company in Italy to date. Edgar was a very misunderstood person. They thought he was hard boiled and insensitive to people, but he was quite the opposite, very sensitive to people and things.

THACKRAY: There wasn't any dramatic shift in decision making?

HOCHWALT: There was no loss of independence, if that's the way you want to put it, except that we did have to get the approval of the board. But, that was so simple.

THACKRAY: How long did it take in the late 1930s to get from Dayton to St. Louis?

HOCHWALT: It took about eight hours by train.

THACKRAY: In that initial period, did you go to St. Louis often?

HOCHWALT: Not too much. They would come here to Dayton. I used to get over there. We had fairly close contact. A man by the name of Gaston DuBois was with Monsanto. He was in the position which I took later, in charge of all the technology. He used to keep in very close contact with us. We had meetings with him regularly. He would keep up to date on what we were doing.

STURCHIO: Could you tell us what Monsanto was like when you and Charlie Thomas first began to work exclusively on new technology for Monsanto?

HOCHWALT: You mean after the merger?

STURCHIO: What was the company like in the late 1930s? What were the major products? What were the major challenges that Queeny and the others explained to you as you began to consider working there?

HOCHWALT: Well, they didn't explain to us, we explained to them! [laughter] We knew that we had to go into synthetic detergents, and we put them into that. We knew that we had to go into synthetic fibers, and we were fortunate that there was a plant operating in the redevelopment of Acrilan. Du Pont approached us, because they were being looked at with a little bit of questioning by the antitrust department. They looked around for a company to license under their nylon patents and they selected us. At that time, we had already joined with American Viscose to form Chemstrand Corporation, of which I was the first president. When that happened, Du Pont wanted us to take the license out, in order to free them from the surveillance on the part of the Justice Department. That's how we got into nylon. Incidentally, Charlie Thomas and Greenewalt, who was the president of Du Pont at that time, were friends. And that didn't hurt either.

THACKRAY: Good friends from some previous background?

HOCHWALT: I think when they were students at MIT. Also, Charlie had a very good friend, Henry du Pont, and that brought him closer to Greenewalt, too. Hank du Pont was one of the du Ponts in the company.

STURCHIO: One of the problems that faced many of the chemical companies in the 1930s and 1940s was linking research to production, and making the transition from the laboratory to commercial introduction more efficient. With your labs in Dayton, what kind of arrangements were there to keep in touch with Monsanto's manufacturing end as well?

HOCHWALT: We put a pilot plant in at Dayton. We began a pilot plant on styrene at Dayton. We put Monsanto into styrene. This was at a time when Rubber Reserve was forming up. Dow was in styrene, too. But we beat Dow out with this pilot plant and got a lot of Rubber Reserve's business. But, that put us also into styrene plastics, having styrene monomer available. So we got into the plastic end using styrene, and other things.

STURCHIO: Would people come from the manufacturing locations to work on the pilot plant with your staff?

HOCHWALT: Sometimes, but most of it was done in St. Louis. They had more chemical engineers and plant men to operate than we had. We could only do it on a smaller scale. We had an acrylonitrile pilot plant in Dayton. We had a pilot plant on fibers and the making of Acrilan in Dayton. That's because we initiated it. But on the other products, general chemicals, the work was done in St. Louis or at their plants up in Merrimac or Boston, or the rubber chemicals at Nitro. We didn't go into that sort of thing. Does that answer your question?

STURCHIO: Yes. I was trying to get at the transition from basic work to commercial production.

HOCHWALT: But if we instituted the process in the laboratory, we usually went through the pilot plant method ourselves.

STURCHIO: Dayton was busy in terms of pilot plants in the early 1940s. You had styrene and some acrylonitrile work. You were beginning to start work on all the low-sudsing detergents, or was that a little bit later?

HOCHWALT: No, "All" was done also at that time. That was an interesting thing. That was a specialty detergent. But to show how chemistry and the chemical industry can make this a better life, as Kettering did with the starter for motors for women, we did the same thing with All. At the time it was thought that in order to have good detergents with good cleansing action with fabric, you needed a large volume of suds. This is Procter and Gamble talking. [laughter] We came up with this product which we eventually called All, an ethylene oxide adduct that was a

marvelous detergent and did not foam--no suds at all.

One day, just by happenstance, Westinghouse came to the laboratory and (they had heard about it somewhere) they told us about their problem. They wanted to come out with a mechanical clothes washer. They said they couldn't do it because the suds flowed right out of the machine and all over the floor, and said their damn machines were no good. I said, "Oh, by God, we've got your problem solved already." I went to the laboratory and gave them the product. I said, "Now, this one will work", and it was All. But, no suds in the damn machine, and that's the reason why the mechanical washer went over. Because we came up with a non-sudsing detergent. We were responsible for that wholly.

STURCHIO: Was it hard to get people to accept the fact that no suds could still get something clean?

HOCHWALT: Well, you could have the detergent tested to determine that without any difficulty.

STURCHIO: So, there wasn't any consumer resistance to it?

HOCHWALT: No. But that's what made Westinghouse come out with a mechanical washer. I hope that doesn't sound boastful. You know, a hell of a lot of this sounds boastful to me. I hope that it's not.

THACKRAY: Not at all. You've had a very impressive career of achievement.

HOCHWALT: Are you getting hungry? Let me see, it's quarter to twelve. Would you like to go down to the Club now and take a little recess?

STURCHIO: And we could start up again after lunch?

THACKRAY: Can you tolerate a little more after lunch?

HOCHWALT: Yes.

[Pause]

STURCHIO: Let's go back to the pre-Monsanto years. Before we started taping this morning you were talking about the growth of your clientele in the 1920s and 1930s. We discussed the way in which General Motors had provided a subsidy for you for a couple of years. You were doing work on polymerization of dienes for them, along with Midgley. The Fyr-Fyter work you told us about was one of your early successes...

HOCHWALT: That's the first one. That's the first invention we had together.

STURCHIO: ...and the royalties from that were helping to support the lab as well. Did you look for other clients? You said that some of them came right to the door after the Fortune ad?

HOCHWALT: You know, as a matter of fact, I don't know how we acquired companies. But I know we didn't have any trouble getting them.

STURCHIO: That's a good position to be in.

HOCHWALT: Standard of New Jersey came in. We developed a product made by Carbide, which was a by-product they got from their cracking stills. We took it and made a resin. There were a lot of unsaturated compounds in it and we polymerized that with aluminum chloride and made a resin which we called Santolube (19). At one time they were going to buy it, but then they lost interest and Monsanto took it over. That's how Jersey came into the picture.

General Motors wanted a synthetic rubber. We were not successful with that although we did determine a lot of the elements and chemistry of the thing. We did not go into styrenes until we joined Monsanto because we were interested in that as a raw material for synthetic rubber for Rubber Reserve, and also for the product per se to make new types of polymers.

The Mead Paper Company was in Chillicothe, Ohio. We worked on sizing agents for their paper (20).

STURCHIO: Arthur D. Little started off in the same area: chemicals for the paper industry. Was that an area in which you did face competition from Arthur D. Little, Inc.?

HOCHWALT: No. We didn't even know what Arthur D. Little was doing outside of a lot of testing work. That was a testing laboratory, which we were not. Ault and Wiborg Printing Company in Cincinnati was interested in developing new types of carbon paper and also new compositions of printing inks. We were with National Distillers because of our work making quick-aged whiskey.

STURCHIO: Could you talk about that? It sounds like an interesting story.

[END OF TAPE, SIDE 3]

HOCHWALT: Well, the way that came about, Roosevelt came into office in 1933. We anticipated his election. Secondly, we anticipated that he would throw out the prohibition law. About a year before that, we started thinking about whiskey and what to do about grain whiskey because you would have to age it for years in the cask before you could sell it, because it wasn't potable. It took that long to remove the greenness by doing it in a cask. We thought that would be a good project to work on, since we knew whiskey would be on the market when he threw prohibition out. Of course, we were right on that.

We started working six or eight months before that and we tested grain whiskey. Of course, it has a horrible flavor. This is the whiskey just as it comes off the still, before any aging in an open cask. The peculiar taste, that horrible taste, is due to congeners which form in the distillation and in the fermentation. Products like aldehydes and acids which have this awful taste are removed. We knew what those products were in grain whiskey. We analyzed it and decided that the best thing to try in order to get rid of those was to hydrogenate it. The Raney catalyst, made from nickel and sodium, was put in with the distilled spirits and heated up. That would hydrogenate these congeners, as they are called, the impurities in grain whiskey (21). And lo and behold, by God, it came out as clear, tasteless alcohol. It took out the greenness completely. Oxidation would probably do it too, but hydrogenation is the simpler way of doing it.

After getting that result, we approached National Distillers to see if they might be interested to be ready for the market when it was open after Roosevelt threw out prohibition. Sure enough, they were and they asked us to continue work on it. We developed a pilot plant which we placed in one of their distilleries in Louisville. Old Granddad Distillery, it was. Sure enough, the product worked beautifully. I understand the finished, saleable whiskey, was still pretty horrible in taste but, nevertheless, it had alcohol in it. And it would be available. It wasn't too good, but at least the greenness wasn't there. We took that and leached wood chips in order to give it a

color and somewhat of a smokey taste which good whiskey has to have. We made three million pints of whiskey for National Distillers, which they had ready on the day that Roosevelt put it back in business so that they could get into the market right away (22).

STURCHIO: That must have turned out to be very lucrative for them.

HOCHWALT: It was. It was a timely thing, but it was also our sense of this happening: Roosevelt would be elected, and he would remove that law. As a I say, we went to National Distilleries, and they were very much interested in it, and we produced this whiskey in a pilot plant at the distillery. We had about three million bottles that they had ready for sale when the law was changed. There was a lot of chemistry in this too. We determined what the congeners were, the amount in there before and after hydrogenation, and so on. We bettered the taste of it so it was potable, although it certainly was not a high grade bourbon whiskey.

STURCHIO: I remember an earlier patent that you had taken out on the problem of orange peel in lacquers (23). Did that also involve hydrogenation?

HOCHWALT: Yes. That was for Sharples. I'm a little hazy on that. We hydrogenated some of the solvents in lacquers, and that slowed up the drying of it to some extent.

STURCHIO: Here's one of the papers you published on that (24).

HOCHWALT: "A double dehydration process in which the treatment of the nitrocellulose with a low-boiling alcohol, followed by a higher boiling alcohol, removes more water from the nitrocellulose and thereby reduces the orange peel. Slowly evaporating solvents in combination with completely dehydrated nitrocellulose reduced the orange peel to a negligible degree." The pH, that was the important part. That tells the story.

STURCHIO: How did they get in touch with you?

HOCHWALT: Phil Sharples was an old friend of ours. Of course, this was one of their main businesses. Through that friendship we talked about it and he asked us to work on it, and gave us a research contract on it.

STURCHIO: Both you and Charles Thomas had a familiarity with catalytic hydrogenation from your work at General Motors.

HOCHWALT: We did. I had a lot of experience on hydrogenation, through the work I did with Kettering in changing benzene to cyclohexane.

STURCHIO: Did the two of you consciously look for research projects for the laboratories that capitalized on the experience you had in those particular techniques?

HOCHWALT: In some cases, yes. We had that background and knowledge, and applied it to another problem. The knowledge was the important part. What the product was, was immaterial. Lacquer would wrinkle in those days, and we called it orange peel.

STURCHIO: So, using this process would cut down on the sanding time?

HOCHWALT: And make a better looking job.

STURCHIO: During the decade that you were an independent consulting laboratory, how did you figure out how to charge clients? A lot of it must have been learning by doing.

HOCHWALT: That's right, but we did it by the number of men required and adding a certain percentage on that. We included the salaries and overhead on those men plus profit. I've forgotten the exact figures that we used. The Monsanto contract may have been twenty-five thousand, thirty thousand, or forty thousand. It depended on the number of men on the job.

STURCHIO: Is there anything else that you would like to tell us about Thomas and Hochwalt Laboratories before 1936?

HOCHWALT: I'll never forget the day that we had the big fire at the laboratory and thought we were out of business. We were working on hydrocarbon cracking and a fire developed. It spread, but it did not ruin the building. It was a matter of picking up the debris and starting over again. It was pretty bad at the time because it was a gasoline fire, but we saved the building and most of the laboratory. We carried right on. That's when we put on the addition to the laboratory. We decided that we needed more space. It didn't hold us up too long.

STURCHIO: What year was that?

HOCHWALT: 1928.

STURCHIO: You mentioned that there were about eighty to eighty-five people at Thomas and Hochwalt when Monsanto took you over. Were there any immediate changes in the number of staff that you had? Did you expand rapidly at that point?

HOCHWALT: When they took over, we had an expansion in physical facilities. More laboratories, a dining room, air conditioning (which we hadn't had before), and we put on more men. I'm not sure what the increase was over a year or two, but it was appreciable. It must have been twelve to fifteen percent more manpower. We were very careful in the men we picked. Eighty percent of them had their Ph.D. from good schools. They were interested in research and the advancement of knowledge. We had men who had a purpose in life.

STURCHIO: Where did you recruit new Ph.D.s for your staff?

HOCHWALT: We recruited from Penn State, Harvard, MIT.

STURCHIO: Did you recruit from Fieser?

HOCHWALT: Yes, we recruited from him at Harvard. We recruited from Conant, and also Adams at Illinois. Speed Marvel was another. One of his sons is working for Monsanto. He's the head of agricultural research.

STURCHIO: Did Marvel ever consult for Monsanto?

HOCHWALT: No. I think he did for Du Pont. Monsanto did not employ consultants. In my days at Monsanto we did put Kistiakowsky on.

STURCHIO: What did he do for you?

HOCHWALT: We got him particularly for physical chemical reasons, but I can't recall the projects in which he was so helpful to us.

STURCHIO: Was that in the 1950s?

HOCHWALT: Yes. And we used to go to the University of Chicago, the University of Dayton, and the University of Cincinnati. Many of the men were from Eastern colleges, although we had some from Michigan, too.

STURCHIO: Aside from Dayton, where you said you did get a lot of people, was there any other school that had the kind of special relationship with Monsanto research that Illinois had with Du Pont?

HOCHWALT: No. Monsanto didn't use university consultants very much. Kistiakowsky is the only one I can remember. I think we [Thomas and Hochwalt] had a better appreciation than they [Monsanto] did of the value those people could be. When we came in, Monsanto's main laboratory was in the Organic Division, which is located in St. Louis. A man by the name of Kyrides was the head of it. He was a Greek and I don't know where he studied or got his degree. But he was not as broad-minded as a director of research should be in outside things. He was more interested in bettering the products that Monsanto had rather than coming out with new products.

When Edgar took us over, it was not only to better the scientific reputation of Monsanto, but he was also interested in new products. He was ambitious to expand Monsanto and increase its basic products, and get into all fields where we could play a part. Kyrides was interested in developing better methods of making them and extensions of them. For example, if you were in commercial solvents, you might add one or two more, but you stayed in the same field. I don't know whether I want to put that in. It sounds as if I'm criticizing Kyrides. Of course, he left Monsanto years ago. As a matter of fact, he was unhappy when they bought out Thomas and Hochwalt.

STURCHIO: You and your colleagues soon began to go into all sorts of new areas.

HOCHWALT: We were getting Monsanto into petrochemicals, detergents, and fibers. But petrochemicals was a very important factor and that's what we added to Monsanto. Both Charlie and I had experience in that area and that's the reason we came up with styrene. We expanded the whole scope of Monsanto activities.

STURCHIO: Could you tell me a bit more about the work you did for Rubber Reserve in World War II.

HOCHWALT: We started it with styrene when Rubber Reserve was starting. We had the pilot plant in Dayton and that was to be one of the sources of styrene for their rubber.

STURCHIO: Did you have connections with the Rubber Reserve Discussion Group in Akron?

HOCHWALT: No, but we became a producer at the time when everyone was starting. I think we beat Dow in the production of styrene. We were a supplier to Rubber Reserve.

STURCHIO: What uses did you put the styrene to right after the war?

HOCHWALT: Plastics and combining them with other olefinic and diene products to make combinations of styrene, butadiene, acrylonitrile, etc. We made a composite, three-unit polymer and they are still doing that. That's one of the big businesses of Monsanto. Styrene was a glass-like, clear, hydrocarbon plastic that was very effective and still is. It's still being used to a great extent for various objects.

STURCHIO: A few years after that, the laboratories began work on acrylonitrile and fibers from it. A theme that runs through a lot of Monsanto chemistry from about 1940 to 1955 is its relation to acrylonitrile.

HOCHWALT: Our fiber was based on that. We thought if we made the fiber, we also ought to make the polymer simultaneously with the development of the fiber from acrylonitrile, which we did.

STURCHIO: What did the market opportunity look like then? Earlier you told us how, in the 1920s, you and Charles Thomas were always looking ahead for new opportunities for the laboratories. What was your perception of the opportunities after the war in those areas?

HOCHWALT: We saw that the country needed synthetic fibers. It was because cotton prices were going up. Rayon was going up in price and we thought that the clothing industry would need additional, available choices. Du Pont proved that with nylon, and we were out to prove it with Acrilan. That's a wool-like fiber, and that now replaces wool to a great extent.

[END OF TAPE, SIDE 4]

HOCHWALT: (reading from a lecture text) "The higher cost of agricultural products, (which means cotton, viscose, and rayon) increasing industrial productivity, and a growing population are the fundamental pressure factors behind industry's drive for newer and better synthetics. Today, Americans want more clothes. They can afford better clothes and there are an ever-increasing number of Americans who order them." We went into the wool-like fiber. Nylon is a silk-like fiber.

STURCHIO: Du Pont had that wrapped up.

HOCHWALT: Yes, and they gave us a license for one of their patents and we got into it. Later, we operated a company called Chemstrand, producing Acrilan (25). I was president of that company.

STURCHIO: Could you tell us about Chemstrand? Production in Alabama didn't begin until 1952. You were president during the start-up phase, when there was still development work occurring.

HOCHWALT: We did the development work in Dayton, but we had the plant in Decatur, Alabama.

STURCHIO: Why Decatur, Alabama?

HOCHWALT: Damned if I remember.

STURCHIO: You just made the fiber. Perhaps it was because the textile manufacturers were located there.

HOCHWALT: I don't recall. It was close to Anniston, Alabama, and we had a plant there.

STURCHIO: Did Viscose have something to say about where it was?

HOCHWALT: No. They were in it because they were even, fifty-fifty partners with Chemstrand. They made me president during this research and development phase.

STURCHIO: There must have been different kinds of problems in developing a new fiber than there were in some of the petrochemical-based research. Could you describe some of those challenges? Many of the problems must have been engineering problems, such as the spinning of fibers.

HOCHWALT: Some of them were, such as the construction of the plant. They had to make the polymer, and that required engineering, of course, for the polymerization process of acrylonitrile under special conditions. Then, spinning the fiber was another engineering problem, and how to wash out the solvent, and so on. The spinnerets would give off a little fiber and that would be wound up. In that process we had to wash out any solvent that might have remained, and come up with a spool of fiber, such as this example of nylon [points to spool of fiber on desk with cigarette lighter on top]..

STURCHIO: You didn't have the lighter attached? [laughter]

HOCHWALT: Each product had its own specific problems that we tried to solve.

STURCHIO: Returning to Chemstrand, polymer science was really coming into its own in the late 1940s, after all the work that had been done.

HOCHWALT: We had a plastics plant in Springfield, Massachusetts. At first, we made the polymer for Acrilan at that plant. Then, we put in another plant to make the polymer right where we were doing the spinning.

STURCHIO: Were you and your other chemists and chemical engineers following the work that was going on in polymer science in general, such as Carothers' work and the work on mechanisms that had been done in World War II?

HOCHWALT: God help them if they didn't.

STURCHIO: Was the staff going to events such as the Gibson Island conferences on polymers, and ACS meetings?

HOCHWALT: They presented papers sometimes. We had an alert crowd. The incentive was there. I'm not saying that they were the best in the world, but they were damn good people.

STURCHIO: After you came back from being president of Chemstrand, you returned full time to being vice president of research, development, and engineering.

HOCHWALT: I was in charge of the whole operation all over the country.

STURCHIO: At lunch, we started to talk briefly about the difference between managing eighty people and a few thousand people.

HOCHWALT: I don't see any difference except putting it on a larger scale.

STURCHIO: Could you talk about the differences in running Thomas and Hochwalt Laboratories in the 1930s and being in charge of all technology and science for a very large corporate organization.

HOCHWALT: I was busier, and I had to have more contacts with the directors of research, the associate directors, etc. Before, I would more or less do it personally, with individuals. I had to let others do that, and they in turn reported to me. You might say my authority was extended through the associate directors, group leaders, and directors of research.

STURCHIO: Did you miss the laboratory?

HOCHWALT: Yes, I did. I stopped doing laboratory work in the 1940 to 1945 period. I missed that.

STURCHIO: You were dealing more with budgets than chemicals?

HOCHWALT: I was dealing with projects as they were going on, but because there were so many, I didn't have any time to spend on them except in a supervisory capacity through my assistants. It was an extension of my authority to other people (26).

STURCHIO: How did Monsanto go about planning long-term development in this larger arena? At Thomas and Hochwalt, clients would come in with a problem or you would seek out a client if you had an answer to a problem. It must have been different trying to plan where the company should be ten years down the road across a broad front.

HOCHWALT: To me, that was more or less obvious in what was going on. If you keep up with the industry and read the literature, you don't have any trouble in doing that. We knew when synthetic detergents were coming out. We knew when textile fibers were coming in, and Du Pont was successful in showing that path. With petroleum and the petrochemicals, you needed certain raw materials for plastics and detergents. That enabled you to carry on in petrochemicals. One follows the other. To me, that's a simple process.

STURCHIO: How did you keep up with things personally? Did you continue to read chemical literature?

HOCHWALT: Sometimes I used to study patents. That's where I saw the directions. For example, the use of a reduction process caused the dimerization of acrylonitrile. That's as far as it went. But I could see that that's a good raw material for the development of materials needed for nylon. I called up on the phone one day and told my director of research to put somebody on this job--the electrodimerization of acrylonitrile. Fortunately, he had an awfully good man and he caught onto it. Within a year, we were making the raw materials of nylon from acrylonitrile, which made one main product of Monsanto useful for two different fibers we produced. It was just a natural.

STURCHIO: Were you buying the nylon intermediates outside before that?

HOCHWALT: Yes. We were making them too, by the standard methods, but this was much cheaper. We put this into molecularized acrylonitrile and that causes two of them to join together which gives you a C_6 chain. Then, you take that and you can make adipic acid, which is one of the raw materials, or you can take adipic acid and hydrolyze it and make hexamethylenediamine. That's one example of my going through the literature and telling them. My name isn't on that patent; it's the man's who did the work (27). However, I had the idea of utilizing one raw material for two fibers.

STURCHIO: You started off in consulting and came full circle back to consulting.

HOCHWALT: Well, I didn't want to just sit on my rear end. I was still interested in chemistry and I keep up fairly well on what's going on. I've had consulting assignments with six or seven companies from 1964 until now. I haven't got any now because I gave them up. I had Petrolite, Mallinckrodt, Witco, an English company, Montedison in Italy, and so on. I used to do a great deal of traveling.

STURCHIO: You would have to, with clients that widely distributed. I have one other question that we usually ask at the end of an interview. You must have accumulated, in addition to the material that you've shown us, other papers and files.

HOCHWALT: I have a scrapbook. I'm not sure if there's anything in that.

STURCHIO: Does Monsanto have any records from your years there? Did they keep your office files?

HOCHWALT: I don't know. I think so. They interviewed me in an article which I gave you (28). That should bring you up to date.

[An exchange about the scrapbook's contents follows]

HOCHWALT: This [reference to scrapbook item] was on a development that wasn't successful so we'd better not talk about it [Krilium Soil Conditioner].

STURCHIO: Wasn't the problem there that word got out too soon?

HOCHWALT: No. It took too much to get it into the soil. You had to press it into the soil, so that it will start agglomerating it from the polyelectrolytic action that's required. It took too much labor to get it in.

STURCHIO: So, the chemistry was fine.

HOCHWALT: Yes.

[additional discussion about the scrapbook]

STURCHIO: Could we end with a few words on your work on the Manhattan project and the Bikini test?

HOCHWALT: Well, there's really not much to say except that I attended the meetings with the Westinghouse people. We were the favorite boys out there. We flew from Washington to California. We boarded a government plane and flew to Hawaii. Then, we were flown to Kwajalein from Hawaii. There we got on a destroyer. We arrived at Bikini the next day. We lived on a passenger ship in order to watch the shots. After the test was over, we inspected the ships, after the radioactivity died down a bit. We found that even cans of fruit were radioactive as a result of the bomb. It destroyed a Japanese battleship. It was a marvelous experience (29).

STURCHIO: Do you remember anything in particular that people talked about afterwards while you were on the way back?

HOCHWALT: Just the effectiveness and the awfulness of the bomb. It struck a note of mental fear to see that damn thing go off, with these immense clouds of smoke going to the heavens, different flashes of light. It was a frightening thing. But nevertheless, I feel the way I said it was. So far as we're concerned, we better keep the bomb and keep it alive as a deterrent.

STURCHIO: Have we left out something that you wanted to tell us about?

HOCHWALT: You've been pretty effective. The only thing that I can tell you is that it was a great life, and if I had to do it over again, I would do the same: take up chemistry. With the opportunities today, I think they are just as great as when I came out of school. It's just that you have to be maybe a little bit smarter or at least be aware of what is going on and what is needed. That's the important thing, if you're going into the chemical industry, to know what people need. Now, are we going to have plastic automobiles and so on? Yes, I think to some extent we will. I think we need it because it would be less expensive if we can get these polymers to have the high strength and endurance that they should have. So, I think the opportunity for the student who wants to go into chemistry is still great. Everything hasn't been done.

STURCHIO: Those words may be as inspirational for some young student as the discussions you had with Professor Wohlleben.

HOCHWALT: I've had a happy life. It was full of discoveries. There's nothing like it. And I've been through that many times--feeling something, seeing something, hearing something that no one has ever felt, seen, or heard before.

STURCHIO: Of all the things that you talked about today, which do you think was the one discovery that thrilled you the most?

HOCHWALT: The Acrilan was one of them. The detergents and the agricultural chemicals, although I had nothing to do with that. I was instrumental in getting Monsanto into that, but Howard Nason and the research group of the Organic Division did it. I used to follow it rather closely. To get more food and more crops per acre, and less feed per animal, I think that's where the movement is going to continue to be. That's why biotechnology is becoming so important. Maybe we can raise plants that would be resistant to insects without pesticides, and that is through biotechnological methods.

STURCHIO: That's an exciting prospect. Thank you for taking the time for this interview. It has been very illuminating.

[END OF TAPE, SIDE 5]

NOTES

1. See, for example, Albert Frederick Hochwalt, Dogcraft. Being a Study of the Various Breeds of Dogs; Their Care and Management in Health and Disease (Cincinnati: Sportsmen's Review, 1908); The Care of Dogs (Cincinnati: Sportsmen's Digest, 1922); Dog Keeping for the Amateur (Cincinnati: Sportsmen's review, 1923); The Working Dog and His Education (Cincinnati: Sportsmen's Review, 1921). Albert Hochwalt also wrote specialized treatises on specific breeds: The Airedale For Work and Show (Cincinnati: Sportsmen's Review, 1921); Beagles and Beagling (Cincinnati: Sportsmen's Review, 1923); The Modern Setter (Cincinnati: Raessler, 1919).

2. Albert Frederick Hochwalt, Arrows of Ambition; A Romance of the Thirty Years' War (Boston: Mayhew, 1907); Greymist; A Story Founded on an Actual Episode in Field Trials (New York: Charles Renard, 1925).

3. William Joseph Wohlleben: B.S., St. Mary's Institute (University of Dayton), 1902; M.A., Fribourg, 1907, Ph.D., 1908; professor and head of the Department of Chemical Engineering at the University of Dayton from 1909 to 1956.

4. Arnold Frederick Holleman, A Textbook of Organic Chemistry. A. Jamieson Walker and Owen E. Mott, eds. (New York: John Wiley, 1915).

5. Charles A. Thomas and Carroll A. Hochwalt, "Process of and Charge for Producing Carbon Dioxide at Low Temperatures." U.S. Patent 1,777,338, issued 7 October 1930 (application filed 16 November 1925); Thomas and Hochwalt, "Charge for Fire Extinguishers," U.S. Patent 1,777,339, issued 7 October 1930 (application filed 12 November 1926). See also patents 1,895,530; 1,895,691; 1,895,692; 1,910,653; 1,973,734; and 2,063,772.

6. Carroll A. Hochwalt, "Catalytic Effect of Alkaline Earth Metals on Gasoline Fires," thesis submitted to the University of Dayton, 1935.

7. See Stanton P. Nickerson, "Tetraethyl Lead: A Product of American Research," Journal of Chemical Education, 31 (1954): 560-571; Joseph C. Robert, Ethyl: A History of the Corporation and the People Who Made It (Charlottesville: University of Virginia, 1983): 93-113; Stuart W. Leslie, Boss Kettering (New York: Columbia University Press, 1983): 149-180; Thomas Midgley, Jr., Carroll A. Hochwalt, and George Calingaert, "A New Metallo-Organic Compound: Diplumbic Hexaethyl," Journal of the American Chemical Society, 45 (1923): 1821-1823; Hochwalt, "Process of Producing Dialkyl Selenides and Tellurides," U.S. Patent 1,578,731, issued 30 March 1926 (application filed 3 October 1923).

8. Thomas Midgley, Jr., "Motor Fuel," U.S. Patent 1,491,998, issued 29 April 1924 (application filed 4 October 1918).

9. T. A. Boyd, "Pathfinding in Fuels and Engines," Society of Automotive Engineers Quarterly Transactions, 4 (1950): 182-195.

10. See Stuart W. Leslie, Boss Kettering (New York: Columbia University Press, 1983).

11. Thomas G. Midgley, "From the Periodic Table to Production," Industrial and Engineering Chemistry, 29 (1937): 241-255; Joseph C. Robert, Ethyl: A History of the Corporation and the People Who Made It (Charlottesville: University of Virginia, 1983): 93-113.

12. Thomas G. Midgley, Jr., Carroll A. Hochwalt, and Charles Allen Thomas, "Polymerization of Dienes," U.S. Patent 1,713,236, issued 14 May 1929 (application filed 25 August 1926); Midgley, Hochwalt, and Thomas, "Manufacture of Rubber," U.S. Patent 1,806,547, issued 19 May 1931 (application filed 22 December 1927).

13. "American Chemical Industries: Thomas and Hochwalt Laboratories, Inc.," Industrial and Engineering Chemistry, 14 (1936): 181; "Thomas and Hochwalt Laboratories, Research Division of Monsanto Chemical Company," Industrial and Engineering Chemistry, 10 (1938): 441-444; Thomas and Hochwalt Laboratories, Chemical Research (Dayton, Ohio: Thomas and Hochwalt, 1933).

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16. "Monsanto's Renaissance Man of Research," Monsanto World News, May 1985: 4-5.

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27. Manuel M. Baizer, "Coupling Cyclic Olefins by Electrolysis," U.S. Patent 3,193,475, issued 6 July 1965 (application filed 13 August 1962); Baizer, "Electrolytic Hydrodimerization of Two Different alpha,beta-Olefinic Compounds," U.S. Patent 3,193,476, issued 6 July 1965 (application filed 29 December 1961); plus U.S. Patents 3,193,477-483; 3,193,510; 3,198,746; 3,218,245; 3,193,480; and 3,218,246. See also J. H. Prescott, "Monsanto's Unique Process Brings Electrochemistry to Organics," Chemical Engineering, 72 (1965): 238-242; Manuel M. Baizer, "Discovery, Development, and Commercialization of the Electrochemical Adiponitrile Process," Chemistry and Industry, (7 July 1979): 435-439.

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