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Interviewee: Pat Youtz

Interviewer: R.R. Mertz

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MERTZ:

of MIT Lincoln Laboratory, conducted in his office, on January—

YOUTZ:

26th

MERTZ:

26th, 1970. Mr. Youtz, would you describe .. where and when you were born, and where your early schooling took place?

YOUTZ:

Yes [?]. I was born April 4th, 1907, Sunbury, Pennsylvania. I did my elementary and high school work at Sunbury public schools. I spent four years at Bucknell University. I was out one year because of an injury to my back. After graduation...

MERTZ:

What did you undertake when you--as your special field at Bucknell?

YOUTZ:

Just a general preparatory course.

MERTZ:

I see, and during your high school days, did you have any particular hobbies or--

YOUTZ:

I was an athlete,

MERTZ:

Aha?

YOUTZ:

And my hobby was football, basketball, track and boxing. I did not, at that time, have any particular interest in radios that were being built at that time. I ... We had a Thomas Edison Club at Sunbury, in which we did some of his early work there, and .. but I was not interested enough to join that particular club at that time.

MERTZ:

I see. And then you went to Bucknell?

YOUTZ:

And graduated. I then went to the University of Chicago. I was in the math and physics departments.

MERTZ:

I see. [?]

YOUTZ:

[?]

MERTZ:

[?]

YOUTZ:

Those times were hard times and depression years, and I was doing some work for Dr. L. L. Thurstone, the mathematician and psychologist. I didn't get--I finished my Master's degree and came back and taught one year at Bucknell, and went back and worked on my doctorate, and got married at that time. I think it was 1932, [?] '33, and be--because of my wife's pregnancy, I had to take a job as a mathematician, doing actuarial work at that time because jobs were scarce.

MERTZ:

In Chicago?

YOUTZ:

Yes, this was in Chicago.

MERTZ:

I see. And the--did you maintain any relationship with the university after you took the job?

YOUTZ:

Except with the particular professors with whom I worked, and L. L. Thurstone, .. in particular, his multiple variant analysis. I worked with him on that, as part of a National Science Fellowship.

MERTZ:

I see. And how long were you--did you work with Professor Thurstone?

YOUTZ:

I worked on and--with him on and off for about ten years.

MERTZ:

I see. When did you start your research with Professor Thurstone?

YOUTZ:

This was--this was research in the form of work. It was not my own research, but his research and putting--doing whatever was necessary to get it out. In his earlier books I think there was acknowledgment--adequate acknowledgment to me on it.

MERTZ:

Did this include--include basically calculations of--of—

YOUTZ:

No, it was the development of the--[?]- multiple variant analysis.

MERTZ:

.. One of the problems that Thurstone had.. just prior--some years later--prior to the advent of digital computers was the.. the problem of polynomial approximations

YOUTZ:

Yes.

MERTZ:

[?]-after he worked out his.. factor analysis,

YOUTZ:

Factor analysis, yes.

MERTZ:

and.. this, of course, predates that,

YOUTZ:

Yes.

MERTZ:

by about ten years or so. How long did you work.. with Professor Thurstone?

YOUTZ:

I stopped working with Professor Thurstone about 1938.

MERTZ:

Was this at the same time that you were.. doing actuarial work in Chicago?

YOUTZ:

That I worked with--?

MERTZ:

Professor Thurstone?

YOUTZ:

Yes, the actuarial work was my bread and butter work, and Thurstone didn't have sufficient money to go around for some of his research. Whenever I could, I did research on my own nickel, earning my living as an actuarial man.

MERTZ:

I see.

YOUTZ:

But I was very much interested in factor analysis.

MERTZ:

And.. then.. this brings us, more or less, up to 1938. .. You were married, .. had a family?

YOUTZ:

No, no family.

MERTZ:

No family. I see. .. You were in--in Chicago?

YOUTZ:

In Chicago.

MERTZ:

And.. then what happens in 19--?

YOUTZ:

The war came along. The clouds started [?] thickening and I decided to get [?]-get out of actuarial work because I'd follow people being called to the services, and took a job wherever --[?] I could that was pertinent. I started out then as a research associate.. on my own--on my own consulting firm, with emphasis on this war work

MERTZ:

I see. What kind of.. .. activity.. did you do consulting work in?

YOUTZ:

Well, it was chiefly the cathode ray tube devices. I saw television coming along. I also saw the possibility of it in the consumer field, so I first took a job as a night lecturer in the night schools in Chicago. You may have heard of the American Television Institute. I was an evening lecturer there for about a year. The--the fact that it was evening is there were students who worked during the day and they, too, were interested in getting into something. At Illinois Institute, I was --went and did--taught some evening courses there.

MERTZ:

In .. in what field was this?

YOUTZ:

This was in the field of electron--what they called general electronics.

MERTZ:

Where had you, in the interim, .. acquired your knowledge of electronics?

YOUTZ:

On my own.

MERTZ:

I see. Did you do this--Were you doing this then during the thirties while you were working as an actuarial and also helping Professor Thurstone?

YOUTZ:

I only started doing this when I saw the war years approaching and Thurstone recognized it too and I--I sort of tailed out what I was doing with Thurstone and start--and started interfusing [interfacing?] as much as possible. Being a consultant, I could take as little or as much work--I could bring myself along as fast as possible. I wasn't particularly interested in being cannon fodder if I could make a contribution in some other direction.

MERTZ:

Did you have any actual laboratory experience?

YOUTZ:

Oh, yes.

MERTZ:

In electronics

YOUTZ:

Yes.

MERTZ:

at this time?

YOUTZ:

I not only taught it, but I also took some courses on my own whenever I could.

MERTZ:

I see.

YOUTZ:

And frequently I--in some places that were teaching more advanced electronics for the particular war machinery, .. after you took a course or two, would give you an opportunity to either be --as a lab assistant or--or actually as a teacher to some of the more elementary courses, because the schools were just understaffed. And I was doing that in the forties when I was called to the University of Iowa.

MERTZ:

Now was--did you have any--Were you at all in any way connected with the several large Navy schools that were set up in Chicago at that time to train .. radio and electronics specialists?

YOUTZ:

Well, yeah, but that was a little more restricted. I--well, I taught--I did teach at the Signal Corps schools, because they were just a little more, I felt, a little more advanced than some of the Navy schools.

MERTZ:

And they had some schools in the Chicago area?

YOUTZ:

Yes. Yes. And from--from - from these schools, I went to the University of Iowa. There was a meteorology program and most of the boys were either ensigns or further along, and they usually went from this general training to the special training which was conducted by the services.

MERTZ:

And how long did you teach at this program at Iowa?

YOUTZ:

Until--until it folded.

MERTZ:

Near the end of the war then?

YOUTZ:

Well, it was March 30, 1943.

MERTZ:

Oh, '43?

YOUTZ:

Yeah. Now when I decided to go to the University of Iowa, I'd written to MIT,--either for a job in the Radiation Laboratory or in the Radar School.

MERTZ:

Had you--did you know anyone at MIT at that --

YOUTZ:

Barrow.

MERTZ:

Could you spell his name?

YOUTZ:

B-A-R-R-O-W.

MERTZ:

All right. And you had met him?

YOUTZ:

I met him earlier as one of my instructors. And they offered me a job, but it was about two days too late. I already had accepted and gone to Iowa, so in order to come back, I just went back and asked if the job was still open. And they said it was; and this was

Professor Radford; and the Professor Radford who got me to come here; and I was still working for him when he died here.

MERTZ:

Yeah. And what--what was the nature of your duties then when --?

YOUTZ:

Was a lecturer, was a lecturer.

MERTZ:

In electronics?

YOUTZ:

In electronics, yeah. I don't think these were--there is any elementary physics. this was electronics associated with fire control gear.

MERTZ:

OH? So it was specifically geared to the –

YOUTZ:

MIT Radar School.

MERTZ:

To the Radar School and the research conducted there and the training of--of personnel in radar.

YOUTZ:

Yes. Correct.

MERTZ:

.. Did you--was this a full-time teaching - ?

YOUTZ:

Yes, indeed.

MERTZ:

I see. .. So that you did--did not at that time do any re--research in the lab?

YOUTZ:

No. In the--At the Radiation Lab? No. It was hard enough to keep up with the new gear that was coming out all the time.

MERTZ:

And .. when did this .. program .. When did you leave?

YOUTZ:

Well, it--the program folded as soon as the war folded, and it tailed out gradually and November first, 1945, I joined the Servo-mechanisms Laboratory at MIT.

MERTZ:

Did you have--Had you had some knowledge of the Servo Lab before this period when you were with the Radiation Lab?

YOUTZ:

No. They--No.

MERTZ:

They--they worked, of course, on--on-- on servo mechanisms--controls for radar antennae on ships and other—

YOUTZ:

Now, let me repeat again so this is straight. I came here April first, 1944, and to the MIT Radar School. And I was transferred [?] .. no--no loss in continuity. I was transferred from the MIT Radar School to the ...

MERTZ:

Servo –

YOUTZ:

Servomechanism Laboratory at MIT. I was hired and was scheduled to work for J.W. Forrester.

MERTZ:

I see. Who interviewed you at that time?

YOUTZ:

J.W. Forrester only.

MERTZ:

And, did he indicate to you the nature of the kind of research activity?

YOUTZ:

Yes. He knew and--he knew somehow--and something I didn't mention: I've always been interested in computers and the design of new computers. And he knew of my interest in this, and Thurstone was interested in designing computing machines and computing devices for his particular isolation of those factors that he always had--always had quite a problem with. And I was always trying to come up with something that would help him isolate his factors in his factor analysis and then get an orthogonal and then rotate them and get the orthogonal set.

MERTZ:

Did you--Were you familiar at that time with some of the computing machinery that was working at MIT .. in the analog[?] ?

YOUTZ:

No, I wasn't.

MERTZ:

I see. ..

YOUTZ:

That was kept fairly well under 'need to know' at that time.

MERTZ:

The--roughly at the same time, there were a couple of .. electromechanical digital computing machines

YOUTZ:

Yes.

MERTZ:

working--Stibitz at Bell Laboratories

YOUTZ:

Yes.

MERTZ:

had one and another one, Professor Aiken at Harvard, the MARK I

YOUTZ:

Yes.

MERTZ:

calculator .. Did you visit the Aiken Computation Laboratory or were you aware of their work?

YOUTZ:

Forrester, when I joined, took some of the other people in the laboratory and sort of pulled them together from the nucleus of his electronic computer section. And, at that time, he made quite a search all over the country looking at every computer and also bringing the word back to us. We were looking at the--these computers from the standpoint that we did most of our work on a sheet of paper.

MERTZ:

Did you --

YOUTZ:

But, he did most--he did most of the seeking.

MERTZ:

He did. I see. Did you--did you join, at any point, in any of the trips to any of the other--such as the ENIAC?

YOUTZ:

Yes, I was down to see Eckert and Mauchly and Von Neumann with .. with Forrester. And that was on my first real--we spent two days and one night, and Von Neumann was an experience. But, of course, Eckert and Mauchley were no slouches.

MERTZ:

Yes, indeed. Do you recall your visit with—

YOUTZ:

Very much so, yes .

MERTZ:

Could you describe it, please?

YOUTZ:

Well, in the first place, they gave us a fairly clear discussion or talk on their particular computer and their computing ideas. And Eckert described the arithmetic unit in great detail. Mauchly was more on the logic and tended on the software. Von Neumann was strictly ... rather theoretical and sort of out of this world, but what he had to say was worth listening to and he hadn't yet published I think his new book on games which included some of this.

MERTZ:

So you--You were with this group that included then .. Steven Dodd?

YOUTZ:

No, Steve Dodd did not go on this trip.

MERTZ:

Oh, he didn't. I see. Oh, on the trip, yeah. I was thinking of the group that formed the nucleus which then developed into the nucleus of the WHIRLWIND.

YOUTZ:

Steve Dodd and I were probably two of the early members of the--two of the early technical members. There was High Boyd and later Harris Fahnsteck, but they were more administrative.

MERTZ:

And Everett, of course.

YOUTZ:

And Bob Everett, of course, he was very, very much one of the brains and--but he worked on the software, I think.

MERTZ:

And, .. was Norman Taylor involved?

YOUTZ:

Norman Taylor was brought in from Bell Labs to lend some strength to electronics and the electronics hardware, but not the computer, not the sto--storage tube.

MERTZ:

Yes. Now one of the questions [?] how did this group--all of you or many of you seem to be involved in --in .. various aspects

YOUTZ:

Yes.

MERTZ:

of putting together a computer

YOUTZ:

Yes.

MERTZ:

and then gradually, or at some point, you became more specialized in the particular problem areas that you were going to concentrate on –

YOUTZ:

They needed--they needed attention and they sort of drew us from those broad special problems to a specific problem. Like it was my job to get the other facilities, manpower, and get those tubes out; and 'Don't give excuses.' [Laugh] And meant it.

MERTZ:

Do you recall about when ... you became, more or less, primarily involved with, to the exclusion of many other things, the--the development of the--of the electrostatic storage tube.

YOUTZ:

Let's see.

[Recorder off]

I joined the laboratory November first, 1946--'45. One of the first things we did was Jay and I took the trip to the University of Pennsylvania. So I would expect there should be a trip report on that, and he did give a meeting report to everyone, .. in the files somewhere. I was surprised, being--being one of the junior members of the group, to be taken on the trip rather than someone else. But, I had thought a lot more about electronic computers and the possibility of making electronic computers out of electro-mechanical computers and was sold on that idea more than the others were. Everett and --and Dodd were working with this analog device and they had a lot of electro-mechanical complements in there and they were very, very suspicious of what tubes would do and the problems you'd have with tubes. One of the things that Jay was concerned about, all, during all of the year 1946, is how we can build a computer with reliability we want, with tubes as unreliable as they are. And there were some very unreliable tubes during the war years, so he was [?]-he still fought for this because he thought that was the only way, he would get high speed and random access. And there those words were ahead of us all the time--high speed and random access. And, whenever anyone made a suggestion for an electromechanical component that came up, and he used to drown them out.

Now it was after talking to Eckert and Mauchly they were also working on a Williams-type storage tube at that time, and--but they were sold on the idea that the Vuillard was not ready for an electrostatic storage tube and they intended to do, use for their internal memory, delay lines. We had thought about delay lines quite a bit during the year, but ruled them out as being too slow. Jay .. hired a man from Radiation Laboratory by the name of Donald Forbes.

MERTZ:

F-O-R-B-E-S?

YOUTZ:

yes. Have you recorded that from somewhere else? Forbes wrote a chapter in the Rad--Rad Lab series ... in which storage by means of just a conventional cathode ray tube gun with the signal coupled to a--to a signal plate. In other words, they had--they--they, during the Rad Lab days, even before 194-- they .. they were working on this during the year 1945, I think. And what they were planning to use was just an ordinary cathode ray tube with a plate up against the--the face, and they worked on that a while and--and

stopped that. Forbes wanted to continue that idea, and Forrester hired him to continue the idea at this place. Well, this was a little bit like the Graphechon, the--the--the barrier tube. It wasn't too far from them. It was a very simple idea. The idea of a cathode ray tube with a signal pl--signal plate on the face was something that appealed to Forrester, because it would be very economical and probably very reliable, if it could be made to work. Forbes .. set up a cathode ray tube with a signal plate, but it had all kinds of cross-talk and couldn't, had equilibrium problems, and it was obvious that this wasn't going to work. Forbes didn't want to give up the idea; so he quit. Well, Forrester doggedly went on after electrostatic storage, but a more reliable idea. He kept the idea of having a building-in, instead of using the--the phosphor or bare glass on the--on the cathode ray tube, he decided to put in his own insulator with a grid in front of it. And he gave a paper on that at Harvard .. Symposium of Large Scale Calculating Machinery. And --

MERTZ:

Do you recall the date?

YOUTZ:

1948 But long--but long before that, he insisted that we go out and find someone who would make one of these for us. Well, the price was just preposterous.

MERTZ:

[Inaudible word] May I ask you one--one other question? Did you or he, or other--any other members of the WHIRLWIND original group .. work .. consider the Williams?

YOUTZ:

Oh, Williams--Williams was very much like the tube that Forbes was working on. There isn't really much difference, and we considered the--except the for Williams had a way of reading and writing, a special way of reading and writing. It's about the same, but we didn't set up--we never once set up a Williams tube set-up, because there were other people doing it in other places and getting results on it. And to Forrester, and to me, it looked as if it was not the way to do it.

MERTZ:

.. Do you recall any consideration of the magnetic drum?

YOUTZ:

Oh, the magnetic drum, the--the delay lines were all considered as part of the internal--but they were too slow. You couldn't get high speed or random access. There's no fast computer now that doesn't have something like magnetic core storage.

MERTZ:

So then .. you were pretty well fixed on trying to design your own?

YOUTZ:

Well, we felt sort of our backs against the wall. We almost had to design and make our own. Now, Everett and Dodd were not particularly in favor of this. They were not--they didn't have--have the enthusiasm for it, partly because probably their background was not along those lines. I had got involved in Chicago in a number of consulting assignments on the manufacture of cathode ray tubes, so it wasn't something new to me.

MERTZ:

So then Jay Forrester assigned the task .. of - of developing –

YOUTZ:

Well, he was still complaining because no one was coming up with a tube. He had talked to Rajchman on the Selectron; and that was a good candidate, he would have liked to have used that. And there--there was an interim period even between our tube and the magnetic core memory that he would--he would have liked to have used the Selectron, but they were too expensive and they were not reliable enough; but it was a good, well-conceived device.

MERTZ:

One of the things that is suggested is the geometry of the Selectron as a tube, or matrix array

YOUTZ:

Yes.

MERTZ:

which .. at that time they were considering other geometries

YOUTZ:

Yes

MERTZ:

At RCA. .. When did you all, more or less, fix upon [a timer?] of a ray which is

essentially a matrix planar array? [?]

YOUTZ:

Well, since we were using a cathode ray tube, and were using a beam to get random access, and had low inertia and everything, we almost needed a flat face, in order to get our equilibrium and not get into a lot of other problems. The Selectron was a bolder and a well-conceived device but I--and they still didn't--there were really construction problems. I think they may have at the end gotten them out, but I didn't follow it that long.

MERTZ:

So .. did you begin working on--on the .. the idea of--developing independently an electronic storage tube .. while at the same time they were thinking of the possibility of using the Selectron and others?

YOUTZ:

Oh, that continued. They never even, even when that tube got almost in production, they were always looking for others. They even reconsidered the Williams tube when these were in the computer and operating, and we were having problems making enough of them.

MERTZ:

I see.

YOUTZ:

We reconsidered the Williams tube and it had had the problems that we expected, we knew it had, and were old that it had.

MERTZ:

But, these tubes as they were finally developed were quite expensive, too?

YOUTZ:

Oh yes. You bet they were. Yes, indeed.

MERTZ:

.. Well, let's go back now. .. Then did you gather some people around you to--to work on the project?

YOUTZ:

Well, Thanksgiving Day, 1946, I had my wife helping me and I went back to Chicago and I said we were .. told her our problems. She was a mathematician too. And I asked her to help me make our first model of a storage tube. We made it, and I brought it back with me, And I also made arrangements with this company to supply guns and supply stems, and other things that we had no way of getting then. But, being a small company, and not worried about patents and other things, they didn't care. They were out trying to make television tubes direct, because there was quite a market at that time. And that was one of the things holding up the production of television sets then: no television tubes.

MERTZ:

This was in Chicago?

YOUTZ:

This was in Chicago.

MERTZ:

I see. Do you recall the name if the .. group?

YOUTZ:

The American Television Institute and that was her name at the time. I don't even know whether they're in existence now... So we make--I--I brought the first one back. Put it on Forrester's desk and it nearly bowled him over. He said, "We're going ahead on this and going ahead fast." Now, this, well, he got big ideas, and we were a little, a little expanded with them, but--and he got big ideas again. I mean they were fine, but he was the one who had to go out and dig the stuff up. At that time, I decided that I was getting a little weak theoretically, and that term I started to take courses again at MIT, and made myself go as a student. And so I wasn't particularly eager to get too immersed in building these things. I could conceive of what the problems would be even to help develop them.

MERTZ:

What course were you taking at this point?

YOUTZ:

Well, I was taking courses in the Math Department. I was--I took one on servomechanisms because I was in the Servomechanisms Laboratory and I had often heard of Guillemin but I--and I was familiar with his books, but I had never taken a Guillemin course, so I took a course--That's the course that I was the two courses I was taking when I first started to make these.

MERTZ:

I see.

YOUTZ:

So I shoed him--Dodd wasn't ready to test it yet and that was his function. So I started gathering materials. Well, there, you see if you look through the literature, there's a lot of people working on these ideas around the country and it was hard to tell where they were getting their ideas, because we very freely showed this to Rajchman, and our ideas on this tube, when Rajchman came up in '48, to this Harvard conference

MERTZ:

.. Who else was working with you .. when, .. in, roughly at the beginning of '47?

YOUTZ:

Beginning of '47--I had one very good technician and later on, I had Frank Caswell who is still with me, join.

MERTZ:

.. There is an article, which you are a co-author of, which came out later with Steven Dodd and H. Klemperer.

YOUTZ:

H. Klemperer was used on the--he joined--Klemperer is an exceptionally good man, who joined the, the electronic computer group .. with the idea that he might be able to work his way into MIT as a professor. He was at Raytheon. He was at RCA and he was at Raytheon, then he was with us. No, he didn't. I had nothing to do with this, this was strictly between Forrester and Dodd and other some thing [?mumbled] but he was a good man and he was a big help on the electro-optics. I had general electro-optics but not enough to add some of the refinements that went into this tube, and that's why his name is in the paper.

MERTZ:

I see. .. Well, then, .. what--what initial problems, after you got into --

YOUTZ:

Well, one of the--one of the big problems was getting started on something like this. It's a materials problem, and it's true of almost any program, even here, our program here at

Lincoln at the moment. Well, if you're in the device work, you're held up because of materials as moves along as fast as some of the other things.

MERTZ:

And –

YOUTZ:

And was out getting materials for this. You couldn't avoid--in the first place, you had to have glass blowing services because that's a very difficult thing to blow and fabricate. You also had to have vacuum pumping and baking facilities

MERTZ:

Yes, ..

YOUTZ:

These facilities I could go back to Chicago whenever I had enough of these things and make them back there, but that wasn't particularly convenient. It was hard on me, particularly when I was taking two courses which I should never have done. But, I didn't have that assignment at that time.

MERTZ:

.. Well, hm, when did you fix on the idea of .. of beryllium ..

YOUTZ:

Well, that was way--that was long--well, we tried a number of insulators which would hold the charge and not spread. But, we also wanted, one of the big things here: we not only want random access, we want high speed. We want fast access. We not only want random access, we want to have fast access, and the only way you can move that storage surface up and down fast is to have--your whole phenomenon here depends on secondary emission. And you want the secondary emission shield to be as high as possible. And we had known from some--from Nottingham, who had heard about it when he was in Germany, that beryllium, if you oxidize it, if you put a thin layer of oxygen, you can get a very high secondary emission shield.

MERTZ:

Had you tried other materials prior to this?

YOUTZ:

Oh, yes. This was the last one we tried.

MERTZ:

I see. Do you recall some of the –

YOUTZ:

Well, one was aluminum oxide. One was anodized aluminum oxide, but none of them--they all had some leakage.

MERTZ:

I see. Well, didn't you –

YOUTZ:

And they didn't have the secondary emission shield--many of them had leakage and none uniformity. This--this![] One of the problems here is that you must have a very uniform surface area, or you--you'll put greater demands on the driving and inspection circuitry.

MERTZ:

Did you .. find that, or even with the beryllium, there--there are border cases .. on the surface between the –

YOUTZ:

Between the little square?

MERTZ:

The little squares of beryllium.

YOUTZ:

Yes, if you don't do it right. We learned how to do it. Ted Clough was the man on that job.

MERTZ:

Clough. C-L-O-U-G-H?

YOUTZ:

Yes.

MERTZ:

Ah.

YOUTZ:

And this was something that we worked on and once we got it, we just held it. And we wouldn't change anything. That's one thing we just didn't change is that beryllium surface.

MERTZ:

Well, was there any particular problem in getting the beryllium .. it was a sublimation technique, if I remember correctly, -

YOUTZ:

Yes, yes.

MERTZ:

to--to which is a high vacuum [?]

YOUTZ:

Yes.

MERTZ:

technique as such. Was there any problem technologically, in terms of the state of the art in high vacuum techniques, to get the kind of uniformity in--in the beryllium spots, so to speak? .. Did you encounter that?

YOUTZ:

We had to work that out.

MERTZ:

Ah.

YOUTZ:

And we had only glass systems, which are very slow, but very good and may also be kept clean. So, we got that under control and kept it under control.

MERTZ:

And what about the read-out problem? Did you have any--any difficulties there in terms of ...

YOUTZ:

[?]

MERTZ:

Yes.

YOUTZ:

Yes. No, well, if they did, I wasn't particularly familiar with them. We had two screens in there to minimize that. But, that was Dodd's job.

MERTZ:

Now those were--Were those screens there--they weren't there at the outset?

YOUTZ:

The first one that came back on Thanksgiving Day had one on.

MERTZ:

Had one. Aha. But that was –

YOUTZ:

Otherwise it would have been just another cathode ray tube.

MERTZ:

Right. But, then they .. that was not sufficient in terms of –

YOUTZ:

Right.

YOUTZ:

Did that develop later, after Dodd started testing the tube?

YOUTZ:

What, the two screens?

MERTZ:

Yes.

YOUTZ:

Well, the louder they complained, the more we had to do. The more we'd add to it, so we just added another screen, and probably would have had a third screen had they yelled loud enough. But, when making these devices, the device person tries to keep his job as simple as possible and the person of the circuitry tries to get as much out of them as possible in order not to--and there's always been that conflict.

MERTZ:

Who .. did--Who was primarily involved in the circuitry?

YOUTZ:

Dodd

MERTZ:

Dodd was. [?] Did Norman Taylor –

YOUTZ:

the memory tube circuitry was Dodd.

MERTZ:

Right.

YOUTZ:

Norm Taylor was in the arithmetic element.

MERTZ:

I see.

YOUTZ:

And the control.

MERTZ:

I see. He played essentially no--no role --

YOUTZ:

No.

MERTZ:

in the circuitry of the tube itself.

YOUTZ:

No, no.

MERTZ:

That was Dodd's contribution. Was there any particular problem of sealing a tube? In terms of--I had heard that there was some difficulty with the problem of implosion, ..

YOUTZ:

We never really had an implosion but one implosion that would have killed someone or hurt someone would have been bad.

MERTZ:

Well, didn't they use tape, ..

YOUTZ:

Yeah, well, that's what you see in this black electrical tape. It's about that wide and the whole thing was taped.

MERTZ:

... two, and two to guard against that.

YOUTZ:

Yes, and later on when they had the carriage run, the display tubes and other things and the rest of the computer, they still used that technique.

MERTZ:

I see. Well, then you had also the task of trying to set up some sort of .. assembly production of these tubes.

YOUTZ:

Oh, yes.

MERTZ:

After you had fixed on a--on a design that you were going to put into the--was this tried out on a--a--a pre-prototype computer system?

YOUTZ:

Well, we had one of two tubes running all the time and were getting thousand of hours on it and then they put out in the computer room itself, while they were working on the rest of the computer, they set up about four tubes. I think there is a picture in there that shows that.

MERTZ:

Was this--what was the relationship of this to the so-called measuring testing tube?

YOUTZ:

That's it.

MERTZ:

That was it. In other words, it was not agreed at that point to hook into the--into the final ...

YOUTZ:

That's correct. That's correct, yes.

MERTZ:

In other words, not unlike the five-digit multiplier that was used for testing arithmetic in the computer?

YOUTZ:

And more important, test the tubes. You see, tubes got a very bad name during the war years because of the technicians; and also the manufacturers didn't do a very good job, the help they had. So tubes --people were really concerned about tubes. I spent a sizable effort under the--this is--out working, and Ted Clough did with me, working on the computer tubes and seeing that the manufacturers made them reliable and had to get them ready for the computers. I worked with Norm Taylor on that.

MERTZ:

I see.

YOUTZ:

But, that--this other work was going on fairly smoothly at that time.

MERTZ:

Now, .. So you decided that it was really kind of inconvenient to commute to Chicago to get these tubes made.

YOUTZ:

Yes.

MERTZ:

And then, what .. what happened then?

YOUTZ:

Then[?]. Well, since my ;home was in Chicago and it looked bad by making these trips at the government expense, [laugh] well, I went to the MIT Radiation Lab, then becoming RLE, and made arrangements with Larry Ryan.

MERTZ:

Could you spell that name?

YOUTZ:

Larry Ryan, R-Y-A-N. He was in charge of the Glass Shop, and then there was another man by the name of--I don't recall it--in charge of the Tube Shop. Well, I made arrangements, in particular with Larry Ryan, to get the--to do the glass work for me and also have their vacuum systems available. But their vacuum systems were not good enough, and I talked Forrester into letting me set up one system and later had maybe eight or nine more.

MERTZ:

.. In--right in the Servo Lab for the --

YOUTZ:

No, by that time, it was the Barta Building.

MERTZ:

Oh, I see, in the Barta Building for the production of the storage tubes?

YOUTZ:

Yeah.

MERTZ:

I see. Well, then that involved increasing the personnel that would be working on the production of the tubes.

YOUTZ:

Yes.

MERTZ:

[?]

YOUTZ:

Yes, yes, there were a lot of students.

MERTZ:

When you once had this going, .. what was your, roughly, your production rate of tubes for the computer?

YOUTZ:

About one a day.

MERTZ:

About one a day? And about how many people did you have working on the production?

YOUTZ:

Oh, well, it's hard to distinguish between production, and then the testing and everything else that goes with it. .. I would say there was one man who made the guns, there was one man who worked on the other assembly, and one person did the--I would say three or four people were involved in making that tube, of about staff quality. And, they may not have been staff, they may have been just EA--they may have been just assistants. But, then there were a number of students who would sit with these--I put a tube like that on the system and pump it. I want someone with it all the time in case something went wrong because they might be able to save something, so we hired students to work the two evening shifts.

MERTZ:

I see. And

YOUTZ:

So we had one student processing a tube, another student doing test work or just so there would be company there in case there was a problem.

MERTZ:

Did you recall about when you fixed on the design of the--the tube?

YOUTZ:

No, things came so fast, so furious at that time. I was involved in, as I said before, the arithmetic tubes, the flip-flops, ..

MERTZ:

Right. Well, once you fixed on this though, there--were there many changes made?

YOUTZ:

In this? No.

MERTZ:

So this was not, remained ...

YOUTZ:

It was something you had to watch very carefully, but it didn't

change very much.

MERTZ:

Aha. Do you recall any important changes that were made after you, more or less, fixed on the design?

YOUTZ:

[Pause] I can't remember.

MERTZ:

Did they find out anything when they put it on the memory test computer .. that was sort of feedback in terms of the design of the tube itself?

YOUTZ:

If they did, I don't recall. I don't recall. That plate that helped avoid some of that. That plate on ... electron guns are. The only thing that might have changed is that holding gun design may have changed a little bit and that plate, because that would pick up any secondary that came back from the surface so that plate--the addition of that plate, yes, was introduced later.

MERTZ:

I see.

YOUTZ:

But, the tubes in the computer I think had the plate in them.

MERTZ:

So essentially all the electro-static storage tubes that were used in Whirlwind of this design were about the same?

YOUTZ:

And there were 32 of them I think.

MERTZ:

Well, and the replacements.

YOUTZ:

And the replacements, yeah.

MERTZ:

What was roughly the tube-life of the storage tube?

YOUTZ:

There were a couple thousand hours and--but again it depended on what they were looking for and how carefully they tested.

MERTZ:

did you find that there was--that there was anything after the tube had been put into operation in the computer that could -- could increase its life? Was there anything that came along?

YOUTZ:

Well ..

MERTZ:

Revised testing techniques ...

YOUTZ:

I don't remember. I don't recall. All I know is the things I would be worried about. The tube-life is--. You see, what they did--I know, yes, well, they would like to be able to put some information on that tube and, as long as there was power, to have it stay on. Keeping information on one little spot for thou--for hundred[s] and hundreds of hours is bound to burn the target, so one way to do it is to every now and then just shift the--shift the storage on that thing. That might have been what you had in mind. It was very definitely found that--questions again the cowhands versus the--there was never any love lost between the maker of the component and the people who were going to test it and use it. And, they--they always feel handicapped--they can't come down and monitor our work because they don't understand it, but we can come up and monitor theirs. And, frequently you found them just taking advantage of us because, sure, I mean you just have this requirement, it would make their job easier but it's almost impossible sometimes to change the ..

[End of Interview]