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### Interview with Dr. Matthew Campanella

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**[00:00:09] Matthew:** My name is Matthew J. Campanella. I worked initially at RCA in River Road in building 53. This was about the time wise about 1952, '51, '52. One of my first assignments was really relating to wave guides. I have studied wave guides and so forth. I have a Master's degree from Harvard, where I studied wave guides. Eventually I got a PhD degree from Penn while I work in the RCA. Anyway, I had this background in wave guides which was of course a fundamental aspect of radars. This was in building 53 on River Road. I maybe worked on that for about 6 months. For some reason or another they needed some people in displays and I got transferred over to displays and things of that sort in the radar system. We worked at River Road for about two years, until eventually I moved from there to Moorestown. Of course, that was a big event for us guys who were there. I don't if anyone is familiar with River Road. The building dated back to World War 1. It was pretty crude, you come in the morning, plus in fact it wasn't an industrial area. and you came in. Your desk was half covered with soot so you really process in addition to going to work. You were going to clean up. Also, we didn't have much space. In the sense of radars you really need space, a lot of space. We were very limited in what we could do at River Road. From day one the idea was that they were moved. We would move somewhere and eventually we did move to Moorestown. They had looked several locations. One was Gibbsboro, if you're familiar with that. It seems RCA did own some property at Gibbsboro, but it was not large enough. With the radar systems and the testing of them you really need plenty of space and they did find a good chunk of space there at Moorestown. The other requirement was that you had to be on a kind, of rail road. The thought initially was that you maybe should ship your equipment or parts of equipment via rail. It turned out as far as I could remember they never did use rail road even though that wasn't initially a requirement to be on a rail and you of you who are familiar with the Moorestown plant you'll notice the rail road there. That was one of the guiding things when they are looking for a location is to be on or very near to a railroad even though they hardly used it. The move to the Moorestown plant occurred about September 1953, if I recall correctly. We were the two larger groups from Camden. Originally, the building or the space there was the asparagus field. When we moved there, one of the favorite pastimes from some of the employees was to go out during lunch and cut themselves some asparagus for dinner that night. Anyway, getting back to the main product line, which was tracking radars, the first primarily program that I was involved in was the Tails Radar, which was a competition between RCA and Bell Labs, I think it was for the Nike missile system. With the competition and it gave, I guess, us our real first chance of coming up with the tactical system. Unfortunately, while we thought we were great, Bell Labs beat us out and find competition. The aspects of the radar system that I eventually

got involved in had to deal with a display part, the monitors and so forth, plus a lot of research and development. They sizing me up, I guess, as a fellow to do research and I ended up doing a lot. Initially, I was involved primarily after my short time with wave guides back with displays. I had gained some background at Harvard with non-linear circuits. By the way, in those days we worked with vacuum tubes. I guess to the engineer today that's really an unknown. They don't even know what it is. Eventually I ended [up being assigned to digital technology. This was a new technology, and my group leader they called me in and he says they were creating a new digital technology group and they wanted me to head it up. That's when I became group leader eventually, unit manager. We were pioneering the use of digital technology. The digital technology that we started out with would not be recognizable by the digital technologists today.

**[0:06:36] Interviewer:** Was this RND program?

**[0:06:39] Matthew:** This was quasi RND but quasi for specific applications we had in mind. The one that comes in mind where we really applied digital technology was for the BMEWS, early warning system, almost like early morning system radar. One of the parts of that system was what was called the radar data conversion data or Rad Com which was converting a lot of the analog data of a tracking radar into digital techniques. Expect that the devices we were using were a little vacuum tubes. We thought that was great. The only problem is you needed one little vacuum tube which contained two triodes in it, to implement what is one bit. Yes, you say, "Wow!" and it is wow because it needs that to implement a byte, which is eight bits, you would need eight of these little vacuum tubes which by technology I'm sure people must say, "You must have been crazy to try to implement it that way," but you had no choice. Digital technology offers so much distinct advantages. One of the problems you are continually fighting with analog devices is maintaining your voltage constant to the value that you want as a reference. Well, if you can digitize that, that goes away. You don't that problem now. Now you're dealing with digits and widgets, as we used to say. Once you got in a digit and widget, it's hard to lose. With analog devices you're continually faced with a problem of changing gain and so forth, which I know changes the value of things. You have many ways of trying to but it achieves very stable voltages [once the problem goes away. Another problem in connection with analog devices and particular peculiar to radars is the idea when you're tracking something. You're tracking in the three coordinates: range, azimuth and angle. It used to be implemented using analog devices, which eventually you have to maintain very strict stable voltages or you're reading would be off. The minute you've digitized it you're away from that problem. Not only that, you have a problem in implementing things analog wise because of the drift. Once you have the control in your gain very strict in things of that sort, once you've digitized it the question is it a zero or one,

yes or no and the gain doesn't affect you that much. As a result of all these things and the advantages, I ended up in that area of the radar technology group. The first big system we devised was Talos, and was mostly analog. It was the tracking radar, the FPN-16. It was where we first applied the idea of digital technology, particularly with respect to digitizing the parameter of range, not so much range but angle. It was where, I guess, one of the first application of a photo angle encoder, where you encode in digits, the position of a shaft. That first was applied in the FPN-16 and which we ended up, it just ended up with the most precise tracking radar in the world. We were able to track even a fraction or a milliradian, if you know what it is. A fraction of a milliradian and a problem you run into that when you did that is normally if you run with a number system, you go through a bunch of numbers and you've actually reached a point where as you go from one number to next number, all the digits change. It's like going from 999 to a 1000. You go from zero to one. That was something you didn't want in connection with radar, a precise system so to speak because you'll be having all the bits changed at the slightest move of the angle of the radar. We use what was called a... I forget the name of it. It was a system where only one bit at a time would change. Eventually, you end up with a coded system, which is not a normal binary system. You had end up for now what today will seem trivia but it would be a software problem instead a hardware problem. You had to come up some way of re-encoding from the standard coded number to a straight binary, and this became a problem because it would require a certain amount of hardware to do that. Anyway, getting back to the involvement is that I got involved with it and we did apply this digital technology. That was interesting in this respect that I experienced. We weren't aware yet of how things can grow and grow. We started out on a program and this was the FPN 16 or the early stages of BMEWS where we wanted radar data conversion. We wanted to convert these analog things into digital numbers. We estimated it initially and we said, "Well, maybe it could be a couple of racks of equipment." We were being very generous. Well, as it turned out our generosity wasn't generous enough. We ended up with about 48 or 45 racks of equipment. Quite a growth and we used to josh each other about it how we ended up with all this equipment. What was driving this unfortunately was the technology. We were trying to implement digital technology using pre-digital devices. For example, as I mentioned, you take little vacuum tube which we thought was nice and small. That was one bit. They could have had two circuits in it, two triodes in this tube and you could implement a bit, which today we think is new even trying. Another thing that was kind of interesting is digital technology run through a program where you had a set of bits which are the control of what to do or not to do. This of course these days is stored in a memory of some sort and you bring out these bits or bites which then tell the controller what to do. We didn't have such things in those days. For our program, it was not a memory stored program. We had memory cores, where we generated the

byte. You had a bank of individual memory cores and then you run a wire through inner core which was in sense when it was activated or not activated at a particular wire. That wire was within the core or out of the core. To get a bite set you had to take for the sake of discussion for one byte it would be eight cores, magnetic cores, and then you would throw a wire in and out of the cores to generate to the bits of the bytes. Kind of crude. It was. We didn't it was at the time. I remember we were using a thousand instruction application in one of the applications of the radar we have been of 16 early days. We had this bank of cores, magnetic cores and we had to thread it in and out to generate and we had our program which the grand number of a thousand steps in the program itself. Can you imagine writing a program today with a thousand and they would through you out of the house? That was a technology. We got to work and it did work. Eventually, I guess today it just... somewhere you might find it as an artefact. The other thing I got involved in, one of the big problem and it still is till today, this was in connection with some research and development I got involved in. It was the three dimensional display in which you did not need your glasses, believe it or not. We come up... group, with the idea that if would take a horizontal plane and move it up and down, and then synchronize that with your time and where the particular target was in time. You could make it appear this spot on the plane to determine representing the altitude and then you had the other coordinates. We actually had a display, we had generated or build which you could actually see and just by looking at it, you could see it without any glasses, without anything where the target was in space. It didn't go too far because of one disadvantage and that was it could handle small systems but not big systems. You would need such a big oscillating surface. The concept is still there. Maybe one of these days somebody will come back up with some kind of vibrating membrane that you can do it. I know today they do have 3D television and you still need the glasses for it. We haven't progressed very far on that.

**[0:18:08] Interviewer:** That was your RND.

**[0:18:10] Matthew:** One of my RND projects. I was involved a lot in RND and a lot in development, straight development. The big program that I got involved in came along within the mid 1950s, when RCA landed the Ballistic Missile Early Warning System. The big threat in those days was ballistic missiles from Russia. This was the cold war. The threat came from over the North Pole. The idea was to build some detection system that could catch these missiles that were coming, early enough that we could react with our anti ballistic missiles. The basic system that came out was what we call BMEWS or the Ballistic Missile Early Warning System. RCA obtained that job. That time we did win one. It was a good one. It was the first billion dollar job that had ever been awarded. I think it dates around mid 1950's about 1955 and that period of time. It involved tracking radars, which was Moorestown's

real specialty. It also involved search radars, which had been subcontracted out to General Electric. The system involved... first the tracking search radar would detect the target and of course that was not Moorestown specialty search radar. That part of it was subcontracted to GE. Once the target has been found by the search radar, then your tracking radar will lock on and then track in and your missile would ride your tracking radar in to the target. That's the part of the RCA. Of course RCA had a whole program. They were the program manager for the program. The hardware part that RCA built was basically the tracking radar, and of course the controls to control move and things of that sort.

**[0:20:37] Interviewer:** How long did that program last?

**[0:20:39] Matthew:** That program started about 1955. The early systems were delivered in the 59's in that era. Three systems were built: One for Thule Greenland, one for Barrows North Alaska, and a third system for somewhere in England. I think the first in the go was the first one, to be in place was the one in Thule. I guess as far as the field testing, the implementation and all that started towards the end of the 50's and then continued on into the 60's. As far as I know they may still be on place but they are pretty archaic these days. That was 60 years ago.

**[0:21:39] Interviewer:** Okay. That was BMEWS, and what did you work on after that?

**[0:21:45] Matthew:** At that time, lasers had just been invented. Of course, involving a device like that had an appeal to people in radar business if you could implement that. We had a research and development program trying to find if we could apply that, and I was involved in this program. When we did develop the system, the experimental system that could be used for tracking, like a regular radar, except that instead of using RF energy, microwave energy you'll be really using Laser light We did build the bread board system where we could actually track something. This took place about the early 1960's. I know that very well because believe it or not something happened. I will allow myself and some other people engineers were testing the radar. That is JFK died at that time. I remember it well because we were out there testing when the world came out. "Have you heard, have you heard? The President has died!" That puts us about that early 1960's. The short coming of laser radar is the fact that you couldn't use it in low altitudes because of weather, clouds. At least it doesn't penetrate or that it's harder anyway. Still once we got above the weather, for missiles, are way above that. We could add some potential use. That was the thinking behind it. If we could develop the technology, eventually they could be used. What's also interesting at that point in time the lasers had been developed. We didn't have the solid state lasers that you have today. You had these kind of lasers that were crystals but they were limited to the amount of power you're component to

always or try to control it as easy as you can today with solid state lasers. But at least the concept was there, we made it work. We did. We did get it work where you can tack them. At about that time I think when I decided to leave Moorestown RCA. I went down to Westinghouse for a while.

**[0:24:34] Interviewer:** How long did you spend at Westinghouse?

**[0:24:36] Matthew:** I was there about two or three years.

**[0:24:39] Interviewer:** Then you came back?

**[0:24:41] Matthew:** No I didn't come back directly. I had some other assignments I went to, and eventually I did come back to RCA. When I did come back by that time, digital technology had improved a lot. I worked for a while on the military computer, the field computer. That was the project that RCA had where they were trying to develop a computer which should be like a multipurpose computer for use by all branches of the service. The whole idea of programming had evolved and things of that sort. Now they were stored in memory, as they are today. And secondary, the use of memories had evolved also. We had better schemes of memory devices. I worked along that for maybe couple of years, but then something else came along that I was interested. I had worked for a while I was away from RCA on FAA programs. RCA had this program where they were the technical advisors to the FAA for a program involving the new concept which was called the Advanced automation program. The government was going to change the way they implemented the track in the radars, then radars on their planes and things of that sort. RCA was a technical advisor. I was assigned to that, and I worked on that for several years. In fact, one of the big questions of that time... you should remember now RCA is the advisor. One of the big questions was the FAA had been using black and white displays. Remember now you're on the vintage of the 1980's, maybe later, late 80's. By that time, color vision was an established thing. But believe it or not, they were using black and white monitors in the air traffic control area. Plus a lot of other reason that had more older technology. They had this program and that's automation program to change a whole approach to how you control those track airplanes, things of that sort. One of the questions that came out because they were using, believe it or not, a mono colored monitors, a single color should be colored with the color. They had asked RCA to investigate this and I ended up the achieving person. We went over RCA because RCA made tubes and things of that sort and come out with a big report. We really made pretty good presentation. They were very impressed. RCA guys were sited for a good job. The bottom line was to go to color, but you won't believe it, there were people within the FAA who would insist that we shouldn't go to color and that it was not worth a cost. How do you like that? As we look at it today this again, hind site is always better of

course. You would never think of staying with monochrome. And they were concerned believe it or not, and this is surprising coming from government people, they were concerned about cost. The colored monitors would be so much more expensive and when did you gain for stuff like that. Well, we gave a good argument.

**[0:28:44] Interviewer:** Okay. That was the FAA.

**[0:28:45] Mathew:** Yes, and that's about the time I left. I was at that time for retire by that time RCA was no longer existence. It was now General Electric.

**[0:28:54] Interviewer:** NGE. Let's talk about your co-workers. What were they like?

**[0:29:01] Matthew:** I liked them very much. I got along well, maybe socially together. Of course, a lot of us were engineers. I had background in ham radio. We have some of that much in common with other engineers, even non electricals, maybe mechanicals. Every year we would have a special ham radio fest. I don't if you're aware of this. They ran an annual simulated situation where there is no communications is broken down, and ham radio comes in and does all the communication, and you have a competition where you try to make as many contacts in 24 hours as possible. We had a crew there including myself who on that particular day would go out in a field near the plant and we'd have a radio station set up and we'd be working all around the clock for 24 hours.

**[0:30:03] Interviewer:** This was just more of a hobby?

**[0:30:04] Matthew:** A hobby, that's correct. It wasn't really work related. It was a hobby.

**[0:30:08] Interviewer:** Did you socialize a lot?

**[0:30:12] Matthew:** To a degree, yes, and to a degree, no. I socialized it whatever things maybe be going into plant or with the group that I was with. I wasn't able to socialize too much outside because at that time as well as working I decided... I was involved in this whole new technology. I said, "Well, if I'm going to have to do this, I have to learn it." I go take courses at Penn, night time courses because RCA encouraged this. We found the course. I started to take these digital technology courses at Penn and at the same I say I'm going to take them as well working it to a program which I did and I find out a PhD in that field. I was busy. I was just recently married. I was like a one arm painter. I was married, raising a family, working overtime with them at the same time going to school. I was busy.

**[0:31:14] Interviewer:** That's a lot. What about your supervisors, what were they like?



**[0:31:18] Matthew:** I was very pleased. I had a supervisor I got along terrific with. When you meet a guy you like, you get along well, he's the one who eventually recommended me for promotion I don't why. I got along very well with him, very nice guy. I liked him. One of the, I won't say unfortunate, maybe unfortunate for RCA, he left the company. He went down to Florida, to Harris and took an executive position down in Harris. The last I heard he had some illness or something and passed away. The fellow's name was Henry Lester. People would recognize him. He was well known when he was RCA.

**[0:32:02] Interviewer:** What was his name?

**[0:32:03] Matthew:** Henry Lester. He used to live not too far from the plant.

**[0:32:11] Interviewer:** What was the work environment like? Did you have what you needed? Did you feel like you were appreciated?

**[0:32:21] Matthew:** I think we were, although you have to keep in mind that we were in a new plant when we were in Moorestown. Therefore they had built and designed it with the intent that it's going to be used by engineers or engineering types and also for building big systems. In that sense I think most people I found no reason or unsatisfied with the lay of the land and what we had to work with. The big problem we had and this is not a problem in this sense. You're building something in connection let's pick it from an engineer's point of view. You're building something, you're recommending it, trying to meet a schedule, usually a tight schedule. First thing you need to need to build a breadboard your concept and test it out. Often you would do something and maybe you want to move it down the hall to another lab to do some common testing. You couldn't do it. You couldn't move it yourself. You had to go get special handlers. I know we couldn't do. We had a way. That was a thing if I had to complaint that I would complain about. I don't think it was RCAs making as much a way and industry in general.

**[0:33:47] Interviewer:** How do you think RCA was looked on in the community?

**[0:33:52] Matthew:** I think it was looked in with a lot of respect. I usually tell people you work for RCA. I think in that sense RCA command a lot of good feelings and a lot of respect, and of course a lot of RCA people themselves.

**[0:34:14] Interviewer:** That's what I was going to get to. There's been an inference that maybe RCA even changed South Jersey.

**[0:34:22] Matthew:** Yes, in the sense in brought a lot of jobs and good paying jobs. The other in the sense that it brought in a lot of talented and highly trained people from outside the local area. A lot of the workers I would have were from this part of the country or that part of the country. It was similar like to being in the

army where they're from different parts of the country. In that respect I think it did a lot for diversity and some people eventually came and lived here. Others said no they came here worked and they went back where they're from similar to what you're having a service. In all my travels and so forth in South Jersey and other places wherever I mentioned I worked for RCA, they always treated me with respect. A feeling that, "Yeah, a great guy." I wish I, like they wished they were there.

**[0:35:23] Interviewer:** How do you think our customers looked on us?

**[0:35:25] Matthew:** Well, the customers I think there were two kinds of customers. One is a government customer which I had most of contact with, and of course the other is the customer in the sense that TV people brought RCA. In both cases, I think they all looked on them very favorably. RCA was always considered a good buy. As far as the government, I never heard any derogatory remarks and things like that. As I said, in the particular case with this FAA program they give us a big recommendation.

**[0:36:03] Interviewer:** If I asked you what was the best thing about working for RCA, what would you say?

**[0:36:09] Matthew:** The best thing?

**[0:36:09] Interviewer:** Yeah.

**[0:36:10] Matthew:** Now you're getting personal in this sense. For me, I'm a Hammontonian. I'm born and raised here. It's nice to be close to your work. When I left RCA, I went down to Westinghouse and I was living down in the Baltimore / Annapolis area. Every time a holiday came along, I had to pack up everything and to come back home to see the parents. I have five kids, by the way, as you can see. After a while it gets tiring. It's nice to be close to home. In that respect I was close to my family. It was a big plus. I think other people felt that way, too. Sometimes they couldn't do anything about it. I had a technician working for me and it was for early I won't get his name. I would get it because he was working in my group, I got to do something about it, and I would tell him from time to time, "You've got to do something!" And it wasn't coming from very far. He used to come from the west side of Philadelphia. To come to Moorestown he had to come all the way from the Philadelphia traffic, and then to Moorestown and he'd always be late. And not only that. Being a technician he was on time clock, he had to clock in. I kept telling him, "Why don't you move?" "I got my roots. I got my family there. I don't want move." Family carries a lot of weight.

**[0:37:52] Interviewer:** What would you say would be the worst thing about working for RCA?

**[0:37:52] Matthew:** Worst thing? I don't know if you can call it the worst thing, but that was something disappointing, let's put it that way. This had been a contributing factor to me leaving. I've been working in different things - digital technology and so on. I did a research and did all of that. Time wise it must have been in the 60's, mid 60's. They had an opening in another area which I didn't particularly want to go to because they need a unit manager there. I figured I had the technical background but I didn't want to go but they forced me to go. The manager above that and I guess they needed and I got pulled out from the position that I enjoyed and liked to go there. It wasn't a bad position just I wanted to do the other one. That aggravated me on the other one. That's about the worst. But it wasn't a big thing. Most of the time I was very happy.

**[0:39:03] Interviewer:** If I asked you to sum up your time at RCA... Just a job? Or how would you sum it up?

**[0:39:14] Matthew:** It was more than just a job. I'd say more of an experience. That's what it was. I learned a lot. I also gave a lot to it at some point and that was at times very hectic. When we first started to get into digital technology, I think I mentioned earlier about how we went from what we thought would be two racks of equipment, to 40 racks, 45 racks. Something else that went with that was a personnel. We went as a small group to what must have had about 30 or 40 people. It's been a lot of paperwork for me. I had to rate them and supervise them and things like that. Still, that's part of the job, I don't begrudge that or anything. I accepted the challenge. I always look back and see good happy years. I learned a lot, I gave them a lot.

**[0:40:17] Interviewer:** We've heard several times a reference to the RCA family. Does that mean anything to you?

**[0:40:23] Matthew:** Yes and no. It means yes, yeah. We did have a sense of family when we were there, together working together even though... We empathized an imagine in my cases very often you go out on dates together and stuff like that with your fellow workers as you go dating two other girls or something like that. It does a whole a lot of things. I think there was a certain amount of feeling of bondship there. Even today if you go to somebody you say you were working for RCA you feel a certain amount of friendship. They have this monthly meeting of the retirees. I used to go to that and I used to enjoy that. My problem now it's so far to go to. I wish you were closer I would go to attend you. I think there is a certain bond of feeling when you run into somebody and you say, "I worked for RCA." Oh, yeah. By the way you've got something to talk about, and a lot to talk. If you happen to be from Moorestown, it's a lot.

**[0:41:35] Interviewer:** Is there anything else that you can recall that we haven't covered? Anything that happened, incident stories or anything like that through your career?

**[0:41:50] Matthew:** Not the kind of thing that maybe general, more of a personal. I think the fact that we were a group that started out as a small group, in this way I think a little on the negative side. We were a small group. In building 53 we were a small group where we could really know each other and then when we expanded at Moorestown it became so large. I lost contact with a lot of people that you're used. No faces and no contact. That was a little negative, I think. But it's part of growth.

**[0:42:38] Interviewer:** It's part of growth.

**[0:42:41] Matthew:** On the whole though it was very good experience and nobody would complain I wish I could see more the guys I worked with.

**[0:42:54] Interviewer:** Yeah