



Dr. Jack Ruina
1961-1963

Interview: January 11, 2007

Interviewer: Tell me your name and your tenure as director at ARPA.

Ruina: Okay. My name is Jack Ruina, although I have a middle name, Phillip, that I don't use, but it occasionally appears, on photo I.D.'s and so on. And I was director of ARPA from January 20th of 1961, the same day that the President was sworn in—that was not quite coincidence—and I left some time the summer of '63.

I: Socially, what was the United States like at that time?

Ruina: Well, I can tell you what the administration was like. The general feeling we had at that time, an indication of the foolishness of some of our thoughts, was that "this administration is doing everything right, and every past administration didn't quite get it right." And somebody wrote the book *The Best and the Brightest*. We really felt we were the best and the brightest. There was no question about it. And that was great for morale. It was a foolish thought, but great for morale, and that was the general feeling. You know, "We're doing it right." That was one aspect of it.

The other is we were in the middle of the Cold War with the Russians. The general feeling, very exaggerated, the Russians were doing it much better in military technology. We exaggerated of course, "We've got to do everything to catch up." High schools were beginning to upgrade mathematics and colleges were concentrating on science and technology. Agencies were being formed, like ARPA and NASA, just to upgrade the science and technology effort. And the early days of ARPA were, I think, rather hectic. ARPA was given a lot of programs, all the space programs, which were later given to NASA.

By the time I became Director, I think things had settled down. Our responsibilities were rather clear. Our programs were rather well defined and the hectic period, I think, was over. And that preceded me. So I was lucky enough

to come in as the first Director during the period when things were pretty clear as to what our responsibilities were.

I: What were the major thrusts at the time?

Ruina: Well, the big concern I remember, when Kennedy ran, was "there's a missile gap," but we discovered later there was no missile gap. Then the Russians were doing work in ballistic missile defense. Well, it turned out not to be ballistic missile defense but something they were doing near Leningrad. But nevertheless, we thought they were active in ballistic missile defense.

There was a true ballistic missile defense test site down to the south, and it was very secret. The U.S. reasoning was, "Well, they're doing all this, and we've got to catch up or do as well, or understand what they're doing."

And so the real emphasis was, "What are they doing in the form of missiles?" "What are they doing in the form of nuclear weaponry?" "What are they doing in the form of defensive systems?"

I: And really focused on the Soviet Union.

Ruina: The focus was on the Soviet Union.

I: What programs were there in ARPA to look at those areas?

Ruina: Well, there was a problem of adjudication in the Army and ARPA. The U.S. ballistic missile defense effort consisted of two parts. We were building a system for operational use and the Army kept that responsibility, and all research, all development for new techniques, new technologies were given to ARPA. The project was called "DEFENDER."

So, the Army had ballistic missile defense and operational system development. Bell Labs was the contractor and ARPA had all the advanced techniques for ballistic missile defense.

But, in fact, one of the most important things we did, we were sort of the honesty brokers. The Army was very conservative. Bell Labs was very conservative. Absolutely first-class organization, but they didn't step forward to implement new technologies. They didn't want to fool around with any new ideas, new technologies. And when it came to evaluating how well their technologies worked, we were the only people in government who were experts. So, we played the dual role of supporting contracting or sponsoring our own research programs—development programs, really—and being able to comment on what the Army was doing.

I: There was something of a climate of fear, was that reflected in some of these agencies?

Ruina: Oh, absolutely, remember the Russians!

We had a Navy satellite program. I think it was called "Vanguard." And I think they could have put out a 20- or 30- pound satellite and that was going to just broadcast Eisenhower's speech or something like that. And then the Russians come out and put up this gigantic payload and then they followed soon afterward and put a dog in space. And people joked about that: "Next thing,

they'll put a cow in space. Then they'll put several cows in space, and then they'll talk about the 'first herd shot around the world.'

But I remember living in Illinois. We used to see the Russian satellite go by and it was an amazing feat compared to this puny satellite we were going to put into orbit.

I: Well, and we looked at it and half of our missiles were blowing up on the launching pad, as I recall.

Ruina: I do know that the Russians just had bigger missiles and during the Kennedy campaign the missile gap was a big issue. Kennedy ran on a missile gap. Before that, we had a bomber gap. So, the Russians were indeed a few feet tall, but we made them out to be ten feet tall.

But the most important thing is what permeated the system and the government was that science and technology was very important, military science and technology, particularly important. "We just have to do everything we can do." There was a feeling that, with the right priority and the right concept, you can do anything. And the average congressman didn't understand the difference between technically feasible and non-feasible programs. Making an atomic bomb seemed not very feasible. But we gave it priority. We got the right scientists. You gave enough money and they had it. Radar, you give it the right priority. You can get it. Later on, they considered all technical possibilities the same way—foolishly.

The feeling was that with the right priority, the right concept, right amount of money, you can achieve anything. And they didn't differentiate between that which made no technical sense and that which made some.

I: How did you happen to become DARPA Director?

Ruina: Well, that's an interesting story. I was at the University of Illinois. I was a professor of electrical engineering and also I headed a radar group at a laboratory they ran. And the fellow who preceded me as head of that group became Chief Scientist in the Air Force.

Later on, the Assistant Secretary of the Air Force for Research and Development, named Dick Horner, who was an aeronautical engineer, wanted a deputy who would know something about electronics. And somehow my name came up and he invited me to Washington. It was a very different kind of setting for me. When I was in the Army I was a Corporal. Here, I was invited to Washington and the guy who picked me up was a Lieutenant Colonel in a big limousine. I was to have a big office with two secretaries. He was going to be my assistant.

I never met anybody higher than Lieutenant when I was really in the Army. I did meet a Major once, but he was a dentist. Other than that I dealt with lower-ranking people and suddenly I was put into this very heady setting.

So, my wife and I thought about it. All my colleagues at Illinois thought it was a silly idea to spend time in Washington but I thought, "Well, why not?"

So, I spent a year and-a-half as a Deputy Assistant Secretary of the Air Force. It was a job with a lot of fun attached to it but it didn't have much

substance. The real power for science and technology was in the Secretary of Defense's Office and with people like Herb York, then the Director of Defense Research and Engineering.

First of all, to me, there was no technical challenge in what I was doing. Also I didn't think what I was doing was terribly important, just signing off on small projects. In that whole period I don't think I did one thing that was of any importance at all that has to do with the ballistic missile early warning system. So, I was ready to go back to Illinois and say, "Well, it was an interesting experience. It was fun and nice to hang around with generals and all that but this wasn't my place."

But Herb then asked me to come over to be one of his assistant directors. Herb was Director of Defense Research and Engineering which was a very important job. Nothing like now. It was a very important job and he had four assistant directors and he asked me to be the Assistant Director for Air Defense, which included ballistic missile defense. And that was a job that had much more technical challenge, much more important. So I agreed to stay on. And then while there he said, "Can you also be director of ARPA at the same time? Have both jobs?"

I agreed to it and I held both jobs for a while, but that turned out to be overburdening. So, I gave up the assistant directorship and then ran ARPA, which was on a different tack. It was real: money was running through me and therefore I had real control of projects. I enjoyed it. I thought it was terribly important and I felt I was doing the nation a great deal of good. But it didn't serve my wife very well. She said I was working all the time, including Saturdays. I was neglecting the kids and my kids, when I ask them that now, they say, "That's true." They never saw me. She [my wife] found going to a White House reception or meeting important people at embassies sort of fun, too, but her day was mostly at home taking care of the kids and I was not there.

I: What kind of an ARPA did you walk into?

Ruina: My responsibility included ballistic missile defense research. I knew the DEFENDER program, which was the ballistic missile defense program, very well and was rather critical of it.

When I got to ARPA it still had a lot of programs that didn't make much technical sense to me, and other programs I was totally unfamiliar with, like nuclear test detection, and so I had a lot to learn. Also, there were a lot of programs that were really concepts like have things in space to attack Russian missiles and radiation weapons to destroy incoming missiles. A lot of those things made very little technical sense. And we studied them and got rid of them in time, and in retrospect, I wish I'd got rid of many more.

That was hard. In those days, everybody thought that advanced concepts were the thing. Advanced concepts, advanced weaponry. Everything, *everything*, seemed possible.

I: I actually found an old newsreel of project Argus. (Chuckles.)

Ruina: Argus was a Christofilos idea, wasn't it?

I: Yes.

Ruina: Yes. Yes. Yes.

Well, that made technical sense. It was far-out, but made technical sense. Christofilos suggested that to communicate with submarines we should build an antenna the size of the whole state of Wisconsin and maybe part of Minnesota. But it made technical sense. Some of the other things suggested made no technical sense.

I: Like what? Do you remember?

Ruina: There was the BAMBI concept of having a large number of satellites looking for things on Earth that looked "hot," that would be ballistic missiles being fired, and they would shoot down and destroy them. Another was the radiation weapons. Still another was for air defense. The idea was that we would have a lot of ground-based antennas that would radiate to helicopters and that would provide energy for the helicopter. It wouldn't need gasoline. It would just hover above getting its energy from the radiation from the ground. And it, in turn, would be able to look around to see if airplanes are approaching. So the effect was that of a tower that was 10,000 feet high energized by radiation from the ground. And that was the concept. The general sentiment was that once you had a concept and you had enough money, you can do it.

There were proposals like that, really Rube Goldberg devices. And the feeling was: if you couldn't prove that it was impossible to do because of the laws of physics that meant it was possible to do it. And if it was possible to do it, "the Russians are probably doing it. If the Russians are doing it, we'd better do it too, if we can get enough money." And the reasoning was that if you couldn't prove it wasn't impossible to do, "we'd better work on it."

That was the feeling at the time and it was very different from what happened later, very different. I think it's important, when you think of the history of ARPA, to think of what that time was like.

And I think Herb York brought sanity to it all and the President's Science Advisory Committee brought some sanity. To me, whenever I used to talk to them in some meeting, I always felt, "Boy, that's a sane group." I felt comfortable talking to them. When I talked to some of the Air Force people—who were very good people—they thought the new Air Force responsibilities were going to be in space including all kinds of nutty ideas.

I: What was that story you told about being the "science honesty broker" when it came to missile defense systems?

Ruina: Well, very specifically, one of the things we did in the project DEFENDER, which was notable and very important at the time.

Bell Labs built the first good anti-aircraft system after the war called NIKE-AJAX. They followed that with another more advanced version and this consisted of radars and interceptors with humans in the loop. Humans see what the radar's putting out and would decide when to release interceptor. So, the system consisted of sensors, interceptors, with a human in the link.

The Army naturally went to Bell Labs for ballistic missile defense, too. They were their contractor and Bell Labs was a first-class operation. But things were happening in ballistic missiles that were much too fast for the human to be in the loop. You only had five minutes or less from the time you first saw the attacking missile until you had to shoot it down; too little time for a human to make decisions.

Also, the interceptor had to have a nuclear weapon to destroy the attacking missile. But to use a nuclear weapon you had to get presidential approval. Now the idea is here you have an attack and some Sergeant is watching and he's going to call the President. So, you had to have an automatic system so the whole thing was totally automate, but the concept was the same: big radars, much better interceptors, much better computers. But it was a totally automatic system.

While the Army was pursuing that, ARPA at the same time was pursuing advanced technologies in interceptors. We designed and developed much better, higher-performance interceptors. We worked on phased-array radars—I don't know if you want to get into that—which were much more higher-performance than the old dishes the Army was using. When we wanted to inject some of that technology the Army, and Bell Labs in particular, said, "No, no, no, no. Those are uncertain, unclear, unproven. We know what we're doing, and we want to do it." But what they were doing was very inadequate for the purpose.

And I remember once when the Army kept pushing that we should deploy a ballistic missile defense system and the Congress was with them arguing that "some defense is better than no defense. Even if it isn't perfect, some defense is better than no defense." And Herb York was great in that regard. He single-handedly kept ballistic missile defense from being deployed.

Later, McNamara felt under so much pressure to deploy the system that he agreed to have a limited deployment. The Army said, "Let's have this limited deployment. We'll just test it and see how it is." And McNamara felt, with all the pressure from the Army, all the pressure from the Congress, he'll go along with a limited system.

Jerry Wiesner was then in the White House as the Science Advisor and thought it was crazy, just nutty to deploy limited defense. And he told the President, "I'll get you the ballistic missile defense expert in the Pentagon, who can tell you about the inadequacies of this system."

As a consequence, I was invited to brief Kennedy the day before Thanksgiving, his first year in office, 1961, and McNamara was specifically not invited, he was not going to be there. So it was Jerry Wiesner, my boss, Harold Brown, and me; and I was the briefer, so to speak.

I only had a few hours to get ready and I prepared on a piece of paper what I'd tell the President, and I talked about NIKE-ZEUS, which was a system being built I referred to as NZ-0. And then I showed how you can improve that system with a new interceptor and call that NZ-1. NZ-1 was the NIKE-ZEUS but with a new interceptor. I then mentioned NZ-2, with a new interceptor and new radar. And I said, "If you start from scratch with a new system—let's call it N-X—it would look like this."

The decision at that time was, "It doesn't make any sense to pursue the old system." It was so inadequate. Not that the new system would be that good, but so much better that if we should do anything, we should do N-X and not NIKE-ZEUS."

Well, it started raining, and Bobby Kennedy came running in and called the President "Mr. President" and he said, "The helicopter's waiting for you. If you don't get in, we won't get to Hyannis Port in time for Thanksgiving."

The President was very informal, extremely informal compared to Eisenhower, who was very formal. He said, "Can you guys come up to Hyannis Port the day after Thanksgiving to continue this discussion?"

Well, what can you say? Say, "No, I'm busy"? And—(chuckles)—so we said we'd come up the day after Thanksgiving.

Then the day after Thanksgiving the President had a series of meetings, one after the other, and this subject was one of them; but I sat in on the meeting right before that. And one of the interesting, little sidelines was that Arthur Schlesinger was the secretary and was taking notes of the previous meeting. And when that meeting about civil defense ended, the President turned to Schlesinger and he says, "Arthur, when you write this up, this is the way you should write it." That's how he put it, that's the way history made, not how it actually happened but how the President wanted it to be written.

When our subject came up—and McNamara this time was there—the President said, "Well, I heard about this ballistic missile defense and I don't think we should do it, Mac"—or whatever he called him.

So, McNamara said, "Okay. Let's not do it," and the subject was over.

I was prepared to give a two-hour talk, briefing charts and so forth, and the matter was over. No discussion, none. McNamara said, "Okay. Let's not do it," and that's all there was to it. So, I really came prepared to give a long spiel on the inadequacies of ballistic missile defense and it wasn't necessary.

I: Given the technology that they have now, how could you penetrate a defense system, and then why are we doing it?

Ruina: That was a real study by Herb York; I was then not Director of ARPA. It was my previous job. Herb York asked me to look into ballistic missile defense and to examine current technology. Forget about futuristic technology; just use current technology.

We looked the American Titan missile, which was a big missile, but existing technology. We took the warheads that Poseidon had. We considered existing warheads, which weighed about 400 pounds each. We said, "We can put about ten of them on Titan easily. No problem." So, we considered ten warheads on Titan and fired it against the ballistic missiles on paper and a ballistic missile defense system couldn't possibly handle it. It couldn't handle ten warheads coming at once.

We said, "Here with current technology, no futuristic technology, we can defeat the system easily." In this we convinced almost everybody that this system was inadequate for the job.

I: By asking these kinds of very good questions, new science was generated.

Ruina: Well, new technology, really. And to jump over to VELA, the subject of seismology and particularly seismology as it relates to underground testing was a very small program. And when ARPA got the responsibility to improve our capability for nuclear test detection, we provided a tremendous push in that area, we really infused that technology, that science, tremendously, so it became important, a big science too, and in that way subsidized all the important seismic work in the country at that time.

I: Now, with DEFENDER, you said that some parts were a little far-out.

Ruina: Oh, yes, radiation weapons and the like.

I: When you looked around, who did you find to head up that program, and how did you find that person?

Ruina: Well, I hate to talk about personalities because some of these people are just fine people. They just weren't up to the job, and when I came into DEFENDER, there was a person heading that program who was in the bureaucracy a long time. And a very capable guy but not up to that job at that time.

And then somehow Charlie Herzfeld showed up. He was at the Bureau of Standards, head of a division or a group, and he looked to me like the right kind of guy. He knew modern technology. He knew science. He knew the scientific community. And so I got him to become head of that DEFENDER program. There are a lot of people in the bureaucracy who are very capable as bureaucrats but weren't up to the job managing modern technology. But there were a few people around who I depended on a lot too, just for informal discussions. One was a fellow named Ben Alexander, who worked for IDA on ARPA programs, and he was an absolutely first-rate guy and I talked to him a lot. Then there were several people on the ARPA staff. One fellow, Ken Cooper, was a Lieutenant Colonel at the time and I'd sometimes ask him to talk off the record. "Let's not talk about the specific program." I just wanted to get some idea of what these people's views were.

There were about five or six people whom I was able to talk to: Tom Bazemore and then the President's Science Advisory Committee (PSAC) people, who were distant; they were far away, but occasionally meetings with them would give me sort of the courage of my convictions.

Of course, my bosses were terrific, both Harold Brown and Herb York—who really, although they were my bosses, I was accountable to them—conversations with them were just as with peers. I'd say, "You know, we have this problem. How do we handle it? What shall we do about it?" I was able to talk to them as peers and they were very sensible people. They were my kind of people in terms of understanding technology and so on. They weren't out in space somewhere and they weren't way behind the times and they were very good. I was very fortunate.

I: Were you a physicist at the time?

Ruina: No, I was an electrical engineer. I was a professor of electrical engineering at Illinois.

I: The reason I ask is that in the university setting there seems to be a mind-set there of peer communication.

Ruina: Well, I think that we were academics. The other thing is the scope of the things that ARPA did was so wide, no one person can really consider himself an expert in many of the fields. I understood what they were doing and I had some opinions but I had to consult people. I mean I think it would've been a mistake to say, you know, "I know this technology well enough to make a final decision all on my own."

I mean, what do I know about interceptors, or interceptor technology, or how feasible a very high-performance interceptor would be to develop and to deploy? So it was a matter of consultation with people and depending on the right people for advice.

And the industry people—some of whom were very good, but you couldn't count on them—they were interested in getting contracts. They pursued contracts and business. But academics were sometimes too remote from business. There're a few guys like Ben Alexander, Ken Cooper and so on that were very important, and some of the PSAC people.

I: The Services all had their research arms, didn't they?

Ruina: They had their research arms but they were not up to the job. Well, let me back off a little bit. I should be careful.

I mean laboratories like Lincoln Laboratory worked for the Air Force and it was a first-class laboratory, but they were rarely involved in decision making at the top level. The Atomic Energy Agency had Livermore and Los Alamos, absolutely first-class places. And I sometimes consulted with some of those people off the record and I can repeat one incident I mentioned earlier. We were building a ballistic missile early warning system called BMEWS. We were going to build big radar stations in Alaska, one in Greenland, and one in England. And RCA had the prime contract for that. They were building the system and the fellow who was in charge of the program was Braynard Holmes. I became very friendly with him later but I had some tough encounters with him during this time.

They in turn subcontracted the radars to General Electric. General Electric in turn subcontracted the transmitting tubes to RCA but a different part of RCA. So, RCA had General Electric, General Electric had RCA.

There were two kinds of transmitting tubes that were being developed for the purpose, Tetrodes and Klystrons. And the Tetrodes were having difficulty, and the question came up, "What should we do with them?" Without going into the details, the responsibility to make that decision was mine. When I was still in the Air Force, the Assistant Secretary was in Europe and he couldn't come home, I had to make the decision. And I didn't know enough about those tubes and how they were performing to say, "I'm going to take it upon myself." I had to talk to other people, more expert. And what's interesting is I talked to the RCA chief engineer. He essentially said, "Tetrodes is the way to go," which was the

RCA tube. "And they'll work. And as a chief engineer I recommend we use the Tetrodes."

The chief engineer at General Electric was a guy named Burt Brown, who was a very able guy. And I called him up, and I said, "We have to talk about this." And he said, "I can't talk to you about business without RCA present. We're not allowed to talk to the government without RCA there, because we're subcontractors to them." And I said, "You have to do it."

So, the arrangement was that he was going to have dinner with me, and it would be an informal dinner. We would discuss the movies or—(chuckles)—or something, but he wouldn't even report that he went to see me. And he ended up saying, "If it were me, I'd go with the Klystrons."

And I went to Lincoln Laboratories, who were expert in these things, and talked to them. And I talked to people like that all over and made a decision. And I remember the Assistant Secretary of the Air Force said, "We've got \$30 million of those Tetrodes sitting and we're going to junk them and you've have to be ready to talk to the Congress as to why you junked those and decided on a different program."

So, from my background as a small-time research director at University of Illinois this was a big decision but I decided that's the way to go. And it worked out very well—luckily.

I: What was your relationship with Congress when you were Director of ARPA?

Ruina: Well, we had to testify to Congress for several reasons. First of all for money and then there were special committees looking to investigate this, that, or the other. But there was no problem with the Appropriations Committee. I mean, they asked a lot of questions but our funding was never in jeopardy.

But what impressed me a great deal, and what should be somewhere on the records is that Herb York was the first one to testify on science and technology issues. And being Director of ARPA I came second but I was there with him when he testified.

I also remember when I was in the Air Force when the Air Force testified on its research budget. Typically, when the Air Force testified, there'd be ten Generals, twenty Majors to bring information, demonstrations that made no sense. It was sort of a circus.

Here was Herb York all by himself, speaking in a very reasonable way. And then he did something interesting. He said, "Let's go off the record." And then he would talk about the difficulty of some programs and the political difficulty he had with some programs and it was totally off the record. And then they'd go back on the record and you'd have the record of the testimony. I thought, "Boy, that guy, he was great," in the sense that he was able to talk off the record. And the Congress had so much faith in him. Here he was, all by himself, and he didn't need all that background, didn't need all that help. And he made so much sense.

And Gerry Ford was on the committee. I never knew Ford as President but I knew him when he was a congressman.

I: You were in the Air Force as?

Ruina: A Deputy Assistant Secretary.

I: So when you became Director of ARPA what was your relationship with the Services then?

Ruina: Well I can't say it was bad but we just didn't have much respect for anything the Services were doing, except the ONR which was a great agency. Those who sponsored basic research, ONR, OSR, the Air Force Office were great places and they sponsored university research very well. But in their development programs they weren't that great then.

I: Well, that seems to be a reoccurring thread that runs through the ARPA/DARPA story, the relationship that the Services had with the agency. Ultimately, the Services become the customer of the agency.

Ruina: Well, we used the military Services as agents, so-called agents. ARPA had a small staff. I think we had 50 or 60 professionals, so when we decided on a program the contract mechanism was written by one of the Services. We'd ask the Air Force, "Handle this contract for us." And sometimes they would even help in the source selection.

But it would be our money going into the Air Force or the Army as the agent and all the bureaucratic stuff that had to go on went through the Services, all the clearances and contracts and all. We didn't do any of that. We didn't have enough of a staff. And that decision to work that way was made before my day, and it worked fine.

Sometimes we had trouble with the agents. I had trouble with one agent. They wanted to run the program, and this was the Arecibo radar I mentioned once before. This is a big radar that was going to be a first-class scientific instrument, and Cornell was building it and the Air Force was the agent. And Cornell then came and complained to me that the Air Force wanted to decide what the scientific program should be and so on.

And Cornell said, "We didn't build this to be builders. We didn't know how to build anything"—which they didn't. And so I ended up taking the contract away from Air Force, Cambridge, gave it to Air Force OSR, and worked out very well.

I: Let's go back with DEFENDER.

Ruina: Our largest project.

I: What were all the parts of it?

Ruina: If you asked me what were the most important things we did, in retrospect—remember I'm talking 40-plus years ago—the most important things we did was develop phased-array radars which the Army didn't want to touch and Bell Labs didn't want to touch. And that became the standard kind of radar for those purposes. Phased-array radar was a radar with a lot of little elements, which you didn't have to steer mechanically, it steered itself electronically. You could look here, look there, look there in about a thousandth of a second. A

steerable beam had to start moving slowly but with a phased array you could watch many targets at the same time, jumping around. And that became standard technology.

We developed high-performance interceptors. And equally important, or very important, is there was much talk about how you discriminate. If a ballistic missile defense system was to work, it had to discriminate between all kinds of junk that was coming in, intentional and unintentional, junk that came along with the ballistic missile; also if the other side wanted to put decoys up, cheap decoys, big decoys. Can you discriminate between decoys and the warhead?

And nobody knew anything about reentry. What happened on reentry? How did a heavy object behave differently from a light object? How did a streamlined object look differently than a blunt object? Can you really discriminate? And there were no measurements whatsoever. Everybody was speculating. Every time you went to a meeting people would invent all kinds of things. But there was no data.

So, one of DEFENDER's most expensive programs was to start a reentry measurement program in Kwajalein. The Army had their Nike-Zeus system there to test and we had our measurement system there. But we were the first ones to make any reasonable measurements.

The important things I remember: important measurements never made before, the phased-array radars, two-dimensional, phased array radars that were pushed and developed, high-performance interceptors, and then basically having a group of guys who gave advice to DARPA about ballistic missile defense, which the Defense Department didn't have. That was our contribution. We did other things but I don't remember what they were.

I: Do you have a sense of the new areas that you were exploring?

Rulna: Well, let me tell you more. I don't remember the details of propulsion chemistry program we worked on. The material science program was more important. Because the decision was made before my day—I don't want to take credit for things I didn't do—to put more money into material science around the country and develop material science laboratories at universities around the country. And requests for proposals went out saying what the different universities would like to do and so on.

And the program was quite unique. And, again, it was before my day. We were going to give four-year funding, or five-year funding, not one-year funding. In the past it was typically only one year funding. We were going to give them a building. If they needed a new building for a center we'd pay for the building. So it was a very generous program. At the same time, it was a way to get going in that area in a serious way.

Also, each year we'd give money for the fifth year in advance. So they were always five years in advance, and for universities, when you're dealing with graduate students and faculty, you can't just turn people on and off. So the idea of continuous funding was very important and this was guaranteed by contract. Now, the Office of Naval Research did a great job in doing it in other areas, but one year at a time.

The program started before my day but the choice of universities was done in my day. And I had a bit of a conflict of interest, because Illinois was one of the universities bidding on it and I came from Illinois. So I didn't involve myself in the choice of contracts at all, the choice of universities, and my deputy, George Rathjens handled the whole thing. And Illinois ended up getting one of the contracts. So did MIT. So did Harvard—all first-class schools.

The interest was not geographic distribution, not to respond to political pressures, but to choose the best schools in the country to do this and we went to the obvious schools. Berkeley, MIT, Harvard were the schools chosen.

And that program was really a model for how programs should be done. And what was interesting was that the Services had a good program of their own in electrics, called the Tri-Service Program in Electronics, where they had about five or six universities, almost the same group, where they had electronics programs, but it was one-year-at-a-time funding, and they did it very well. They did very well.

But it occurred to me at the time, "Why don't we do with the electronics programs what we do in materials programs? Why don't the Services hand the electronics programs over to ARPA? I'd give them five-year funding; give them buildings, if they needed; make sure the programs were of top quality and serving the country well; then give it back to the Services. What a deal."

But they were very worried about it. I had meetings with the people, and they said, "You guys are here and you're hot fires now but you're only temporary. Who knows what'll happen to you next year? We don't want to jeopardize the program and our involvements. We want to keep it," so I let them keep it. I don't know if it would've been a good deal or not but we were quite prepared to say, "I'll get funding from Congress for five years if you guys can't get it." These were first-rate programs. It should be funded for five years.

I wish I had more courage to do more things than I did. I'm proud of some of the things I did and I wish I had courage to do more and more courage to stop some of the stupid things we did—which there were many.

I: What were the ones you were most proud of?

Rulna: Well, some of the programs I was most proud of, of course, weren't that important at the time. The command-and-control program, which ended up with the Internet. Bringing in Licklider, who was hardly in the establishment as a bureaucrat or a scientist. He was off doing his own thing, very imaginative guy but sort of off in space a little bit. I was very hesitant in hiring him but then we ended up with the Internet. The most important thing we've ever done, probably, is you look at the Internet. And we started it all.

Another small program was the Arecibo radar which was, as I mentioned once, this big radar that Cornell was building. Everybody in the Ballistic Missile Defense Office and my office said, "That's not important for us. Let's drop that program." But I realized it was a very important scientific program, maybe not to the Defense Department, but it was a very important scientific program and, "How can the country drop that program? There's nobody else to pick it up?" So although it wasn't important for ballistic missile defense it was an extremely

important national scientific program.

So I remember going to my boss, Harold Brown, and I said, you know, "I can't testify to its importance to ballistic missile defense, but how can we drop this thing?"

And he said, "Go and do it if you want to."

And so we continued with it. It turned out to be a first-class instrument, did great science for many years, but its relevance to ballistic missile defense I can't tell you was zero, but pretty near zero.

And I used to have a rule in those days which served me well, I think, which was that a program's merit was a product of its relevance to our mission and to the Defense Department, and its quality. If the quality was zero, the answer was zero, no matter how relevant. If its relevance was zero, no matter how good the quality, the answer was zero. But I didn't follow that always because the Arecibo relevance was pretty close to zero and the quality was first-class. So, I didn't follow my own rule. (Chuckles.)

And there're other things, small things, that I'm sure we pursued. Like the Lincoln Laboratory reentry program was very important and I don't know to what extent I was responsible for it. I just don't remember. I don't want to make myself out to be a great hero.

So I think we did some important things. Those that remain important today, everything in the ballistic missile defense turned out not to be important because we're not deploying the system, except the stupid thing we're doing now. And nuclear testing came to naught. We never got the right kind of treaty with the Russians. And the things that turned out to be very important were very minor.

I: What about the projects that continued that you wish you'd had the courage to kill?

Ruina: A lot of them never continued with big dollars but there're a lot of things, like radiation weapons. We had a program to look at all possible ballistic missile defense thoughts that people had and spent a small amount of money doing studies in all that. And they were just nutty right from the beginning to end and you would say, "It's not even worth it to have people get together and discuss it." So there were, I'm sure, a lot of programs along those lines.

In retrospect, you know, the big issues, how well can you detect nuclear tests if the Russians have it, how well can they hide a test? And a very clever guy at RAND, one of the Latter brothers, got the idea that if you make a big hole underground and you test a weapon in the big hole its seismic signal would be very much smaller than if it was tested the way we normally test.

Well, some of the holes, we're talking about 300, 400 feet across. But making such a big hole underground that would be undetected was difficult. And when you do a test we would not be able to detect it and the Russians would be able to cheat, therefore; by building big holes, they could cheat on a test ban.

At first, people dismissed the science, saying that he wasn't saying things correctly, but then even people like Hans Bethe said that the calculations were correct.

But the feasibility—imagine building a 300-foot hole and our satellites wouldn't detect the mountain being created nearby? Or, they thought they'd test in a salt dome. They would wash out the salt and suddenly a river would be all salty, and we wouldn't detect it?

But we spent a lot of money. We did some tests. We did some tests in smaller holes and we pursued that with a lot of money, unnecessarily. And the whole thing was so infeasible.

I: Are there any projects that you look back at that you say, "That was so neat!"?

Ruina: Well, everything related to the Internet and how the technology evolved. The thought at the time was that we would have large computers and a lot of terminals, just like power systems now, where you have a big generator and distribute the power and then everybody is metered, has a transmission line to his house and taps off and can control how much he wants, and there's this big idea, the idea is these big computers with a lot of terminals. I guess we have a little bit of that now.

It turned out that the technology of computers has advanced so much and so fast that you were able to get a lot of capability into a small computer and you didn't need the big, central computer. It was much better to have small computers distributed. Then how do you network them and the technology grew and started following that direction. And that occurred in my day, the fact that technology, the computer, solid-state devices and so on were such that you could get a lot of power into small computers. Then you didn't have to pursue the large, central computer with terminals all over the place. So the science went in a different direction than expected.

Licklider did a great job in getting the right people in and a lot of people to pursue it, and, as I said, the Internet got developed that way. I had nothing to do with it. More than Gore, but not much. (Chuckles.)

You read any history of the Internet and my name is mentioned but only because they say I hired the guy or I was there or something. But I can take zero credit for it.

I: Let's talk a little bit about Vietnam and ARPA's role.

Ruina: Well, I don't know how, we were given a program. It was not a program we pursued but somehow we were asked, or directed, to start a program to bring technology to the Vietnam War. At that time the U.S. was involved, we were only advisors. We didn't have all the troops and we weren't involved in combat. We were advisors in Vietnam.

And the question was, "What new technology can we bring to bear that would help the Vietnamese?" And the program started was called "AGILE" and we had one person at ARPA who was a Deputy Director who was extremely enthusiastic about it.

It never appealed to me because we were interested in advanced technology, advanced concepts, and this was more gadgetry variety. Also, my politics were such that I didn't like the Vietnam War so maybe that was a bias.

Also, I went to Vietnam in '61 or '62. I had a long meeting with Diem. He

was the Prime Minister and also with his Minister of Defense and with the Americans. General Harkins, who was then the chief military guy in Vietnam, invited me to his morning intelligence briefings. And I was so unimpressed with the whole show. For example, Harkins got this intelligence briefing from American colonels who were intelligence people. And I chatted with him afterwards. It turned out that there wasn't a single American—it's hard to believe—not a single American in the military that spoke Vietnamese. Not a single one.

So, I said, "How do you get your information?"

They said they get it from the Vietnamese colonels. So, we were being fed what the South Vietnamese military told our military and that was the information we had.

The Deputy Director of our aid program there was a retired Marine Corps General and he invited me to dinner. And I remember him telling me, "All the things you read in the newspaper are not right. Things are going very badly here. It's not the way you read about it."

And I said, "Here's a Marine Corps General telling me that."

The Defense Minister of South Vietnam, [I] had a meeting with him and he thought maybe I had more influence than I had. He said, "When you go back, you should know that your press here is doing a very bad job. They're all left-wing and they're reporting this badly."

I said, "Which press are you referring to?"

He says, "The New York Times, Time magazine, Fortune magazine." That was the "left-wing press," in his mind.

We introduced defoliants into South Vietnam which later became infamous. There was concern that people were being ambushed on roads, and the idea was to clear about 100 feet on both sides of roads of foliage so the Viet Cong couldn't be there to ambush traffic on the roads.

Well, when I talked to Diem he said, "That's not important. What you have to do is kill, destroy the Viet Cong crops."

Well, politically, destroying crops wasn't a very wise thing and I said, "How do we know what crops are Viet Cong?"

He said, "I know. I know."

And he took a big map, and he said, you know, "That field is Viet Cong. That field is South Vietnam. We will tell you which fields and you have to destroy Viet Cong crops."

The whole thing turned me off so much. That whole experience of meeting with Diem, the meeting with the Defense Minister and his referral to the "left-wing press."

We later hired one of the few Americans—not Vietnamese, not Vietnamese-Americans—true Americans who spoke Vietnamese. There was a guy at Yale, a professor of Anthropology, named Hickey—boy, I remember his name!—and we hired him through RAND. We got RAND to hire him to go to Vietnam and to assess certain things and he knew the language.

And we had a "strategic hamlet" program, not ARPA but the Defense Department. And he came back with a report.

The official report said, "The program's working very well. Everything's working."

He came back and said, "It's a disaster." And he talked to Vietnamese. He talked to people. He said, "The whole thing stinks."

We were introducing all kinds of gadgetry, building fast boats for the rivers and so on. The whole program made me very uncomfortable. And I think Harold Brown became uncomfortable with it also. My impression is though he pushed it at the beginning, later on it wasn't supporting the program, and it wasn't paying off very well.

And besides, I tell you my political slant was such—and I hate to bring up political opinions—but that war was not...we weren't doing the right thing there. And we were getting the wrong information.

I: Were there other elements besides gadgetry? Were there sociological elements or anthropological elements?

Ruina: There may very well have been but I don't remember them. We may very well have had some behavioral scientists involved but if we did anything it was totally insignificant. It was the gadgeteering that turned me off that it wasn't useful for the purpose at all. Wasn't useful for the purpose and that we were getting bad information on the war.

So of all the programs we had I was not satisfied with them at all. And my successors Herzfeld and Sproull, I don't know how they felt about that.

I: You say you wish had the courage to do more. What would you have done?

Ruina: Well, like the electronics program I mentioned.

I: Yes.

Ruina: Other programs that were long-range and would have been much more basic to American scientific and technological capability, rather than pursuing concepts that were supposed to solve some important problem.

The base of American technology needed upgrading, like the material science project, like the electronics project, like the reentry physics project. And we should have been doing more of that and I did not follow some of the, quote, "concepts," ideas, gadgetry, I don't remember with how much money but we didn't spend much money there, but we shouldn't have spent any, in retrospect.

Sort of interesting situation at the time for me. I think it's important, and as Director of ARPA, I decided my credentials as a university professor were going to disappear unless I went back to the university. I was gone for four years. And I knew that although this is a very important job and very exciting that this is not a career for me and my career was at the university. So I went back and ended up at MIT rather than Illinois.

When I was at MIT for one year the President of IDA left. He had some problems with the Air Force. The Air Force didn't like him at all because the Air Force wanted the U-2 and he did the U-2 at the CIA and was very successful, but they never were ready to accept that the CIA would do something better than they can do, particularly an airplane.

Anyway, they needed a new President of IDA very quickly and somehow I was asked to take the job. And I was very reluctant to take it. We had just come from Washington. In time, I was convinced that I should take it and I did. And the job had a lot of prestige, more than being the Director of ARPA. It was a very prestigious job and you had the people before me—Gary Norton, Dick Bissel, Max Taylor after me—you know, a lot of prestige associated with the job. Much higher salary than a government job.

So I was in a position as president of a think-tank to advise the government, and earlier being the director of an agency that did things, and the difference is fantastic. It's worth describing that.

The people on the outside are advisors and really don't realize they don't have much authority. They can advise and sometimes people take their advice. And when it comes down to making decisions it's the guys there at the right time that are making all the important decisions.

The IDA job was prestigious and a lot of prestigious people had it before me and after me. But the ARPA job was one where one had real authority to the extent that you affect history in any way—not the IDA job.

I: The JASON group was a group of outstanding scientists who were advisors to the government and it was interesting. Have you been involved with JASON activity at all?

Ruina: Okay. The JASON activity, or the JASON project, was started before my day. I don't know if Eugene Vigner's name was mentioned as one of the people or if Charlie Towne was mentioned as one of the people who thought of that. How can scientists, physicists primarily, in this country contribute to the national effort? Remember we were very worried about the Russians. The Russians were doing great things. How can U.S. scientists contribute to the U.S. effort?

The idea emerged to form this group of JASONS that would study technical things then advise the Defense Department on issues. ARPA paid for JASON. We bankrolled JASON. So when I came to ARPA JASON was a group we paid for.

And so I got to know some of the people, most of whom I didn't know before, and later became friends with a lot of them.

From an advisory point of view, from an analysis point of view, they were terrific. Whatever money we gave them was money extremely well spent. I mean they did studies about the feasibility of certain advanced devices and they were extremely useful and extremely intelligent, as you'd expect.

Let me tell you a little more.

When I left ARPA, I became a member of JASON. I was invited to become a JASON. So for one year I became a member of JASON. When I became President of IDA, IDA was the administrative head of JASON. JASON was sponsored by us, now it's sponsored by MITRE. So I saw JASON from several perspectives: paying for them, being one of them, and being the administrator of them. So, I think I'm the only one who had any experience of seeing them from every perspective and having tremendous respect for their capability and their role as expert advisors and analysts.

However, when they write about themselves and they talk about themselves, they think they were great decision makers, which they were not. They talk as if McNamara would depend on them—actually McNamara never heard of JASON.

So, on a certain level, people would consult them. “Does this beam weapon make sense?” for example. “Does Christofilos’ idea of making Minnesota into an antenna make sense?” And they give you very good analysis and the people were extremely good. But they did not play any role in the decision-making column. They were not there to talk to the Secretary of Defense about, “Should we have a test ban?” “How well can we detect a test?” They just weren’t there.

Now, some individuals in JASON later became members of the President’s Science Advisory Committee and so on and, therefore, had some influence via that route, but not as JASON-ites. Funding JASON was money extremely well spent on the part of the government. The advice and analysis were extremely important but they weren’t in a decision-making role, which I think some of their writings makes it sound like they were. They were not in any way.

There was no way you can compare a JASON member to a guy right in government in the right spot who is making the decisions. I don’t know what it’s like now but I’m talking about then.

I: What was it like during your tenure there? Did you have any problems with support or with the Services?

Ruina: Well, I didn’t have any of those problems. It was a period where science and technology was great and I’m sure the Services didn’t like us, but I had a great boss. To the extent that I had dealings with him, McNamara was very supportive. To the extent that we had influence with higher-ups, we were an influential source. I never had a problem with money. So, I think we were riding very high and I had none of those problems, and very little in the form of bureaucratic problems.

There were always some problems. For example, the Air Force liked the Tri-Service program and the military Services didn’t want to give it away. Also Herb York had the idea we should devote all of Lincoln Laboratory to ballistic missile defense, “We ought to have a laboratory that’s devoted to ballistic missile defense, just like Livermore is devoted to nuclear weapons technology.”

And I approached the director of Lincoln and he, I think very rightfully, said, “We have good relations with the Air Force and we would like to keep the arrangement we now have.”

So, we compromised and he said, “We’ll just devote a section of the laboratory to ballistic missile defense.”

So although we sometimes had difficulty with the Services on that one at the beginning, I don’t remember having much problem later.

And I was very fortunate. I had two great bosses. And to the extent that I dealt with McNamara he was great, too. He was straight business. When you had a meeting with him he said, “Send me a paper. We’re not going to spend any time for you telling me the background. Give me the background ahead of

time. I'll read it, and we'll discuss the issue."

And that's the way it was. Just sent him a paper. He read it, and we discussed the issue. No background necessary. He was straight business. I guess I really didn't know him as a person while I worked for him but later on I got to know him after we both left. We went to some meetings together and so on and I got to know him as a person and I got to think of him as a decent, nice human being. But not when he was Secretary of Defense. (Chuckles.) He was a real tough egg.

I: What was it like talking to Harold Brown?

Ruina: Oh, very easy. Harold was very easy. Well, York was easier. To this day I am very friendly with Herb York. We talk to each other on the phone about once a month. I see him every year. I don't have that kind of relationship with Harold. Harold was much more formal and more of a bureaucrat, not in a derogatory sense, but I think he fit into the system and allowed himself be fitted into the system more than York.

But both of them were easy to deal with. For me, very easy to deal with and I dealt with them as peers, rather than say, "This is my boss." Well, I mean I could say, "This is my boss," but the conversations were always, you know, "How do we handle this problem?" I was very lucky.

As I said, my relationship with Johnny Foster, which came later, he wasn't quite the same. His background was different. His style was different.

I: What kind of a role, if any, did serendipity play?

Ruina: A lot. (Chuckles.) In one's life, for sure. I examine my own life and think that the single greatest factor determining the path my life took was just sheer luck—sheer luck. Judgment was second and ability was third. (Chuckles.)

Well, when I came to ARPA I inherited all the programs and the people who worked on them, you inherited who you got. We had a high priority that I could bring in any military officer I wanted to and I tried to get Lou Allen, who was then a Colonel. He had a Ph.D. in physics and was a Colonel in the Air Force, and I wanted him in ARPA. But he came to me. He said, "I really don't want to go to ARPA. I'd rather stay in the Air Force."

I just thought, "I'm never going to have a guy come who doesn't want to come."

He stayed in the Air Force and he ended up being up Chief of Staff of the Air Force. So, he made the right choice. (Chuckles.)

So, the people you come across and the luck you have with who are the people on your staff, who are the people who are your bosses. I was just very fortunate in that regard.

It was a great environment.

I: General Betts seemed to consider himself pretty much a caretaker after Johnson left. Managed the programs that were there, didn't lay down any necessarily new foundations to make sure that ARPA didn't go away.

Ruina: Yes. Very reasonable man. Well, I found him the same way. I don't

know how he got the job, but he always really belonged in the Corps of Engineers. He was an extremely reasonable person to deal with. And whereas during the early days, the York-Johnson days, there was all kind of turmoil, new programs, big programs, confusion. I think Betts sort of toned the whole thing down, but I never thought of him as really running the place. I think after York, I think I was the first guy to run the place.

I had good relations with Betts and I personally liked him a great deal but he wasn't a real force in the history of ARPA, I don't think. I don't know how I come across but I brought a whole new sort of an academic, different, non-bureaucratic flavor to the place. I don't know if it was good or bad. Just different.

I: Who was the first scientist or first academic?

Ruina: Herb York.

Well, he wasn't the Director, but he was really running the show. He was running the show and a very powerful guy, had a very individual style. He did things in a way that was so different than the bureaucrats. When I was Director of ARPA he had a heart attack, very serious heart attack, and he had to walk. So, his secretary would call me. You know how the Pentagon's laid out, E Ring and D Ring. We both had E-Ring offices but we were about a quarter of a mile apart. (Chuckles.)

And his secretary would say, "He wants to talk to you, and he's leaving his office now. He'll pass you in six minutes." And I'd come out and I'd start and we'd walk around and talk. He had the most unusual way of doing business. And also his testifying in Congress alone and going off the record.

Harold didn't do that sort of thing. Harold was more establishment, but Herb had that and still does. And still does.

I: What do you see as DARPA's key to survival?

Ruina: I don't know. The key to survival now, I don't know. I know they still have a fantastically good reputation because very often you'll see, "The Department of Energy should have a DARPA," and, "The Department of Commerce should have a DARPA." It means that it was a group of, I think, capable people running it and I think the people who immediately followed me certainly were. I don't know what happens after that.

Their pursuit of advanced technology. A relatively free hand. I had a fantastically free hand. Much less bureaucratic than most government agencies, by far, more than any that I knew at the time. And maybe that, an agency like that, would be great. And of course there's a lot of waste done, but a lot of other government agencies have more waste. Just free-wheeling, to a certain extent, and we have competent people. I think free-wheeling with competent people is important if you want to make interesting advances. That's the secret of the agency and my guess is it's pretty much the same now. I don't know. I became removed from ARPA after Herzfeld, I just had very little to do with the agency.

I: Well, there seems to be a certain fearlessness about it.

Ruina: Well, Heilmeier I got to know pretty well. We're both on the MITRE board. An extremely competent, sensible guy. If that's the measure of other Directors, they're very lucky to have people like that.

Here I was minding my own business in Illinois and I actually got shoved into this track to be so quickly in that track. It changed my whole life. From minding my own business in Illinois to oh, head of a nice group and so on, to get into this high-temperature operation.

I took to it easily, though. I had to get used to the rank, and you're meeting with Generals, and having a General as an assistant is something working for me later in ARPA, it took a little while to get used to. But not long. (Chuckles.)

I: Was it fun?

Ruina: It was. There was a fun part of it but mostly it was business. It was business, and serious business. Once a while I look back, you know, I don't know if you know I'm an immigrant. I was born in Poland, came from an immigrant family, university professor, and suddenly in the midst of all this high-pressure. But it's amazing. You get used to it very quickly.

I look back and there were a few things I didn't do that I really regret doing. Somewhere along the line I got the Flemming Award. I think that either five or ten outstanding young men in government are chosen every year. I think young men under 40. And I once got the Flemming Award, the outstanding young men in government.

I didn't take the award too seriously. I knew there was an awards ceremony. But I didn't realize it was going to be what it turned out to be. It turned out several Supreme Court justices were there. Edward R. Murrow was the chairman of this group. Big pictures of the people who won the award.

And I thought, "Gee, if my mother was only there, she'd be so happy, so pleased. Why didn't I invite her to this?"

To me, it was not such a big deal, but to her it would've been really...seeing all the Supreme Court judges. Here's this immigrant lady, didn't speak English very well.

So to this day I think of it. Why didn't I invite her to that?

I: Is there anything else you'd like to say?

Ruina: No, except that those times were very special and then I think there were great opportunities for people in science and technology. We took advantage of some. I regret we didn't take advantage of others. It was a job I loved at the time. Took too much of my time. And I was surrounded by great people, and I was very fortunate in that regard.