

# TELEVISION

EDITED BY **RICHARD BREWSTER**, 145 LITTLE PECONIC BAY ROAD,  
CUTCHOGUE, NY 11935 PLEASE INCLUDE SASE FOR REPLY.



## An Interview With Howard C. Lawrence, Television Engineer: Part 1

*The following interview was recorded on May 14th, 1988 at the Cherry Hill home of retired RCA engineer, Howard Lawrence. As an undergraduate at MIT, Mr. Lawrence worked with Hollis Baird, who was then developing his electronic TV system in Boston. Lawrence went on to have an interesting career with RCA.—RB*

### Mechanical Television

I graduated from MIT in 1938. For my thesis work, I designed a television receiver. I had been interested in television for a long time; I had a 'Nipkow disc' which was a very crude and primitive sort of thing. There was a station in Newark, New Jersey and, if I remember right, it was on North Broad Street. It was either WOR or WJZ [that] had their broadcast stations there back in the 20s. Up on the roof they had a big [antenna]—one of these 'top-loaded' things they used to have on ships with lots of parallel wires with a feed down the middle of it. I believe it was in that same building and probably some of the same people that were broadcasting 60-line television experimentally. I believe it was in the broadcast band or just above. It was somewhere between 1.5 and 2 megacycles.

I had built a Nipkow disc and I didn't have a drill press and I didn't have any other way of getting the holes in—so what I did, I used a phonograph record. I put a hub in the middle of the thing—bolted that on—and I laid out the spiral and I put the holes in it with a hot needle. The speed control on the motor was just my fingers on the edge of the disc. And I never got a real good picture out of it. I would get things that would sort of flicker in sync and flicker out as I would put my finger on it. At least



*Howard C. Lawrence.*

that's about as far as I got with that. I think I was 10 or 12 at that time. And then I sort of got away from it.

### Electronic Television

When I got towards college at MIT, I got interested in cathode ray tubes. I wrote papers on that and the work that Nipkow and others did. Then when it came close to my senior year—in those days we had to write a thesis to graduate—I decided I would do a television receiver. The television receiver was based on primarily British publications because they were doing a lot more work over there in England than we were over here.

The techniques in it were mostly all oscillograph techniques. For example, I used gas-discharge tubes for the horizontal and vertical oscillators. And the amplifiers you got right out of the literature from the RCA publications and some of those other places. The sync separator, I think, was a triode separator biased off. Later on they used diodes for separation. I had a big investment in the cathode ray tube. I can still remember I spent seven dollars and a half

for the two-inch cathode ray tube which was about as big as I could afford.

In the meantime, I had gotten to know people like Allen Dumont. Allen Dumont at that time was building oscilloscopes. He had a laboratory which was on Valley Road up in Montclair and a number of stores which he had taken over for his work. He had done his original work in his home. He was a bachelor for many, many years. He didn't get married until his late 30s or early 40s, I guess it was.

But I got to know him. I stopped down at his place. I saw him expand and I think I got my two-inch tube from him, if I remember right. But I did have to pay the seven dollars and a half to buy the tube! Later on I went from a two-inch to a three-inch tube...that was a gigantic step. Then eventually I got a five-inch tube!

I also had a National Union [CRT], because I got to know Marshall Wilder, who was chief engineer at National Union in those days. He was interested in television on the side. Marshall was another one of these fellows, of the engineering type, that spent all his time on his career and he didn't get married until his late 30s.

But at any rate, he was building cathode ray tubes. He built a monoscope; they had an aluminum foil pattern that was hit by the beam and it was printed with printer's ink. And the printer's ink would depress the secondary emission from the aluminum. And that way you could pick up a signal—you'd scan it. And in the early days you would sync the transmitting tube and the receiving tube with the same source of sweeps, so you didn't care what the frequencies were. It made a good thing for experimental use in the early days.

I'm getting a little ahead of myself. I did this; I guess it was toward the end of my senior year after I had my receiver going that I really got to know Marshall Wilder. I saw his tube and made some suggestions on how to improve the monoscope. He then gave me one. That's how I got my first monoscope.

*You mentioned Dumont; what sort of a person was Dumont?*

He was an engineer; he was a nice sort of

a guy. He did a lot of the design work himself. He was an experimental type and had previously worked for Westinghouse up in Newark. When I graduated from college he offered me a job to go work for him back in his early days. He had just bought that plant over in Clifton; it was an old pickle works, if I remember right, that he had renovated. But I knew one of the fellows for whom he had worked. He was a plant manager for Westinghouse and I told him I was thinking of going with Allen. And he said, "He's a dreamer; he's not a good businessman." So, I decided that I would go with RCA; I also had an offer from them at the time. I knew I could have gone to work with Hollis [Baird]. RCA looked like it had the greatest opportunity.

*Going back now to your dealings with Hollis Baird. . .*

Okay, when I started building my television set there were some circuits I had to work out, of course. I had ideas, which worked out, and I got to know Hollis—they had a school in the Back Bay section of Boston. I used to stop over and see him and see what he was doing and I told him what I was doing. We discussed my ideas for the sync separator and I think I may have made a small contribution to his work. I don't imagine he kept it because the field was expanding so fast in those days and knowledge was coming out and the *RCA Review* was publishing new circuits almost continuously.

Each issue would have some more on television because it was one of their big subjects at that time. But when I wanted to check my receiver out—get a picture over the air—I had the monoscope, so I could check it myself—but then when I wanted to get it over the air, I'd call Hollis up and say, "Do you mind putting a picture on so I can check it?" And Hollis occasionally...I can remember one time he had just finished a new iconoscope—they made their own iconoscopes—and he called me up and said, "Would you take a look and see what it looks like to you?" Baird explained how they would make iconoscopes and then change the process a little bit...they would deposit a layer of material on a sheet of mica

and then they had to take each one of these tiny cells which were put on as a vapor and then make each one of them into a photo-cell. That, of course, was capacitively coupled to plating on the back of the mica.

And he had another guy, an older fellow who was a sort of businessman in the school; he was not a technical man. One day when I went over there, he said, "We made you a consultant in our outfit." So he said, "See..." and he pulls out a piece of stationary and it says on the top of it, 'Howard C. Lawrence, Jr. - Consultant.' I never got anything for it and he never asked me about it but I was always very proud of the fact that I was a television consultant while I was still in college! Ha, ha, ha. But, as I said, I used to go over there periodically—I used to talk to him [Baird] occasionally on the phone when we were talking about these things. I never kept up with him after I graduated.

*What sort of a facility did he have?*

As I recall, it was on the second floor—his laboratory was—and I can remember he had several racks, telephone company type racks like I have my ham gear on here. And he had a technician...one of those guys who were so typical in those days who was not a college graduate but he was a glass blower. He was a 'tube-type' technician. He also did a lot of the wiring and he had the usual 'haywire' type of stuff that the experimental people had. I can remember that there were tables around with stuff on it and he had a camera that he put the tubes in to try 'em on...they were all iconoscopes in those days...

*Did he get a fairly reasonable picture?*

Yes, he had nice pictures—they were mostly...things...I mean he had the camera set up and you'd walk in front of it and then you'd turn and look and see what was coming out the other end. He didn't have any programs...I mean it was mostly a research type of operation. I don't think that Hollis was interested in the broadcast station; I think he was interested in the techniques—at least that was my impression. [This was in 1938.]

*Did his quality of picture compare to what RCA had at the time?*

I don't remember that...I remember it was a fairly decent picture. He did have the usual 'fan-type' resolution patterns on 'em. But I can't even remember right now what sort of resolutions he was getting on them. He had the standard 441 line interlaced picture. He had a sync generator...I don't know where the sync generator came from...I suspect it was out of the RCA publications somewhere.

After graduation in 1939, I went to work on RCA's production line as a student engineer. I was a troubleshooter working for the test department. RCA had set up a special production line in Camden to run those [TV] sets. They put it in a different building then where the normal home receiver production was. And they ran out a small quantity; it was a few thousand, if I remember right. Those sets were used at the New York World's Fair and they were also installed in few key people's houses.

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*Part 2 of this interview will appear in the October issue.*

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#### **RADIO RAMBLINGS**, continued from page 40

their daily schedule.

The old Western Electric transmitter was replaced decades ago and its parts are probably being traded on eBay now. The old transmitter building and 600-foot tower are gone. Because of campus expansion, a new transmitter building and tower were installed approximately one mile west of their original location.

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#### **REFERENCES**

All of the information for this article came from my personal experiences as an employee of KANU. The stereo FM block diagram was downloaded from the following internet website: <http://hamchatforum.lefora.com/2009/11/14/broadcast-vhf-fm/>

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## An Interview With Howard C. Lawrence, Television Engineer: Part 2 (Conclusion)

*This is the conclusion of an interview recorded on May 14th, 1988 at the home of retired RCA engineer, Howard Lawrence. (Part 1 appeared in the July Journal.) As an undergraduate at MIT, Mr. Lawrence worked with Hollis Baird, who was then developing his electronic TV system in Boston. Lawrence went on to have an interesting career with RCA.—RB*

*Lawrence...Continuing...*

**A**fter graduation [from MIT] in 1939, I went to work on RCA's production line as a student engineer. I was a troubleshooter working for the test department. RCA had set up a special production line in Camden to run those [TV] sets. They put it in a different building than where the normal home receiver production was. And they ran out a small quantity; it was a few thousand, if I remember right. Those sets were used at the New York World's fair and they were also installed in few key people's houses.

### Changeover From 441 To 525 Lines

After those first sets came out, somebody in the television terminal engineering group decided that you could see the line structure in the [441-line] picture but you don't see any horizontal resolution. An object just fades from one to the next; maybe we would be better off if we erred a little bit on the side of too many lines and sacrificed horizontal resolution. If your bandwidth is fixed, you can play with these two; you can make them both come out equal or you can make one be higher than the other. So they said, "Let's see if we put more lines in, you might get a more pleasing picture."

So we had this so-called 'juke' [sp?] equipment, which was a big cabinet; so high with a tube in the top which had all the sync

generating equipment in it—it had a simplified version sync generator—it wasn't as stable as the other. We used to have to adjust it periodically to make sure it stayed in sync. It had a little scope in there so you could tell it was in sync.

So they set that up with a viewing receiver and they put a monoscope in with a resolution pattern. Then they set the resolution pattern at a 45-degree angle [obviously a specially-made monoscope], so presumably you were getting sort of an average resolution of horizontal and vertical on the thing. Then they tabulated the various numbers of lines you could have with the sync generator which used these certain discrete steps—that were multiplied from one to the other.

It was my job to set the equipment up to these various numbers of lines. Then the lab design engineers would go over and look at the picture and read the resolution and then they would go whisper to somebody over here who was tabulating all this stuff what they said the resolution was. There were six, eight or ten of them. And then when they got all through, they plotted this curve—resolution versus the number of lines as seen on this 45-degree deal. And it came out that the peak resolution was around 525 lines!

So they decided that this looks like a good place to switch. Elmer Engstrom, who later became president of RCA, was in that lab. Dr. Zworykin was still working there at those times; George Beers, who headed that up, [as well as] Merrill Trainer [and] Wally Poch—a lot of those old time names from back in those days. They then thought it over and decided, well, it's worth getting out, changing all these sets; readjusting all these sets that are in the field, because, after all, there were only a few hundred out at that stage and we'll go to the FCC and tell them that we want to

change the standard, which they did. So that's how the 525-line [system] came in.

*At this point was Dr. Zworykin away from things?*

Dr. Zworykin always kept pretty close to these things. He was pretty much an engineer's engineer, you know. He liked to get into things like this. His degree was an honorary degree too. In fact, most of them—Dr. Engstrom's degree was an honorary degree. I think George Bourzie [sp] had one in here. The department at RCA in the labs—I know, I worked in the RCA labs in Princeton back in the late 60s and early 70s.

Even then, they were taking people who had done outstanding work which they thought should be honored with a doctor's degree—and somebody would pull together all this data on them and write 'em up and then they'd find some equipment that they could maybe donate to some university somewhere and then they would try and work up a deal with such and such a university. And this is what they did with Dr. Zworykin and Elmer Engstrom and I think George Bourzie—George never was one to go around with the name 'doctor' in front of him. Dr. Engstrom always did. Dr. Zworykin always did.

### **Dr. Zworykin's New House**

If you want to shut that thing off, I'll tell you an interesting story about Dr. Zworykin. [*Obviously, I didn't shut it off.*] Just to let you know the kind of guy—got to know him up in Princeton—had known him a little bit down in Camden when I was in the training program. But I didn't know him as well as I did many, many years later when I was in management. And I used to see him once in a while and we'd have lunch together and he'd get to talking about old times.

He was towards the end of his career and at that stage he'd look back at the old times instead of looking forward to the new times to come. The fellow who had worked directly with him back in the television days told me this story. This fellow was one of these guys who spent all of his time on work and playing. There were quite a number of them at RCA. They had their own airplanes and they did a lot of skiing back in the days

when people weren't doing as much skiing. They all had elaborate cameras and so forth—but no wives.

So Doc Zworykin comes to this fellow, Loren Jones—Loren, I'm sure is retired now—and he says, "Say, Loren, there's a piece of land out here near Medford Lakes. Would you fly me over so that I can get a view of the thing from the air?" So Loren agrees and says "I took Doc up and we went out and looked at it and there was a lake out there and in the middle of this lake there was a peninsula. Doc was interested in the end of this peninsula to put his home on.

We looked it over and later Doc went out and put some stakes in where he was going to put his house up. I flew him up there again sometime later and he said he didn't like where the stakes were so he went down and changed them a little bit and we flew over again and he finally decided that that this is what he likes. So he looked up to see who the owners were of this place and it was an elderly woman from up in New York.

He contacted her and she said that she would sell it and that she wanted so much a front foot for it. So he measures across the base of this peninsula and multiplies it by the front foot number and offers her that amount of money. So she writes back to tell him that isn't what she meant—she meant the front foot around the lake. So he starts building his house—that was the last correspondence—he put in the footings; starts putting the walls up and so forth and so on and one day...

This story I got from his daughter: The sheriff came up one day and he tried to tell Zworykin that he wasn't supposed to be building there; he had no arrangements and so forth. Zworykin couldn't understand him and he [the sheriff] couldn't understand Russian! So the sheriff writes back to this woman in New York explaining that he is sorry that he can't make Zworykin understand and there is nothing he can do.

So Doc Zworykin continues building and he had the place pretty much up and enclosed. And one day Doc Zworykin was out there working and his daughter was there with him and this big chauffeur-driven auto-

*(continued on page 64)*

mobile comes up to the front. And he says, "Hey, I think this is probably the people that own the place."

So the two women get out of the automobile and Doc Zworykin comes out, and in his best Russian court manner, bows low and says how happy he is to see them and how fortunate they are to have him, Dr. Zworykin, who is a big name in television, on their land and how it's going to increase the value of their property, to have him build on there. And they ended up giving it to him for the price he offered. Can you imagine a guy with the guts to start building on a place that he didn't even have verbal agreement for? That's the kind of guy this guy was! He was a very interesting guy.

### **Hugo Gernsback**

I wrote a series of four articles for Hugo Gernsback's publication, *Radio and Television*. I think I got ten dollars or twenty dollars an article or something like that. In those days, thirty dollars was high. This was in late '38 or '39, somewhere back in there. But his checks bounced when they came to me! So I wrote to him and he said, "Send them back and I'll give you new checks." So he did and they bounced too.

I got my dad to check and he contacted one of his lawyer friends and found out that Gernsback has \$100,000 in claims against him. I finally got a ten dollar check that cleared and I finally decided to look him up in New York. So I went to his address in downtown New York and the superintendent

says, "He is not here anymore, he moved to such and such a place." I eventually found out that he apparently ran up big debts on his building and he'd move to another building and he had moved to a number of places around New York City.

So I went over to this other place and I thought I was going into Sherlock Holmes' study! Because it was a second floor room; the whole place was filled with bookshelves with old books on them—some of them with leather bindings and some with bindings that were falling apart and so on. Tables all over the place with pieces of apparatus on all the tables. And here's Hugo Gernsback sitting there—he was a rather tall, slender fellow, again, like I imagined Sherlock Holms would look like. Very friendly guy and he talked to me and told me a lot of nice sweet words and so forth. I don't remember anything else but I just remember the impression.

But in those days—see he used to hire people to work for him and he'd pay them next to nothing—we didn't have minimum wages in those days. They'd get a little experience and they'd quit. And almost every magazine that we dealt with—I used to write for quite a number of magazines—in almost every one of them, the fellows had gotten their start with Hugo Gernsback. They could always get in because there were always openings because people were always quitting. So he was the training guy and I would get to know these other fellows and I'd usually get the subject around to Hugo Gernsback and I learned quite a bit about his techniques—he was a real character.

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## More on the Howard Lawrence Story

### Lawrence's TV Receiver

**B**ack in the July issue of the *Journal*, I noted that Howard Lawrence was required to write a thesis in order to graduate from MIT in 1938. Another MIT grad, John Terrey, helped me acquire a facsimile of Lawrence's thesis, which described the design and construction of a working *two-inch* television receiver. The 35-page document details Lawrence's learning process as he carried out the project.

Lawrence noted that he had become interested in taking on this work by a four-page RCA advertisement in the December 1937 *QST* encouraging radio amateur experimentation. This, together with the RCA's experimental television broadcasts from the Empire State Building, encouraged him to proceed.

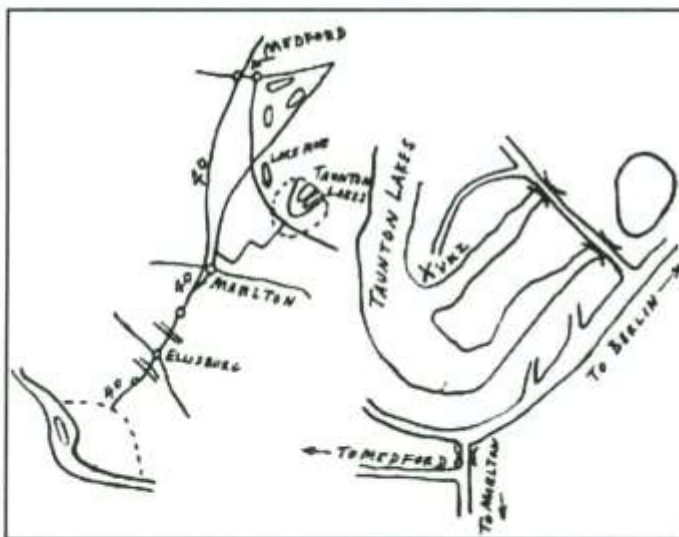
Early on, he decided that he would have to settle for a small picture tube since the expense of a larger one could be two-thirds the cost of a complete set. Lawrence noted that one experimenter had even built a set using the recently marketed one-inch 913 CRT! In addition to the advantage of economy, the small sized tube had a lower voltage requirement for the second anode, eliminating the need for a dual voltage supply.

Lawrence's video-only receiver tuned from 40 to 65 MHz. The front end consisted of a 6C5 oscillator driving a 6J7 mixer feeding a 13 MHz, two-stage IF strip employing

newly available 1851s. A 6H6 detector and another 1851 fed the grid of the 24XH CRT. Lawrence believed that two stages of IF gain would be adequate for reception of WIXG (Hollis Baird's station), five miles from his MIT location. He indicated that most of his testing was done with the Baird transmissions.

Interestingly, Lawrence incorporated a switch to reverse the polarity of the video signal, suggesting he believed that transmitted video signal polarity had not yet been standardized. He also experimented with kHz was adequate, considering two-inch viewing screen. Lawrence used a 6J7 sync separator followed by a 6C5 driving a pair of 885s (Thyratrons) for both horizontal and vertical oscillators. These fed 6J7s that drove the CRT deflection plates.

The power supply consisted of a multi-winding transformer and a type 80 rectifier.



*Dr. Zworykin invited more than 110 guests to his housewarming at Taunton Lakes on July 19th, 1939, providing this map. Courtesy The Restelli Collection.*

A capacitor input filter incorporating two chokes provided a well-filtered 475-volt output. The completed receiver was constructed as three assemblies; power supply, receiver, and the video/sweep circuit unit.

Lawrence depended on Hollis Baird, chief engineer of the General Television Corporation, for his test signals. He would contact Baird, who put WIXG on the air at his request for testing! Lawrence noted that Baird's 150-watt transmitter was operating at 44 MHz, horizontally polarized, with negative modulation. According to Lawrence, Baird's synchronizing pulses were the same as used by NBC in the RCA experimental broadcasts.

Lawrence tested his receiver on an upper floor of MIT Building 10, in the storage stacks of the library. His receiving antenna was a half-wave zeppelin. When tuning in to the received video signal, he used earphones at the output of the video amplifier and listened for the high-pitched 13,200 cycle tone before connecting to the CRT grid. He noted that WIXG did not provide a sound transmission at this time.

How I would love to play with that receiver!

### **Zworykin's Lakeside Home**

If you will recall, in the TV column of the October 2012 *Journal*, Lawrence told of how he had heard of Zworykin's home con-



*This Google Earth graphic shows what appears to be the same location indicated on the Zworykin map.*

struction project located a peninsula in a lake near Medford NJ. I spent some time on the internet with Google maps trying to discover just where this home was built. I even contacted local municipalities with no success.

Then I happened upon a website on TV history by The Restelli Collection. One of the documents displayed was a copy of a sketch that Zworykin had provided to guests coming to his housewarming. It shows a road leading onto a peninsula in Taunton Lake. This sketch, together with Google map analysis, suggests that his home was probably located at the end of a private road off Piney Run Road on Taunton Lake. I would be delighted to have folks in Southern New Jersey check this out! 