

An Interview with

ROBERT HERR

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Conducted by Arthur L. Norberg

on

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Charles Babbage Institute (Minneapolis, MN)

Charles Babbage Institute  
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Abstract

Herr reviews his family background and education at Haverford College, education at the University of Minnesota in the 1930s, wartime activity, and his postwar work. During World War II Herr worked for the U.S. Navy's Bureau of Ordnance, primarily on methods of defending U.S. ships against magnetic mines. The bulk of the interview concerns his work starting in 1946 at Minnesota Mining and Manufacturing Company (3M) on magnetic tape development. After the introduction of magnetic tape in 1949, Herr started a the Electric Products Lab in 1952 at 3M, and later was vice-president of the Data Recording Products Division. He also discusses 3M's relationship with Engineering Research Associates and Control Data Corporation.

ROBERT HERR INTERVIEW

DATE: 19 May 1986

INTERVIEWER: Arthur L. Norberg

LOCATION: Charles Babbage Institute (Minneapolis, MN)

NORBERG: Mr. Herr, could you tell me something about your family background? It says here that you were born in Philadelphia.

HERR: That's right. I was the third, afterthought child, in Philadelphia, born in 1918 during the first world war.

NORBERG: In what part of Philadelphia did you grow up?

HERR: I grew up in west Philadelphia, not far from the terrible explosion and fire that they had there a couple years ago.

NORBERG: That was a... if I remember, that was a chemical plant wasn't it?

HERR: No, that was when they had the riots...

NORBERG: Oh, the MOVE movement. Oh yes, yes, yes...

HERR: ... Still mad at everybody.

NORBERG: Yes, now I understand what the...

HERR: That's not far from where I was brought up.

NORBERG: What did your father do for a living?

HERR: He was what they called a traffic trunk engineer with the Bell Telephone Company of Pennsylvania. A traffic trunk engineer did with large sheets of paper what they now do by computer: he told and advised the company how to route telephone calls from one place to another. And where they might need some more long distance telephone lines.

NORBERG: Was your mother employed outside the house?

HERR: Never.

NORBERG: What sort of activities did the family participate in: were they religious, political, social?

HERR: My mother was very religious, my father wasn't; and I guess I was as a little boy because my mother put me there.

NORBERG: Where did you go to school?

HERR: I went to Harrity Grade School, West Philadelphia High School, and then to Haverford College.

NORBERG: What occasioned the choice of going to Haverford?

HERR: Chance. The way most things happened to me in my life. I had been entered in Princeton, where my father went, and I went over there and I didn't really like it very much. I said well, maybe I should change, but I really don't know to where. And I don't even know who suggested that I look at Haverford, but I did. And they said, "Oh, we'll fit you in." So I went there. It was just that casual.

NORBERG: What had you gone to study?

HERR: I didn't know what I was going to... I was going to college.

NORBERG: How did you come to choose physics then?

HERR: Well, my chief interests were mathematics and foreign languages, and I couldn't see how to make a career of languages without teaching, which I didn't think I wanted to do. So I found something that I could use my math in, and be good at, which was physics. I thought that would be a better way to earn a living. It was.

NORBERG: In 1938, that's a little questionable. Certainly after the war it is not. Who was at Haverford at the time?

HERR: Well the professor, head professor there, head of the physics department, Dr. Palmer, who died not too many years after I graduated; and then the head of the department was Richard Sutton, who was mostly my teacher when he was there. He's written a book, *Procedures in Experimental Physics*, well-known in almost all colleges. He was the one I was closest to.

NORBERG: Did they advise you to go to the University of Minnesota then, after that?

HERR: No. By the same sort of plan that I followed in going to college. I first of all made the decision that I would try to go to graduate school, if I could find somebody who would give me a scholarship or assistantship or something. Then I wrote to four schools: Princeton, because of its being in my background and being an exceptionally good physics school and nearby and so forth; Penn, which would have had the advantage of my living at home, and would have been a good idea; Carnegie Institute in Pittsburgh, because I had heard that the thing to do was to study solid state and that that was a good place to do it; and to Minnesota, for reasons that are absolutely lost--I have no idea. I think that I didn't know at the time whether Minnesota was north or south of Iowa, or where it was. I'd never been west of Gettysburg in my life, and I wrote and asked Minnesota. Now, I don't know where I got the idea. I'm sure I said hey, is Minnesota any good? But I think it was a flier on a bulletin board, and if it'd been a

Wisconsin flier or a Michigan flier there that day instead, then I would have written to them, because I had no reason at all to write to Minnesota. I do remember why I chose it: I got offers from all four schools, and I ended up choosing Minnesota, because the more I thought about it the more I thought that I'd had a very parochial existence up until then and it'd be good to get out to a different part of the country, and so I went to Minnesota.

NORBERG: Now you came to Minnesota in the math program, or the physics program... I'm sorry, it says physics and mathematics.

HERR: Minor in math, the same as I had had.

NORBERG: Now, who did you work with when you came here?

HERR: Well, I did two things. Buchta was the head of the department, J.W. Buchta. It was a pretty small thing at that time, almost all physicists in all countries knew each other, and I knew everybody in the department. But the guy I worked mostly with was Rumbaugh, because I was assigned, so to speak, to him, and Williams, and helped build that two million volt Van der Graff generator that you see over there back of the physics building. But I knew Ed Hill pretty well, and... I knew everybody in the department.

NORBERG: And then, the war came.

HERR: The war came a year and a third after I got here. It really wasn't, we weren't at war, but I was persuaded we would be at war by Rumbaugh, who was leaving to go down and work for the Navy, in the Bureau of Ordnance, as people were being called all over to help with the Navy's degaussing program, which was a very vital and under-reported feature of the history of the United States and of the war. So far as I know very little has been written--you know, the glories about radar and bombings and so forth--but actually the sinking of vast numbers of ships by magnetic mines, for which both the Navy and the Merchant Marine were totally unprepared, almost lost the war for this country. There were a lot of us brought in there, and we had to hurry and build mines, or build... this was not to

make mines but to protect the ships, degauss the ships, and we had to figure out where to put coils and how to submerge instruments and learn what the field of a ship was. So I did that for five years.

NORBERG: What in your background involved magnetism?

HERR: Nothing.

NORBERG: So, you went there just on the strength of Rumbaugh's asking you?

HERR: Rumbaugh said, "well, don't be foolish, come on down here, they need you, and if you stick around you'll just get interrupted, you'll never finish your Ph.D.," -- which was very true -- "Cause, you know, the war will snatch you up in someplace. Here's a place where you can be really useful, where you're needed, and where you'll be working in something that's at least professionally attractive." And that's what it turned out to be.

NORBERG: All right, so you arrived at NOL sometime in 1940?

HERR: Yes, just before Christmas of 1940.

NORBERG: What projects did you start working on yourself at that point?

HERR: I worked along with several other people, for Rumbaugh, Professor Rumbaugh from here, down there, and our job was to build some ranges, first job, was to build some ranges to really measure and understand the field of a ship. Which nobody had ever bothered to measure, except I suppose some Germans... This was a very broadening experience for someone who didn't know very much about ships and had never been at sea, and didn't know anything about mines either, you know.

NORBERG: Why? Tell me a little bit about how you people went about this task?

HERR: Well, in order to measure the field, first thing, the British had developed what they called ranges, which consisted of a loop of coil on the bottom of some bay or river about the right depth, which is a little bit more than the draft of the ship, cause that's where the danger is. And of course, this picked up as a ship steamed over it, it integrated the flux on a GE recording fluxmeter and produced a chart, which we all learned to read like a fingerprint expert reads fingerprints. They'd been doing this in order to put some coils on and see what worked better, but there had been no mathematical approach, and there wasn't any idea of just how good it had to be. Our idea was to study this more carefully so that we could... Because we could see that ultimately all the ships were going to have to have coils, it was going to take more copper than the United States had lying around, and it was going to cost zillions of dollars, which it did, and it was going to be important to do it very fast, if we weren't going to lose the war, which was true. Then we built... Rumbaugh's first effort, that I helped him most actively with, at first, was to build a stationary magnetometer proving ground. We went down to the Chesapeake Bay, near Solomon's Island, Maryland, and scraped one ton per ship size of oysters off the bottom, trying to make sure we didn't have any chains, anchors, and so forth in the way, jetted bronze pipe down, and then suspended in that at different depths five feet apart, magnetometers, these were flux gate magnetometers, which we suspended on bronze cable in there, and brought the cables out, and fixed all the leaks and everything else. This way we could have a ship stationary and we could have these things fixed, we also had some on a boom, which we had sailors, all cursing madly, dragging around at different positions and depths, while the bosuns were irritated that they couldn't be fighting the war and so forth. Did this for quite a few months, and got a lot of valuable data. I did that off and on for five years. Although before I was done, I spent two of those years in Panama, as the chief physicist of the Canal Zone.

NORBERG: Let me get back to NOL for a few moments.

HERR: This was also important from an ERA point of view, because down there were Bill Brown of the University here, and Sid Rubens, and Arnie Cohen, and...

NORBERG: Was Cohen there at that time? Rubens was, but I'm...

HERR: Sid Rubens was for sure...

NORBERG: I'm not sure Cohen was.

HERR: Well, I'm not sure that he was. Now that you ask me that, I'm not sure that he was. He may not have been.

NORBERG: But Wetzel was there?

HERR: Wetzel and Rumbaugh were both there, yes.

NORBERG: And Brown and Rubens, all of whom came back to Minnesota after the war, is that correct? In one way or another. Now, what association did you have during these tests in Chesapeake Bay, with what, say, Rubens was doing back at the laboratory?

HERR: Very little. I never worked closely with any of those people except Wetzel, and then Rumbaugh.

NORBERG: So were Wetzel and Rumbaugh and you in the same group?

HERR: I was assigned to them yes. And Rubens, I don't know what he was doing.

NORBERG: Well, he was also doing magnetic flux work, but using laboratory techniques.

HERR: Yes, but whether he was calculating something or whatever, and then we traveled around the world on different ships. Most of us, I wasn't in Washington very much.

NORBERG: Apparently he was all the time, because he was doing laboratory analysis on the size of the coils and

shape and so on.

HERR: Okay, so he was modeling ellipsoids to approximate the ship and so forth. He was working for Scott, from the Carnegie Foundation...

NORBERG: I have it, so that's okay. One last question then on the Panama Canal Zone: what were you doing down there, the same sort of thing?

HERR: Well, I was supposed to go down there and improve, install, and update -- this was in '42 -- the existing mines and ranges. This was an important stop, since so many ships passed through there, and we still didn't really know all about the effects of changes in latitude, which is how much of the ship's magnetism is permanent, and how much of it is induced, and what it takes to change it, how permanent is the permanent part. We were thinking of demagnetizing ships and how to do it. I was supposed to update and improve the facility. There was a team down there that had been operating ranges and measuring all the ships as they came through the canal. Every freighter and so forth. We'd signal up to set the M-coil at such and such, and you'd give them a new chart and new settings, and collect the data and study it and so forth. But I also then got involved with other parts of the defenses of the canal, and I had a submarine warfare, submarine detection.

NORBERG: What sort of projects were they?

HERR: Well, we were looking at other and better ways of... everybody was very much afraid that a submarine could lurk very close to the... the big hazard being if they could get a torpedo actually in the canal, so as to sink a ship in it, they probably couldn't damage the locks that way, but if they could sink a ship in the canal, it would really play hell, because all Navy and commercial shipping pretty much depended on those... Well, you know, the idea was to help with those defenses, in a kind of an operations research kind of way.

NORBERG: I see, rather than doing some other sort of magnetic research.

HERR: That's right. We did do some other ideas, too. I did some work on what we called thermal detection at the time, which had never really been done, or at least not to my knowledge. We went around with thermocouples, dragging them in the wakes of ships, not measuring the heat the ship created but the delayering of the water, which produced very definite signatures amazing distances behind a ship, and even in very rough weather.

NORBERG: Oh, I'm surprised!

HERR: It didn't tell you which way the ship had gone.

NORBERG: As the war was coming to an end, were you doing any planning as to what you might be interested in doing.

HERR: No, no. After Panama I was up in Newport, and up there I was working on the torpedo range station and introducing some statistical concepts into the testing of torpedoes. The Navy had systems which they guarded very jealously. I would say every time a torpedo was made they'd take it out to the range and fire it, and if it ran at the right speed and depth and within so much of the right direction, then they'd send it out to the fleet. And then also, a certain small percentage of them were tested for turns and at more than one depth, and so forth.

NORBERG: Does that suggest that torpedoes were tested before being sent to ships?

HERR: Oh yes. Had to be. Once it was tested you know, it was sent. It caused a lot of trouble when they found that over in the Pacific they... well, the range techniques were very silly, but their method of treating the data and the logic behind it was even worse. What we wanted to do was test some tested torpedoes. This was considered a very wild idea to do, because the ships were out there needing them and we could cause the loss of ships and lives while we wasted time retesting these torpedoes. It was a very bitter discussion. But we did eventually get to test some, and we found that the success of those was just about the same as those that had never been tested, which I think maybe

QC would have determined anyhow. We also found out why so many ships, a torpedo passed underneath ships, torpedoes set for fifteen feet were repeatedly passing under freighters which were known to have drawn twenty feet or so. And the Navy didn't know what to do about that, cause they were at the right depth where they tested them. It didn't take a great physicist to find out that they tested them... the pressure mechanism, which sets the depth and controls it, is set against a sealed chamber, which was sealed in waters in Narraganset Bay and then taken to the South Pacific, where it heated up.

NORBERG: So then it would drop lower.

HERR: Big days on the science front. [Laughter]

NORBERG: And did this introduce you to either people, or the New England climate, such as it is?

HERR: The only reason that I ever came back here to Minnesota was that Bill Wetzel...

NORBERG: MIT?

HERR: Oh, I went to MIT, that's right. I went to MIT; I can't remember why. It's strange, but I can't remember why I went to Haverford, or why I went to Minnesota, or why I went to MIT.

NORBERG: What did you study at MIT?

HERR: Physics and math. I know what I did there, and I did work in underwater sound, but it was new to me. I worked under Dick Bolt and Richard Fay in the acoustics lab, but these weren't people that I had known to any degree previously.

NORBERG: Was it your intention to get a Ph.D. at the time?

HERR: It was sort of my intention, but I didn't have a definite aim in that direction. Pretty soon children were coming, and Wetzel was after me to come back out to Minnesota, and I did. Now again, I don't know, I'd never heard of Minnesota Mining, except to know when I was in graduate school here that there was a company by that name, and that they made Scotch Tape. But Wetzel said "Oh, you'll love it, come on out." And so I did.

NORBERG: What were your first tasks at 3M?

HERR: Well, after about three days there they said well, you know, we're thinking about looking at magnetic tape as a product. And of course, Minnesota had nobody in this place. There was one other physicist, but of course he wasn't practicing physics, Ned Matt Davis, you know, Scotchlight Laboratory, and Bill Wetzel. He wanted me to see what I could do about that. He asked me to go down to Chicago, which I did. I talked to people down there who had made a BH meter and so forth, and I got some ideas about how to test possible tapes.

NORBERG: Who were these people? Where were they?

HERR: Marvin Camras, at what's now IITRI; what was it then?

NORBERG: Armour?

HERR: Armour Research Foundation. And I got to work trying to build, and I got started testing. I did a few other things. That wasn't a full time thing right away, cause 3M hadn't made a decision, you know, to make magnetic tape. 3M had made magnetic tape once before, or twice before, at the request of... The records are at 3M. That was before I got there. They had been asked, I'll say '44 or '45, they had been asked as a coating company to coat some gloop, which I think Brush was involved with one, and another was a government defense something or other agency, which asked them to do this. And they had coated some stuff up, you know, the thickness of paper or film and sent it back. But they got thinking about this I guess, and there I'm not sure... you would have to go to Bob Westbee to

find out why 3M, or how 3M made this decision. I was the newcomer there. But I was asked to put together, if I could, a tester. Of course, the company didn't have an oscilloscope or a vacuum tube volt meter or anything. They had a whole zillion chemical engineers, but they didn't have anybody that knew a flux line from anything. So I, along with doing other things then, I was in the physics lab. I spent most of my time from very shortly after I got to 3M until 1952, most of my time was in magnetic recording.

NORBERG: Let me get two things straight before I ask you some questions about 3M again: when exactly did you arrive at 3M.

HERR: October of '46.

NORBERG: And when did you go down to Chicago?

HERR: October of '46.

NORBERG: Okay, same time, so we can sort of date their interest from then.

HERR: I gave a talk down there on acoustics... or maybe it was November. Practically right away Westbee said... Well, I had said when I was hired I'm committed to give a talk at the Acoustical Society Meeting so I got to have a few days off right after I come to work if you want me to start right now. I don't remember the days, but I went down to the Acoustical Society meeting and gave a paper on acoustic lenses for underwater sound.

NORBERG: Now, what was 3M like when you arrived? Can you give me a feeling for the size of the company and the number of people in what I'm going to call research and development, although you may not.

HERR: I can't tell you the number of people in research and development, and everybody's definition of that is different anyhow. But sales, when I got there, I think the year that I came I think the sales were like 65 million dollars,

or 68 million, something like that, I don't know, 70 million. I think then as now they spent about five percent of their income on R&D, however they define it, you know there's big questions about that. These technical people and their support amounted to say, five percent. So they must of spent like 3 million dollars, something like that. At that time, I suppose a typical technical employee probably earned ten thousand a year, or so, maybe. I didn't; I earned three sixty a month.

NORBERG: Was the research activity broken up into the divisions?

HERR: No. It was broken up into the various product labs, but there were no divisions at the time. There was one vice-president for research and development, and there was a vice-president in charge of the central research lab, and then each of the divisions. There weren't very many [divisions] tape, abrasives, roofing granules, reflective products, and adhesives. I may be wrong, but I think five divisions, maybe there was something else I can't remember. Each of those had a product lab that was run by that division's technical director, just as it had, for the most part, its own sales people, and its own factory, manufacturing concerns. So in this case, the work was all done in central research, which is where Wetzel and I were. Now Wetzel was really, he pushed this thing, and of course he spent the whole rest of his life at it real hard. Westbee was the, in my opinion, the entrepreneur, you know, that made it all happen.

NORBERG: In what way?

HERR: Well, he's the guy that really made people approve it, got the money, you know, got the approval to hire people, and I think's the one that was the entrepreneur at 3M. But you see I'd like you to talk to Westbee, if you want to know that answer, because from where I sat, I saw him, Westbee and Wetzel interact. But I never knew for sure how much Wetzel was pushing Westbee and how much Westbee was pushing him. And the other thing that really made it go was Mr. McKnight. Now Mr. McKnight -- you're familiar with who he was -- Mr. McKnight was very interested in this business. It was... he just got all excited about it. He was down in my physics lab looking at little loops of tape and listening to beeps and so forth. He couldn't leave it alone. And that's why it went, because most of the company didn't think much of it as an idea. I know from, again, I wasn't responsible for that at all. But I know

from some of the things Wetzel and Westbee said to me that Stephens, the head of central research, went over there from the University here, he thought it was a waste of time. And I think most of the people in the other divisions all thought it was a... what the hell would you want tape for, you got magnetic wire, and besides it's going to, it's far from what the company knows anything about. It was mostly negative, except in a situation like that, where the vote is nineteen to one, and Mr. McKnight was the one, why he prevailed. You've got lots of support. And I can even remember that..I can remember..whether Westbee told me, or I concluded later on, that it was really only allowed to proceed because people thought, well, it won't cost any money. We already have the coaters and slitters and we have an iron oxide plant at Copley, Ohio, and you know, so it won't cost anything but a few hours of time anyhow. Well, they were very wrong, it took a lot of effort and time, and the first thing...

TAPE 1/SIDE 2

HERR: We never used the first gram of oxide from Copley, Ohio, and the first thing we found was that we had to get all new different kinds of coaters, slitters and so forth, so it was a false reason for allowing us to go ahead.

NORBERG: Well, now as you did go ahead, though, what turned up? Let me ask that.

HERR: It went very fast, very, very fast as new products go, then or since or in my experience, practically ever. Because there was a big need for, big appetite out there. And there was a lot of excitement -- the excitement was about the wrong things. I mean if you read the Sunday supplements at the time and so forth, they talked about this miracle of recording: we could record cycles on tape and people would be able to write letters to each other by tape instead of writing them out, living letters. But the biggest thing was that it was going to revolutionize the music business because nobody would buy any more records; after all, if you could just record what was coming on your radio, why would you ever bother to pay a record company to record it for you? It would be the end of the record business. This is what was the popular conception. Now the fact is... I gave a talk over here just a few weeks ago at the EE Seminar of Jack Judy's regular seminar -- they are thinking about comparable problems that are coming up with optical recording today. Now I happen to believe that most of the perceived big things that are going to happen

probably never will or won't be very big and that the important things will be new things that optical does better and aren't being done today. But that was certainly true then. You might be interested to know what the first really commercial use, the first commercial, well, I won't say that, there were two. There was the big use and big appetite in broadcast to get something of broadcast quality so you could record and play back later. The first product that we sold, I think, with a real bonafide commercial value to them, was 35 mm film for the making of motion pictures. And the real value that that provided -- there was better sound than on those old photoelectric tracks -- but the real value that it provided was the instant playback, the fact that you didn't have to wait till the next day to see if you had to do yesterday's shooting over again. In other words, you could record it, play it back to find out if everything was okay.

NORBERG: Now what sort of substrate was that? Was that a cellulose...?

HERR: That was a regular cellulose-acetate -- they weren't using cellulose-nitrate still -- motion picture film. And DuPont and Kodak were both in the business. We were competing with their film.

NORBERG: What was new about the 3M film? Anything?

HERR: Well, nothing new, except that it was magnetic and the people responsible for bringing this miracle about in the industry weren't very enthusiastic about it. You know, these people had spent their lives writing papers about the relative advantages of variable density versus variable area, photoelectric recording, and solving the problems and distortions of the current. And all of a sudden they're faced with magnetic, and all the standards committees and the big moguls and so forth don't know anything about it. I believe that the reason we were successful there was that in the first place we took the trouble, which they (Dupont and Kodak) didn't, to run a good technical service. I got on a sound committee, SMPE sound committee, and I wrote lots of papers which we gave out, you know, sound recording notes. These are all available from 3M, if you haven't seen them I have some. I'd send them out monthly. These were world-wide experts in recording who didn't know anything about magnetic recording, didn't understand what a flux line was, didn't know how a head worked, didn't understand what contact was about, or why a permanent magnetism in the head would give you an even order harmonic distortion or whatever. And so we were seized upon

by these people who were in danger, you might say, of losing their jobs and their preeminence.

NORBERG: These people meaning Dupont and Kodak?

HERR: RCA and Westrix -- Western Electric. Those were the two main producers of sound tracks. Then the people at the studio that led the sound department at Paramount, or at 20th Century, or whatever, they were all ignorant of this and they didn't have any staff that knew anything about it. But it was clear that they had to do it because of the instant play-back feature. It's interesting from the perceptual point of view to see why this new technology succeeded. It wasn't one of the things that anybody thought much about, you know. And right from Vladimir Poulson on down through the magnetophone people and so forth, instant play-back was not the feature, but that's the first thing that really succeeded.

NORBERG: Let's drop back...

HERR: The other thing, though, that went on was the radio business, as I say. And that had a lot of push because of Bing Crosby and Jack Mullin and the Magnetophone and so forth. There was a big desire to make a machine sort of like the, and we would make a tape that would cooperate with that machine and be a standard in the radio business.

NORBERG: I'm going to come back to that because I did some interviews with the Ampex people some years ago.

HERR: Myron Stolaroff...

NORBERG: Stolaroff and Ginsberg and Poniatoff and some of that group. But let's go back to this October of 1946 and the visit to Chicago. What came of the visit with Marvin Camras?

HERR: Well, first I met a fellow who knew quite a bit about it, so I had somebody I could talk to. There wasn't very

much written about this, you know. And the second thing is he hadn't invented anything and he gave me really his design considerations and so forth for a BH meter, which helped me a lot, because that enabled me to measure the coercive force without designing and doing it three times. In other words, I came back with some dimensions in mind, the number of turns and I could have the shop put something together. They made a BH meter so I could measure the loops, because prior to that we'd just been looking around at bins of different iron oxides, some of which were not even magnetic and some of which had different coercive forces and particle sizes. How I was able to make something to correlate this with some observations. But I didn't have anything to observe. The only thing I could do for a while was to take a piece, slice it with two razor blades a quarter of an inch wide and splice it into a piece of Brush's tape which was used on the Brush Sound Mirror and see if it was louder, softer, noisier or whatever... the Brush machine and its bias. It was very crude. It was during those stages that we set up the arrangement with Sid Rubens and friends at ERA. And I actually, before I was set up, while I was having the shop build stuff and trying to get the company to spend hundreds of dollars on amplifiers and meters, Bill Wetzel and I used to drive over to ERA at Prior and Como, or wherever it was...

NORBERG: Minnehaha and Como?

HERR: ... and I'd go over there with -- we had a guy making oxide, H.K. Smith. He's dead long since, a colloid chemist, we had plenty of them. In other words, we had people that had no idea why they wanted or which oxide they wanted to have. He would make them some oxide and he would disperse it in different binders and coat it by little hand coaters and so forth. I used to drive over there with him, Sid Rubens would put it onto his drum which he was testing with Scotch tape and then they would spin the drum and tell me whether the pulses were bigger that day or larger or smaller or more noise or less noise, saturate it with DC, make a noise spectrum and so forth and then I'd go home and try a different batch. I can even remember people at 3M while I was trying to buy this equipment said, "Well, what are you doing now?" and I told them and they'd say, "Well, why don't you just keep that up?" That's what a great effort it was.

As a matter of fact, talking of great efforts, at that time Kodak and Dupont both dropped out of the business. I don't

think I knew at the time, I think we may have suspected, but we later came to know people in both organizations and do, I think, know why they dropped out. Kodak dropped out because -- they made many efforts to get back in, but they dropped out again so -- but at that time they dropped out because they, like 3M, they had a wrong perception of what was, you know, the importance of the whole industry. They felt that it was impossible for them to go on having iron oxide around their photographic film plant, because one spot of iron oxide is a big, black dot, you know. It practically never occurred to them that the business is such that it would warrant a separate coater or a separate building to do it. Dupont dropped out because of a slogan, motto, or some handed-down wisdom that says that we at Dupont don't compete with our customers. For example, we make cellophane and 3M makes it into a pressure-sensitive tape. We make this and that but we don't compete with other people. Well, they did make photographic film, I don't know what they thought, but anyhow, or maybe they wanted a good excuse to get out of this, which cost them a lot of trouble and not making much sales. Again that was a company which at that time knew a lot about dynamite, knew a lot about nylon or rayon or whatever, but they didn't know anything about electronics. Of course they've since decided that was very important and made great strides. In '47 I think they decided it was a mistake for them to mess around with that.

NORBERG: I still want to pursue this late '46 and early '47 time period in that when you arrived at 3M what sort of equipment was already there? You mentioned the Brush Sound system...

HERR: I don't even think it was there. It may have been there, but I think there was nothing there but a wire recorder and somebody had heard of Brush Sound Mirror and we eventually bought a Brush Sound Mirror.

NORBERG: What was the wire recorder? Was that by any chance a German Magnetophone?

HERR: No.

NORBERG: Had you every seen one up to that point? Did you see one afterwards?

HERR: The German Magnetophone is a tape machine, not a wire machine. I've never seen a German wire machine

NORBERG: Was there a Magnetophone tape machine available?

HERR: No, no. Only what Jack Mullin [brought back], and you've been through this story I take it.

NORBERG: I'd like to hear your tale of it.

HERR: Oh, I don't know anything about it, except that I know it from Jack, whom I know personally and I saw at the time. Jack came and visited 3M to try to work with us to tell us what he needed and so forth. So I saw the pieces of the machine. I saw them in California. I don't remember just what order I saw which ones in. He was looking for a machine that he could use, he needed a medium to make this machine and to develop a new machine. He wanted, of course, to develop a better machine if he could and a better medium if he could and we didn't know how to tell him what would be better. So I worked with, Jack came to the Benz Building in 3M a number of times, and I visited him on the West Coast a number of times. I can't remember all the iterations of that.

NORBERG: Well, what were...

HERR: See, he was working with Ampex to develop, ultimately to find a way to make a commercial machine. He was a kind of a go-between. I can't remember his exact relation to whom. He later of course became, or maybe at that time was, part of Bing Crosby's organization. I can't speak for him.

NORBERG: Did 3M have an association going with Ampex at the time?

HERR: No.

NORBERG: Is it your understanding that Ampex was developing their own tape then?

HERR: No. I think they were developing, I think Jack Mullin was developing a machine which would serve as a prototype for something that Ampex would manufacture. But this is not the fall of '46. This is, you know, around '47 or so. And they were expecting, Jack was expecting to get the tape from 3M. Ampex to make the machine. They weren't interested in making the tape at that time, maybe they did but I don't know.

NORBERG: All right, back to those machines that were available at 3M at the time when you arrived. Did you try to ascertain what the problems were with those machines, so as to develop a research project to improve them?

HERR: Well, I built the BH meter and then I later built a little loop tester and so I could measure signals. I used a Hewlett Packard wave analyzer so I could tell about distortion and I tried different... Of course, Smith was starting to make different oxides, some with higher coercive force. Those early ones, you see... Our first tapes were Mapico black and had coercive forces I think of about 110 oersteds and that's what the Brush machine and the heads were set to do and the like. But it didn't take us very long to think up the fact that if you were trying to get more energy and a better signal-to-noise that you really shouldn't be using a little equant particle like this. Between Wetzel, Herr and Smith...

NORBERG: I'm sorry. A little what type of particle?

HERR: Equant, I said.

NORBERG: Equant?

HERR: Yes.

NORBERG: E-Q-U-A-N-T.

HERR: That's a crystal habit.

NORBERG: OK.

HERR: Lamellar, tabular, equant, columnar, you know, acicular. We decided that the circular particles would be better if we could make them. Smith knew how to make them, so he made some and they did turn out to be better. It was quite an invention. Turned out to be a hotly contested patent. It was an independent invention on our part, but I think it was anticipated by some general prior art and some work at Armour, also. I can't remember that for sure. I was one of the inventors when it was first filed. As the claims gradually got knocked apart and so forth what remained turned out to be a Smith patent, not a Herr, Wetzel and Smith. So we were working on oxide and the colloid chemists were busy working, and we were trying to tell them, you know, trying to figure out what the effect of coating thickness is and how thick we really wanted it, roughness, smoothness, wear, abrasion. The heads were all made with mu-metal and they wore out pretty fast if you made a good grade of sandpaper, which is what rouge cloth is what we were making to begin with. Of course, we wanted a high density and we were dispersing it with ball mills and blenders of all different kinds and looking at the damage to the stress of the material, what it did to the magnetic properties. It was a very unacademic, very experimental approach to things, but we quickly found that some things made the recording quite a bit better and we learned that we wanted a square hysteresis loop. We wondered why some tapes were exceedingly difficult to erase and how to avoid some of that. Hyflux tape was on the market. I didn't mention that. Do you know about hyflux tape?

NORBERG: No.

HERR: That's interesting tape. Hyflux tape was made by Indiana Steel Products people, the people who made permanent magnets. And they had a terrible tape. It was some kind of a porous paper backing that was sort of coated, sort of impregnated with iron particle type. I'm not talking about the fad that started in the '70s, I'm talking about the one that was going on in the '40s. They had iron particles. They must have had tremendous heterogeneity and they also were pyrophoric; every now and then a box caught fire. It had an enormous hysteresis loop. It wasn't

very square at all, I mean 2000 oersteds; you wouldn't erase it really, so you could never get it really cleared off and clean and so forth. It was out there being sold, though. They must have known then... Bob von Behren came from there, so if you talk to him, he could tell you all about Hyflux tape. That was never our real competition and they didn't stay in the business. It was a poor product and they obviously hadn't done what we were doing, which is try to understand what the world needed and to help people understand how to use it.

NORBERG: If I understand what you're telling me then, you were working on the testing of the tape samples that were being produced by Smith and the people who...

HERR: And then later the production, wasn't really production, but the making of tapes in more than hand spread size wasn't done in the Benz Building, it was done in the Tape Pilot Plant, because they're the ones that had the coating equipment. It was partly against their better judgment by Mel Hegdahl, later vice president of the division after Dr. Wetzel. They were making significant runs by known coater technology and trying to slit them into rolls and learn what iron oxide did to slitter knives and making rolls of tape to send out.

NORBERG: Well, the reason I pose...

HERR: Those also I would test each day as they made some more or tried a different experimental batch, a different coating speed, different temperature, different colander or different paper backings or film backings and so forth. They'd send them down to me in Benz Building and I'd tell them what was good or bad about it.

NORBERG: But the reason I posed my statement that way is, the question comes up did you make any attempts to improve the measuring equipment other than the BH and flux meters and so on by doing any research on recording heads or circuitry for read/write or any of that?

HERR: Let me think. Well, I think if I'd known you were going to want to know so much I could have brought more papers along. I think I misunderstood the scope of what you're interested in. I thought you were only really

interested in interactions between 3M and ERA.

NORBERG: We can have another meeting, that's ok!

HERR: But, yes, I got very much interested in which transients were causing certain changes in the permanent magnetization of heads and proper ways of switching. These were more user tips and this is what we could publish. And it helped make 3M successful, because we weren't about to tell them and no user would have cared anyhow about how do you disperse it and so forth. What I was doing and what they were telling people, users needed to know. Well, I was concerned with layer-to-layer transfer of signal and why this was occurring and trying to understand long time effects. Why signals got harder to erase after a period of time; invented selective erasure, way of getting rid of transfer. This was a big thing. This is all analog. There's nothing today in a digital world. But the magnetization of one layer by the next layer wound to it. Then I studied the idealization of the ? fields, stray fields, promoting transfer and I found ways to erase that transfer layer without touching the recorded signal, which frequency erase fields will do. Patented that. No one's ever used it. Contact duplication, of course, came along for us in the '40s [possibly '48, '49]...

NORBERG: '49 it was published.

HERR: You know, it wasn't very long before I was making copies magically. Mr. McKnight was down there to look at it and was excited. That was an interesting experience for me, because that subject -- and it's still active today. The Intermag Conference in Phoenix last month had a paper on contact duplication -- this was disc recordings. They're going to do it all over again. I also had lunch, dinner with a guy at Dupont, who claims that they now really have spent a lot of money and they really got video duplication. It's hard to get me to listen to those people because it's a subject that has this absolutely insidious effect on people. There's this feeling that you're getting something for nothing, you know, instead of all these heads, and electronics and really expensive multiple recordings and wires and amplifiers and so forth, just run the tapes together and it's recorded and you could run it just this side of the speed of light if you could get them to not slip as they go by the idealizing, whether it's field or heat or whatever. It just seems

so, it just gets people excited. And it has done some, the first talk that I gave, you say you have this stuff on duplication, there were several articles published: *Electronics Magazine*, *Teletech*, and so forth. I don't remember the articles so much, but I remember the first presentation at the National Electronics Conference in Chicago. I went down there to give the paper and I had 5 copies of the paper with me. It was unreal. It's never happened to me since, but when the session was over I was just besieged by people including reporters and everybody. They wanted copies, they wanted interviews, pictures and statements from 3M and so forth. Only thing I could do was to arrange a meeting for the next day, because here I was head of the Physics Lab in Central Research and I just was not going to make complete speeches to the press or anything. Well, without any interviews that was carried nationwide that night, because there was no television to speak of, but it was on radio all over the country. We've got the clippings by the 3M clipping service -- you know, 3M hires these people -- it was in hundreds of newspapers all over the country: Gatlinberg, Tennessee, Boise, Idaho, you know, just all kinds of little towns in Alabama and Maine. It was featured in Newsweek magazine, that week they had a picture of Robert Herr with his magic box. They printed up, they sent a public relations guy down to Chicago on the train that night with a whole ream of reprints. They were all gone just like nothing.

NORBERG: This was on tape duplication now.

HERR: And it just seemed like people couldn't believe such a marvelous miracle. I didn't think it was that miracle-like, but the world did. You can't really understand it. I'll bet you that 3M, in addition to making a half a dozen copies when I first got approval of the paper and then about 500 that night before sending a guy to Chicago with them, with some statements, and some statement from Westbee or somebody that we could use, but that night they said this is really pretty hot and I think they said to print 5000 copies of the article. But I think 5 years later, they probably printed 15,000 copies. I'm sure that we've given them -- I don't know any numbers, it's got to be quite a few reprintings in the thousands that were sent out. Every 5 years it would appear, like a tidal wave or something, inquiries coming all over and people starting up a new project and they want to know if they can have a copy of this paper and a copy of the patent and all this stuff. I guess it's never been used for anything successfully.

NORBERG: What was the reaction back at home among 3M people who up to now sound like they were a little skeptical as to whether...

HERR: Well, long before this they were no longer skeptical. That skepticism vanished rapidly, because everybody could see that this was a big, successful product, only a few months after everybody... Because you know you just couldn't make [enough]. We were shipping it, we were shipping it to customers, for many, I'd say no more than 8 or 10 months after we made the first hand spreads of oxide. And that just never happens.

NORBERG: So that's in about August or September, let's say 1947.

HERR: Oh, I can't remember those dates.

NORBERG: As I remember the National Electronics Conference in Chicago, that was November of 1947.

HERR: Oh, I think it would be later than that.

NORBERG: Then it must be another one than the one I'm thinking of.

HERR: I don't have the right things with me to do this.

NORBERG: We should check that, because that would be interesting to know.

HERR: I think that's more like '49. No, the enthusiasm around 3M changed very rapidly, especially with Mr. McKnight getting more excited by the day and the sales going on and visitors from all over the world, you know. If they'd have had 15 of me, which they didn't have any others of, we got Byron Murphy in on the act then I'm sure, it was just like a long-distance switchboard back in the days when people didn't likely make long-distance calls. There were people all over the country and all over the world calling in. Wanting me to come to Europe, come here, come

there, copies of this, papers, dates, can they visit 3M. So it was very apparent to the company that whereas they hadn't been very excited about it, the world was. And so that attitude of "what would we want to do this for?" that...

TAPE 2/SIDE 1

NORBERG: If this event in September of 1949 was so earthshaking on the company in terms of the immediate reception by the press and by so many writers in the magazines in the country, what was the competition like at the time? Who did you people at 3M see as the principal competition for such tape?

HERR: I can't, I don't know that I can really give you a good answer to that. I was pretty well concerned with the technology and standards and I was very much concerned with the commercialization, but working with the users, not plotting the role and not involved with the selling of it particularly.

NORBERG: But you didn't hear things about Ampex is going to come out with a new coating and therefore, we have to work on something else?

HERR: No, no. I really can't remember that being a concern of ours. We had, you know, we started out with 100% of the market, essentially that, and we were just making that, growing, and building equipment, producing and so forth as fast as we could for many years.

NORBERG: Two other questions occur to me on this same topic and one of them is when did 3M begin manufacturing recorders of their own? Didn't 3M put out recorders for a time?

HERR: Oh yes. Well, that work, I'm going to give you very little information on, because I don't want to misstate, Westbee might be able to do better. But the reason I say this is at the end of 1952 I had been asked to leave the Physics Lab and to start a new Electrical Products Lab, which the company never had before. We just sold some electrical tapes, which were made by the Tape Division and were a separate sales force. Westbee really wanted to

build this into a division. Of course, it's been built into a whole group of divisions, but in those days it was just a sales force. He wanted to make a division out of it. He wanted permission to start a separate lab apart from the tape lab, because he wanted to get into ? ? and connectors and lots of things that the tape lab could never get to that way. And I left the Physics. So from '53 through '62 or so, I was running my tail off trying to get a whole bunch of electrical products started. I retained my academic interests and my friends and so forth in magnetic recording, but I really didn't, I wasn't there for the day by day stuff. I was involved in the very first meetings with IBM on computer tape and I really had nothing much to do with the video business at all in those days. I can't tell you about dates.

NORBERG: Well, how about the audio recorders?

HERR: Well, the audio recorders really started, I think if I'm not mistaken, the audio -- again, I don't have very good dates on that -- but we had two efforts in the recording business outside of some developmental work of 3M's which never saw the commercial light of day. One was, we bought the Revere Company down in Chicago and made Revere Recorders, Wallensak recorders, but it wasn't done in '52. I can't remember when it was done, but I wasn't involved with it in any way.

NORBERG: But it was later than '52, you think?

HERR: Oh, yes. I think so. I can't remember being involved in that at all, except knowing the people who were doing it, you know, hear them at talks and parties or lunch table or something, but I had nothing to do with it. The other was when we acquired, really, the part of Bing Crosby Enterprises, which did recording work. Now that had been picked up by a bunch of people who worked for Bing Crosby, and they were making, they were going to make a TV recorder, and they were going to make various other things. They ended up with a business making the first, best, really broad-band instrumentation recorders. I got very involved with that starting in 1966, when I was sent out to California to run the Mincom division. But it had been our division, it had been 3M's since '60 or thereabouts, '59, '60 somewhere. They had been working on these subjects prior to that time in the '50s, Jack Mullin. This was high technology recording, primarily for the intelligence services in the government. It was primarily a government

business, making very big, fancy, \$50,000, \$80,000 recorders, enormous for that time band-width first one and a half, well, first couple hundred thousand and so forth, one and a half, say two megacycle band width. We didn't have megahertz in those days. They were the best in the world. Ampex later was in that business in a big way and we certainly competed with them. But that's what was going on in the '50s. Some 3M history might carry those people's employment dates, you know, dated from when they came to work for Bing Crosby.

NORBERG: Unfortunately, I haven't seen any of that. The things we've been able to turn up on 3M's history don't go into that sort of detail, so it turns out not really very helpful.

HERR: But 3M was very prominent in that early work. There they built heads, the best in the world. These heads sold for thousands of dollars apiece, you know.

NORBERG: Now, were these video heads or were these audio?

HERR: Straight track instrumentation heads, some of them were FM, some were, most of them were really, well, quite frankly they were broadband and the idea was to record from as close to zero up to maybe 2 megahertz with very little time-base distortion. What you really wanted to do is to, instead of a bunch of audio recorders, you wanted to record the whole AM spectrum.

NORBERG: Now were you in on the development of those heads?

HERR: I ran the business for a while, but I wasn't there at the early start of that business.

NORBERG: Let's go back to late '40s again. I want to get to this mixed ferrite project eventually. As time went on from '46 through to '52 when you went to the electrical products development, who else joined the group? How did the group expand?

HERR: Well, as I said Byron Murphey, Dr. Byron Murphey came there. I can't remember, but very early in the magnetic history. He was a previous graduate student and I am just trying to remember where he came to us from. He was a fellow graduate student with me and I'm trying to think where he was, but it escapes me. He worked with us for a number of years and then went off to work at Sandia and later at Livermore and he just retired two years ago from out there. Byron did an awful lot of the bench work also in testing and ideas, and some of the papers were co-authored with Byron. So he was very active in the early magnetic development work there. Other assistants got added from time to time, but I must say, most of them for the most part were not active in the recording. Clark Johnson, late of Vertimag now out in Colorado, was hired by 3M. He never worked for me. I think I had something to do with hiring him, but I think before he came to work I was off to run the electrical lab and he was doing magnetic recording work there. I think good work, I think from '53 to '59 or something like that that he was around. In the meantime, there were other people who, they formed a division and I stayed behind in Central Research to get started on electrical work and that kind of thing. And so in the divisional lab, there were various people who did have, who had to have, electronics skills. Originally, they called quite a bit on a fellow named Bob Marchant, who died years ago. He built a duplicator, not a contact duplicator, but a multi-drive, you know, a big machine with a big drive and a lot of rolls and everything, signal, you could make a lot of tapes. We didn't want to be in that business, but we did want to see it take place. That was one of those things which 3M did in order to get the ball rolling.

In fact, they had this outfit here in Minneapolis, this is, again, not part of my background. Larry Lueck, now head of MMIS in Chicago, was the guy that later left 3M to run this business. He helped set it up and everything; later left to run it and of course, later went on to all kinds of marvelous things. Andy Persoon that I mentioned was the guy that probably would have the best recollection from the coating and manufacturing of tape, and the packaging, the commercial, he didn't do the production but he was involved right from the beginning. He was one of the fellows who was making the samples and involved in that sense. Jack Hill worked at 3M. I think later at ERA and so forth, if my memory's good.

NORBERG: Jack was on contract when he was with ERA to finish a job that he had been doing on sandpaper machine, I think, a coating machine making sandpaper.

HERR: He was involved with some early part of the magnetic work if I'm not mistaken, helping with it or helping this fellow Bob Marchant. He was not a researcher; he was an engineer. He built things, you see.

NORBERG: That would be Jack's ability, too, as a mechanical engineer.

HERR: Yes, right. And I guess I'm... Vic Mohrlant is a guy that can tell you an awful lot about the audio and the video business, much more than I can.

NORBERG: How do you spell that last name?

HERR: M-O-H-R-L-A-N-T or D-T. Vic headed the technical service part of the lab under Persoon, under von Behren first and then under Persoon for many years. Dick Dubise joined the laboratory -- oh, that was later. He never really headed the magnetic research so much as he did other recording. He did electric beam recording. He certainly did magnetic recording. He's still over there. He's a corporate scientist now. Vick Mohrlant would be a very good one to tell you about the content of that divisional lab, because really shortly after the divisional lab got any real capabilities of their own other than coating, slitting, and that kind of capabilities, which binder to use and probably get the surface smoother and cure at which temperatures and all that. That's about when I kind of got out of the picture.

NORBERG: Whenever one develops a new product of this kind such as the tape, other auxiliary equipment must be produced in order to produce the material. Were you involved in any of the production development equipment at all?

HERR: No. None at all.

NORBERG: That was a second question that I had in mind.

HERR: I really...

NORBERG: All right, before going on to ERA, I'd like to ask you something about interactions with Brush Development Company. Did you have much of it at all?

HERR: No. I had letters back and forth. Otto Kornei and what's his name...

NORBERG: Begun was there.

HERR: Joseph Begun.

NORBERG: Did you meet these people at professional society meetings?

HERR: Yes, and at the standards meeting and so forth. I was on one of the committees with Begun. There were other people. A big, big leader in the industry. I have a lot of that stuff, but mostly I wouldn't have it at home, notebooks and so forth at 3M, which I'm sure could be made available to you, but oh hell, they're in the vaults there and they're not my property they're 3M's. Big areas of expertise: RCA, in Camden and also in Hollywood, was a big source of papers and the like. Also Stromberg Carlson had a fellow who in the very early days was one of the creative thinkers, writers, speakers at conventions and trade shows, and I can't think of what his name is. I'm sure he's not alive anymore because he was... I remember him as a 60-year old man when I was doing this at age 30, so I'm pretty sure he'd have to be almost 100 now. I don't think you'll find him. Lynne Holmes was his name from Stromberg Carlson. Art Blaney was RCA in Hollywood. So there were these centers and, of course, Marvin Camras in Chicago. Nothing special in the government. It was years later before there was anybody doing anything creative or original in any government laboratory as far as I'm aware.

NORBERG: On these standards committees that you served on, was there discussion about the differences between data recording and audio recording?

HERR: In the case of, say, the SMPE -- it wasn't the SMPTE then -- they were only concerned with recording audio. It was a band width that was suitable for release on film, so it was a very narrow scope. That was with their standard. Now since then, of course, the SMPTE has got into television and there are all kinds of standards. When I served on it there wasn't anything involved with it except motion picture sound, because that's all the whole society was about. Not just sound, pictures and everything but I was on the sound committee and that was all it was concerned with. In the case of the later days, of course, we got people from the divisional lab, marketing people and so forth, representing on a number of committees at the IRE, Institute of Radio Engineers that no longer exists, and AIEE, which is a forerunner of today's IEEE. They all had committees. In the case of digital data recording, I never had anything to do with any standards there. I was really, some of the last things I did was interact along with other people, interact with IBM in that big effort which IBM got together with 3M and at quite a high level. This was planned. We went off to Poughkeepsie, and I mean Mr. McKnight, Westbee, Wetzell, Herr, von Behren, there must have been ten of us all went up there and stayed in that old mansion that they had there at Poughkeepsie and met for about three days with the top planners of IBM. IBM wanted to make a magnetic tape memory. They had developed ideas, you know, vacuum columns, drives, blocks, data, and all this stuff. That was their business. They wanted a medium and they knew little about magnetic tape. It was a cooperative arrangement. I don't mean it was a conspiracy, it was a customer. They came to us as the best equipped vendor to do this and we worked very closely with them on a private basis to develop the kind of product which they needed.

It's a wonderful way to develop a product, because there are always a lot of compromises that have to be made, if you can't do it all yourself. And even if it were all done in one company you always had to make these compromises. The machine guy wants the tape to be absolutely uniform in width with absolutely no curl and no stretch and infinite strength and so forth and the tape guy wants all those things to be somehow taken care of in the mechanics of the machine, there's tolerances, oh, how wide the track has to be and how straight it can be steered and all of that sort of thing. Very, very useful businesslike constructive arrangements. But there were no standards, you see, because nobody was using any tape. There had been some metal tapes, of course, had been used, and people had tried putting stuff, of course, on tape. But a real high-quality, well controlled, error controlled sort of thing that IBM came

out with as a result. And that was a very great thing for 3M. There were no standards, I mean, if there ever was a defacto standard, that was it, because there wasn't anybody else working to come out in the same way with anything.

NORBERG: ERA had an interesting experience with IBM in 1949 and '50 in connection with magnetic drums. When was the computer tape discussion going on?

HERR: Early '50s. I can't tell you the... But it would be like '51 or '52, something there. Conceivably. Not in the late '40s, certainly.

NORBERG: Who did you meet with when you went there to IBM?

HERR: I've lost it. I'm sorry I can't tell you.

NORBERG: I'd like you to reflect a moment on a couple of the people that you have mentioned quite a number of times in the discussion over the last hour. One of those is William Wetzel and the other is McKnight, who I'm sorry I can't remember his first name at the moment.

HERR: William.

NORBERG: William, also William. William McKnight.

HERR: William is not Wetzel's name. Wilfred. Wilfred W. Wetzel, William L. McKnight.

NORBERG: I guess I just assumed that the W was...

HERR: He was known as Bill.

NORBERG: What can you tell me about Wetzel, since I can't ask him at the moment? What was his background? Was he also a physicist?

HERR: A geophysicist. And he taught over here at the University of Minnesota, taught geophysics.

NORBERG: Now is that before he went to NOL?

HERR: Oh yes. He went down there. He went down there very early, and as a matter of fact, I have trouble with the memory, because I attributed some things earlier to Rumbaugh that may have been, Rumbaugh was involved also, but I'm not sure that it isn't Wetzel more than Rumbaugh that... Both of them, maybe Wetzel more than Rumbaugh who conned me into going down there in December. As a matter of fact, I drove his car and his wife down. He went down there and got absorbed and I had to bring Lydia and his old Chevrolet and their household or apartment possessions and drove them all down to Washington. Right after the Armistice Day blizzard. Do you remember?

NORBERG: What sort of fellow was he to work with? How did he go about interacting with the people who were his professional colleagues?

HERR: He was not socially at ease; he was not an easy fellow to meet and be with. I'd known him for a long time, but he was moody. He was very studious and independent. He was bright; he was a good physicist. He was not smooth.

NORBERG: What was his way of dealing with a technical problem when the two of you would be discussing this?

HERR: Oh he would just get a piece of paper out and start drawing pictures and lines, saying what he thought, leaving it. But he was good at listening. He was very much a doer, a very practical guy. He was not bad theoretically. But he was a real doer in the sense of work all kinds of hours, hard and so forth.

NORBERG: How about McKnight? What can you tell me about McKnight?

HERR: Most people around even 3M today can't tell you very much about McKnight. I had no special friendship with McKnight, but I can remember more about McKnight than most people now alive only for the reason that he got so hot about this magnetic recording that I spent quite a few different meetings, hours, trips, luncheons, dinners and everything else with Mr. McKnight, only because as I say he was so hot on magnetic recording. So I got to know him better than most people, not through any special cleverness of mine, but just because he didn't know most of the other people that were hired when I was.

NORBERG: So what did you learn about him?

HERR: Mr. McKnight was an exceedingly shrewd person. I mean that in the most complimentary way. He was very patient. I remember him best because he had the most wonderful talent of asking questions. He grasped ideas very quickly and he asked the most penetrating questions. He remembered everything you ever told him, too, so you had to be very careful what you answered. You could never expect that he'd forget that if you wanted to tell him something different, because he had a marvelous memory and a very... He spent an awful lot of time asking questions, which is a trait commonly found in people like that. He had quite a lot of patience for a person of his position, power, wealth.

NORBERG: Did he come in and tinker with things in the lab while you were working there?

HERR: No. No. No.

NORBERG: He would just ask questions then?

HERR: That's right. He was also very participative. It's very hard, of course, you couldn't today. Al Jacobsen or Lou Lehr couldn't do what McKnight did, because the company is 100 times bigger, 150 times as big in dollars. It's

probably 30 times as big in complexity, so you'd have to expect AI to do each day what McKnight did in a month. So obviously you can't, but in those days, McKnight really... He didn't just read reports or talk to Westbee in the executive dining room or anything; he really got involved. He went out and talked to Sarnoff at RCA to find out what he should be thinking about this. He went and talked to the people at Dictaphone. He wanted to know what were the problems and the needs and so forth of magnetic tape based, belt based, Dictaphone dictating equipment. And the president of Dictaphone came up. He took the initiative... He didn't try to make... He never made any decisions as far as I know in, say, telling Westbee what to do next. He worked more as an enabling influence. He knew what he liked and what he didn't like and he put his weight behind what he wanted and he'd take time and trouble, phone calls and travel and so forth to make it happen. But he was a... It was a privilege to have encountered somebody like that. He was really quite a great figure. Just like everybody else he was human and not perfect or anything, but he...

NORBERG: Do you have indication why he took such an approach to magnetic recording? He never said.

HERR: I think he just saw this as something that was a great thing for the world. He may have had a better perception than a lot of people. I don't know what his perceptions were. He wasn't great in telling me what he thought.

TAPE 2/SIDE 2

NORBERG: You mentioned some time ago, now, that you and Westbee and maybe von Behren and others would travel over to ERA from one side of St. Paul to the other. What did you find when you went there? Do you remember your earliest visit, for example?

HERR: I don't remember one from another. And you know, I never got into ERA's business. They were all busy and, you know, I met Norris over there, and I knew... It was mostly a couple of people there that I knew, and I didn't want to waste their day and I didn't have all that time of mine to waste either. I would go in with the samples and they'd take some readings and give me some numbers and I'd leave. Now, I knew they were making a drum memory, but I

didn't spend a lot of time thinking about why they were making a drum memory or why they were making it the width, diameter and speed that they were. And I don't know what they were doing, when you get right down to it.

NORBERG: What then did they tell you about their needs?

HERR: Nothing.

NORBERG: Well, they would have to tell you something if you were bringing them tape samples.

HERR: No, they were doing this as a favor to Wetzel and me.

NORBERG: Is that right?

HERR: Yes. At least that's why I thought they were doing it.

NORBERG: The others feel the opposite, that you were doing them the favor by supplying the materials.

HERR: Maybe later we supplied the materials, but when I was there they were taking lab samples and giving me a free analysis of the recording characteristics and signal strength, noise.

NORBERG: Now that was when they were...

HERR: That was my only interest in it anyway. As far as I was concerned they were making drums. We didn't make drums and I wasn't trying sell them anything. Maybe later we did. I think there was a time when they wanted to buy some magnetic coating material from 3M and I'm sure they dealt with Wetzel. I don't know what they did. We had an objection, of course, to selling what we liked to coat, but they may have, they probably did sell some or give some at least on an experimental basis, samples or something that maybe they coated some drums with. But I didn't have

anything to do with it. They were a free testing lab that I was... As far as I was concerned, I was imposing and using my own personal friendship credits with Sid Rubens and others to get some free tests made until I could get capable of making my own tests in my own way.

NORBERG: Then you brought over samples of tape and would they adhere them to the drum? Do you remember how that process went?

HERR: I think they just used a piece of cellophane tape.

NORBERG: Because later on, as I recall Sid telling me, that they took some of the backing off and then glued it, glued the magnetic tape to the drums.

HERR: I didn't do any of that.

NORBERG: Okay, you were not around for any of that.

HERR: They would have been free to do that, of course and we would have given them, I'm sure the latest sample rolls for them to try. That must have been with Bill Wetzel, not with me.

NORBERG: Okay. That's...

HERR: I agree. That's why when your girl said you're going to take about two hours to record what you had to say about ERA, I thought, well, it's not going to take more than about one minute, because I don't really know that much about ERA.

NORBERG: Tell me about your interaction with Sid then. It was quite close, as I understand. Well, not quite close, it was close as I understand it. That is, there was technical information being transferred back and forth of various

kinds. You yourself just pointed out to me that you acknowledge Sid in this paper from 1951.

HERR: I don't remember how that arose, whether... I can't remember. I remember making the head, you know, I remember talking with Sid, but I can't remember who pushed who, quite frankly. He may have said, I wonder if you could make a head out of ferrite and I tried, he gave me a core. I'm sure he gave me a core, which had come from Ferroxcube or whatever, in New York there. But I don't know whether he said, "Hey, if I gave you a core would you chop it in half? It was a pretty crude head, you know, I cut it in half by cracking it in half and sanding it down with some of 3M's relatively coarse-grained sandpaper and made out at the shop a little clamp that would hold the pieces near each other and a little formex wire around it. Well, you can see the pictures. Pretty crude. But then we thought one mil gap was pretty good, very hard to get with that, too coarse. And I didn't even know what other grades they had. They had a book by Snoek of Philips in Holland. I was faced with the problem of heads and I was thinking about higher frequencies, of course, than were needed for audio. I was concerned with permalloy, but I don't remember whether I was searching for a solution for that and thought... Or maybe Wetzel said, "How would a ferrite be?" And I said, "I don't know I'll try to find out. I just don't know."

NORBERG: Rubens claims that he brought you the material and the idea.

HERR: He may have. He may have very well.

NORBERG: I was trying to confirm.

HERR: And obviously I didn't carry it on very far. On the other hand, I must have thought... You know, I did some thinking about it, because I knew then that the frequency limits for permalloy were severe because they're so fragile and so easily damaged by any flexing, bending, or whatever. And if you've got to handle high frequencies, then you've got to have very, very thin laminations of... It was just a terrible job to stack and insulate against eddy currents and not stress after annealing. I was sure thinking about what could you use that would go to high frequencies because we were already -- when is this? '51 -- well, we were doing a lot of thinking about video by then

and we realized also people wanted to duplicate tapes and if you want to get done you want to run it fast and if you were going to run it fast you must increase the bias frequencies. It has to handle higher frequencies and, you know you're going to need megahertz instead of the...

NORBERG: Megacycle.

HERR: ... instead of kilohertz, and your heads... or you will want higher frequencies. Certainly if you're going to record video, somebody looking at how you could do that.

NORBERG: Just as an aside, I found a draft of this manuscript that you had sent to Rubens for comment, and it was dated December of 1950. All right. The one last point that I'm trying to ascertain something about has to do with ERA's initial coating of drums with materials that they were spraying on. I've heard tales about obtaining the material from 3M, quite legitimately, in which Rubens and Howard Daniels and others asked 3M for some coating material, but there was a resistance to the initial request.

HERR: Right.

NORBERG: Were you in on these discussions?

HERR: I wasn't involved, but I know what you're talking about. 3M had some slogans, you might say, similar to those I referred to at Dupont or something like that. It wasn't 3M's way of thinking to do a little research if you're going to make a coated tape and then sell the coating material. That's our business, you know. 3M perceived itself as being in the coating business. It was kind of a knee jerk reaction: sell the coating, no! You know, we don't sell that. People wanted us to sell pressure sensitive adhesives so that they could make other things pressure sensitive adhesive. 3M would never sell anybody any of its pressure sensitive adhesive material. Later they had double coated tape that they could sell so you could use it as a... But somehow 3M got its coating and its value added and so forth in there and they thought, almost without evaluating the merits, if anybody said, would you sell us some of

your pressure sensitive adhesive in a can so that we can coat it on something that we want to stick removably, it would have been a post-it. The answer was no without thinking and if you're in that environment... Wetzel probably didn't think it was a good idea and he probably knew that if he asked the management of the company, they would have said no without thinking Because we just didn't sell that. The Adhesive, Coatings, and Sealant Division sold glue by the can, but we were very careful to make sure that they didn't have anything in their cans that anybody could use to compete with 3M's coated products. And that was the way the company was run.

So if Howard Daniels asked Bill Wetzel for a can of the stuff the same as what we put on PSL162, Wetzel would say, well, we just can't do that, and let's see what can we do. But they may have sold it to them. They probably would have been willing to supply the material on a non-commercial basis, that is, on a confidential non-disclosure agreement, which they would sample and they could tell us about the data and we'd analyze it. You know, that I would readily believe that they would have done that either on a formal or informal basis. But as far as giving them something on the basis that if they then wanted to buy a drum of it that we'd supply that, too, I'm sure there would have been a lot of resistance, whether it was reasoned or emotional, there would have been a lot of resistance.

NORBERG: Well, apparently some was supplied, and it was supplied by putting it in a dispersion, I think, or suspending it somehow in another medium that you couldn't use it for coating tapes, but you could use it for coating drums.

HERR: I believe you, but I don't know anything about it.

NORBERG: Okay, good.

HERR: I even remember that that sort of thing was going on, but nobody asked me what to do. I didn't have anything to do with dispersions anyhow. I wouldn't have known what to give them.

NORBERG: Did you have anything to do with any of these companies after you took over the electrical laboratory?

HERR: Well, I ran the electrical lab from the end of '52 to like '62 and then I was in marketing research. While I was there, there was concern with all the products of Westbee's group which were electrical and magnetic and film and so forth. And then I was dispatched out to Camarillo. During that time, you know, I worked with people's skills in the lab and I had new ideas. I was investigating a phonetic typewriter and I was looking at all sorts of things. Thermal-electricity, I got that project, for better or for worse, started at 3M; it never turned into anything. Then I was dispatched to California to run the Mincom operation out there, which was really in the video and audio and instrumentation recording game. When I came back to Minnesota, I was really head of the Mincom division, which was working very closely. I was right back in the mainstream of magnetic recording by then, you see, '70.

NORBERG: But from the video side rather than data. Is that correct or not?

HERR: No. More from the data side rather than the... The video, we didn't make recorders. We did make them from time to time but, as I say, the... It was a consumer market, a very small commercial market. We didn't really compete with Ampex and so forth. We had a home recorder out before they were being sold generally, but 3M's not very... Never really did what you have to do to make a commercial mass product like that and produce it. Research we had people, just as we did digital audio and so forth. Making the machines has not been...

NORBERG: Were the ideas then sold to someone else to make them or did people leave the company and start new companies?

HERR: Usually it just died and it got picked up and done by somebody else.

NORBERG: Somebody else. Okay. The question that I asked had to do with your further associations, if any, with places like Remington-Rand, Sperry Univac, Control Data and so on.

HERR: Well, Control Data, for example, I was then general manager of the data recording products division, division vice president. Control Data was a big customer. We sold them disks; we contracted to make disks for various of

their special early disk packs and cartridges. So I knew some of the executives over there. I never... I was never very close to their operations.

NORBERG: But you've pointed out a continuing association at least between the companies.

HERR: And certainly with Ampex. And I was involved with licensing operations. I worked a big cross-license arrangement out with Ampex, so I knew a few of the people there. But it was never a close distance relationship. Same with companies in Japan. Of course, as Mincom we bought from Sharp, from Matsushita, from Sony, quite a few machines from Sony, from Sanyo, and I knew those people. I was a customer in that case, an OEM customer. So yes, I had continuing industry connections. And I still have today. As you can see, I bill myself as a consultant. I don't do very much, I just do enough to keep my brain in gear. I'll be going next week, well, this weekend, I'll be going east. I've got some business in an optical-recording area to do. And, as you gathered, I was, you know, I went to Intermag last month; I had people to see there. I'll go to major conferences and... I've done quite a bit of work with, not really anything currently active, it goes off and on, with Norwest Venture Capital, helping evaluate different companies and start ups that they might or might not invest in. So I'm still in the business enough to give me something to think about.

NORBERG: Well, this has been very helpful. I want to thank you very much.

END OF INTERVIEW