An Interview with

S. REID WARREN

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Conducted by Nancy Stern

on

5 October 1977

University of Pennsylvania

Charles Babbage Institute
The Center for the History of Information Processing
University of Minnesota, Minneapolis

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Abstract

Warren was a faculty member at the University of Pennsylvania Moore School of Electrical Engineering and served as supervisor of the EDVAC project. He discusses the EDVAC, the personal interactions of the project members, and the effect of the project on the Moore School. Central to his discussion are J. Presper Eckert and John Mauchly and their disagreements with administrators over patent rights, which led to their resignation and the founding of their own company. Warren discusses John von Neumann, the distribution of his 1945 draft report on the EDVAC, and its lack of proper acknowledgement of all the EDVAC contributors. He also discusses the University's patent policy, its effect on the project, and the inability of the Moore School to remain at the forefront of computer developments.

DATE: 5 October 1977                                                      INTERVIEWER:  Nancy Stern

LOCATION:  University of Pennsylvania


STERN:  First, I know that you were born in 1908, but I know very little about your background.  I wonder if you can spend just a couple of minutes on that.


WARREN:  I attended high school in Lansdowne (a suburb of Philadelphia) and came directly to the University of Pennsylvania as a freshman in 1924 at the Moore School of Electrical Engineering.  Near the time of graduation I couldn't make up my mind where I wanted to go, so I took one year of graduate study and worked with Professor Charles Weyl.  I decided I'd like to do some work in the field of applications of electricity in medicine.  So, we set up a laboratory here in the field of X-rays (X-ray films of the chest in particular) and that work continued and I got to teach in the graduate school of medicine as well as in the Moore School -- so I never left the place.


STERN:  You don't have a degree in medicine per se.


WARREN:  No, just in electrical engineering.


STERN:  During the war did you use your background in medicine?


WARREN:  No, in fact the laboratory that we had for the purposes of electromedicine broke up during the war because the people who were working in the laboratory went off to other things.  One young man, Dallett O'Neill, went into the Army and worked on the procurement of X-ray equipment because of the background that he had with us.  I went off to a variety of war research projects under the OSRD and the U.S. Navy and so on.  And I stayed here during the war.  And also I did a lot of teaching during the war, too.


STERN:  So that the Moore School did have contracts with the Office of Scientific Research and Development

(OSRD) during the war?

WARREN: Yes, we had many of them.

STERN: Obviously the purpose of my discussion with you relates to the computer developments. So, let's start with the ENIAC. I know that you weren't involved on that so we'll treat it as a background. Then we'll to into your specific involvement with the EDVAC.

WARREN: I do want to make a preface here. I have a reasonably good memory but not a perfect one and the documents and so on which I once had relating to the computers at the Moore School are now elsewhere. So that you'll have to take what I have to say based solely on memory with no background documents, unless I refer you to documents elsewhere.

STERN: I understand that. Sometimes I find that discussions with people are even more important than going through the documents because there's just os much you can get from a physical piece of paper. This interview technique is enormously helpful. First, when did you learn of the ENIAC project? Do you remember that?

WARREN: NO I don't. But I think it was within six months of the first actions by Mauchly and Brainerd.

STERN: That would be the April '43 period.

WARREN: Yes, that would be about 1943. The point being that many of us here who had tenure status had clearances and there were general free discussions, and so on, so I was pretty well up-to-date on how things were happening. But I wasn't in on the very first actions and so on.

STERN: I understand that there were some on the faculty that were not very impressed with the project in the beginning.

WARREN: I can't give an answer to that. Personally, I was very much impressed, it seemed to me that this really was something that might pay off. I don't recall a negative view on the part of other members of the staff. But, that's something that you should inquire about among the individuals.

STERN: Yes, I have spoken to some people -- Prof. Brainerd particularly -- and he indicated that it was a struggle. Specifically, it was a struggle with Pender.

WARREN: Well that wouldn't surprise me at all. I think that that was certainly true. But I don't think it was so much a negative view as the fact that things were happening very fast and Pender had a whole lot of different things to look at and he wasn't being enthusiastic about anything. Incidentally, Pender has had a very interesting ability which I think is responsible for my staying in this place. He had the ability to bring people together who were utterly different in objectives, in methods, in character, in personality, and let them do what they wanted to do. He did this so magnificently that it was very stimulating.

STERN: That's very interesting. I've had some difficulty pinning down in my own mind his relationship to the others. I know that he was Dean but in terms of his interaction, I've heard he put a damper on much of the computer projects.

WARREN: No, I'll tell you what I think may have happened there although I wouldn't think Dr. Brainerd would react in this manner because he knew Pender so well. But I think Pender's attitude was that you go up and say I have a new invention, it looked as if it would be able to make on optical arrangement so that people in their homes could look out at the moon and see everything enlarged, etc. He would say, "And what makes you think that's going to work?" And this would kind of stimulate discussion. If you fought back and argued with him, then fine, everything went beautifully. But I never had the feeling that he lacked the ability to perceive progress. By the way, that little picture is he. Charles Weyl, my boss around here for many years before he died some years back was a photographer. And I found this among Charlie Weyl's remaining pictures when his widow asked if we would like some of them. This of course was a posed picture... but I don't think Pender was much of a poker player.

STERN: I understand that Pender had quite a background. Did he study with Poincare? He worked with the chap at Hopkins who I guess won a Nobel prize -- Henry Rowland. This gentleman at Hopkins proved that if you move an electric charge it would produce a magnetic field. This has never been done before. But this chap had Pender as a student at Hopkins. Pender developed this method to do this quantitatively and to show that the measurements of the magnetic field fit the velocity and charge density and so on. And when Pender set this up, Poincare set it up in Paris, and wrote and said not true, he didn't do it. So Pender was financed to go over and demonstrate his equipment to Poincare. And it came at a time when there was an international congress of electricity in Paris and there was a big to do about it.

STERN: Pender had his Ph.D. from Hopkins which I believe was quite a feat at that time.

WARREN: That's right.

STERN: That's very interesting. I'd like to discuss your later relationship with Pender when you were actually supervisor of the EDVAC. But during the war I get the impression that OSRD or NDRC (National Defense Research Council) projects were awarded to large prestigious institutions. These institutions seemed to be funded more readily than smaller schools. Do you think that is a fair evaluation?

WARREN: I was at an age then (around 35) that I didn't know too much about what was going on in other schools. In fact it was during the war that I began to visit with MIT and places like that. So that I don't know what the feeling was at that time. But we simply sat down and wrote proposals and back they came and we got representatives of OSRD and NDRC who came around visiting us and so on. I never felt that we would be favored, I had the feeling that they were dropping things here that we were capable of doing.

STERN: You think Pender was sympathetic to the innovative ideas of younger people?

WARREN: Yes.

STERN: What were your initial impressions of Eckert and Mauchly, can I ask you that?

WARREN: Yes, I'll be glad to give you that. Eckert came to us as a student and so he was a member of my class in introductory electric circuits and electromagnetic field theory. I also helped Pender teach -- in other words Pender would give a couple of lectures and then I would go off to work and give the quizzes and recitations. And Eckert was the kind of youngster that you find I would say one in two or three hundred who if you tell him that that picture on the wall is a black and white enlargement, he would then say I'm not quite sure that is so, what makes you think that it's just black and white. Don't I see a slight tendency that there is a blue color. He wouldn't take anything on faith ever from anybody. And I think there were lots of people who reacted to this and thought, well, what the hell does he do that kind of monkey business for? Why doesn't he sit back and listen? But always obviously a top flight student. And I hope you do interview him because you can ask him to confirm or deny that following statement. I think that I understood him and he understood me. So that my reaction to him is that of an exceedingly good student, exceptional person. Now we go off to Mauchly and that's quite a different situation. We decided (I guess it was Carl Chambers who was the instigating person in this) that it would be a good idea to offer some courses under something which had a very long title that I've forgotten. I guess you can find that somewhere...

STERN: ESMWT?

WARREN: Yes that's right. Engineering Science Management War Training Program. (Carl Chambers ended up in charge of all of this.) One of those courses was designed to retrain mathematicians, physicists, etc. to be electrical engineers. And this was a summer course and it was highly concentrated and so we wrote out an outline of what people should know and that they were going to do electrical engineering work and advertise this. Low and behold we got all sorts of people who had distinguished careers. But one of them was John Mauchly who came to us from Ursinus College and said I'm the Professor of physics at Ursinus and I'd like to see what you people have in mind. Well within a very short time he had shown clearly that he was the kind of person who was already partly an engineer

as many good physicists are and that he did (I don't recall by the way whether he took all of the courses or not) end up being a member of the staff and took an office which I suspect was the corner office over on this floor where Josh Gray is now. And I've always gotten along very well with John and admired him greatly. I had one strong criticism of him and that is that he has not the slightest idea how to organize a half hour conference. It would always to three quarters of an hour, one and one half hours, two hours, and he'll talk about everything off in tangents and sometimes I thought how could a man who acts that way think as well as he does? But I got along well with both of them and I like them both and I had great admiration for both of them.

STERN: I'm interested in your statement about the ESMWT course. Your phrase was, "It was a program to retrain scientists to be electrical engineers." I have not heard that kind of terminology before and it's interesting to me because of my interest in the relationship between scientists and engineers. From your peripheral relationship in the early days on the ENIAC -- were there any conflicts because there were people that came in as scientists and were now being retrained as engineers? Did the engineers frown upon this?

WARREN: No, I think Pender is responsible for an attitude throughout the Moore School in its early days and to a certain extent still exists. He (Pender) was initially a physicist. He became an engineer. And so his attitude to people on the staff was, if you can do the job I don't care what you are. Maybe you went to the Wharton School and studied business but as long as you can do the job, let's get it done. So I don't think there was ever any feeling of antagonism of that kind at all.

STERN: When ENIAC first got started (I'm speaking of the '43 period and on), I'm not really clear as to Mauchly's organizational position. Did he interact with the engineers for example in any organizational way?

WARREN: The Moore School is never famous for block diagrams -- and furthermore I'm not sure I ever knew. Dr. Brainerd is the one who can answer that. He should know precisely the organization. Carl Chambers would be equally good. Have you talked to Carl Chambers? Or to Grist Brainerd?

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STERN:  No, I haven't.  I've spoken to Dr. Brainerd but I've never spoken to Carl.

WARREN:  Carl Chambers is now in Florida but Ms. Davis who watches over me and probably talked to you first when you called me knows exactly how to get in touch with him.  And I would like to make a strong recommendation and that is that you don't set off on your final business without finding out some things from Dr. Chambers.  You have come upon his name as a witness?

STERN:  Oh, yes, I certainly know his relationship to the Moore School and those projects.  Now, you had said some things about Eckert's personality with respect to how he came in as a student and I've heard other comments about that.  I wondered about his relationship as supervisor -- as chief engineer which was his title.  Was he able to interact with his engineers in a meaningful way?

WARREN:  Yes and no.  It's not a clear cut picture.  He certainly is not an administrator, he is not the kind of guy who knows the rules of management and follows them and so on.  On the other hand, he works so hard and does so well that everyone who works with him or under him admires him and will follow.  Now sometimes in that mix you get the result.  In other words people would scream about it -- Why does he want me to work nights?  I'm supposed to take my wife out one night every sixteen weeks, etc.  But then he'd come in and pat somebody on the shoulder and say, "You know the problem about circuits that you were working on -- how about this."  And everybody glowed.  So that he's a mixed person.  I'd make a guess, and it's purely a guess, that he has occupied important positions in Sperry Rand and that none of them as far as I know has been top of the heap watching over several departments, etc.  He's been pretty much a lone wolf.  Does that fit with what you have heard?

STERN:  Absolutely.  I don't think I phrased the question very well -- I mean did he specifically *direct* his engineers?  Or was it more an interchange of ideas?

WARREN:  I think some of those -- but I think he directed in that sense very effectively.  And as he told somebody -- he wanted a new block amplifier because the last one on the life test didn't do so well.  And he would say that's your

job, you get it done. I have this suggestion maybe, but he'd come back two weeks later and say how's that going.

STERN: The first order of business on the ENIAC was development of the ring counter. Did Eckert design that himself or was the design a group effort?

WARREN: No knowledge. Now let me tell you why I may respond briefly or abruptly about other things. I was not concerned directly with the ENIAC. What I learned about was by hearsay by talking to my colleagues. And so my knowledge is therefore not very great.

STERN: You were closely related to Brainerd during this period as well. I assume you had the same kind of offices. What were his reactions, from your recollection, to Eckert and Mauchly specifically? I mean I know his reactions now -- I'm curious about his reactions then.

WARREN: I think the only possible procedure on my part in this conversation is to be completely frank and trust your judgment about what's used of what I say.

STERN: I'm not using anything without your expressed permission.

WARREN: I appreciate that. I have the feeling that (by the way let me give you the full name) John Grist Brainerd. In the old days we called him Grist. In recent years he seems to prefer John but I call him Grist. Grist Brainerd is a person quite introspective as you have learned. He tends to form opinions about people and then stick to those opinions, more or less permanently. He does not react well to "screw ball" people. And accordingly he didn't react well to Eckert but I think he admired him greatly, and I think he later felt that Eckert was really the responsible person for the development and that Mauchly was somebody off in the distance somewhere. Whereas from my point of view again based on now too much knowledge -- it looked to me as if they complemented each other beautifully. That Eckert and Mauchly properly, jointly received credit. But I can't tie my opinion down by saying here's a piece of paper that Mauchly did on such and such on one date and the Eckert did such and such on another date.

STERN: You say that he reacted to Eckert's personality initially. Brainerd was also responsible for Mauchly being appointed on the staff of the moore School. So clearly at last in the beginning he had some confidence in Mauchly's ability. When did that begin to change?

WARREN: No idea. That's something that I don't think anyone can answer.
I don't think that he would show what was happening at all.

STERN: How about Pender -- what was his reaction to Eckert and Mauchly?

WARREN: Pender liked Eckert very much. And I remember one beautiful thing which shouldn't be recorded but let's record it anyway. I was sitting in a class room with a group of junior students and Pender was lecturing -- suddenly Pender stopped and looked down and frowned and I turned around and looked to see where he was looking and Eckert was there sleeping. Pender picks up the eraser from the blackboard and said, "If you're going to come to class, why can't you stay awake?" And Eckert said, "Why?" However, Pender was the kind of guy that that didn't phase him in the least. He admired Eckert very much, no question about it. And what his reaction to Mauchly was -- I've no idea. I don't think I've ever observed the two of them together.

STERN: Where was Pender's office? Was it in this building?

WARREN: Right where Dr. Brainerd's office is now. This whole suite are the rooms -- which I call the geriatric corner now, which are devoted entirely to Emeritus Professors -- that used to be the Dean's headquarters.

STERN: I see. So he did have direct relationships on a day to day basis with the staff.

WARREN: Oh, yes.

STERN:  That's something which isn't too common among most schools today from what I gather.

WARREN:  No, that's quite right.

STERN:  Were you aware of von Neumann's early involvement in 1944?

WARREN:  I'd have to have this reviewed for me, I think I was familiar at the time but not now.  Now, what happened in 1944?

STERN:  I know that he came in September or perhaps August of 1944 to view the ENIAC and that's when he became tremendously interested in the entire concept of an electronic digital computer.  I was curious as to the Moore School's initial reaction to von Neumann's involvement before the litigation problem clouded the issues.

WARREN:  Right, I can't give you any comments relating to his first arrival because I didn't meet him until a little later.  Now let me tell you what happened, in order for me to answer properly my opinion about some of John von Neumann`s activities here.  I don't know the dates but at some stage of the game Pender came to me and said, "Look, the ENIAC requires lots of attention and Grist Brainerd is running it there and the EDVAC is beginning to look as if it might be something.  And that ought to be handled separately, would you sort of watch over that particular project---the EDVAC."  And I wasn't quite sure why this was happening.  I don't know that I know today.  I think the person that could give you a good answer on why it happened would be Eckert and Mauchly.  At some stage of the EDVAC project I met John von Neumann and from then on I watched during his activities here very closely and joined some of the conferences which were held in one of the small class rooms.  Eckert and Mauchly, and Burks, Goldstine, and me and so on.  But when he first came here with respect to the ENIAC -- I'm not familiar.

STERN:  From my records you became the supervisor of the EDVAC project around Jan. '45.  Is that correct?

WARREN:  Well, that's what I was going to ask you.  What was the date?  Because  I was going to tie that in with

what you were saying about von Neumann's arrival.

STERN: According to my understanding, in August of '44 there was some thought given to another computer -- the EDVAC. The two accumulators had been built for the ENIAC and there was no question in the minds of the engineers that the computer would work. And shortly thereafter von Neumann became involved -- October '44 the supplement was approved for the EDVAC and in my records it says January '45 was when you took over.

WARREN: That's probably correct.

STERN: Brainerd was supervisor of the ENIAC project and also of the EDVAC for the first couple of months. Part of Dederick's testimony (of the Ballistic Research Lab) stated that you were involved with medical engineering and that he thought it was a kind of odd choice to be taken on a EDVAC supervisor. Can you comment on that at all?

WARREN: The reason I suggested that you ask Eckert and Mauchly why I was selected to that position is that I was somewhat mystified at the time and whether my inference was correct or not I'm not sure -- but there had been some conflict of personalities within the ENIAC project and that therefore somebody wanted a different supervisor for the EDVAC project. Now I was never considered to be an expert in the field of computers or to be helpful in any way with respect to the technical aspects of computers. I think I must have been brought in largely as a kind of diplomat to try to smooth things over and keep them running well and watch out for the Moore School's interest. And that's in fact all I did. Except that I did sit in and listen to the conferences on the EDVAC with considerable gain of knowledge by me about people and about the EDVAC.

STERN: Can you give me some idea about how those meetings went? Just a general idea.

WARREN: They occurred without any regularity -- perhaps once every couple of weeks. And they consisted of Eckert, Mauchly, and von Neumann, and me always. And then occasionally Burks, or one of the other chaps from the project. And occasionally people who von Neumann would bring. My job was to watch out and see that

everybody was properly cleared for this kind of discussion.  What they were generally was just kind of free association meetings.  Somebody would get up at the blackboard and say, "You know the other day I had an idea that maybe if you established a single generator of pulses, it could be the clock for the whole computer.  That would be the real basis -- and then, of course, you would not be able to do things simultaneously but you'd have to do them sequentially if you were going to follow clock pulses."  And then they would discuss this back and forth and scream at each other and say that was a stupid idea and so on.  And this went on quite regularly.  And I've known now more than three of four geniuses in my time and von Neumann was among the top.  He was simply amazing -- just no question about it.

STERN:  Even in an engineering sense?

WARREN:  I'm not sure in an engineering sense, but he accepted the limitations from an engineering point of view. Somebody would tell him that that can't be done and then he would go on from there.  I never thought of him as an engineer -- he was a mathematician and philosopher.

STERN:  Was there any mystique associated with these discussions?  After all, a great eminent mathematician was now coming to the Moore School.

WARREN:  Let me admit that being extremely naive, I was not knowledgeable about great mathematicians except from a little bit of contact with professors on campus.  With no knowledge of who they were or why.  Von Neumann was just another man when he came but I don't think it was more than an hour and a half after I first met him that I began to appreciate what kind of person he was.

STERN:  Clearly, then, there wasn't any mystique because you would have sensed it as he entered the room, so it was always a working relationship amongst the staff.

WARREN:  Oh yes, that's right.  Now one person who of course did appreciate von Neumann's ability before he came

here was Herman Goldstine who was a mathematician also. Did you talk to him?

STERN: Yes, I have, on a number of occasions. Do you think it was unethical of von Neumann to come out with his 1945 draft report without giving proper acknowledgement?

WARREN: Yes.

STERN: You do think so. Do you believe that von Neumann was not even aware that the report was published -- or was disseminated -- and that it was mostly Goldstine's doing? (Now I've heard some people say that and I've read some testimony to that effect.)

WARREN: No, that I cannot believe. I can't say that I know it's not right, but I can't believe it. Let me give you my picture of what I think happened -- but again, I have no proof. In one of the discussions in one of the little class rooms, von Neumann said, "I wonder if it isn't about time to put a few thoughts in a report. Would it be all right with you people if I prepared a draft which would be simply for our purposes circulating here?" And the answer was universally yes. So he would bring in some pieces of the report and show it to everybody and everybody said, "Fine." Finally he submitted a draft which was to be reproduced here. And it was reproduced in numbered copies and the feeling was that it was for use right within our group and then we heard that it had been sent to England and a number of other places... and at that point the lack of naming of people with different ideas became crucial. So from my point of view, this great genius who I greatly admired double crossed us in no uncertain way. Now as I say I can't prove that. If he was so damn innocent that he did all this without thinking about the facts then he's more naive than I thought he was.

STERN: A man with his reputation -- I wonder why very frankly -- I mean he didn't need the acclaim that would come with that sort of thing.

WARREN: He certainly did not. Now I think by the way that this is a topic that I've never discussed with anyone

before. I may have traded some opinions with Carl Chambers but not with Grist Brainerd, not with Pender, not with Mauchly nor Eckert. Now that you've stimulated me to think about it again -- I'd be interested to know how my comments compared with let's say Mauchly whom you have already spoken to. What did he think?

STERN: Oh he is on the record about this. In discussions with me he has been very forthright in his opinion of this matter. But from what you're saying -- it sounds as if it was not something that was discussed amongst the staff.

WARREN: It was only discussed among the staff in the following sense. We all understood that John von Neumann was preparing a report which was tentative in nature for circulation among us, period. And then of course, it got out -- and then afterward, it became "*the*" report. Sometimes when I've had plenty of sleep and lying awake nights I think of this and think it was my fault. But I don't know how I would have stopped it. I've looked back at the events and I couldn't prevent it from happening. I doubt that at that time (while I've had such great admiration for von Neumann not only as a mathematician but as a sincere man), I don't think I would have had the courage to go to him and say, "Look, why didn't you put Eckert and Mauchly names out front... Or Sharpless -- or somebody like that?" So I guess it was the old story based on one of my major reasons for staying in the university and that is that I had the feeling that I can trust everyone I can deal with within the university -- so I trusted him. If that's an error it's an error.

STERN: I also thought perhaps part of the initial idea for publishing a report might be because von Neumann was a scientist who believed that the way you gain priority it to publish a report... where the engineer tends to think more in terms of final products than of the published report.

WARREN: This could be... but I also have the general feeling that von Neumann is far better a writer than either Mauchly or Eckert -- they were not famous as writers. Did Mauchly state that von Neumann sent this report to people outside without letting us know?

STERN: Yes he did. I don't think I'm violating any confidence to say so since it's in the testimony as well... his

feelings and Eckert's on this subject are all in the public record.

WARREN: I read an awful lot of papers that had nothing to do about the testimony and thought maybe I was going to be called -- but I never was. And was glad not to be. That was a messy sort of thing.

STERN: The report came out June '45. In October of that same year there was a conference at MIT in which Mauchly has claimed in his testimony and in documents that I've looked at -- that Brainerd prevented his being invited to this conference. And he appealed to you in written memos to do something about that situation. Do you recall the incident?

WARREN: No. And let me tell you of personal property of mine -- so that you'll understand. When I go through some fairly unpleasant events, and they finally are worked out in whatever way they're worked out, I tend to forget them -- I have a hunch that this sounds right, but I really don't know. Did Mauchly go?

STERN: Mauchly did eventually go.

WARREN: Oh yes, I know he did -- because he and Eckert and Goldstine and I went up there on the train together.

STERN: In fact I've even seen the receipts from the hotels at that time.

WARREN: Let me tell you a small anecdote about that trip... We landed at West Philadelphia Station or 30th Street (I forget which) and Goldstine comes in with a -- it must have been August?

STERN: The conference was in October.

WARREN: Okay. Then I'm not talking about the same thing -- skip it.

STERN: Well, tell me the anecdote anyway.

WARREN: Goldstine came in with a newspaper which was reporting on Hiroshima and he said that stuff's been highly secret -- "I've just happened to get into it because I was out in Los Alamos and nothing is known about that -- it's a process called fission." And I said, "Herman, beginning in 1939 I started teaching the graduate students in radiology about fission and indicated that there may be possibilities of producing isotopes that might be useful in medicine by some means or other." Goldstine said, "You can't do that, that's secret."

STERN: That's very interesting. What was Goldstine's actual relationship to the development during this period?

WARREN: The Moore School? He served very effectively in a very important capacity. He was the official representative of Aberdeen (BRL) on the campus to watch what we were going and then he stuck his nose into everything. And aroused some antagonism because of that. But he did it effectively, he was helpful technically, he learned a lot of the technical matters involved in some of the aspects in the thing and came up with bright ideas. He was always helpful in getting things done by other people in the Army -- I thought he was an eminent character -- very good.

STERN: You didn't see him during this early '45 period primarily as von Neumann's associate?

WARREN: No I did not. Again, perhaps I was naive but I didn't see him that way.

STERN: And he did make technical contributions?

WARREN: Yes. They were likely to be those bordering on mathematics -- like programming and language and that sort of thing.

STERN: I thought that was what you meant. When you mentioned Hiroshima, it brought up a question that I have

for you -- what was the reaction of most of the people at the Moore School to that whole atomic bomb?

WARREN: Do you mean the Moore School or the University?

STERN: I mean specifically the people relating to this computer project.

WARREN: One of them Sharpless -- thought it was hideous.

STERN: He was a conscientious objector.

WARREN: Yes, he was a conscientious objector -- the other I don't think I know. There was a feeling of my golly that was certainly an accomplishment. How did they ever do that and keep it secret. Amazement, I don't know otherwise. I don't recall at that time arguments about the moral business of whether Truman should or should not have decided the way he did.

STERN: Except for Sharpless. Can I ask you your reaction?

WARREN: I was naive. I was 37 or 38 and I think I had such great admiration for the scientific and engineering factors involved in developing it. I also at the time was convinced that the dropping of the two bombs had prevented the loss of several million lives, many of them Americans. So that I think I favored it at the time. I must admit that since I've gotten older -- I thought what would I have done if I had been in Truman's place. And the answer is that I would have dropped it on a small island somewhere, where there weren't any people.

STERN: In general do you think that Eckert and Mauchly were treated unfairly by the University of Pennsylvania?

WARREN: Yes and no. With respect to their employment, I think the answer is a nice clear cut no. With respect to patents, it's a mixed picture. We have a patent policy which I guess nowadays would be looked upon as very, very

naive.  We didn't go out of our way to help people, and our general attitude was let's make it so it's helpful to the human race and so on.  And as I say this is extraordinarily naive and we should have learned not to do that.  So that perhaps from the point of view of patents and soon, they got a pretty bad spot.  They had a patent attorney called Smith.  Have you talked to him?

STERN:  No I haven't.

WARREN:  Well, if you want to inquire about the treatment of Eckert and Mauchly by the University with respect to patents -- you can get it from him because he'll know the answer and have his facts to back it up.

STERN:  I'm not sure I understood what you meant when you said that they weren't treated unfairly in terms of employment?

WARREN:  Well, I think there were some persons who said, "Why didn't we make Eckert and Mauchly full professors right after the war was over?"  And as you know, they wandered off and did their own business first and they were bought up by Sperry.  And I'm not sure that either of them would have been happy or would have contributed effectively as professors in the Moore School.  They didn't have the ability to conform in the manner that professors must conform without losing their own independence.  And so I think that if they had been appointed in a full-time faculty -- which maybe either or both of them would have liked to have been -- it wouldn't have worked, either for them or the Moore School.

STERN:  Nowadays you have professors at universities who are there to do research and to bring necessary funding into the university.  It's one of their major functions.  From what you're saying, that was not the attitude of the Moore School back in '45 or '46.  Little attention was given to post-war research and the government funding was not...

WARREN:  We were probably a bit shortsighted on that.  That's another question that you should ask Chambers.  Carl Chambers, who was director of the Moore School before he became vice president for engineering has a number

of interesting abilities. One is that when you talk to him, you decide he's almost incoherent. Another is that he has the best broad vision of what happened in the Moore School in the last forty years of anyone I know. Including Pender, if he were alive. So he is a person that you'd want to talk to if you possibly can. He could tell you more than I about the relationship of Eckert and Mauchly to the Moore School just after the war was over. You asked a question about hiring faculty member to bring in funding. Something very strange happened. Herman Goldstine published a book that you have seen -- *From Pascal to Von Neumann*. And I got a hold of a copy of the book and read it -- I rather liked it and thought he had done a remarkably good job considering the fact that everybody is biased... and less he so than I would have expected of him. And while I was reading this thing I came to a footnote that he refers to a report that I wrote suggesting a path of research for the future in the Moore School. I had forgotten that I wrote the report -- now whether that means it was an unpleasant event -- I don't know. But I finally got somebody to dig out a copy and read it. I don't remember what was in it or where the report is or was. But I do recall from the reading which was when he published the book ('72) -- that when I read the report -- I thought that's a remarkably good report from an unrealistic point of view. It doesn't indicate any directions that the Moore School should take in order to attract persons to bring in the money to do the job. It was all in terms of what the Moore School was equipped to do, what kinds of people were to be brought in to take care of undergraduate, graduate education, and research and so on. But nothing in there says that "look, if you can get some good PR professors that can beat the people in Washington over the head -- get them by all means." Nothing like that.

STERN: I was curious as to who if anyone at the school thought in terms of encouraging government-supported post-war research? Because lots of people elsewhere clearly did.

WARREN: I think that the persons who were deeply involved in that area would be Pender, Brainerd, Chambers. These are the three.

STERN: What about Travis who became supervisor of research?

WARREN: Oh, I forgot Travis because he has left since -- but he should be included.

STERN:  What was your relationship to Travis?

WARREN:  He and I were personally excellent friends beginning in 1978 -- when I was a first year graduate student and he was a second year graduate student.  He came from Drexel over here for his graduate study, when Drexel had no graduate program.  And ever since that time Irv and I were not close socially but we got along well together and enjoyed talking together.

STERN:  I meant your relationship within the University.  He was supervisor of research and you were supervisor of the EDVAC project.  Does that mean theoretically that you reported to him?

WARREN:  I reported to him.

STERN:  Once he came back in '46, he was very clearly from all the documents aware of the fact that there was government money available for research.  He also believed that the Moore School should move in that direction.  But from your recollection there was no evidence that anyone else appreciated that fact much before that time.

WARREN:  Well, you much ask Brainerd and Chambers and you can't ask Pender.  Ask them, I'm not sure.  I don't remember that this idea was ignored in the Moore School -- I just can't put my finger on any place where it was brought into a focus.

STERN:  It would seem to me that computer development would be an area where it should have been brought under focus.

WARREN:  I think that that report that I wrote suggested that this ought to be a strong area for further development.

STERN:  I think that was a '45 report as I recall.  How did things progress in terms of the EDVAC development during

the period in which you were supervisor?

WARREN: What was the date of the preliminary report that von Neumann prepared?

STERN: June 30, 1945.

WARREN: What was the concluding date of all the contracts relating to the EDVAC?

STERN: 1951, I believe.

WARREN: I did not stay with the EDVAC project throughout that whole period. And what I don't know is when I dropped out of it, or who took over my place. I haven't any idea -- not the slightest idea.

STERN: During that time when you were supervisor, was that as much an Eckert project as the ENIAC was?

WARREN: Yes.

STERN: It wasn't a kind of thing where Shakespeare became...

WARREN: No.

STERN: Eckert and Mauchly began to have their problems with the University right after Travis became supervisor of research. Travis issued a statement and then had a meeting in which he said, "All people who wish to continue as employees of the university must turn over their patents to the University."

WARREN: Yes, at least I think so.

STERN: And on the basis of that ultimatum Eckert and Mauchly handed in their resignation.

WARREN: That makes sense. That helps me to decide on some dates. This must mean that I became director of the EDVAC project as some date which you can specify for me. Let's say '45. At that time, Travis had not yet returned. Accordingly Chambers was supervisor of research -- was he not? I think so. When Travis came back, I think I bowed out, and someone else took over the EDVAC. Because when you asked me if I reported to Travis -- I thought that didn't make much sense -- I don't remember reporting to Travis -- although I wouldn't have minded reporting to him -- I think I reported to Chambers.

STERN: Why did you bow out when he returned?

WARREN: I think that was a wish on my part combined with the feeling that I had served my purpose which was getting people over a bump -- as I've said there was some diplomatic difficulties. I think that having come through that and got the thing rolling -- it was almost a production job. I was finished and then I wanted out. I wanted to get back into radiological physics and undergraduate teaching and graduate teaching.

STERN: Particularly when the war was over. I guess everybody's orientation changed. Having said that about Travis giving this ultimatum to all the research engineers, do you think that was a reasonable request to make of Eckert and Mauchly at that juncture?

WARREN: I'm not going to comment on that for the following reason: I can't imagine Irv Travis doing that unless the University had changed its patent policy so that he was asked to do it.

STERN: Well, his specific testimony indicates that he requested a change in the patent policy. When he returned, he hoped to change the policy based on his experience in the Navy and his knowledge of the Hopkins and MIT patent policies.

WARREN: Oh, I see, so he was going to go about it by acting himself within the Moore School.

STERN: Yes. Then he brought this idea to Pender and there is some controversy over how Pender reacted to this.

WARREN: I was out of the picture there.

STERN: Did you have much contact with the Army representatives from either the Ballistic Research Lab or the Ordnance Department?

WARREN: A limited amount and all of it exceedingly pleasant and inspiring. Let me see if I recall some names. Col. Gillon -- oh he was out of this world in helping us. I remember once calling him on the telephone and saying, "Col. Gillon I have an unreasonable request," and his answer was, "Well, that usually takes ten minutes longer than a reasonable request. What is it?" And I said we need an oscilloscope -- and I gave him the number -- and we have no knowledge of anywhere where one is except at the Underwater Sound Business in San Diego... where Herman Goldstine thinks there is one. And Gillon says, "I'll call you back." One half hour later he calls back and says the oscilloscope is on its way. We had number of dealings with him at that time. A gorgeous person and of course much more than that he (I don't think he was an engineer) somehow acted as if he was.

STERN: He went to West Point.

WARREN: Yes that's right. Col. Simon I've met occasionally, the civilian people of Aberdeen, Dederick you mentioned, there were several others that were most cooperative. We did a lot of teaching up here of Army personnel who worked down there. I remember the fright that I had the day I walked in on 50 WACs and started to tell them about approximate mathematics.

STERN: How is it (aside from the fact that there was a war going on)... that all of these people -- these "computers" -- that were doing the work down there, were women. Do you think it was just because many men were not available?

WARREN:  I believe that they were doing things that the draft would not permit men to do.  Now why we didn't find some handicapped men who didn't pass the physical -- I have no idea.  My guess is that that was the old male chauvinism period when a male wouldn't be caught dead in the company of a bunch of women learning how to punch some keys on a desk computer.

STERN:  That was kind of a clerical job despite the fact that these women had degrees in mathematics.  You'd still regard it as a clerical job.  Did the people of Aberdeen allow the Moore School to function more or less independently?

WARREN:  Yes.  That was one of the things which made us like them so much.  Their rules and regulations were quite reasonable.  They didn't tell us how to run the place.

STERN:  Were you involved in the Moore School course given in '46 on computers?

WARREN:  Given for whom?

STERN:  Well, there were representatives from universities both in the United States and in England and the government, some industrial representatives as well.

WARREN:  I think the answer is no.  Although we had visitors from overseas and from around the country in large numbers and I did help to sort of host them, but I think my part in that was sort of casual.  What was the chap's name from England?

STERN:  Wilkes.

WARREN:  Wilkes was one but the second one... it was a three syllable name.

STERN:  Do you mean Hartree?

WARREN:  No.  He was the first.  One of them was the source of our news that the von Neumann preliminary report had been sent abroad.  Because whoever it was a pretty close personal friend of Mauchly or Eckert or somebody. And suddenly a letter comes over here from England and says, "What's this report doing circulating around Great Britain?  Why aren't you people highlighted in the thing?"

STERN:  Were you still supervisor of the project when all that controversy occurred with respect to the New York Times article?  Were you involved in that?

WARREN:  What was the date of that?

STERN:  The date was January 15th or some time in January of '46.  Right before the dedication.

WARREN:  Oh.

STERN:  Von Neumann had been discussing with RCA the possibility of a joint project and they went down to the Weather Bureau and held a meeting.  The meeting was reported in the *Times* and von Neumann was depicted as the person responsible for the computer development.
WARREN:  I have peripheral memory of that, but I wasn't involved in that.

STERN:  You have a peripheral memory of the reaction?

WARREN:  Well, the reaction here was horrible.

STERN:  Not only on the part of Eckert and Mauchly.

WARREN: Oh no, in general, quite general. I think that was the point at which I felt most guilty for not having somehow prevented the circulation of the initial report, which was advisory in nature.

STERN: It seems to me that that was a difficult thing to prevent. Prior to the dedication ceremony itself, the ENIAC had been tested for Los Alamos problems. Frankel and Metropolis came from Los Alamos and ran those problems.

WARREN: Have you spoken to Irv Travis?

STERN: Not yet, I have a letter in to him. I'd like to see him. Do you know specifically where he is? I wrote the letter to Burroughs.

WARREN: He lives in Paoli as far as I know.

STERN: So he should get the letter because the Burroughs Branch is there too.

WARREN: Oh yes, sure.

STERN: I don't think he was back yet. The Los Alamos test was in '45 and I don't think...

WARREN: Okay, that's Chambers then.

STERN: I'll have to talk to him about that. You mentioned the meetings that the staff had when von Neumann was involved in the EDVAC. Besides these meetings how else was there an exchange of ideas? Was there any formal channels of communications outside the University -- that is with MIT or with RCA or with some other organizations?

WARREN: Not to my knowledge. This was a purely local discussion for mutual stimulation according to me -- the naive supervisor of the project. And it acted that way, everybody said what he thought, somebody got a little tired and said let's adjourn till next Tuesday or something like that.

STERN: What about familiarity with other projects -- the Aiken project at Harvard for example?

WARREN: I would guess and this is based on an uncertain memory -- I think that Eckert and Mauchly and Von Neumann and Burks knew what was going on elsewhere quite well. How much detail, I don't know because our contacts were more effective in some areas than in others. For example, I think we did very well with the people at the Bell Labs -- Stibitz and Williams and so on. And I think that MIT was coming through very nicely. We may have been in contact with IBM as well. I'm pretty sure that this was part of the job that Herman Goldstine did so well. He learned where there might be good information and he brought it back and got people in contact and so on.

STERN: Was there any eagerness on the part of the staff to publicize the project?

WARREN: Let my put my opinion very bluntly -- I think we were so terribly busy with doing what we had to do, that nobody had the slightest thought about publicity at any time whatsoever. Again, that's sort of innocent but that's the way I think it was.

STERN: IBM took part in the ENIAC phase in terms of supplying the input and output equipment. Did the IBM engineers get involved at all in any of the discussions?

WARREN: I don't think so. Again, that's Brainerd not me, but I don't think so -- I think that this was done by our people going to IBM -- getting the technical information, coming back, writing letters to people saying, "May we have this machine and that machine?"`

STERN: So from your experience, IBM did not demonstrate any significant interest in this kind of development.

WARREN:  No.

STERN:  And none of the major manufacturers did.  Doesn't that strike you as kind of odd?

WARREN:  I'm sure they had the interest but didn't quite see what was going on here and how it fit in with them.
They were still making punch cards.

STERN:  There was evidence that suggests that T. J. Watson, Sr. of IBM just didn't think electronic computers had
any future at all.

WARREN:  That's quite right.  Don't forget one thing -- and that is that very early on the ENIAC was looked upon for
what it really was -- a kind of dinosaur -- its life was quite limited on earth and I think people had not yet begun to
look ahead saying, "Well, what happens if you speed this up by a factor of 100 times to 1.  What happens if you have
equipment that will last forever, or at least for thirty years?"  and so on.  Now of course there were good reasons for
that, the transistor had not yet been invented and vacuum tubes were pretty uncertain gadgets, and so I don't think it
was too obvious that electronics and computers were going to move ahead as fast as they did.  However, this is
precisely the point where I tried to get some reports out of Mauchly and Eckert without success.  I think if somebody
would sit down and write up the ENIAC the way it should be written up -- it would turn out that it *was* the major
transition from the beginning ideas to the present day.

STERN:  Eckert and Mauchly did not write very much -- did you see that as a problem?  And would you say that their
attitude toward publishing goes beyond the simple predilection of engineers not to write?

WARREN:  It is a difficult question to answer.  I spent something like 45 year trying to persuade students that
speaking and writing was at least as important as solving differential equations.  And, without much success.  On the
other hand, the criticism of engineers as poor writers and perhaps poor speakers is exaggerated beyond the truth in

my opinion, and in no uncertain way. I don't think in terms of average engineer -- I think there are a lot of people who write fairly effectively and a few who do not. These two gentlemen (Eckert and Mauchly) are quite capable of writing if they wanted to but they hadn't the patience to do it. They have never understood that to write something that's clear and concise takes four writings and a lot of blood, sweat and tears. So they don't do it. But they use the English language well and they understand what people say to them -- so it's not a lack of ability but more of a lack of patience.

STERN: You mentioned about speaking. Did Eckert and Mauchly give many oral presentations -- either one of them?

WARREN: No, except around here on an informal basis -- they were delighted -- but I don't recall their being among the invited lecturers. Our public relations were horrible. If this same thing had happened at MIT -- Brainerd and Chambers and Mauchly and Eckert and Goldstine and so on would have been invited all over the place to give all sorts of lectures, seminars, and so on.

STERN: Well who was responsible -- was it just the fact that you think public relations was not there?

WARREN: Yes, just nothing. The attitude here was -- so, we've been pretty good engineers here during the war -- now let's get on to something else.

STERN: That is certainly the attitude that I've sensed.

WARREN: I think it's highly accurate.

STERN: But to look back, it's strange. You mentioned that the ENIAC was used as a kind of "dinosaur." Now to me that means "archaic" -- how could that be -- here was this new revolutionary device?

WARREN:  Well when you look back on it in terms of what we have today, what do you see?  You have a decimal system with a ring counter -- what can be sillier than that?  You have a bunch of vacuum tubes which wear out, so you have to use them way below rating in order to make them last a decent length of time.  There's so many of them that no matter what you do some of them fail occasionally, etc.

STERN:  We were talking about the public relations, or the lack of it. Was there any concern for secrecy once the project was declassified?

WARREN:  I don't know and you're talking about a period when I was busy getting used to a normal life again -- so I was busy with other things -- I don't know what happened on that.  I don't recall a feeling of secrecy, no.  Except I'm sure Mauchly and Eckert were involved in this sort of thing.  You see, one of the things that happened after the war is precisely something of which I'm very proud.  But which worked to the detriment of the Moore School -- namely, some of our best people left the Moore School and started their own companies.  Not just one or two but five or seven.  I can't be unhappy about that but it did remove a lot of talent.

STERN:  You can't be unhappy about that -- why?

WARREN:  About our students starting new businesses.

STERN:  From your perspective that's an exciting prospect?

WARREN:  Yes, that's what engineering schools are for, isn't it?

STERN:  Yes and no.  In a sense that I would think that from the perspective of the schools to do research is more prestigious.

WARREN:  Oh yes, but what I say is that we took in a bunch of youngsters during the war and they contributed very

effectively to research programs but they had the initiative and backing and so on to go out and start industries on

their own, and of course, that's what engineering schools are here for. To help industry develop and to help

government laboratories develop as well as to help the Moore School and other schools to develop.

STERN: A man like Von Neumann for example looks down upon someone attempting

to set up his own business as not being in the academic interest.

WARREN: That's quite true. Of course what happened was that, I suppose, we ended up with the people who

thought the academic interest was primary. And, if we've been a little larger then we might have come out nicely

divided. But I've no unhappiness about those who wished to get out and start their own business.

STERN: How do you account for the fact that a school like MIT manages to attract (even then managed to attract)

both types?

WARREN: Well I think there are two things -- we weren't big enough, we were sort of below critical size and I think

MIT did a quite remarkable job from way back when -- not just during the war you see. So it was already the sort of

the school like Zurich.

STERN: Were you aware of any competition between the Moore School and MIT regarding computer development,

or regarding any other developments?

WARREN: Oh there's always a feeling of competition between us in all aspects. With respect to details, no.

STERN: Considering the fact that this school at that time was a relatively small school and MIT was "the"

engineering school, it says a lot for the Moore School.

WARREN: That's right. And looking back I thought it particularly interesting that Irv Travis grabbed a hold of the

idea of working with Aberdeen during the depression to make the parts for two differential analyzers, and set one up here and then went up and make peace with Vannevar Bush and his colleagues and then got all the information from them. That's something that I think is very important. And that is the Moore School didn't start with the ENIAC project.

STERN: In computers you mean?

WARREN: Yes.

STERN: Did you have any dealing with Sam Caldwell of MIT?

WARREN: I knew him but I think largely because we attended the same conference occasionally.

STERN: Regarding?

WARREN: Computers.

STERN: Were you aware of any hostility on his part towards the Moore School?

WARREN: I think I was told that there was hostility but otherwise I didn't know about it. He was a fairly peculiar character incidentally. Gordon Brown who was dean up there, I think it was Gordon who once told me after Caldwell had died that after the war Gordon called Caldwell in and said, "I'd like you to set up so and so -- I think we are going to do big things in such and such a direction." Caldwell said, "I'm not going to do it." Gordon says, "What do you mean?" Caldwell said, "I've been chasing my tail for eight years and I'm not going to chase it anymore. For the next year I'm going to do as little work as I can and during that period I'm going to set up the plan for the rest of my life."

STERN: And did he do that?

WARREN:  Yes.

STERN:  These meetings that you attended with Caldwell -- they were with respect to the NDRC, or with respect to his role in MIT?

WARREN:  With projects of various kinds, mostly with respect to the government.  As a matter of fact I'm thinking in terms of conferences like that one where you have the date and everything else -- everybody went.

STERN:  That was an MIT conference.

WARREN:  I don't think I've met him elsewhere.

STERN:  Isn't it interesting that MIT should be the first one to have a computer conference, when the Moore School was doing all the exciting work.

WARREN:  It never occurred to me.

STERN:  Well, there was correspondence between you and Caldwell.

WARREN:  Was there?

STERN:  Yes, saying that, "It was a very exciting meeting and we think we're going to try something similar at Aberdeen next year."  And Caldwell said that would be a good idea because he thinks the world is ready for more computer conferences.

WARREN:  That's fascinating!  Was it a "Dear Sam" or "Dear Dr. Caldwell?"

STERN: I think it was a "Dear Sam." It seemed at that time that you and he were aware of the fact that there needed to be some additional communication about these ideas because there was really no other vehicles. Let's consider the commercial issue again. Mauchly has been criticized for having commercial interest in computers (early) prior to the end of the war. Were you aware of those interests?

WARREN: No. I don't know what you're talking about.

STERN: I'm talking about the fact that one issue raised in the Honeywell Sperry trial was that Eckert and Mauchly had commercial interests as early as 1944.

WARREN: I have no knowledge of that.

STERN: You were not aware of Mauchly going to Census or the Weather Bureau in the immediate postwar period to...

WARREN: Well now I knew two things about John Mauchly which may have a bearing on your question. One, he was early on very much concerned with weather predictions, and that was one of the things that led him to believe that maybe a high speed computer would be a useful device... was the idea of setting it in one place and learning from thousands of miles from various stations of what was going on. I also knew from the minute he thought of that sort of thing -- he also thought in terms of the Census. But I'd bet he was talking of that kind of thing in 1942. But as for *commercial* procedures based on those thoughts I had no knowledge at all. I mean it isn't illegal for a college professor to think things like that about Census and weather is it?

STERN: No.

WARREN: It's amazing that anybody would criticize him for thinking in those terms.

STERN:  Well in fact there has been a lot of criticism from that point of view, but when you say he'd been interested in weather and the Census particularly would seem to me that either he wanted to do this with government contracts at the Moore School or to set up his own business to do this.

WARREN:  Oh, I would interpret it as being a thoughtful college professor having a bright idea of some things that he thought might be able to be done and being useful to some government agencies.

STERN:  And my impression from the other point of view was that the man had tremendous insight into commercial possibilities for this machine far sooner than anyone else.

WARREN:  Well if he did, he sure slipped badly.  He never made any profit out of it.

STERN:  No, but his prediction about the possibilities for computers were realized.

WARREN:  I don't agree with this at all.  I think you'll have to ask Mauchly.

STERN:  You don't agree with what?

WARREN:  The idea that he was commercially driven at any early stage of his career.  Please don't misunderstand me.
 Anybody who has worked as an assistant professor at Ursinus and looks at his salary check, is not adverse to finding some ideas that would make him some more money.  This is true of anybody -- professor of philosophy, or...

STERN:  The commercial issue is difficult to assess. Within certain circles it is not a negative thing but in other circles it is.  And it's very difficult to discuss the issue precisely because of that problem.

WARREN:  I'm not at the point where I'm willing to discuss whether it's a good thing or a bad thing -- I'm just at the

point where I don't think he did it.

STERN: You don't think that he was even aware of the commercial possibilities of computers prior to '46?

WARREN: Well to be aware and to push towards them are two different things. I think he was aware as every one of us was. But I don't think he was putting on sneakers to say now how can get a job that will make me thousands of dollars a week and so on.

STERN: Were you aware of the fact that Atanasoff had developed a computer?

WARREN: I had heard Atanasoff's name probably for the first time at discussions with Von Neumann, Burks, etc. but I have no memory of what his name meant. To me he was somebody who had been a consultant to Los Alamos or something like that. That's all I knew about him. So that I never was informed, at least I never absorbed the knowledge that he was involved with computers.

STERN: Based on your early experience with EDVAC, can you tell me anything about what some of the causes were for the problems that were later encountered in getting the machine to work? It took far longer than anyone expected it to.

WARREN: You have to talk to my successor. That happened after I was involved. When I was involved nothing much really happened except the report from von Neumann and the beginning structure. And then after I went out it was set up in a room on the third floor back here and then I kept saying why doesn't it move. And the answers were all sorts of bureaucratic things and so on, and if there were any technical problems I don't know about them.

STERN: When you say why doesn't it move -- I'm not sure I understand?

WARREN: Why wasn't it delivered to Aberdeen and put into use. It stayed here unmercifully long. There were all

sorts of complications about transportation insurance and so on. I wasn't involved in that and again Chambers is the guy to talk to.

STERN: The Moore School's role in computer development definitely declined after the war from all the evidence.

WARREN: Or didn't progress as fast.

STERN: "Or didn't progress as fast" is a better way to look at it. Why? Can you give me some ideas?

WARREN: I've often thought about this and I don't understand it. I suppose it's lack of personal leadership. And it's not clear as to why that should occur because up until about 1952 from 1949 Carl Chambers was dean and he had a clear perception of the importance of this. Why didn't it develop -- I don't know. After 1952 Grist Brainerd was director -- we stopped having a dean and why he didn't push it further -- I don't know. If I venture a guess, which is nothing but a guess, it is that we set up a group within electrical engineering within the Moore School and gave them pretty much a free hand and they didn't develop the way we had hoped ;they would. Now whether that's the fault of management, or the people involved, or what -- I don't know. But don't forget that if you list the people who made the major pushes in the '30s and '40s you would have Travis, Brainerd, Chambers, Eckert, Mauchly, Sharpless, Burks, and I'm sure I could add another four of five of whom in 1952 we have present Chambers, Brainerd period! Now what I'd like to intersperse with the names that I gave you were the names of about six to eight young people who did quite important contributions of individual circuit developments and that sort of thing during the ENIAC -- EDVAC period who later went out to some of the companies that were formed after the war. So somewhere in that mess of facts is the explanation...but I don't know what it is.

STERN: Speaking about some of those engineers that you talked about, is there anyone specifically that you remember as really making significant contributions?

WARREN: That's part of what the controversy is about, isn't it?

STERN:  I think only in terms of who invented what particular thing.

WARREN:  If I had in front of me one of the ENIAC reports, which I guess I have at home now, on the front page is lists a whole lot of people and I could go through there and check and say these people did major things.  But when you ask me to come up with names, I can't do it.

STERN:  Sharpless left the Moore School early too.  Is that correct?

WARREN:  Sharpless and two others.  What was that called?  There were two major companies.

STERN:  Technitrol.

WARREN:  Technitrol and the other is called AEL Industries.  (American Electronic Laboratory)

STERN:  Who formed AEL?

WARREN:  Connie Fowler and Lee Riebman.

STERN:  They were not involved in the computer project.

WARREN:  I don't think so.  I think Lee was in the Navy and I think Connie Fowler was here.  Then there were several others who went with computer companies.  What was the chap's name -- a Russian name.

STERN:  Well, I think Shaw and Chedaker went with...

WARREN:  Shaw and Chedaker were major contributors but that's not the two I'm thinking of.

STERN: Sheppard I know went also.

WARREN: Sheppard, Merwin.

STERN: I think for a time Shaw went to the Institute for Advanced Study with Burks and...

WARREN: That may well be, I didn't follow Shaw's subsequent careers. Is he still alive?

STERN: No.

WARREN: He was an albino and they very seldom live beyond the age of 40 or so. He was a very bright boy.

STERN: The age of most of the people working on the project was phenomenal. It was a youthful group. Speaking about those people working on the EDVAC when you were involved -- were there any scientific concerns of the group related to mathematics, electronics, or something to that effect?

WARREN: I'd have to have a list of names in front of me to tell you that for the following reasons. At the time that I was trying to watch over that project, I think I had connections with at least two other projects. The names and titles of which I don't remember. Now that was true of a lot of people working at the Moore School at that time. So that I could go through the list and Joe Blow was also working on such and such radar thing. But I can't do this without names and as a matter of fact I don't have the records anyway. Suffice it to say that the individuals who were assigned to the EDVAC were not necessarily full-time on the EDVAC--even thought most of them worked full-time.

STERN: I see.

WARREN: It was a very flexible organization.

STERN:  Do you know anything about a machine that was called the EDVAC 1.5?  I've read about it and I just don't understand what that means.

WARREN:  I haven't the slightest idea what that means.

STERN:  I think Travis might know.  That was later on.  All in all from your experience with the Moore School... how do you think those projects (the ENIAC and the EDVAC) compare in terms of contributing to the University's status?

WARREN:  I suspect that if the Moore School is known anywhere, it will be known for the ENIAC so that I think that was the outstanding one with respect to now.  Interestingly enough I gather that in my younger days which perhaps means that I was living in fairy tales -- the Moore School had a very strong reputation before the war as an exceedingly good school of electrical engineering.  Which has continued.  But the ENIAC and the EDVAC -- well let's put it the other way -- the two differential analyzers -- one for Aberdeen and one for us, the ENIAC and the EDVAC were like people.  With a plateau on either side.  And I think there's no question about that.  Now, something very strange happened which began back in the late '20s.  The medical field in which I was interested in came about in the following fashion:  there was a physician there that had tuberculosis and was cured and then went into the field.  He came out here to see Harold Pender one day and said, "We hadn't met before but I work at the Phipps Institute and I'm trying to take X-ray films of the chest and the apparatus is awful and there are all sorts of things which I think can be done to improve it.  You've got anybody around here who would like to help?"  Charles Weyl volunteered -- this is 1925 or 26.  They worked together and accomplished some important things... and then they got some money and that's when I got into the picture.  So I was part of the laboratory staff.  And that blew up during the '30s to the point where I think the Moore School may have been as well known in the radiological field for that work as later it was (in a certain area) for the computer.  After the war, the X-ray work dropped off (in fact during and after the war) and the electromedical work took a different slant entirely and now has become a separate department outside the Moore School.  Whereas the ENIAC after the war became a big thing -- that's it.  So the Moore School's reputation is complicated as is true of most institutions.  But there's no question that the ENIAC and the EDVAC were part and

parcel of the major push in that direction.

STERN:  In terms of what it's known for?

WARREN:  Yes.

STERN:  What about in terms from your experience in terms of actual intellectual achievement.  Do you think it has been given too much significance?

WARREN:  I don't think you can dissociate those two things into separate questions.  That is if you ask me what contributions the Moore School has made which are intellectually most significant... it would take me the next two weeks to try to figure out an answer -- and the answer wouldn't mean anything except that that was my prejudice.

STERN:  Well, let's call it your opinion.

WARREN:  Well, let me put it a different way.  I've worked in the Moore School since 1929.  At no time have I seen more than one or two individuals on the teaching or research staff who were intellectual deficient -- at no time.

Now I said one or two -- and Pender was beautiful at this sort of thing -- he would call in Mr. Smith and say, "Mr. Smith, I have a request from such and such a school in the midwest and they want somebody who is in the field that you are -- would you be interested in my recommending you?"  And generally Mr. Smith would decide that he was being done a favor and he would go... and do very well.  But the answer was Pender wanted him out of here.

STERN:  I'm unclear on Pender's actual administrative role in the university.  That is, there is evidence that suggests that he was easily swayed by those under him.  And there was other evidence to suggest that he very much had a firm hand.

WARREN:  Oh, that's the most beautiful remark I've heard in years.  Both of these things are true.  People are complicated -- they're not simple, but I think in general he was his own man.

STERN:  It has been suggested that a new patent policy instituted in '46 was responsible for Eckert and Mauchly leaving and it has been further suggested that Travis was responsible for this on his own without Pender's approval -- Pender clearly had to give it the go ahead -- this is where I've gotten them.

WARREN:  You'll want to see both Travis and Chambers.  I think then you will have the most balanced basis for judgment of anybody I've ever known.  I think you have followed this most effectively.  And you're almost to the end, I should think of getting evidence from people.

STERN:  Well I don't know if it ever ends.

WARREN:  You're quite right.  If you want to take the ENIAC reports and go through every individual (there's some of them still living) but, at some point you have to say I better write it.

STERN:  Yes, exactly, at some point soon.  Before I go see Chambers and Travis -- can you tell me their relationship to each other?  That might help me.

WARREN:  Carl and Irv.  To the best of my knowledge -- quite good.  I don't think that either of them was terribly warm with the other in a close social sense -- but I think they admired each other, liked each other, got along well together, met in meetings all the time -- there was no sharp antagonism of any kind.

STERN:  And with Brainerd too?

WARREN:  That's another story.  There's an awful lot of antagonism with respect to Grist unfortunately.  But, I don't know if I know the details and I'm not sure they'd be helpful to you.

STERN:  When you say antagonism, do you mean with Chambers or with Travis?

WARREN:  Both.  Although in the case of Chambers, the antagonism was accompanied by Chambers' proper and very high opinion of Brainerd.  So that when it came as a question of recommending people for honors -- Chambers would recommend Brainerd when the honor would fit his case.  So that while they had rough edges, they got along better together than I think Travis and Brainerd.

STERN:  Both before and after the war?

WARREN:  Yes.

STERN:  Thank you very much.

WARREN:  You're quite welcome.

END OF INTERVIEW