



**Dr. George Heilmeier**  
**1974-1977**

*Interview: January 16, 2007*

**Interviewer:** Your name and tenure as director of DARPA.

**Heilmeier:** I'm George Heilmeier, and I was the director of DARPA from late '74 through the end of '77.

**I:** Was it DARPA or ARPA at that time?

**Heilmeier:** You know that's an interesting question because it was part DARPA and part ARPA. At that time, the administration wanted to pursue dual-use technologies—and of course the Pentagon wanted to produce results that could impact national security. So, sometimes we would be called DARPA, and depending on the audience, sometimes we were ARPA. (Chuckles)

**I:** You were first a White House fellow then you became associated with DDR&E?

**Heilmeier:** That's correct.

**I:** —and Vietnam was still was going on?

**Heilmeier:** Yes. Vietnam was still with us, although tapering down to a certain extent. People were also concerned about air warfare, particularly the surface-to-air missile threat. And at that time the Soviet Union had a very large submarine force and so anti-submarine warfare was another critical need of the Pentagon at the time. So, those were the two, big issues.

**I:** Did you work with John Foster?

**Heilmeier:** Well, when I served as Assistant Director of Defense Research and Engineering, Johnny was the Director of Defense Research and Engineering for a couple of years. But then he left and there was a succession of other DDR&E's that followed him.

**I:** What was your role at DDR&E?

**Heilmeier:** I was Assistant Director for Electronics, Physical Sciences and Computers.

**I:** Describe the environments you were in.

**Heilmeier:** Well, it varied from place to place. There were some areas where there were really some very competent people, very committed who understood the missions and the technology. There were other places where, when you were working at the leading edge of technology, and the competency or professionalism wasn't quite as good.

**I:** Redundancies?

**Heilmeier:** Lots of redundancies, particularly in the area of electronics. So we put together a tri-service group and met on the order of once a month to exchange ideas about things that were of mutual interest that we were going to be doing. And that led to a fairly significant reduction in duplication and overlap.

**I:** Budget savings?

**Heilmeier:** Of course.

**I:** Your background was electronics.

**Heilmeier:** Absolutely.

**I:** What did you do before you came to Washington?

**Heilmeier:** I was a researcher—began as a researcher with RCA Laboratories in Princeton, New Jersey. I was there for approximately ten years, the decade of the sixties. I worked in the area of flat-panel displays and succeeded in inventing the liquid crystal display.

**I:** Why did you leave RCA?

**Heilmeler:** Well, RCA was a very bureaucratic operation at the time, and I thought we needed to move faster on the liquid crystal display project, but it didn't quite work out that way. So I lost my passion for research in that area, and my view has always been that when you lose your passion for a particular area that represents your work, you should leave with it. So I decided that I was going to leave RCA and fortunately I was selected as a White House Fellow and I served as an Assistant to the Secretary of Defense, who at that time was Mel Laird.

I had been very close to Johnny Foster when I was the White House Fellow there, and Johnny said to me, "I'd like you to stay on as my Assistant Director." And that sounded exciting to me. I thought it was just going to be a year or two, and it lasted a lot longer than that.

**I:** RCA was bureaucratic and you go to the Pentagon?

**Heilmeier:** Well, the interesting thing was that working with Johnny Foster, there

wasn't much bureaucracy. Johnny made decisions. I had enormous respect for his technical competence, but he was also a guy who knew the importance of technology in national security. He was a leader, and we got along very well together. He taught me about the role of technology in national security. It was one of the most exciting periods of my life.

I: Did the fact you both had science backgrounds help your communication?

Heilmeyer: Oh, definitely, because the areas that I had extensive knowledge in weren't necessarily the same areas in which Johnny had expertise—although Johnny is the Renaissance man. We complemented each other in many respects—I learned an enormous amount of science and technology from Johnny. And maybe he learned just a little bit from me. But we're still very, very close.

I: He came out of nuclear physics, didn't he?

Heilmeyer: That's right.

I: You later became the DARPA director? How did that happen and when? What was that like?

Heilmeyer: Well, Johnny was gone by then. It was late 1974, and Mal Currie was the director of Defense, Research and Engineering, and Mal and I got along very well together. We shared a common interest in electronics. He asked me if I wanted to be the Director of DARPA. I thought about it for a while, and from my position in OSD, I thought, "Gee, we're just beginning to get some things really rolling." Did I really want to go to DARPA?

He more or less talked me into it in many respects. He said, "You're going to be involved with some of the leading-edge technology in the world. It'll be a very exciting place. You'll have your own budget and you'll be able to get things done."

So eventually I decided that I would be interested in the job. I talked to Jim Schlesinger, who was then the Secretary of Defense. Jim decided that I was his choice so I wound up as the Director of DARPA.

Now I was in DARPA for only a couple of weeks when I thought, "I made a big mistake. I should've stayed in" (chuckles) "in DDR&E."

I: Why?

Heilmeyer: Well, at DARPA at that time, I found a lot of things that needed to be examined with a little more depth than DARPA was essentially capable of at the time. It was particularly true in some areas of science and technology, whereas, in the systems area we had some really good people. But I was concerned that we weren't deep enough in the technologies and science that were going to be more important to us.

I: Did you encounter tensions between bureaucrats and scientists?

Heilmeyer: Well, there was a little bit of that, but we simply didn't tolerate those kinds of conflicts. We had one mission and we made sure everyone understood

that. The stovepipes that large organizations sometimes are capable of producing—we simply didn't tolerate that.

**I:** You've been credited with turning DARPA around after it had been on the ropes. What happened, and how did you do that?

**Heilmeier:** DARPA was a hierarchical organization. There were some office directors at DARPA who said, "You don't talk to my people. You talk to me". My response was something along the lines of, "Why don't you try to perform an impossible sexual feat?" We weren't going to tolerate that kind of nonsense.

I became fairly close with the real technical capability of DARPA, and that helped us move ahead because I could make decisions more quickly. We had an excellent team that was beginning to form. There were people who didn't have responsibilities, who were capable—a lot more capable, than their positions would indicate. They more or less grew into larger-responsibility positions and we just had a ball.

**I:** Did you read every proposal that came to you?

**Heilmeier:** Every DARPA Order. Now a DARPA order is the last step before you fund something and it requires the Director's signature. Well, some of my predecessors had gotten out of the custom of reading the DARPA orders. When I became the Director of DARPA, I spent an enormous amount of time reading each one of those and commenting on them—you know, starting the dialogue. People began to give things a lot more consideration and dig a lot deeper than perhaps they had done in the past. So I think we became more efficient and more productive.

**I:** Did you change any of the contracting or funding structure?

**Heilmeier:** Well, we ran into some problems with universities—certain universities—not all, by any stretch of the imagination, but there was a group that felt that they were entitled to funding from DARPA. Our view was that we'll fund *ideas*. We're not funding a university—we're funding ideas. That was counter-culture in some universities at that time.

I had one person visit me who said, "Look, Heilmeier. You don't understand. It's your job just to get the money to us. You shouldn't be asking questions. You shouldn't be asking us to be accountable for results," and what not.

And my reaction was, "Oh, that's very, very interesting. Thank you very much."

But we decided that we were going to fund ideas—good ideas—and we didn't care where they came from. They could come from Succotash College or one of the major technical universities in the country but the key was funding good ideas. We did get a lot of pressure from that position, but the right thing to do was fund good ideas.

**I:** When you became Director how did you weed out the portfolio to keep only those high potential projects?

**Heilmeier:** As you might expect, there was a lot of discussion. We would critique each other, ask questions, and we agreed that we were going to use a set of questions and institutionalize them. We called that “the Catechism.” With no jargon, the questions in the Catechism were, “What are you trying to do?” “How is it done today and what are the limitations of current practice?” “What’s really new in your approach and why do you think it can succeed?” “Assuming you’re successful beyond your wildest dreams, what difference does it make to national security?” “What are the risks that are involved here and do you have a risk reduction plan?” And then, finally, the blocking-and-tackling questions, namely, “How long is this going to take?” “How much is it going to cost?” and “What are the midterm and final exams?” That became the Catechism.

And even today, there’re some Office Directors in DARPA who, on their business card, have those questions on the back of the card.

**I:** How many projects survived that?

**Heilmeier:** I don’t really remember. A better question would be, how many of those projects changed as a result of the exchange and the discussions and the like?

**I:** Did it have a major impact on quality and relevance?

**Heilmeier:** It had an influence on quality but we began to attract better people as well and from that standpoint, I got some excellent advice from a former Director, who said, you know, “Every night before you go home, you ought to reflect on the question, ‘What did I do today to essentially bring better people into DARPA?’”

**I:** Where do you find those people? How do you attract them to a government agency?

**Heilmeier:** Well, we found some people from universities who wanted a change of pace. Some people we were able to bring to DARPA were already working in the aerospace defense industry who wanted to be in a position to move faster and to see a bigger portfolio of ideas. It was an exciting place to work and it still is.

The quality of the people is key and the teamwork among the staff in DARPA was key. We were very, very fortunate to attract some good people, because we had a passion and excitement for what we were doing. And people thought, “You know, I really want to join that team.”

**I:** Was the approach evolutionary technology or revolutionary technology?

**Heilmeier:** Both.

**I:** How do you do both tracks?

**Heilmeier:** There are two ways to look at things. You can look at the technology initiatives that *drive* a business—and then you can look at the technology initiatives that are going to *change* the business. We were heavily biased to the latter, but we couldn’t ignore the former. You build confidence among your customers—in our case, our customers were the military Services—if you can

take a problem that's important to them and solve it quickly, or bring a new point of view to it quickly. Then they begin to generate some confidence in you so when you come and tell them we're going to build an "invisible" airplane, a stealthy airplane, they don't *laugh* as hard as (chuckles) they might have otherwise.

I: Was the relationship between the Services and ARPA damaged at all by the war? Was there a need for repair?

Heilmeier: Well, I think that first of all, you have to understand the problem the way the customer understands the problem. You can bring new ideas and new approaches to solution(s) to the problems but you've got to work on problems that people consider important. Remember that question in the Catechism, namely, "Assuming you're successful beyond your wildest dreams, what difference does it make?"

People in the military Services had that question in mind, namely, "What difference is this going to make?"

I: Did they ask why ARPA?"

Heilmeier: On occasion, they did.

I: Please give me an example where ARPA was able to solve a service's need quickly?

Heilmeier: That happened in numerous cases as a result of very real problems they had in the field.

I: Describe the M-16 or the AR-15 rifle situation. Did it damage relations with the service?

Heilmeier: Well, I'm not sure that DARPA had to take total responsibility for what happened with that particular field piece. From time to time people get involved in a particular area—for example, people in a service laboratory might not fully appreciate the problems involved—or they think they can go further in solving the problem than they're capable of. So, it works both ways. It's never an either/or. That's one example.

I: How was your relationship with Congress?

Heilmeier: I thought we developed really an excellent relationship with Congress and we did it in a way that was unexpected by Congress and the congressional staff. When I would go over to defend the DARPA budget I would talk about the things that went well in the past year, the things that *didn't* go so well and what we were going to do about them and then where we were headed.

Now, the people who were responsible for legislative affairs in the Pentagon almost went crazy when I said, "I'm going to talk also about the things that weren't going so well."

They said, "You can't do that. You only talk about the things that are going well."

And I said, "No, no, no, no. We're going to talk about all aspects of what

we're doing.”

Finally, they said, “Well, if you’re that crazy, take charge of it.”

We found that Congress really *liked* that approach and we gained credibility. When we came over with dramatically new ideas they had some confidence that we would tell them when it was going right and when it wasn’t. That was a new experience for them.

I: Did that affect your budget?

**Heilmeyer:** We had to fight for every dollar because during the period I was the director of DARPA there was a tendency to want to reduce defense spending. Since research and development had a longer-term focus there was resistance on the part of some in Congress to fund those R&D projects. Their tendency was to take some money out of the R&D budget and put it into a systems budget that needed some additional funding.

I: Bella Abzug.

**Heilmeyer:** (Laughs.) Okay.

Yeah, we had some interesting discussions with her staff. She thought we were essentially developing a capability to read people’s minds and she thought that we shouldn’t be doing things like that.

And we *weren’t*. We would have *liked* to have been able to do it—(chuckles)—but of course we couldn’t. The press had picked up pieces here and there and they drew the conclusion that we were developing capability to read people’s minds.

And finally, Congresswoman Abzug, backed off because she had other things to worry about. But for a little while she thought DARPA was just an organization that had to be monitored more carefully, because they just might do something like that—namely, read other people’s minds.

But we used to get calls from people who read the newspaper and wanted to find out what we were really doing.

I can remember one individual who would call regularly and he claimed that we had some machinery that was really driving him crazy. My secretary began answering these phone calls regularly and at first she denied that we were doing anything like that. But he would call back and say, “Oh, my head, it’s hurting. You must be trying to do this and it’s impacting me in strange ways.

Finally, she got so tired of—of talking to this guy, she finally said, “All right, I’m going to turn the machine off.” And there was a pause, and he said, “I’m feeling better already. Everything’s”—(chuckles)—“everything’s beginning to get very clear now. Would you please keep the machine turned off?”

So, of course—(chuckles)—every once in a while, you ran into something like that.

I: What was your relationship with the Secretary of Defense's office? Did they change over time?

**Heilmeyer:** Well, when I became the Director of DARPA, I was selected for the position by Jim Schlesinger. Jim Schlesinger was the kind of guy that you could

talk to directly. After I was the Director of DARPA for I would say four months or so, we had a new portfolio of things that we wanted to do. There were some things that we changed, some things that were entirely new, and there were some things that were continuing.

In any event, I went to see Jim and told him that we were setting a new direction, and that we had six silver bullets—I called them “silver bullets”—that we were going to focus on. I told him that I was going to give him the background on them and what the implications were. I said if he doesn't like these he should tell me now because we're going to start working on these in earnest. And so he said, “Fine. Tell me what you're going to be doing.”

The meeting lasted the better part of an afternoon. It was a one-on-one meeting in his office. I went down through six things that we thought represented silver bullets and he said, “Well, what do you mean by a ‘silver bullet’?”

I said, “Well, it could mean, on one hand, a capability to do things we couldn't do before. It could mean for the same price you get approximately ten times the performance. And flip it the other way, for a lower price, you got an equivalent capability.” So, he said, “Fine. Okay, I accept those definitions.”

So, we talked about the “invisible” airplane. By “invisible,” I meant could not be detected easily by radar. At that time, there was a very, very big problem, because the enemy had surface-to-air missiles that were shooting down aircraft. Jammers were sometimes effective, sometimes not so effective. The Israelis lost large number of aircraft in the '73 war due to surface-to-air missiles. So that topic was right on the leading edge. We told him we were going to build an aircraft that would be extremely difficult to acquire and track by radar. And we told him how we were going to do that.

Then we talked about the fact that we were going to make the oceans more “transparent.” Anti-submarine warfare—the submarine threat, was a very large threat in that period of time, and there was some new science that had been uncovered that could have a substantial impact on our ability to detect and localize quiet submarines at long range

Then we talked to him about high-energy lasers, and in particular, the role of high-energy lasers in space and what we were doing to not only develop high-energy lasers, but also to examine the potential of such a weapon in space—primarily thinking about ballistic missile defense.

We talked about using our computer technology to make adaptive command-and-control systems. In other words, instead of the commander having to adapt to the system, the system would essentially adapt to the commander.

We talked to him about not only vehicular diagnostics, but *prognostics*. In other words, if you were going to engage in a long battle with some specific armored vehicles, you'd like to know whether these vehicles were going to be able to continue on and pursue the enemy—or whether they would break down. That was what we called prognostics. And if they did break down, what caused it so you could repair them more quickly.

Well, these were the kinds of things we talked about with the Secretary and he was intrigued. Towards the end of the discussion—I guess we were

there for about three hours—he got up and, in typical Jim Schlesinger fashion, his shirt tail was hanging out, he said, “This is great.” He said, “I like everything you’re going to do. Now, what can I do for you?”

And we said, “Well, there are a couple things that we could really use your help on.”

And he said, “Tell me what they are.”

Well, we needed a leader for the ASW program and we had spotted one. He was a Navy captain who had a degree in signal processing, knew the anti-submarine warfare mission very, very well. We had spoken to NAVPERS about our need for this guy, and they said, “You’re not going to get him. We’re not going to let him go. He’s going to stay in the Navy on a Navy assignment.”

He was just so perfectly matched for this problem, that I had to take one last shot, and if the secretary said, “What can I do for you?” I thought, well, we needed this particular captain.

And he said, “Okay, fine. I’ll do it. I’ll get him for you.”

Well, it wasn’t a week later when I got a call from the Navy saying that they were assigning the captain to DARPA.

To this day, I can still imagine what went on. I could see Jim Schlesinger pick up the phone to call the CNO and say, “I want you to assign Captain So-and-so to DARPA,” and just hanging up. And I could see, in my own mind, the CNO turning to his aide, saying, “Who is Captain XXX, and why in the name of good sense does the Secretary of Defense call me and tell me to assign him to DARPA?” I can still think of the way it was done.

There were some other crazy things. Like, I was getting calls from some of the Secretary’s SD staff. These guys knew that DARPA’s the only place where the Director signs the checks and they would say, “Well, the Secretary wants you to fund this particular program,” or, “this particular study,” and the like.

I’d listen to them, and say to myself, “You know, some of this is crazy. Some of this stuff doesn’t make any sense at all.”

I said to the Secretary, “I’m getting these calls from your people telling me that you want me to do this or you want me to do that. Some of this doesn’t make all that much sense from a technical standpoint.”

And he said, “Well, if I want you to do something, I’ll call you down here or I’ll call you by the phone and tell you what I want.”

And I said, “That sounds fine to me.” That solved the problem.

I wanted to join the Officers Athletic Center. That was the last thing I wanted and I kept getting put off. I said, “This sounds trivial, but I’m kind of an exercise freak and I’d really love to be able to go down to the Officers Athletic Center before I go home at night and work out and I just can’t get a membership.”

He asked, “Well, why can’t you get a membership?”

I said, “Well, they have a list of people, and I’m not an officer.”

So, he turned to his aide and said, “Why don’t you get George into the Officers Athletic Center?”

His aide said, “Well, I don’t think that’ll be a big problem. We ought to be able to handle that.”

In any event the first two things went very well—got done very, very quickly. This one didn't get done so quickly. Finally, his aide told us, "I've been working on this, but I'm not able to get this done."

So he went back and told the head of the Officers Athletic Center, under the direction of SECDEF, that the SECDEF wanted this guy, George Heilmeier, admitted to the Officers Athletic Center. The guy who was running the center said, "Well, you know, we got these rules and what not, but we're a military organization and the Secretary is really our commander. If he writes an order and orders us to do this we have to obey orders."

When Jim Schlesinger heard about that, he said, "I'll take care of that," and bingo, everything went smoothly and I became a member of the— (chuckles)—Officers Athletic Center.

But that's the kind of guy that Jim Schlesinger was. He was a nonsense guy and if he believed in something or he thought something could be done he wanted somebody to go do it and not make a lot of excuses.

And DARPA was that kind of organization.

**I:** During your tenure did you have to change ponies with Secretaries?

**Heilmeier:** No, he was my boss for most of the time. Then Don Rumsfeld came in so I worked for Don Rumsfeld for a while. Now, Don did not have the—the same passion, shall we say, that Jim Schlesinger had for new things at that time. You know, Don—you know, he was introduced to a position, had lots of responsibilities and, you know, he had to get up to speed. Very, very bright guy, but his view was, "If you tell me this is the right thing to do and you can essentially explain it to me in a language I can understand then we'll do it."

Jim always wanted to know what was going on. He'd ask, "How's that invisible airplane going?"

He'd call up and we'd chat for a little bit about it. A couple of times he said, "I want you to come to my staff meeting on Monday morning and I want you to tell them about what you're doing in these six things that we laid out as our silver bullets."

So, he had more of a direct interest.

**I:** What was the look on his face when you told him you wanted to make an invisible airplane?

**Heilmeier:** You know, I don't really remember, but with 20/20 hindsight, knowing Jim Schlesinger, he probably would've been intrigued with that statement. When we told him what we meant by it and he became more and more interested.

**I:** Pretty exciting.

**Heilmeier:** He would ask, "When are we going to have this? How are you going to make this work?"

We told him we were going to design an airplane to minimize radar cross-section and we would take whatever aerodynamic performance that we got out of that aircraft. He thought that made a lot of sense.

I: Did you find that ARPA/DARPA was "the honest broker" to the Pentagon?  
Heilmeier: I would say there were people at DARPA that you could trust with that role and we did.

I: Did people call you and say, "You're making an invisible airplane. Let me tell you my idea?"

Heilmeier: No, because this was a highly classified program at the time.

I: Do you see that as the defining moment to your tenure there?

Heilmeier: Yes. It was probably one of the more exciting and important things that I've done in my life. People say to me, "Well, you invented the liquid crystal display," and everybody has a liquid crystal display of one kind or another. "That must've been the highlight of your career."

It wasn't. It simply wasn't. It was working with a relatively small group of really capable people who really believed in what they were doing. It was interesting to see that compensation meant nothing to these kind of people. They were people who were trying to help their country. They were true patriots, and it really didn't matter to them what the compensation was. It was, "Can we build an airplane that will save people's lives and accomplish important missions?"

That was a tremendously exciting time.

I: How did you manage a bunch of pieces —many people, many projects, different people working different parts of a project?

Heilmeier: It was one company, it was one group. Because of the level of classification of what we were doing, there weren't a lot of people who dropped in and dropped out.

I: Your family didn't know you were doing this.

Heilmeier: That's not unusual. You don't talk to your family about what you're doing if it's highly classified.

When the aircraft had its first flight, Kelly Johnson from Lockheed was one of the principals from Lockheed who was working on this. He had requested that a bottle of champagne be flown back from Europe in an SR-71 to where we were going to have our first flight. After we had the first flight we opened that bottle of champagne and everybody drank a toast. We thought at the time that was a breakthrough in modern aviation.

I took the empty bottle home with me. Kelly Johnson signed and dated it and suggested that I do the same. I signed and dated it, took it home, and put it in my study at home. My wife kept saying to me, "You have that empty bottle up there. What are you going to do with that? Are you just going to leave it here? At least have a bottle of champagne that's *full*, not just an empty bottle of champagne."

I said, "Some day, I'll tell you why that's significant."

Finally, during the early days of the Carter administration, they talked about the fact that they had a new concept that was going to have tremendous

importance—that we wouldn't need the B-1. And when that was discussed publicly for the first time—no details—I said to my wife, “You know that bottle that's upstairs in the study?”

And she said, “Yes.”

I said, “That bottle is related to what was said about a new concept.”

I still have the bottle, by the way.

I: Making the oceans “transparent” —what was that about?

Heilmeier: Well, at that time there was a discovery made that showed the ocean to be far more coherent than anyone had previously thought. Off of the East Coast and the West Coast and a couple of other places there were these arrays of acoustic sensors that could essentially detect the fact that there's a submarine out there somewhere.

We demonstrated that you could correlate the signals two different arrays and not only detect a quiet submarine at long range but also localize it. We built an experiment to demonstrate that was true. We brought the signals from the two arrays back to the West Coast where they were processed. We could now not only detect submarines at long range—we could also localize them. Prior to that discovery, you'd say, “There's a submarine somewhere out there in the northern Pacific.” After the experiment you could say, “—and here's where it is.”

I: Were you ever taken aback by the size of the ideas and the size of the experiments you were doing?

Heilmeier: Yes, I think I was. I was fortunate in that I had been close to Johnny Foster for a couple of years. I was almost like his shadow. I learned so much from him about the role of technology in national security, and I had seen many interesting projects and programs under development at that particular point in time that when I went to DARPA I had a little bit of advantage. I had been exposed to a guy like John Foster who has a very, very broad bandwidth guy. When I came to DARPA, I could fit the pieces together a lot better than I could if Johnny hadn't taught me.

I: What kind of approaches and thinking does DARPA need to solve problems?

Heilmeier: It seems to me that one class of technologies that are quite important are technologies that can collect lots of data from different sources on different subjects and “connect the dots,” so to speak. That's what computer technology is enabling us to do.

It's not the same large-system hardware programs that were the way we approached problems when there were two world powers who more or less were peers. Now the problem is much more asymmetric so the technologies that may have been useful back then are no longer necessarily the preferred technologies. The information technologies are the place where we probably will gain the most leverage.

And, of course, there are the sensors and the surveillance equipment that enable you to collect data and information from very diverse sources. That's where I think there is great promise for dealing with asymmetric conflicts like we

are facing today.

**I:** Looking back, what would be your proudest moment at DARPA?

**Heilmeyer:** I had so many days that were really good days that I don't remember the stuff that wasn't so good. But that early morning liftoff of the Have Blue aircraft—the first Stealth aircraft—that was demonstrating the principle of stealth—that was a very, very exciting morning for me. I—I thought to myself, "This small group of guys has made aviation history this morning."

As I watched the liftoff from the end of the runway, I reached down, and I pulled up a couple of stones that were pink stones and put them in the pocket of my raincoat. I still have those too.

There are times like that when you are working with a good bunch of guys who are really committed. You think that maybe you had a role to play here. I like to think about my role as the guy who kept everybody off their back. I was the guy who practiced "no-excuses management" by preventing some bureaucrats from interfering with their progress.

Now, when I say "no-excuse management," I don't mean you're going to crucify somebody for not delivering. What I mean is that with all the problems these guys were going to have on an everyday basis—the bureaucracy doing this or the bureaucracy holding them back from doing that—"No-excuses management," to me, takes away those problems so they could focus on the very important tasks to which every member of that group was committing their careers. That's a nice feeling, to think you enabled these guys to do their very best when, in a different set of conditions, the bureaucracy and all the excuses would've covered them or held them back.

I've had a different career almost every decade. In the sixties, it was liquid crystal displays. I thought I'd never do anything as important as that again. Then, in the seventies, it was working on national security challenges and initiatives. From a science and technology standpoint, I thought I could never do anything more important than that.

As you go to different careers, you find that the things that make you happiest have changed over the years. For me, in the sixties, it was inventions. In the seventies, it was leading-edge technologies that could make a difference. Then you find yourself being a coach, or mentor. You see a bunch of guys reaching their full potential. They're just as excited about what they were doing as you were back in the sixties. That has tremendous satisfaction associated with it.

**I:** What was the turnaround for Stealth? Was it fast-track?

**Heilmeyer:** Yes, it was. We didn't invent things that didn't need to be invented. In other words, when we wanted a flight control system for this unstable aircraft that had a very low radar cross-section, we took the flight control system out of an F-16. In other places, people might've said, "Well, we've got to design a new flight control system."

We said, "No, no, no, no. We're going to get this sucker to fly and we're going to get it to fly in two years."

That meant you couldn't reinvent the wheel.

I: When you look back, are there any regrets or any second thoughts?

Heilmeier: We were so focused on those silver bullets that maybe there were things I should have spent more time with, but let's just talk about computer science and information systems. We had good people working those. They weren't as highly classified, and there were inventions that had to be made. Those had a longer cycle time. Whereas, in the Stealth case, by golly, there was a fundamental principle—we were willing to sacrifice aerodynamic performance for low radar cross-section—that's a pretty fundamental idea. If you were willing to break the rule that said, "When you design an aircraft it has to have high performance"—if you were willing to give up on that then maybe there was gain to be had in another parameter turning out to be extremely important to survivability.

I: What do you mean "you don't go to DARPA for a career, it's a career change?"

Heilmeier: DARPA is an unusual organization in the government because it can make decisions and act quickly. If you put your topnotch technical people on a project, and you have the checkbook—(chuckles)—in your pocket and you don't have to go to your boss every other day and ask him, "Can I do this?" or, "Can I do that?" and if you have a group in Congress who looks at what you're doing as important, you have all the pieces together. You won't find that in very many places. Even big commercial companies have some of the bureaucracy of the Pentagon.

Some of the finest people I've ever worked with were people in uniform—people who were temporary civil servants. Let's put it that way, because they certainly weren't in it for the money.

That reminds me of Bob Gates. Bob and I have been friends for a long time, and when his country called again, he answered the call.

I: Do you go to an organization like that for the fun, not for money?

Heilmeier: Very, very true. "Fun" may be one way to describe it. Rather than saying "fun," I'd like to say "commitment, dedication, and passion." It was a serious place from the standpoint of the missions it supported.

But, you know, just being around people who were smart and thoroughly committed, *totally* committed made everything worthwhile.

I: When you looked at the state of computer technology and information processing, what did you see and were you happy with what you saw?

Heilmeler: When I came to DARPA, DARPA was spending a non-trivial amount of money in artificial intelligence research. Artificial intelligence had the right name. It had the right "bumper sticker," but there was some fine research going on. There was also some research that, for lack of a better description, was going to take a very, very long period of time.

We felt that artificial intelligence could contribute but it wasn't contributing to national security. We outlined a couple of problems we thought artificial

intelligence might help on. At first the community said their job was research, and basic research at that—and my job was to get money to them. My reaction was, “Look, you’re not writing any reports that I can look at and get some idea as to your progress. You don’t submit interesting proposals. You expect to get money without proposals and somehow that’s not the way we’re going to be working.”

We gave them a couple of problems and they continued the research. On the other hand, I could tell the Congress that we were doing something useful as a result of that research. For example, back then, Morse code was still a pretty important problem. The problem was how you recognize whose fist is on the key on the other end. We thought that artificial intelligence might—(chuckles)—be a solution to determine not just what’s being tapped out but who’s tapping it out. So several university scientists got working on that problem and they became reasonably successful.

Another was the fact that in anti-submarine warfare when you would collect these acoustic signals, they would be displayed as “wiggly lines” on a recorder. There were some Navy people who could look at that and say, “I think that’s our target” just by looking at what we used to call the “smoky paper with the wiggly lines.” We thought that maybe we could automate this process. Another group decided to take on that challenge and they were reasonably successful there as well.

There were some disagreements, early on. I think we both understood each other’s concerns—I gave a little, they gave a little, and I think we were better for that because there were some areas of research that were going on that, to be quite honest with you, I didn’t understand. We brought in some people who could do some evaluations. But to me, the important thing was, “What can we do with this technology *now*, not 20 years from now—that would be important and would contribute?”

There were members of the university community who respected that point of view. The agreement was, “You work on these problems that we think are important —they’re near-term—and we will continue to fund basic research in this area.”

**I:** Had the relationship between the universities been soured at all by the war?

**Heilmeier:** I wouldn’t say so. Of course, I’m looking at a very narrow portion. I’m looking at science and technology in universities—those folks tend to be a little different than people who have, perhaps, a political perspective on the war. That was, of course, the Vietnam War.

**I:** In what way(s) did you have dealings with the JASONS?

**Hellmeier:** JASONS was a group of university scientists who would take on tough challenges. Was there arrogance? Yes, but there was arrogance on both sides. During my tour, a certain segment of the JASONS made a very important scientific contribution. My reaction was that if they didn’t do anything else during my period there, they would have been very, very important contributors. I’ve always felt that the relationship between DARPA and the JASONS was one in

which you would talk to them about an important problem in a context they could understand—which would be a scientific context.

If you don't have that kind of relationship, then you're going to find that, "These guys are brilliant scientists but we weren't successful in parsing a problem in terms that their science could be applied to it."

I think DARPA went through a period where that was the case. We weren't speaking the same language as the scientists who were part of JASONs. I'm not doing any finger pointing here but people that were part of JASONs made their best contributions when they knew what the problems were, not from a political standpoint, but from a technical or scientific standpoint.

**I:** Asking the proper question?

**Heilmeier:** Indeed.

**I:** Please describe an example of their contribution?

**Heilmeier:** Well, a small segment of JASONs recognized the importance of coherence. They were the ones who recognized that the ocean was far more coherent than anyone had thought it was.

At that time, there was a segment of JASONs who "connected the dots," so to speak, very, very well.

**I:** Were high-energy beams that part of an anti-missile defense system?

**Heilmeier:** The DARPA focus was on high-energy lasers for space applications. Of course, high-energy lasers had a lot of other potential applications as well, but we focused on space-based lasers and in particular, high-energy lasers in space. We didn't know the answer—and I'm not sure there's an answer even today—but we were wondering if you could propagate energy at the speed of light, maybe you could sit up there and essentially attack ICBMs when they are in their most vulnerable state, namely, when they are lifting off a launch pad and beginning their climb. The weapon to deal with that would've been a high-energy laser—and where would be the best place to put it? In space.

We said, "The first thing we need is a high-energy—(chuckles)—laser we can put in space." Then we did a lot of analysis of that particular approach and its potential effectiveness as a space-based weapon system.

**I:** Did it go anywhere?

**Heilmeier:** I think variants of it did. In the Reagan administration, people began to think about ballistic missile defense in a very serious way and you could say maybe people will eventually revisit it again. But at that time, we had some really capable people who were no one's fools. We worked through the numbers and saw that, hey, if we could do this, this and this, then maybe we could do that, that and that

Now, here we are, over 30 years later. We still haven't done "that, that and that"—(chuckles)—but the concepts were such that maybe some day we'll see a different approach to ballistic missile defense. Maybe space based lasers will play a part in it and maybe they won't. But at that time it was a pretty exciting

thing to be involved-with.

**I:** Your relationship with Dr. Cooper was interesting. Did you recommend him for the office?

**Heilmeier:** A few years after I left DARPA the new Director of Defense Research and Engineering, Dick De Lauer at the time, was looking for a new Director of DARPA. He asked me if I had any suggestions. I had worked with Bob in DDR&E. I thought Bob was very, very capable so I told Dick that I thought Bob ought to be somebody he talks to. He said, "You know, that's a good idea."

So, he did, and Bob selected.

**I:** What do Directors do after they leave DARPA? What did you do after the DARPA decade?

**Heilmeier:** I went to Texas Instruments. I had job offers in the aerospace defense industry out on the West Coast. There were a couple of reasons why I decided on Texas Instruments. When we went to the West Coast the price of houses—(chuckles)—was very scary. But something occurred while we were out there that made a big difference. We went to dinner at the house of the CEO of a major aerospace defense company—other officers who reported to him were there. I was still looking around. Our daughter was upstairs with this particular gentleman's daughter and they were having their dinner up there.

The next morning, my wife and I noticed that our daughter was very, very upset. We were going to the airport that morning to go to Texas Instruments in Dallas and she started crying. She didn't want to talk to us about it but finally she said, "Please, Dad, don't"—"don't take the job here."

We found out that the CEO's daughter explained to her what was going on with drugs and what-not out there in California. That incident had an impact on us because I didn't want to go to an aerospace company and then go back to Washington trying to build on relationships and what-not, because I pushed some folks pretty hard when I was here, and I didn't want to go back to the same people and say, "Please give us this contract or that contract," or whatever.

At Texas Instruments, I could work in areas I found interesting from a science and technology standpoint. I didn't have to go back to Washington to ask forgiveness from people I had beaten up pretty badly—(chuckles)—when I was here.

That plus the fact that Dallas was a different environment in those days and the people at Texas Instruments worked hard, were very committed, very dedicated and shared the same values that our family had. We thought this was going to be a good place to be. It turned out we were right.

**I:** What do you think is the key to managing an operation like DARPA?

**Heilmeier:** Understand at some level what your people are really trying to do and show an interest in it. Show that you really think the work that they're doing is important because you're taking time to learn about it. Don't tolerate stovepipes and don't tolerate a hierarchy. If you want to ask some questions, go to the guy who's doing the work. That was my management style. From RCA

days all the way through the rest of my professional career.

I'm not saying that I know the right way to do it. Different people have different approaches, as you pointed out. But I felt most comfortable just walking around the place and engaging people in technical discussions. I very rarely would have discussions in my office unless it was an issue that required privacy. But mostly I'd walk around DARPA and talk to people in their offices where the thinking and work was being done.

**I:** Were you able to isolate the different programs?

**Heilmeier:** Yes, but you know, it was my style to read all the ARPA orders before signing them. Not everybody would find that something they felt was the way they wanted me to operate. DARPA was a lot smaller in those days. I wanted to know things in as much depth as I could accommodate. So I would read the DARPA orders, write comments on them, and send them back. The guy who was sending me the ARPA order would say, "Yeah, but you don't understand this." I'd say, "Fine. I'll be right down. We'll talk about it."

**I:** Were there any high-risk projects that went out too far but where you learned a lot?

**Heilmeier:** I think the adaptive command-and-control area was one that didn't deliver on my watch—but I think it became more and more important. People began to recognize that this was an important way to approach command-and-control.

**I:** Were you still in the era where you could get a project proposal on your desk in the morning and write the check that afternoon?

**Heilmeier:** Sure.

**I:** What did it take to knock your socks off?

**Heilmeier:** An idea that fell in the "silver bullet" category that enabled us to do something we couldn't do before. "If we're successful, here's what we could do."

For example, in the command-and-control area, one thing in the back of our minds was the fact that you'd like the commander to be able to ask a question and then get a relatively quick response. When we went out to CINCPAC fleet, we saw that if the commander asked a question, it might take him a week to get an answer. He didn't have the databases. He didn't have the database management systems. He didn't have the capability of a query-response approach.

Today, as a result of the work that was done, we're seeing the ability to log into a database and ask a question. You might get an answer back that says, "We can't answer your question but we know about the following things that might be important to you."

That's what we had in *mind* back then but we didn't have the foggiest idea of how to produce it. Well, 20 years later, here we are. We've got the search engines that we didn't call "search engines." We called them "adaptive command-and-control," because we wanted the commander to be able to ask a

question and have the systems search the databases and come back with an answer—or, come back with the statement, “can’t answer your question, but here’s what we *do* know about that that may be important to you.”

**I:** Were there any obscure technologies that became particularly relevant?

**Heilmeier:** The stuff that was being done at DARPA and around the country on artificial intelligence—today, you don’t hear the term “artificial intelligence”. Why? Because it’s become a part of computing as we know it today. In other words, a technology area was absorbed by a much larger area. The whole concept of expert systems, back then, was really leading-edge technology. Now it’s taken for granted and is embedded in many systems that use computing in management and control.

**I:** What is the key to DARPA's continued success?

**Heilmeier:** It’s the people. It’s good people, ideas, flexibility, and resources. That’s what it’s all about.

**I:** There aren't any other DARPAs around—how come DARPA's so unique?

**Heilmeier:** DARPA has had its good times and its bad times—(chuckles)—let’s face it. I’m sure you could find pockets that really want to be like DARPA but one of those four things is missing. What some people in management don’t understand and you see this in the commercial world in many instances as well—if there are seven things that are important, most companies will do four of them, because they’re relatively easy for them to do and they’ll say, “Hey, we did four out of the seven. Hey, that ought to be enough to get us over the top.” What they don’t understand is that if there’re seven things that are important, you got to do all seven, and you have got to do them well.

The four things that I mentioned to you as being key to DARPA’s success—I can have smart people who are committed and have a great deal of passion about their work, but if I don’t give them flexibility and resources, I’ve created a problem.

By the same token, I can give them flexibility, but if their ideas are not focused on anything, they usually don’t produce anything. So, you can look at each point and essentially draw the conclusion that, “Hey, I need all four of these- good people, ideas, flexibility and resources. I can’t do three out of four if I want to be successful.”

I’ll add this as a fifth one—you have to have a little bit of luck, too. You know? Not everything’s going to work the way 20/20 hindsight said it worked. No, you have to have a little bit of luck too.

**I:** I was going to ask about serendipity.

**Heilmeier:** There’s some serendipity but I like to call it “luck.” I can remember when I was at RCA and we started to discover new effects that led to liquid crystal displays. We would not have gotten very far if we hadn’t built prototypes of those displays. At that time, RCA had a vice president by the name of Vladimir Zworykin. Vladimir Zworykin, in the eyes of many people, was the guy

who essentially invented black-and-white TV. He spoke with a thick, Russian accent, and I can remember my secretary coming in one afternoon, and she said, "Dr. Zworykin wants to see you," and, "You should go upstairs right away."

So I went upstairs and he was in his office, and he said, "What is this invention that you have made? People are so excited about this. *Why?* What's going on?" he said.

I said, "We discovered four, new electro-optic effects in liquid crystals and we've demonstrated we can make reflective displays based on them."

He said, "Yes, but how did you *do that?*"

I said, "I guess we just stumbled on it."

I'll never forget his words. In his broken Russian he said, "Stumbled, perhaps, but to stumble you have to be moving."

What an insightful comment to make!

Stumbled, yes, but we *knew* what we were looking for. Now, people say, "Well, you didn't know what you were looking for. You just stumbled."

Oh, no, no, no. We started out knowing we needed to build a flat-panel display. *Why?* Because TV as it existed then required an electron beam at kilovolts. The way the world was going was integrated circuits at volts, so you had to have a new effect that didn't require an electron beam for addressing. Integrated circuits would not provide the sophisticated addressing technology if it required kilovolts.

We knew that we had to have an effect that was low-power and low-voltage, if we were ever going to build a flat-panel display. And it had to be reflective, by the way, because if you wanted to get the power down, you know, you couldn't be emitting light, like light-emitting diodes and electroluminescence and things of that nature. All you wanted to do was modify ambient light by controlling its reflection or transmission.

People had a great deal of difficulty understanding that what they were seeing was not emitting light. We'd turn off the lights in the room, and of course, you couldn't see the display. Everybody said, "Oh, so *that's* how this works. It's *reflective.*"

We said, "Yeah, that's right."

The Japanese have a wonderful way of doing things. The Kyoto Prize was awarded to me for the invention of the liquid crystal display. I had to give five different lectures over a period of ten days while I was there for the ceremonies and all the other things that went with it.

I was going to give a talk that dealt with some ideas upon which a future Kyoto Prize might be awarded. I was working hard on this because it was *fascinating* to me. I thought, "I'm really going to do this," because, perhaps, it would fascinate others as well.

The Japanese required me to send them copies of those speeches almost two months before the ceremonies. *Why?* Because they wanted to translate them and wanted to make sure all the translators knew exactly what they should be talking about at specific parts of the talks.

I told them what I was going to do. I got a response because I had sent them an abstract. They said, "We don't want you to talk about new science in

these lectures. We want you to talk about yourself. You have to talk about all the things that influenced you, not from a science and technology standpoint, but from a life standpoint.”

I began to reflect on that topic. To me that was a gift the Japanese gave me because then I could go back and think about growing up. My parents, my mom and dad, didn't go past the eighth grade in school. We lived in one of those boxy row houses in a neighborhood that would remind you of the early twentieth century, where these row houses were clustered around the factories in Philadelphia.

I can remember all the sacrifices my parents made. I went to high school and my parents didn't even understand what I was studying. But they understood the importance of an education that they didn't have. When my father went away to World War II, it brought back the memories of how my mother reacted because my father was in every major invasion in the Pacific Theater after mid-1944 except for Iwo Jima. My mother and dad had a code they used so that when my dad wrote to Mom she knew where he had been. My mother put up this big map on the wall of the bedroom and she would put a thumbtack in the island in the Pacific where he was going to be or had been.

Much later, I thought about that fact that they didn't have any money to give me for school. On Monday when I would get ready for school—my mother had a sugar bowl, an empty sugar bowl that was in a cabinet. My mother would always put money in there on Monday morning for me to go to school.

As I grew into my teenage years, I recognized that, hey, this was hard, very hard, for them to do. They were very excited about what I was doing and they wanted me to go to college. When it came time to go to college, I wanted to major in physical education. I won a scholarship to the University of Pennsylvania and some other Ivy League schools. The problem was that the Ivy League schools didn't have a physical education major so I had to pick something else. I picked engineering, because my father said to me, “Look, everyplace I've ever worked, the engineers wore clean clothes and made a lot of money.” Bingo. That had to be it. (Chuckles.)

I had to go to the University of Pennsylvania on a scholarship, not Yale or some of the other Ivies, because my parents couldn't afford room and board for me there. So I took the elevated and the trolley car to school and lived at home.

When I think about that now, it just chokes me up. I remember in the sixties I won a prize and the prize was the Eta Kappa Nu prize for Outstanding Young Electrical Engineer in the United States. The ceremony was going to be in New York City and my mom and dad said, “Gee, we're so proud of you, but we're not going to the ceremony.”

My wife and I said, “Well, *why?* Of course you're going to the ceremony.”

My mother said, “We're—we're afraid we'll embarrass you.”

And—(choking back tears)—what can you say?

Finally, a buddy of mine at RCA said to me, “Look, there'll be a limousine that will take your mom and dad from Philadelphia to New York.” And he said, “I want you to know that I'm going to be with them every minute. I know why you're concerned, and I'm not going to let anybody embarrass your mom and dad.”

My wife had taken my mother out and bought proper clothes for her to wear there.

Both my mother and father are now dead, but in 2005, I had a couple of very, very interesting weeks. Because of what the Japanese asked for, I was able to think about them. You take so much for granted.

I: We heard only two Directors prior to you had invented transitions. How was the mechanism in place?

Heilmeier: First, the fact that DARPA reported to the Secretary of Defense at that time, second, the fact that Jim Schlesinger was very, very interested in what we were doing, and third, when President Carter was elected, Harold Brown became the Secretary of Defense. Harold Brown was very, very interested in science and technology and an excellent scientist in his own right. When the top people in the Services recognized that the secretary was interested in something, they became—(chuckles)—interested in it. What we did was visit with those folks and we would talk to them, not in the language of science and engineering but in a language they could understand. I would go see the Chairman of the Joint Chiefs about every month and-a-half and I'd spend an hour talking to him about something we were doing but putting the emphasis on, "If we're successful, here's what could happen."

As a result, the first thing you'd get was invitations, "Why don't you come and have lunch with me and tell me what you guys are up to now?" When we would run into difficulties, we would let the Service chiefs know that we were having difficulty and, by golly, they would work the problem with us.

That's what happened with Stealth. In the case of Stealth, the Air Force was *dead set* against DARPA building an airplane. Boy, did we get the static on that. "You don't—you shouldn't be building airplanes. *We* build airplanes."

You say, "But we're not going to build a lot of airplanes. We want to demonstrate this principle."

"We are not going to help you. Forget it."

We said, "But we *needed* some help from you folks."

"We're not going to give it to you."

I can remember going to see General Dave Jones who was the Chief of Staff of the Air Force at that time. I said to myself, "Look, there's just nothing else we can do. You've got to play the card. The Air Force isn't going to do it anyway so go see the Chief and if the Chief says no, that's it. But maybe the Chief will say yes."

I went to see him and when that door opened into his office who was sitting there but the general who had told me in no uncertain terms that DARPA was not going to do this and it would be over the—(chuckles)—Air Force's dead body?

As I went in, I thought, "It's all over. I'm going to get fired. They're not going to help us." We gave the briefing to General Jones and at the end he turned to the general and said, "You're going to help these guys."

And his response was, "Yes, sir."

And by golly he was good to his word. He wasn't going to do it, but when

he got ordered to do it, we never exchanged a word that was a negative word. He didn't come back and say—(chuckles)—“You son-of-a-bitch, I'm going to make sure that you're...” None of that. Everything we wanted or needed from the Air Force got from them.

You get into situations like that. We had a similar situation with General Rogers, the Chief of Staff of the Army. We were building a lightweight armored vehicle, very agile, with a .75 mm automatic cannon. The reason we were doing that was, by analogy to historical times, as more and more armor was put on the knights, they couldn't move around very fast and consequently they were vulnerable targets. Well, we were thinking about the same thing from the standpoint of armored vehicles. It turns out that the odds of the guy who gets off the first shot in an armor conflict—a tank battle—generally won.

And here we were. There was a gun that one of the most famous gun designers in the country had invented for us that could get two shots off very, very quickly—within seconds—and we wanted to build on that a very lightweight armored vehicle with an anti-tank gun that could fire more rounds than any other tank gun.

We were building on history. I went to see the Chief of Staff of the Army because at the time, the Army was doing the M-1 tank and they were afraid this thing would sweep the M-1 out. They wouldn't help. They weren't interested. But General Rogers said, “Boy, this sounds like an interesting idea.” He said, “I think we ought to be doing both of these things.”

The Army said, “But the Congress will make a choice, because this is going to be much less expensive.”

I said, “Well, look, General Rogers. I know what's going to happen. You're going to go to the head of the Army Materiel Command and he's going to say, 'Nothing doing, and he's going to explain to you all the reasons why you shouldn't do this.'”

He said, “Well, I'm going to call him anyway.”

So, I left.

The middle of the afternoon, I got a call from General Rogers. I was thinking to myself, “Well, it's all over. He talked to him, and the Army decided they weren't going to do this.”

He said, “Well, you were right. I did call the head of the Material Command, told him what I had heard from you and he gave me all the reasons why it shouldn't be done. But I'm really interested in doing this, so tomorrow morning—first thing tomorrow morning, I want the Army officer who's been working this in DARPA to come and see me.” (Laughs.)

General Rogers said, “I think I'd rather have him in the Army working on this program rather than running the program from DARPA.”

My reaction was, “Who cares where he sits?”

We went ahead and did it. There were shortcomings because .75 millimeters wasn't enough for *all* of the Soviet tanks that were out there. Could kill some, but not others that were more heavily armed and what not, but it was that kind of relationship and cooperation that made things work.

I: Communication at the top is key?

Heilmeler: We hadn't had very many Marines in DARPA, so we asked to have a Marine assigned to DARPA. The Marine Corps, even at the Commandant level, tried very hard to find a Marine that they could send to DARPA during my tour there and they couldn't find one. So the Commandant called me and said, "We've been looking for a Marine officer who has an engineering degree and who would be the kind of guy that you would want in DARPA and we can't find one."

I said, "Well, General, he doesn't have to have a degree in engineering. We just need somebody who's got experience in weapon systems used in combat. All we want is a Marine that's been shot at."

And he said, "Oh! If *that's* what you want, we got plenty of those guys."

(Laughter)

So, off we were. (Laughs.)

I: Any other thoughts before we close?

Heilmeler: You know, based on what I know about DARPA today, I think it's a better organization than I can remember during my time. They've got a number of really exciting programs and good people. My reaction is that DARPA is at the top of its game. That's the way I feel about it, anyway. Tony has a couple of ex-Directors who meet with him maybe twice a year. We spend a half day. Tony tells us the things that are going well and what they're doing and he talks about things that aren't going as well and challenges that he's faced. I think DARPA's near the top of its game. They've got some really interesting stuff going on.

I: That's reassuring.

Heilmeler: That's the way I feel about it, anyway.

I: Thanks.

Heilmeler: My pleasure.