Oral-History:Buddy Harris

About S.T. "Buddy" Harris

Born in Waverly, Tennessee, S.T. "Buddy" Harris received his bachelor's degree in electrical engineering from the University of Tennessee in Knoxville, where he was a member of the Sigma Chi fraternity. He attended college on a cooperative education program while working for Southern Bell Telephone Company. After graduating, he became a full-time telephone company employee. During World War II, he worked on developing airborne radar systems in the Navy. After the war, he managed the plastics division of a Virginia company. In June 1949, he moved to Dallas to join Geophysical Service Inc., the Dallas company that would become Texas Instruments. During the war, he had met Patrick Haggerty (/Patrick_E._Haggerty) and Eugene McDermott, Geophysical Service employees who became key TI executives. By 1951, Mr. Harris was Texas Instruments' vice president of marketing. He joined the company's board of directors in 1963 and served in that post until his retirement in 1998. He passed away December 31, 2007.

The interview focuses on his role in producing the first transistorized radio, the TR-1. He describes the process of recruiting a manufacturer to make the radio, finally settling on I.D.E.A. after other companies showed no interest. He discusses the tensions and difficulties involved in bringing the product to market, as well as the consequences of the radio being priced too low (an opinion he shared with Haggerty). Though production petered out, the radio helped open up the transistor market, in general and for T.I. in particular.

About the Interview

S.T. "Buddy" HARRIS: An Interview Conducted by Michael Wolff, IEEE History Center, 5 March 1985

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Interview

INTERVIEW: S.T. "Buddy" Harris

INTERVIEWER: Michael Wolff

DATE: 5 March 1985

PLACE: Dallas, Texas

Background and Early Career at TI

Wolff:

I understand you were Texas Instrument's first marketing director.

Harris:

Yes.

Wolff:

Did you come here in 1951?

Harris:

I think so, but I'd have to go look it up.

Wolff:

Tell me a little about yourself. What were you doing before you came to TI and what brought you to TI?

Harris:

That doesn't have anything to do with radio (/Radio), does it?

Wolff:

When I interview somebody and write about them, I like to say a little about their background and how they got to the company.

Harris:

I was in the Navy. That's how I knew Pat Haggerty (/Patrick_E._Haggerty), and that's how I came to TI. Bob Olson, who was the original chief engineer of the organization, was my closer friend, and I came here mostly because I knew Bob. Bob had a fair amount to do with this even though he was not directly involved in this project. He had other things to do to keep the company running. He is now dead. Bob and I were closely associated in the Navy.

Wolff:

I believed he also hired Roger Webster.

Harris:

That's right. As he did me.

Wolff:

Did you come to TI directly from the Navy?

Harris:

No. I had several other positions before I went into the Navy. I came to TI from a company that was involved in the plastics business. I worked there for several years. 1951 might be the right time.

Wolff:

What exactly was your job description when you came to TI? What did they say they wanted you to do when you came here as marketing manager?

Harris:

There was no such thing in those times.

Wolff:

That's why I'm asking. Did you pretty much define your own job?

Harris:

Certainly. We were small enough.

Wolff:

What was the first thing you did?

Harris:

I don't remember. It's been too long. We started running the company of course. Our sales at that time were very small — $10 million. We had to do a lot of things. Our main product in those days, and from the very beginning, was military equipment we were making for aeronautics. Pretty soon after that we got in the transistor business and took military [unintelligible] the time.

Recruitment of I.D.E.A.

Wolff:

I'm particularly interested in what led to the radio (/Radio). Is it correct that it was largely Haggerty (/Patrick_E._Haggerty) who wanted to develop a market for transistors?

Harris:

Pat Haggerty (/Patrick_E._Haggerty) was running the company, but we all wanted that. That was our main purpose in life at the minute. We had developed transistors we thought would do the job, and we contacted every major radio (/Radio) manufacturer in the United States. I did that first thing. I got them all by phone, by telegram and every other way. We got no response out of any of them.

Wolff:

About how many were there?

Harris:

There was RCA (/RCA_(Radio_Corporation_of_America)), Zenith, Hoffman on the West Coast and another one in Chicago. Then we did our best to try to promote it, to get them to seeing that we had something. We went ahead and made a sample, as you probably heard from Roger.

Wolff:

You visited every major radio (/Radio) manufacturer?

Harris:

I contacted them all, I didn't say I visited them. I went to see several, and I did talk to all of them. I sent them all wires and got no response. Pat and I then went to the electronics show in Chicago. I have forgotten what it was called at that time. We looked all over the place for products that might have some applicability to the new days of solid state. Of course radio (/Radio) was predominately in our minds because we thought that was a market that existed, and we saw the Regency work. They were making TV tuners, but the TV tuner business was getting close to running out. That was their only product and they had made a big splash out of it, but then they didn't have anything.

So we made arrangements to talk to Ed Tudor, who was their president at the time. He was amenable to the idea of something new. He didn't know what, and he didn't know about semiconductors. He had heard of them but didn't know what they were. We talked to him in Chicago and then arranged to show him the possibilities with the little radio (/Radio). At that time it was the original model that Roger Webster probably showed you.

Wolff:

He told me it had six transistors.

Harris:

That's right. Then it was determined by both of us that the job had to be small and at a certain price, even though we were wrong. It should not have been that price, it should have been higher.

Wolff:

Did it sell for $49.95?

Harris:

That's right. That price was set at Tudor's insistence. He was wrong about it. It should have been more. It would have sold the same amount if it had been more. We were pretty ignorant about the consumer market at that time, so we didn't get positive about what we thought to the point we should have. Then of course the design job, to try to make one out of the four transistors so that it would meet that price, was a real job. Roger Webster, Jim Nygaard, Dick Koch (/Oral-History:Richard_Koch) and his boys did the packaging job for the electronic portion. They did a good job because they had done that kind of work before. Our big job was, number one, developing the transistors; number two, developing a circuit for this radio (/Radio), which our boys did. Then of course the business of the four transistors and the diode were the key. The IF frequency, which was important, had to be changed from the 455 in order to do that. Then the problem was making the transistors and the radio (/Radio) at the price and selling the radio (/Radio). That was not too difficult in the sense it was new and the size was important and it made a big splash. We had an outfit in Chicago, the guy that started Sundowner Club. I can't remember his name. He was more interested in his club than he was in the advertising business.

Wolff:

The Gaslight Club.

Harris:

The Gaslight Club. That's right. He had done a lot of consumer advertising and had worked with Regency before, so that's where we ended up. It was maybe fancier than it should have been, but he did a good job.

Wolff:

Let me go back a minute. Was the idea to get somebody to build a radio (/Radio) as a way of developing the market for transistors (/Transistors)?

Harris:

Sure.

Wolff:

When you contacted these radio (/Radio) manufacturers, what was the reason they gave for no interest?

Harris:

They didn't have to give a reason and they didn't give one. They were producing tube radios (/Radio) and didn't really care. They were busy doing what they thought was the right thing at the minute, and the vacuum tube people were promoting their products fully. RCA was the largest. They weren't interested at that stage of the game, and that was true of all the rest of them. They didn't see this as the change we thought it was, but none of them had to say so — even though they said so publicly in many meetings that these things were a fly-by-night affair. They did not say that to us, however.

Wolff:

It was a typical problem of "not invented here"?

Harris:

Partially that, plus a large capital investment in the tube business had a lot to do with it, I think. They didn't want to change. That's true of all businesses.

Wolff:

Right. It was interesting that Haggerty (/Patrick_E._Haggerty) in his talk said that they had to persuade I.D.E.A. to take this up.

Harris:

That's probably right. I think we did have to persuade them. The persuasion was a twofold problem. They needed a product rather badly since they were about to run out of their tuners and they needed something. But just like everybody else, they thought this was a wild idea. Nobody had built a radio (/Radio) using transistors (/Transistors), it was all brand new. They had to recognize that it was a possibility. Yes, there was convincing to be done, and they had to convince us that they could do it.

Wolff:

What made you think they could do it?

Harris:

We went up to their operation in Indianapolis and looked it over and talked to their people. We were pretty convinced that their packaging methods were good enough that they could do it — even though many times we had to hold the line in terms of size and a few other things because they kept wanting to compromise a little bit more. It was a continual battle.

Obtaining Components for Transistor Radio

Wolff:

In other words they wanted to make it a little bigger? Is that it?

Harris:

They always wanted to compromise somewhere — compromise the battery, compromise the size of the unit and compromise the tuners. None of these small components were available. We had a fight with the speaker. We had to get Jensen to make a speaker, and nobody had made one that size that ever worked, so this took some doing — as well as some of the capacitors, which were small and had small voltages. Nobody had made them, so they weren't available. We had to do a lot of work in that regard. Finally we got it all done, but this took some doing on both our parts.

Wolff:

In other words it was not I.D.E.A.'s sole responsibility to get the components?

Harris:

They were going to make the radio (/Radio), but the job was ours. We did the design, we did the push, we did everything. We were sure it was going to work, so we were in there making sure it did work with everything that had to be done. We were at least a little bit more powerful than they were in terms of our size, so it took some pressure on both our parts many times. They had some sources, and we helped develop those sources with them.

Wolff:

I see.

Harris:

But it was a mutual problem. It wasn't a one-sided thing in any way.

Wolff:

You both worked on the suppliers.

Harris:

We had to.

Early Dealings with I.D.E.A.

Wolff:

Is it correct that you learned of I.D.E.A. through a magazine ad?

Harris:

That's a good question. That's always been a debated point. I remember seeing this ad. It was talked about a lot. I remember when we went to Chicago to that convention we had some notice of them and that could have very well been from the ad. I don't remember it, all the details. That's been discussed around here many times, and I can't tell you. I'm sure there is something to it. I know we had the name when we went up there. We looked up the person, and at least made it a point to see that booth.

Wolff:

I think you met Tudor (/Oral-History:Edward_Tudor) at the Chicago Parts Show.

Harris:

Yes. I think that's what it was called.

Wolff:

You made a point to see Tudor (/Oral-History:Edward_Tudor) at the I.D.E.A. booth.

Harris:

I'm not sure we even saw him there. I think we made a contact to see him later.

Wolff:

Okay. When you first met with Tudor (/Oral-History:Edward_Tudor) he was somewhat skeptical of the idea?

Harris:

He was no more skeptical than anybody would have been about something as new as that. I think he was reasonably open about it. But skeptical? Yes.

Wolff:

Maybe you can explain one thing that Koch told me. He said there was so much secrecy about it that his boss told him, "We're going down south to make some repairs on some equipment. Come on the plane with me." Then when he got on the plane he said, "Well, we're not really going to do that. We're going to TI to build a transistorized (/Transistors) radio (/Radio)." Do you know why they should have done it that way?

Harris:

Yes. We were doing our best to keep it quiet. We didn't want it to get out until we were ready to announce the product. We hadn't done the job yet, in the first place; the transistors (/Transistors) were still in design. We had made some, but we hadn't made them at the price we were talking about. We were not sure we'd do it. Well, we were sure but nobody else was sure.

Prices for Radios and Transistors

Wolff:

Speaking of prices, there is some confusion about that. I understand that TI initially considered building the radio (/Radio) themselves and marketing it themselves, but cost estimates of over $100 retail discouraged management. Is that true?

Harris:

We never considered that. I don't know where you got that idea, but that's not true. Where did you get that?

Wolff:

This is from an interview that was done by an IEEE fellow with Koch.

Harris:

He was wrong. He didn't know what he was talking about. He was not a part of the decision, incidentally. He was a part of the technical decisions and that's all.

Wolff:

Yes, I understand that. That's why I'm asking you. You never considered doing the radio (/Radio) yourself?

Harris:

No. That would have been wrong for us to do.

Wolff:

It is correct that I.D.E.A. had to buy the kit of transistors (/Transistors) from you?

Harris:

Correct.

Wolff:

Did they pay $12.50 or $10?

Harris:

It ended up $10. I don't remember whether it started differently. I think it was $10 all along — $10.90 or $10.80 maybe. Something in that range.

Wolff:

I guess it started at $12.50 and then it got less when they knocked out a transistor (/Transistors). That may have been it.

Harris:

I don't think that's true. I don't know where you got the $12.50 figure. I don't remember that ever being in the act except that there were lots of prices kicked around when we were trying to settle where it was going to end up. Until we got the product cost, the prices were not all that firm. We were doing our best to make the price and they were doing their best to make the product, so we all had to come to some mutual terms as to where it ended up. Any preliminary numbers wouldn't mean a thing. They were just talked-about numbers.

Wolff:

The reason you could get it down to $10 was because they came up with the four-transistor (/Transistors) design.

Harris:

We came up with the design. Dick Koch did add the idea of the diode unit all right. And then everything else fitted.

Wolff:

That brought it down to five. And then after that, he knocked out another transistor (/Transistors) with a converter circuit.

Harris:

Yes. That was a mutual problem. He and Roger did that together.

Wolff:

Roger remembers that it was mainly Koch who did it.

Harris:

He's got more to say about it than I. I remember it being a mutual thing. I remember when it happened very well.

Production and Distribution Challenges

Wolff:

In your role as marketing manager, you did a lot of the coordinating work with Regency?

Harris:

I did it all. I was in charge of that. I was up there every week for a long time. I got sick of the place. I didn't like Indianapolis in the first place, and I sure didn't like to go up there in the snow, which I had to do many times.

Wolff:

What was your biggest problem in the coordination? What kinds of things did you have to do?

Harris:

The same old problems — getting something done within the price and the time. There was a new problem every day. There was nothing outstanding other than that every day there was a new crisis. I have forgotten the name of the guy that was their marketing man. Dick somebody. What was his name? Maybe you have it there.

Wolff:

There was a Hayworth.

Harris:

No, he was financial. He was a production man.

Wolff:

There was Ray Morris, who was Koch's (/Oral-History:Richard_Koch) boss. I don't know any of the other people.

Harris:

You must know that man. You'll find it in the correspondence somewhere. He was the elderly guy who was their marketing man, and he set up their distribution. I got more thwarted by the distribution process than anything else. He had been dealing with a bunch of distributors around the country — agents, really — and I didn't care too much for many of those agents. We had to reach compromises about what we were going to do. They made a three-step system distribution: agent, distributor and retailer. And that was expensive. We tried to change that, and this was against his knowledge and against his field. It was really one of the relative problems of the whole project. It should have been handled directly through wholesalers, but that's the way it ended up and that's the way it went.

Wolff:

It ended up with just the wholesaler or with the three-step?

Harris:

They stayed with the three and that was not a good answer. Maybe it was the only answer. I can't even say at this stage of the game. The product was new and they were uncertain about breaking into the major retailer chains, which were controlled in those days by a very few radio (/Radio) manufacturers, which had to be broken. Maybe it was the only way it could be done, but it was a major problem all along. I spent a lot of time at that.

Wolff:

There was something else a little strange that I wanted to ask you about. There was some reference to a black market in transistors (/Transistors) developing.

Harris:

I don't know a thing about that. I think that's somebody's imagination. There wasn't any black market, because there weren't any transistors (/Transistors).

Wolff:

I can't find the reference to that now. Maybe it will come up.

Harris:

I think that's quite erroneous. I don't believe that anything like that could have taken place. There were just not enough of them. One of the main problems was getting sufficient quantities out in time. There was no black market in them.

Wolff:

I may not be recalling the reference correctly, but there was something about a black market I wanted to ask you about. Anyway, one of TI's big problems was in learning how to turn out enough transistors (/Transistors) at the price.

Harris:

That's right.

Wolff:

Was Mark Shepherd in charge of that?

Harris:

Oh yes. He was in charge of transistors (/Transistors).

Wolff:

I've been told that he was too busy to see me and that I should send him some written questions. What do you think would be good to ask him about?

Harris:

I don't know what you want. Do you need some specific data?

Wolff:

Just about the problems. Were you aware of any particular problem in the manufacture?

Harris:

Of course we were all learning how to make them at that time. It was brand new, and it was a complicated process, the grown-junction transistors (/Transistors) and the testing. He set up production lines which were rather rudimentary, but they were production lines. Incidentally, there are some pictures of those in the plant.

Wolff:

That would be interesting if we could get one of those pictures.

Harris:

You could get them, but you can't get them today. The guy that handles them is out of the plant today. His name is Jim Lacy, and he's not here, but he's the man that has all of those. We have been collecting them for the Smithsonian.

Wolff:

Webster mentioned that. Do you think I could call Lacy and ask him for a picture some other time?

Harris:

I'm sure you could.

Allocating Resources to Radio Project

Wolff:

Good. Okay. Tell me about Haggerty (/Patrick_E._Haggerty)'s role in all of this.

Harris:

Pat was the boss. He was running the show and of course running the company in addition. Of course he kept his eye very specifically on this project because he saw its importance. He and I were in contact daily during that time, and sometimes much more than daily.

Wolff:

I gather from what Pat Haggerty (/Patrick_E._Haggerty) has written, that the OST management system was used with this project. Is that right?

Harris:

Not really. It may have been used in a rudimentary sort of way, but we had not fully developed it as a system at that time. It was too early to say that it was in use. I put the OST system in effect in the company, but that was quite a bit later. There is no question that it was not in existence at that time.

Wolff:

Could you elaborate a little on the principles you used?

Harris:

The same old business. There were very few of us, so we did our best to allocate as we should. It was an R&D allocation. Much more important at that time was how we used our best people and what money we had to spend for our technical programs. We spent time trying to be sure that was correct as far as we knew how. It was always a problem because we had limited money and limited people. We did the best we could.

Wolff:

You spent a lot of time determining how many people —?

Harris:

We had to. We had to allocate between this project and running the company in terms of keeping it going. This was a development program as far as we were concerned, and we had to make it run, but we also had the other parts of the company to run. The two had to be balanced.

Wolff:

Okay. About how many people did you have on this?

Harris:

I don't have any idea.

Wolff:

Can you give me some feel for what percentage of your resources went into it?

Harris:

No, I can't without past records. They're probably gone.

Production Numbers and Decline in Sales

Wolff:

Okay. Talking about shipping numbers of units at $10 per unit, that was the 4-transistor (/Transistors) package. Right?

Harris:

Yes, that's right.

Wolff:

Okay. And the total units manufactured were a little over 100,000 as you remember. That's 400,000 transistors (/Transistors), and that means 100,000 radios (/Radio). Of course they went on from the TR1 to other versions.

Harris:

The actual total number has been asked about a lot, and I have done some looking into that in the past. As I remember the point — and this point is only memory, I don't have the final numbers complete — but I remember somewhere between 130,000 and 150,000 were the final numbers made.

Wolff:

Is that of all the models?

Harris:

That's all of the models.

Wolff:

Then it sort of petered out?

Harris:

It petered out for several reasons. In the first place, by that time the competition had begun to get into the act. Secondly, the Regency people were not making any money and going broke at a rapid rate. We were off on other projects by that time and doing other things with the semiconductors (/Semiconductors). It had been picked up as

being an important attribute to the electronics business and people were after them, so we were going on to other things.

Wolff:

Like what?

Harris:

I don't even remember.

Wolff:

Audio File
MP3 Audio
(463_-_harris_-_clip_1.mp3)

Haggerty (/Patrick_E._Haggerty) made a statement that is kind of intriguing. He said that if you had sold it for a higher price you would have made enough money to have perhaps become the Sony of the consumer market. **Harris:** I not only agree with it, I think he is absolutely correct. He and I spent many hours talking about that. That would have been so had we merely priced the unit at $10 more. That would have been the marginal difference between the distribution costs and the cost of manufacturing, to let it become a product that would have allowed continued R&D. **Wolff:** If you had been able to have that continued R&D. **Harris:** That's right. You never know what you might have done with it, but had that happened it would have made an attractive enough economic problem that we would have gone ahead and done it, I feel sure. Looking in retrospect, I'm not saying that was the right thing or wrong thing, but it certainly would have been possible. **Wolff:** Do you remember what year they stopped manufacturing the radios (/Radio)? **Harris:** No, I really don't. **Wolff:** They don't either. **Harris:** It wasn't very long.

Failure Rates and Production Problems

Wolff:

Koch recalled that one of the problems they had was high failure rates, and that you came in to check on that.

Harris:

Every week. There were always two or three failure rate problems, as there are in any product like that. Firstly, it was packaged much more tightly than anything had been packaged in those days. We had problem of holding in that little board inside the unit, and we had problems with the solder being too hot for the transistors (/Transistors) to take it. We had to work out many quality problems.

Wolff:

You said there were three problems. The tight packaging and the solder were two.

Harris:

The soldering with a tight package. One reason was because it was a dip-solder process. Everybody was used to that process because all the electronic components up to the time had taken the heat without any trouble. We had no experience with semiconductors (/Semiconductors), so we had to go through that problem too. We had to find out what that was, and that took some doing because that had to be compromised so that everything else would work. Then there were always mechanical problems. There were several wires soldered in the unit, and those wires always give trouble. Then there was the battery problem.

Wolff:

What was the battery problem?

Harris:

They just didn't work. Many of them were bad.

Wolff:

How did they solve that problem?

Harris:

Just putting quality and [unintelligible].

Wolff:

That was the 22 1/2-volt battery.

Harris:

Right.

Impact on Texas Instruments

Wolff:

What would you say was the effect of this project on Texas Instrument's future?

Harris:

You can guess about that any way you like. I think it had an effect in terms of kicking off the use of semiconductors and caused people to finally recognize that it had a future. It was new enough and a big enough splash that people had to pay attention. Whether it did more than that, I can't say, but it certainly did give that kind of an impetus.

Wolff:

Did it lead indirectly to your getting IBM as a customer?

Harris:

That's hard to say. I think it did. Tom Watson himself admitted — maybe Pat reported at one time — that he had seen them and he bought some and gave them to a number of his employees. I'm told this — I don't know it — but he said, "If this outfit can do this, they can sure as hell make the devices we need to make the 703 work." That's when we got involved with the Regional Computer Project.

Wolff:

You sold transistors (/Transistors) for the IBM 703.

Harris:

I think that's the right number. It was the first major transistorized (/Transistors) mainframe unit. We didn't sell them. That was something that had to be worked out with IBM because they were working on the project. We were a supplier to them.

Wolff:

You supplied the transistors (/Transistors).

Harris:

Right. They were special transistors (/Transistors) of course.

Wolff:

Were they designed by IBM?

Harris:

They were designed by both of us. We all had to work that out. They were special. IBM was not in the transistor (/Transistors) business at that time.

Wolff:

In what way were they special?

Harris:

They had to meet their product requirements. Most transistors (/Transistors) are special.

Wolff:

I see what you mean. Okay. Is there anything I didn't ask that you want to add about this story?

Harris:

No.

Rollout of TR-1 and Black Markets

Wolff:

Is it correct that two market areas, New York City and Los Angeles, were selected for the TR1 introduction?

Harris:

It depends on what you mean by introduction. Chicago and Dallas were involved. We introduced it here in Dallas at the same time. Those of course were big markets and they got a big push. I suppose you are quoting from Regency somewhere.

Wolff:

This is the interview that was done with Koch (/Oral-History:Richard_Koch).

Harris:

I suppose in their minds at Regency they saw it that way. We saw it other than that. Our goal was to try to get it as broadly spread as we could, so there were other places than those two. However, those certainly got the initial push.

Wolff:

Koch also said the new sets were so popular that they began to show up on the black market in Boston and other cities.

Harris:

That's true. They showed up in the black market at increased prices. Somebody would go buy them and bring them around and give them to some of the specialty stores to sell for a higher price. We never could trace it, but we knew it happened.

Wolff:

That's what I was remembering about the black market.

Harris:

That was not really a major thing. It never really caused much trouble.

Wolff:

It is sort of a cute detail.

Harris:

Yes, that's right.

Wolff:

Then he goes on to say the original purchase order from Regency to TI was for 100,000 kits of 4 transistors (/Transistors) per kit at a price of $10 for each.

Harris:

That's something I had to work out.

Wolff:

Is that a correct statement?

Harris:

I don't think that is correct. I think the first purchase order was for quite a bit less. Regardless, once we saw that the unit had gotten over the hump that was about right. I don't remember the initial order because it took many smaller orders to get it going.

Wolff:

Eventually the price to Regency was $10.

Harris:

Yes.

Wolff:

But the initial order was 100,000.

Harris:

I don't think that's right. I'm trying to say that I don't think that is correct. There were several orders, which I had to see, which were orders that existed to get us started. I think there were some for 5,000 and 10,000, numbers like that, to see whether the thing could be made to go or not. However, when we really got around to setting a production schedule the way we were going to go once we saw it was going, 100,000 was right. There were several others after that too.

Wolff:

Your target was to have something out for the Christmas market of '54. Were you ever worried that they weren't going to make that deadline?

Harris:

Sure. Worried every day, 24 hours a day. They were worried too. They were working hard at it within the limits of their resources.

Wolff:

I think that takes care of the questions. Thank you for taking the time to talk to me about this.

Other People Involved in Production

Harris:

You asked about one thing which may still be hanging, and that is what to ask Mark Shepherd. What do you want to know? He was a guy that had to build the transistors (/Transistors). That was his job. He had to set up the first assembly line to do it and had to make it work at the price. He had certain resources with which to work. What in particular do you need for your story?

Wolff:

That's helpful. I'll just ask him if he recalls any one thing that was a more difficult problem than anything else.

Harris:

I'll tell you two things he'll obviously answer: money and people. There was a young man with me all this time who was his right-hand man. His name was Jim Nygaard. Most of the time Jim went with me to Indianapolis to straighten out things that might be going on while Roger was here doing the work. I think he worked for Roger.

Wolff:

Yes, at the beginning.

Harris:

Jim is still around. He's retired, but he's still in Dallas. He has a rather vivid memory of many of these things and could probably answer some of the questions you are talking about with Mark.

Wolff:

Yes. Webster suggested I call him and I will. Who did the actual assembly? Did it require particularly skilled people?

Harris:

Not really. It was more a matter of conventional but tight assembly approaches as they had used in their TV tuner. It was the same kind of thing they had been doing in that regard but a lot tighter than they had ever done — tighter in terms of size, dimensions, fit and everything else.

Wolff:

What about the transistor (/Transistors) fabrication at TI?

Harris:

It was new. We had to start from scratch.

Wolff:

I know. Who were the people doing it? Were they chemists and people like that?

Harris:

Yes, there were chemists. The chemists' problem was the growing of the transistors (/Transistors). The grown-junction situation was a real problem, and that's the key. Once that was done then the assembly process of putting them into cans was done with relatively unskilled people — even though we had to train the ones that came along. They were girls of course.

Wolff:

Did the design for that come from Gordon Teal?

Harris:

The design for the grown-junction.

Wolff:

Yes.

Harris:

Well, Gordon was one of the people. There were several in the act. Boyd Cornelison really was the guy that developed the first puller. He is alive but not capable of talking anymore. He lives somewhere in East Texas. I understand he is completely incapacitated.

Wolff:

Webster had recalled that you used double-diffused grown-junction transistors (/Transistors) and that was Teal's contribution.

Harris:

Teal was the head of the laboratory at the time and doing grown-junction work. Willis Adcock (/Oral-History:Willis_Adcock) was in there too. Willis is still here, I think Gordon still lives in Dallas.

Wolff:

Yes, he does. I talked with him a few months ago.