Frank Taylor: We are at the Woods Hole Oceanographic Institution in the Redfield laboratory to have our third session with Dr. Donald Anderson about his career, his upbringing, his education, which, for me, has been an absolutely fascinating thing. You would recognize it if you listened to my dinnertime conversation with my wife when I kind of go over my day. I do not know how many people I will talk to about your fraternity experience. Fraternities who have this eternal bad rap, but a fraternity at a place like MIT – and this will always amaze me – that was going to make you reach your potential, both academically and socially, which I think that is just a really neat thing.

Donald Anderson: No question about it.

FT: Well, we went through a lot of your early career, and we went through your origins here at the Oceanographic Institution. One of the issues that everybody in your position faces is you not only have the pressures that are put on you by making your field grow and flourish – and I use those terms with you, because it is not just the case of doing research. You are also building a movement of a sort in looking at a specific area that is very critical to the world, because we are talking food sources here and things of this nature. We are also talking trust in the kind of products we might buy in a market or something to that effect. So, you have those pressures, but you also have the pressures of being put in a position of needing to satisfy the powers that be that keep you in an institution like this and going through the whole tenure process. What was that like for you?

DA: The institution's one of those places where you come here, and then fairly shortly after, you take a position, you're already worrying about tenure. Believe it or not, it's sort of something that is there. It's probably true in every academic position you would have. You just know that everything you're doing down the line, at some point, there is a day of reckoning that's coming. It's one of those that you have to think of well in advance and make sure you've done everything you can, so that when that time comes, you're going to have a positive decision, because you can't do everything at the last minute. Tenure is based on publications and research that take time. Yet, a lot of it's out of your control, it seems, because if you don't get funding, if this project, this proposal, doesn't happen, then you're spinning your wheels, you're spending time writing proposals instead of papers. So, it's sort of always there. I was fortunate because, early on, I was able to get funding right away. I had funding even as a post-doc here for some studies in the local waters. As the next few years came by, I was able to hire some people, get some graduate students, and slowly start to build up a program. There's no question that I definitely want to be appreciative of my students and my technical staff. But the students in particular that we have here at this institution are really top-notch. So, as you look and say, "Well, how well were things proceeding towards tenure," well, a lot of that was because I got some good students who wrote good papers who were doing very good science that I was, in a sense, getting at least some credit for. So, the process of tenure, though, is not just writing papers. That's a big part of it. But it's showing leadership. That was another thing that we were told you would demonstrate. Here at this institution, teaching is one element of a tenure decision, but we don't teach that much. So, it's not as important as these others. So, how do you show leadership? That means, right away, starting to help to organize workshops or special sessions at conferences to actually try to move your field forward in some way. I took that very seriously and started to undertake those kinds of activities, to get involved in planning activities in my field. At the time

there really wasn't a lot of coordination at that level. I remember we had a big conference in 1979 or [19]78 down in Florida, and there was supposed to be a group of people to help figure out when the next big conference. That was the second one in the red tide field, and we were going to have the third. But no one stepped forward to start organizing the third. So, a number of years went by, and I and others were saying, "What's going to happen?" Since no one was stepping in, we did. So, three or four of us started calling each other, and all right, let's organize an international conference. I had never done that, but you sort of talk to people. You figure some things out. We ultimately had a conference up in Canada that I was part of the main organizing committee and one of the editors of the book. This was all the kind of leadership that you need to start demonstrating. Once you do that, then I was asked to help in the next conference in the series. I've been part of that committee forever. It's just one example of the kind of things that you have to do, and step into a void when there isn't anybody else willing to do that. But at the same time, you have to have established some level of research that really makes you stand out to your colleagues, because they're all getting letters saying, "This person is up for tenure. What do you think? Are they top-notch scientists? What do you associate with them? When you think the name Don Anderson, what comes to mind?" Jim McCarthy, one of the people in my thesis committee, he was from Harvard. He was one of those very much responsible for helping to get me a post-doc down here by arguing with people. I remember that story when I was initially turned down. He told me once that "When you finish your Ph.D. – but also, in the next few years – you want people to hear your name and think right away one thing – not of ten things, but one thing. Red tide, whatever it's going to be, that's what the case is." That's what the tenure process, in a sense, is getting a feeling for, is when people all over the world, in the country, elsewhere, are being asked, "What about this person? What have they done? What's been the impact?" You want them to think, "Oh, yes, I know about this person. I know what he's done in this area," and so forth. So, what I was fortunate is when my time came, I had been, at that stage, a leader in the discovery of the cysts, these resting stages of the red tide organisms, their physiology, their distribution, how to map them out, all of these things. Something that's just fundamentally important to this field. Right now, it's just a portion of the big field that I'm working in now. But the one I focused on did well, and I think that had a lot to do with the tenure decision. So, I remember, I was out at Friday Harbor, actually taking a course on dinoflagellates that a colleague was giving out there. That's when I got the call from John Steele telling me that I got tenure.

FT: What does that feel like?

DA: I remember it very well because it feels great. Because in one sense, you now have gotten this approval from just a wonderful institution and very challenging institution. At the same time, though, I remember someone who was with me said, "Oh, that's wonderful news. What does that mean? Does that mean you now get a secretary? Does it mean you now have a bigger office or this or that?" It doesn't mean any of that. I joked with them. I said, "Actually, what it means is I think my salary is going to go up five thousand dollars. But I'm the one that has to raise more grant money to cover it."

FT: [laughter]

DA: At that level, it's not like it is at some institutions, you become a chaired professor or

something. They give you a lot of things. That's not the case here. But nevertheless, you then are able to say, "I can stay at this institution for the rest of my life as long as I continue to be productive and so forth." I do remember thinking, at the time, back to when I was first hired into the department. George Grice was the department chairman. He sat down and he said, "I want to tell you what your future prospects are in our department or in our institution," and he says, "if we just go by the numbers." He went through then the odds of making the first promotion from assistant scientists and then there's a two-year decision frame, and then there was another two-year decision. Then there was a four-year decision that was associate scientist with tenure at the end. Each one of these decisions had a probability associated with – just based on history – how many people made it from here to here? How many made it from there to there? When you put those probabilities together, the bottom line was that you had about a one-in-four chance of making it through the institution. This is one-in-four among very intelligent and skilled people that are the others in your department and so forth. Now, some of those people leave on their own, but some of them are told they either have to leave, or they sense that, and they leave beforehand. So, there, when I'm getting the call, I'm thinking I did it. I made it through that difficult process and I am now welcome. You feel like you're part of Woods Hole before then. But when you get tenure, it's like you have now been officially accepted.

FT: You have a group of peers that have accepted you.

DA: Yes.

FT: That is really neat. One of the things that occurs to me is – correct me if I am wrong in this assumption, but it would seem to me that your tenure process might have been a little bit more difficult in that you have to go through this very difficult process that you have just described of gaining tenure. This is truly the major leagues as far as science is concerned. You also had a new field.

DA: Yes.

FT: That had to be sold too. The idea that the field was worthwhile and could be expanded in the future had to be a part of that tenure process too. So, that was really kind of a big chunk to bite off.

DA: Yes. One of the things they say about tenure is that it's not supposed to reflect your funding or your funding potential. I mean, that would have been a big plus for me, because I think by that point, people were starting to realize how big this red tide field was, how much potential there was for a lot of good research in it. But they say at least that that would not have been a factor, that it was much more what have you accomplished and have the impacts been really significant in that field and moved it forward. So, I feel good that at that stage, people clearly thought that was the case.

FT: Well, one of the things that I have discovered in doing these oral histories is that perhaps one of the biggest accolades you can have as a scientist is being referenced in someone else's paper.

DA: Yes.

FT: That is kind of an imprimatur, if you will. You mentioned, though, way back, that you had originally applied for a position here that dealt with blue water.

DA: Right.

FT: That did not work out to start with. Then after the person they thought they were going to hire was going to be no longer considered, and they came back to you. I remember you said that "Well, I am not a blue water man. I mean, I deal with coastal," in kind of a bemused sense if you will. But then there was the person that had the faith –

DA: John Ryder.

FT: The impression.

DA: John Ryder, yes.

FT: Yes, that this was going to be a big thing. That was pretty neat. That, I think, says something about the quality and character of the people in the institution to be able to see what is down the road and is going to be very, very important.

DA: Yes. I mean, I give that credit to Jim McCarthy also, who I said was the one who got upset when I was turned down for the post-doctoral scholar award here and called people and said, "What's going on? How did this happen?" Because he not only, I think, had faith in me as a scientist, but in the field as well. I think he knew this was a topic that had some legs to it. Then John Ryder, all I know about the situation with John Ryder in the department is that after they decided this other candidate was not going to be hired, said, "Well, wait a minute. Let's bring this other file back up, because I think this is somebody and a field that we should have in this department." He clearly had to get support from others in the department. But I did hear that it was his bringing it up, at least, that started the discussion that led to my being hired.

FT: You bring out two really kind of important things here. Number one, you really have to have someone established that is also going to speak for you –

DA: Yes. Oh, yes.

FT: – during this process. That means that someone that is further along in their career than you have to have a certain amount of faith in what you are doing and how you are going to be able to carry it off. That is one issue. The other issue is that the gentlemen have to be able to see far enough in the future to know that this was going to be a field. That really happens to hit me in discussing Bob Gagosian's life with him or history. One of the things he talked about a lot was his ability – or in some cases, inability – to develop a department that was going to be new and was going to be necessary down the road. I mean, he was very good about mentioning two or three examples of things that he did not think that he did particularly well. But this was a case where someone said, "This is a department we want to have and encouraged," kind of thing. But

what happens if you do not get tenure?

DA: That would have been an interesting thing to think back on. I think, at that stage, I would've had a fairly easy time getting in a faculty position somewhere else, because I did have a lot of papers. I did have a lot of credibility. I was already leading some aspects of my field, and it was a good topic. So, I think I could have gone elsewhere. But the truth, though, is that this institution, as hard as it is on us in terms of the pressure to raise money and to keep labs going and so forth with just the softening environment and so forth. As hard as that is, it is, on the other hand, an amazingly great place to do research. Sure, I could have gone to a university somewhere, but I doubt I would have had the impact I've had in my field. I would doubt I would've had as many publications, as many research projects. I think a lot of things would be very different. Woods Hole allows you to focus on research and on your field. You go to university, we have to teach a lot of different courses. You have a lot more committee work, things like that. You just siphon off that much more of your time and energy and you can still be very productive. I'm not trying to say that there aren't really highly productive and very, very important people in universities. There are many, many, many. But I'm just saying that the pressures push you towards other things. Whereas at Woods Hole, the focus can remain for the whole rest of your career on research. I have to admit that that was also a time, when you get tenure, you begin to think even more, "Now, I need to look well into the future. How am I going to keep my lab, my people going?" The way you typically do it is you have research projects and you try to build on those and so forth. But in pretty short order, you realize you've got most of the agencies that can fund you, or you've already got money from them. It's hard to see how you can keep the program going if you just are reactive, if you are just sitting there saying, "Here's an opportunity that's been advertised for proposals. I'm going to respond to this." I think it actually was advice from Bob Gagosian or someone else here who just said, "What you really need to do is to help build programs." I related earlier about having chatted with some former officemates about how they got NASA to fund probes to Pluto and other planets and so forth. There's no reason we couldn't organize in the U.S. to have the U.S. red tide community to have the same type of political clout and scientific clout. In that era, that's what I was spending a good bit of time doing, the argument being that if I can put money into the field, then there's more there for me to compete with and to compete against to get funding for the future. That's worked out very well. When I look at it now, we've got so many more. I don't know what the factor is. It's maybe fifty times more money in the field now than we had many years ago. We've got a lot more people for sure. But at the same time, we brought in agencies that didn't use to fund this kind of work. We've created programs where the agencies do have money that's targeted for our field, and we're no longer competing against everyone in biological oceanography for that money. We're just competing amongst ourselves in this red tide or HAB community. From that sort of time on, I've been able to keep the lab going. A lot of the same people are with me that were with me from the beginning. That's been both a challenge, but it's been something that I feel is almost like an obligation. They've helped me get where I am with all their hard work and so forth, and I need to keep them supported.

FT: It is interesting, in an oral history with Bob Ballard, I asked him one time why he had been so successful in his Deep Submergence Lab work. He said that he was able to attract the best people, pay them about half what they would get in some other institution, and stay with them for life. He felt that was his biggest plus. He did not mention finding the Titanic or anything

else, but that was his biggest plus. You have just described what the whole tenure process is like. The idea of keeping your field going, keeping your lab going, keeping you know a feeling of real responsibility with people that work with you – and notice I do not say work for you. I say work with you.

DA: Yes, that's correct.

FT: It is an important distinction.

DA: Yes.

FT: But because of this, your administrative duties have increased.

DA: That's right.

FT: When you talk about getting money, you talk with obvious enthusiasm about what is going on in your field and the research you are doing. I would assume that your administrative duties have really escalated by many factors over the years. How do you keep the two things – the administration and your desire to continue your research – going?

DA: Well, it's no question about it. Administration's a big word. It includes a lot of different things – everything from proposal writing to report writing to budgeting and all of those things. Early on, you just sort of do it. It's part of what you have to do as your day-to-day work. The bigger your program goes, the more people you have, the more projects, the harder that gets. One of the characteristics of labs, at least in biology, here at Woods Hole, is that we have a lot of projects, especially these days. Years ago, it used to be possible to get quite a bit of your salary on one grant, maybe three or let's say four months or five months or something like that. These days, you're lucky if you get a month or two weeks or something like that. So, the net result is that many of us are running on six, seven, eight, nine, ten projects. Each one of those has proposals. Each one has reports and all these things that are required. So, after a while, as the program grows, I realized that I was struggling, and that I was having a hard time getting the scientific papers out, because I was spending so much time doing this other work. I remember talking to the people, some of the guys in the lab, saying, " I am going to hire somebody. I've got to choose. I'm going to either hire sort of a high-level post-doctoral or research associate person to be out in the lab – because I spend a lot of my time in my office these days – helping you with ideas and methods and so forth, or I'm going to hire an administrator to help me in my lab – something more than a secretary, an administrator." They said, "Well, we really want someone out in the lab. We really need that out here." I remember thinking long and hard about it, and then I remember shaking my head and saying, "No, I am the big bottleneck right now. There's too much piled up on my desk that I'm not getting to. So, I'm going to hire someone." I was very lucky that, at that point, a woman who had been our departmental administrator, Judy Kleindinst, for eighteen years, she had been with six different department chairs and so forth. She just said, "I don't want to do that job anymore. Don, can I work for you?" I told her if she did, the whole department would lynch me, because she was so important to all of them. She was a really fine, fine administrator. But she said, "I'm going to leave anyway, and I will tell everybody that." So, there it was. I then was able to bring somebody in who – right now, I can't

imagine how I could have run this lab without her, or certainly, somebody like her. That's been one of the secrets then, is to actually commit resources to someone who really helps with all of that administrative level of things at a high level. I still do a lot. There's no question. I still do a lot of what you'd call administration. But I still have enough time to supervise the lab and the students and do a lot of this international and national work too. But again, it's like everything else. It's getting the right staff.

FT: Having the personality and excitement of what you are doing to attract people like that, that is a component of it. From the administrator standpoint, you not only have the nuts-and-bolts kind of things, but many times, I peek in. Actually, during the first session, I saw this happening here. A younger, kind of wide-eyed person that you have to mentor, get them working, that is teaching too.

DA: Oh, yes.

FT: That may even take more time than teaching a class where you have got a syllabus and you are going to get up there. I mean, this is a young person who has committed to your line of work, in your laboratory, and looking for you to guide them. That is a big responsibility, and that is going to take a certain amount of time too. How do you deal with these young folk?

DA: Well, it really does vary student to student, especially, as I said, in this program, we have these very talented students, but each one of them is different. I had one student who would come in here virtually every day to tell me what had just happened or what was about to happen. I liked that, actually. I'm still very, very close to that student. It was a wonderful relationship. I've had other students that would come in here maybe once every two weeks, but they were very independent types, and that's sort of the way they want it. It's like a horse that takes its own lead. You let them go, and they need these mid-course corrections here and there, but you recognize that that's their nature and that's a good way to build independence and so forth. So, there's been the whole spectrum of that sort of mentoring. I have to admit that I've enjoyed all of it. But part of it that's been a little bit difficult, but also enjoyable, has been my female students. A number of them, I have, over the years, gotten to see that they tended to be more timid, not wanting to be confrontational and so forth. Unfortunately, in some parts of science, you have to be more aggressive to get ahead. So, that's been part of the mentoring. I've got one student, Deana Erdner, who's now a professor down at University of Texas. She and I used to have this little code word where I would say, "Deana, you're doing it again."

FT: [laughter]

DA: That meant that she was not being sufficiently pushy or just aggressive or something. The way that I found – and I don't want this to sound chauvinistic at all – but an awful lot of the male students I had, that was just natural. I'll always remember, at one point, the very end of Deana's thesis, she's sitting in this office, and she's talking to me. We're going through something that's an important discussion. One of the other male students, he just sort of knocks and comes in, and he starts sort of interrupting. Deana just looks up and she says, "Gaspar, he's with me now. Get out."

FT: [laughter]

DA: I just looked at her and I was like, "Whoa, there we go. That was good." It was just sort of someone who was pushy, and she pushed back. I was just, "All right, this is good." So, anyway, that's been part of the mentoring process also, and it has many different aspects. As I look back, I have tried to give my students a lot of latitude, a lot of independence. They've got all the facilities I can offer them, a lot of support from other people here, from post-docs, other students, and the technicians who know a lot and this whole institution and everybody around. So, there's a wonderful opportunity for them to move forward themselves. If you give them too much guidance and too much oversight, then there's going to be a point at which they maybe don't feel that they've done it all, or that it all is due to their abilities. I don't want them to leave here thinking that. I want them to leave here thinking that they're really top-notch and that they have everything that it takes to be an independent scientist. That's perhaps just because that's the way I grew up and the way I was. I was always doing things on my own. Even starting out here at WHOI, just me and there was no one else. I wasn't part of a team of people doing red tide research. It was just me, and I think that worked out well. So, that's been the approach I have taken with students and so forth, is they need a lot of attention, then they'll get it. But most of the time, I will be sort of hands off and watch that development and only step in as I have to.

FT: It is really interesting that you have done something kind of naturally that became very loud and clear when I talk to people that were in the joint program. I asked one of the leads in the joint program, "Where was the point where you felt this student was going to be able to continue on as opposed to not going to be able to continue on?" The answer was, when they reached the point that they say, "Well, I think I should go in this direction." In other words, they started to own the project and be able to look ahead and see [inaudible] point they have to take it over and carry through on their own. That is exactly what you are talking about here.

DA: Oh, yes.

FT: How about the technicians? Do you use technicians in your lab?

DA: Oh, yes. Our lab has typically three to four technicians, which is quite a large number by standards, at least in this department. But I've always found it to be important just because of the lot of experimental and fieldwork we have to do. It's the same thing there. I've got people who are very independent. I do a lot of traveling. When I go away on a trip, if I'm going away next week, and tomorrow or Friday, I will just leave here at the end of the day, and I will most likely not have said a word to anybody about what they're going to do next week. I don't need to. So many times, everybody knows what they're doing, and they're in the middle of these long – these projects, multiple projects. Again, they don't need that much supervision. Periodically, we'll have meetings and talk about where they go, and then it's off they go again. So, it's the same thing. It's letting people work on their own as part of a team without constant micromanaging and other things. Perhaps that's one of the reasons I think people like working in this lab, people like being in the lab, is that it's very flexible in many ways. I let people have flex time for their family or whatever, but also, they don't feel like I'm breathing down their necks all the time. One way or another, it has worked out very well, because we do produce a lot of good results and get things done. But it's the same approach. It's not with a great, heavy level of oversight. You pick

the right people. You get them going and then nudge it here or there, and it continues in the right direction.

FT: You used what I think of as a very important word, which, "You have to create as a team."

DA: Oh, yes.

FT: The team concept basically is that no one really is allowed to be a superstar. You are all kind of aiming towards certain goals and working with each other. It is a symbiotic relationship, if you will, in many ways.

DA: Everybody has a role. When I look at why we have survived, why this lab as a team has survived, the core people are still here. They've been the ones who were with me for twenty years.

FT: That is a long time for someone to be in that position.

DA: Especially here at Woods Hole, yes. If you think about getting grant after grant after grant in order to fund not just one technician, but two or three of them, an administrator as well, plus myself. I mean, it is a long time. But as I said, it's been a productive team, and that's why. I wish I could say I had the foresight to know, when I hired some of these people, that they would still be with me that long and they would be exceptional employees. I hired people I thought were good, but they've worked out well. They've grown in the position. They meshed well with the style that I have for running this lab, and it's lasted. I've just fortunately never been in the position of having somebody that really didn't work out. So, we're a team where everybody knows their roles. Dave Kulis, who's worked with me, is the first one I ever hired within a year or two of me being hired. I maybe even hired him when I was still a post-doc when I got some funding, but certainly right after that. He does a lot of the laboratory, culturing, a lot of the experiments in the lab, a little bit of the field work as well here and there, but by and large – and he's here. He's doing toxin analysis and so forth. Bruce Keafer, who was hired a few years later, is largely my field guy. He's the one that coordinates a lot of crews' activities, whether it's on large ships or small ships, and a lot of the field measurements that we make at different levels. So, he's very important there. So, they're two very complementary people that, together, then give me access to projects or funding in several different areas, several different agencies – one that might just all be for field oceanography and others that might be either for genetics or for physiology or for toxin chemistry and so forth. So, you then have roles for them to play. I could go through everybody else in the lab, but through time, we've found just little niches for each one that, together, makes the whole team. It works.

FT: It is interesting if I could make an analogy with a Major League Baseball team. They talk about a team.

DA: Yes.

FT: Every now and then, some new superstar will be paid an enormous amount of money – that you would probably run your program for the next twenty years – to go in and exercise a whole

bunch of third-class levers, if you will. That person goes into the locker room, and because of their personality, all of a sudden, the teamwork falls apart. When you are bringing people, what do you look for?

DA: Well, we really do have a very sociable lab. We're well known on this floor, at least, for how many birthday parties and other parties. You walk in the lab, usually, somebody's got some sort of food out there that they've brought in. So, that's something right away. It's not just that somebody has some skills, but that they're good with people and that they're nice to have around and so forth. That's been an important thing. But it's also that I need to recognize what it is that I need each of these individuals to do, and then to find somebody who does that well and who doesn't necessarily aspire to other things. You would have a lot of conflict here if people were looking at each other's job and saying, "Well, I can do it better than he can." It's better that, "All right, this is an area where you work in, and there's enough latitude and enough work to keep that going, that there isn't any sort of envy about going to someone else. Now, one thing that is, I think, worth remembering, at least, is that in the same vein of trying to think of how do you keep a program going, how do you maintain a high level of research productivity at a place where you need multiple grants of different types. That's the critical part of all this. That's a real challenge. What I realized early on is that you had to keep diversifying. I said, that earlier on, a lot of my work was on these cysts, these resting stages. Well, you can only ride that horse for so long, because pretty soon, you've answered a lot of the questions and so forth. So, you have to start branching into other areas. But how do you do it? How do you get that skill? How do you bring in that knowledge? There's a couple of ways that's happened for me. One of them has been through the students. I can think, for instance, back to one of my earlier students, Peter Franks. He came to me wanting to do a little bit of field work as well as some numerical modeling. We did lots of field work, but the modeling was new to me, really. But the field work, especially we had been doing all these little Cape Cod salt ponds and estuaries and so forth. Peter, we got him sort of focused on sort of going out and getting our feet wet in the big open ocean. It wasn't really open ocean, but it was the Gulf of Maine. But it's still the ocean as opposed to these small little things you could do in a power boat. So, now, all of a sudden, we need bigger boats. It's a whole different level. It may not sound so imposing, but when do you go out and sample? How often do you sample? You've got a certain amount of money for ship time. How do you even know the cells you're looking for are going to be out there in that huge ocean as opposed to they're always there in that salt pond? But that's what we got with Peter. We were able to figure out a good place to study. We did start working off of Portsmouth with this one little transect we kept running back and forth in Portsmouth, on one of the research vessels from New Hampshire. It started then from that one transect. We found some very interesting things. The next phase of the work was then we had five or six or eight transects that extended from there. That has turned into – some decades later, to this massive field program we have in the whole Gulf of Maine. But I can look back and say that getting our feet wet, going out into the Gulf of Maine in the first place was something that I was able to do because I had a good student who was willing to take on that challenge, who knew some things that I didn't know, was willing to help bring this lab along, and then we kept going. That's happened in a similar way with some of my other students that have brought in either skills already that they had or interests in, let's say, molecular biology and things like that. So, that's been one way to broaden the activities of this lab. So, it was no longer cyst work. Now, we're looking at what's in the water column. We're adding a modeling element to it. There's other measurements to be made that all of a sudden, we're going to have a

separate project to do this. The cyst work's over here, so now, you've doubled the kind of things you're working on. Then sometime in that timeframe, which would have been around the late [19]80s, there was talk. You could sort of start to get the feel that in oceanography and biological oceanography, one of the up-and-coming areas was going to be trying to bring a lot of these tools from medicine into use in our field. In particular, what was called molecular biology was starting to become a topic of discussion. You'd have a few people in our field trying to use these methods, but it was still very much a small activity. But I could tell it was going to be a powerful technique. So, I arranged to go and teach myself that. This institution doesn't have sabbaticals, but I was able to get a little bit of money from – I don't even remember what source. I then found a colleague over in France who did this kind of work on the organisms I worked with and ended up spending nine months in Southern France learning molecular biology and having a nice break from Woods Hole. Came back and was able to write my very first sort of molecular biology proposal and got it funded. We've taken off from there. We now do a lot of molecular work in this lab. So, that's yet another avenue for support and for funding. So, now, we've gone from sort of at the field level with ships and satellites and other things, big oceanography to experimental work in the lab to genetics and molecular studies, and sort of the entire spectrum of these organisms, we can now cover. I never would have guessed that I could have done that coming out of a civil engineering program at MIT. But by having these really good students who could help me with these new methods and by taking time and learning new approaches and seeing them ahead of time, seeing that, all right, this is the area that I see at the field going into. I want to have these capabilities that's allowed this program to stay vibrant, to stay productive, and to stay funded.

FT: It is interesting. The Woods Hole Oceanographic Institution was never founded as a biological institution. It was a physical oceanography kind of place. But it is interesting – yourself and several others here, over the years, have just increased the importance of the biology aspect of this institution quite a lot. I really think, now, that biology is pretty much a major part of what goes on in this institution.

DA: There's no question about that. I mean, it used to be, years ago, we could never get the physicists to even talk to us about any of our issues. It was like the same thing. I'm talking about going out of the Gulf of Maine. It's one thing for us to measure the cells, but to know what the currents are doing and what's moving these cells around and all of that, you needed to have people that are trained in that discipline to help you. But they had all their own questions to answer, and biology wasn't that interesting to them. But fast-forward to the present, and many of the physicists are interested in biological questions. We've had some wonderful interactions with physicists in our programs. It's just one example of how biology has been accepted, and it's a vehicle for the physicists to answer important questions too.

FT: The breadth of knowledge you need in order to pursue a career field here is really kind of mind boggling.

DA: Yes.

FT: [laughter] It really is.

DA: I think that's one thing where, if you try to say what is it that characterizes people at this institution, there's several things. One is a level of energy or drive, whatever you want to call it, a type A personality or something – people who can put up with a lot of work, a lot of extra work, evenings, weekends, and whatever, a commitment to their field. But also, at least the type of a mind that can do lots of things at once. What's probably at the third level is minds that can grasp new ideas, not necessarily be expert in them for sure, but be conversant in them. I can speak with my physicist colleagues and be on the same page and get somewhere with those discussions. I'm not a molecular biologist, but I can speak with them and understand things there too. I'm not a toxin chemist, but I can speak to them too. So, you need this breadth. I think I've been fortunate that for whatever reason, I am comfortable or conversant in a number of these very different fields. It's not that I was trained in them, but I sort of learned them, and I'm comfortable with them.

FT: Well, I think I told you when we started this whole process of the oral history, that I have always been amazed in this institution, how many people are doing very, very important work in disciplines that were not their academic training, that they have moved on into other areas. Of course, to me, one of the big advantages of this, it allows you to see a much bigger picture than someone that is very focused in some little arcane kind of thing. I mean, you really get to see a big picture here.

DA: It's not like we have to do it or we're having our arms twisted to do it. That's fun. I mean, that's what is really exciting about this work, is that you do have a big picture and an understanding of a lot of different levels, and the world is richer for it.

FT: Oh, yes, absolutely. It is really interesting. You have got to pay for all this. You keep mentioning, "I need to get funded for this." The originals here back in the thirties had no idea where the money came from. "Well, the institution gave it to us." Then it got into a period where people would, in many cases, write a couple of pages, and end up with this big grant that would carry them for a long time. I saw this happening in education. Then it got to the point where grants I used to get that would carry me six or seven months, all of a sudden, were three or four weeks. I would have to put all these things together, which meant a lot more writing, a lot more emphasis on a part of the process that I did not particularly want to do. I have heard two different responses to grant writing here. There are people that absolutely hate it, and there were people that say, "Well, I like it because it helps crystallize my thinking and ideas." Where do you fit into this?

DA: Well, I'm probably somewhere in the middle because it does crystallize your ideas. It does help you to take something that may be just something as a vague concept and turn it into something more solid. On the other hand, we do it too much. I'm sure you ask any WHOI scientist certainly could ask me how many papers fully completed. I'm like, "You've got all the data. You've got everything you need except time or sitting over there on that desk." I would say, right now, the answer is five or six. Now, why can't I get to those papers? I mean, those are the ones I want to write. I've just had two or three papers in the last two or three weeks go through here where someone else is the author, and I'm editing and I'm adding my pieces to it and so forth. For some reason, I tend to put those under first priority. I'm not sure why I feel obliged to do that. But I get those out, and another one comes in when I get those out. But then

mine will sit, and it's harder and harder to find the time to just devote to writing and formulating your own papers. Why? Part of it is proposals. Part of it's just phone calls, administration, meetings with students. All these other things take a lot of time, and that keeps getting put off. It's very hard these days to find significant chunks of uninterrupted time where you can build a paper from the ideas or just the data that you have. Unfortunately, proposal writing is one of the reasons that we are fragmented that way. So, I wish in many ways we didn't have to write as many. It's not likely to happen just given the nature of this institution and the nature of the funding system. But if we look to a dream of the future, it would be that every WHOI scientist gets six months of hard support or something like that. They still need the right grants for the rest – and probably, people who work for them – but they have a little bit of a pressure relief.

FT: A little wiggle room in there.

DA: Yes.

FT: It is interesting, and I think maybe it is time to move into the future, if you will. You mentioned NASA a couple of times. What NASA has done is a wonderful public relations job, and that has gotten a long way towards funding a lot of their projects. I know at the Smithsonian Institution here, in space, as a teacher, I could go into a NASA center downstairs and have a little name tag. They would assign someone to me. Whatever I wanted to do, they were able to employ someone to – I wanted to do something with paper airplanes one time. We were studying lift and air currents and all that. This person came out with seven huge cases full of materials, and we went through all of those kind of stuff. There was a point that they thought oceanography was going to be a wet NASA, that it was going to have the same kind of feel. We had the Cousteaus. We had the Bob Ballards. They were in popular television. For whatever reason, that did not work out. That would have solved a lot of your problems as far as funding and things like that of concern. What do you see as the future? Where would you like to go with your team?

DA: There's a lot of the technologies that we are using now or developing now that I can see becoming routinely operational, if you will, in the future. First, let's just look at the area that we study the most, which would be the New England, Gulf of Maine, Cape Cod areas. We have been developing and working with actually one of my former students, Chris Scholin. He was the one who came in the office all the time and just wanted to talk about what's happening each day. Well, he went out to the Monterey Bay Aquarium Research Institute and has made a very great career for himself designing and building instruments that takes some of the molecular biology that he had started here to ways of detecting and enumerating these toxic algae using instruments that are just moored in the water, that are just robotic instruments. We've been working with Chris to try to bring some of those instruments out here to get them to work on our organisms in this area, to adapt the probes and things that are inside for the various species of interest. But one of the visions for the future then is that we would start to instrument our coast, whether it's the small estuaries and areas on the cape, or on some of the coastal waters – or even Georges Bank, with these sensors that are out there that are measuring all the typical oceanographic parameters, but also are specifically measuring and detecting our red tide or HAB species, and then sending that information ashore. So, I could sit right here at my computer and see that there's cells here or there, on this level of abundance. That data by itself is interesting,

but that then would be incorporated or assimilated into these numerical models that we've also been building with this team and my colleagues in other departments. That then would lead to forecasts, lead to just the same way you watch television and see weather maps and so forth. "Here comes this storm," and so forth. Well, there's a great deal of observation information in that. There's also a great deal of modeling in what we get from the weather bureau. That's what I envision for the future, not just here in New England, but all over the world. That we would have sensors and instruments and models and understanding that would allow us to start visualizing what's happening in our coastal waters and what the threat is and what the danger is. Then management can respond to that so much better. So, that's one aspect of the future. It sounds simple. We'll have these little probes that detect these cells. We're already there. We already have those. But there's a lot of the genetic work that's going on now that is starting just now to identify the genes that are involved in some of these important processes, like the genes for making toxins or the genes that are involved in nutrient regulation. That means that you could also then, in your research, begin to either study what is the physiological condition of these cells that are out there. In other words, it's one thing to go out and count and try to measure nutrients that are there in the ambient environment, but that's not the same. I mean, it's like looking at an auditorium of people and being able to sort of measure things that are in the air around them. But what you really want to know is who it is that might be sick or who it is that's hungry, who it is that's eating too much, or whatever out of that community. Those techniques are coming because of molecular biology. They are the ability to find just cellular or molecular markers of certain physiological conditions. We're not there yet, but it certainly can be envisioned. So, being able to tease apart some much more detailed aspects of the physiology and the nutrition of these organisms is another thing that's coming. At the population level, one of the emerging areas right now is, again, recognizing that we don't just have a single – let's call it a genotype, a single type of organism that's in our big blooms. We've used a lot of the same sort of forensic techniques that they use in crime scenes and so forth to analyze some of these populations and finding that they're full of individuals. It's no surprise. The human race is full of individuals. But we're now being able to get that resolution on these tiny algae in the ocean to be able to identify these different individuals. Then that has its major implications, because then it's certain subsets of those individuals that are then selected by the environment to become the ones that are the dominant ones at the end of one of these outbreaks. They can be more toxic or less toxic than a different group of individuals. So, being able to identify them, being able to understand why one cohort and one group emerges and another one doesn't, is an important aspect of the future of this field too. So, that's on the research side. There are management implications as well. I also have seen the way our field has grown internationally. I'm very gratified to see that, because I've also put a good bit of effort into international program development. The number of people and the number of countries represented in our conferences keeps going up. It's fifty to sixty countries at every conference. It's as many as seven hundred, eight hundred scientists and managers just attending a conference. So, it's grown a great deal, but there's still a lot of areas in the world that don't have very much capability for either doing research on or monitoring or managing these problems. Again, I've been spending time in a variety of countries, whether it's Hong Kong, in Namibia, right now in the Middle East, several countries there, trying to help them develop these capabilities, trying to help set up routine monitoring programs, but also research capabilities. So, the more those kind of efforts and those by others expand the capabilities all over the world to deal with this problem, that's part of the vision of the future, is many, many competent research and management teams all over the world

dealing with all the manifestations of this red tide problem. There's so many and they're so different in different areas and they truly take teams everywhere to be able to do it. We're there in many, many countries. No question about it. But there's a lot of countries that still need help and guidance and so forth.

FT: Let me ask a question at this point, because as I have sat and listened to you through the course of these interviews, I have heard, for lack of a better word, kind of the traditional, "Well, this is the research project. This is what we are looking at." Now, what you are describing here almost sounds as though we are talking about public health.

DA: Oh, yes, for sure. I mean, I won't say it's the only driver for a lot of this, but public health is one of the major drivers for at least a significant portion of the red tide or HAB research. People get sick. People can die. There's a threat there, and you have to control it.

FT: [inaudible] mentioned public health, and you were going on.

DA: So, there's certainly many of the different types of outbreaks or blooms that don't threaten humans, but they do kill fish and shellfish or marine mammals and seabirds and so forth. They are also a major motivation. That's also a major motivation for research and so forth. But still, most of the people that are concerned about red tides, they're worried about the public health aspects of it. So, that's always been a plus for us. It's a sort of a blessing if you think about it. If you want to study microscopic algae or phytoplankton in the ocean – and there are people here that do it just because they are important for primary production, for just the food web effects, and so forth. They do find they get funding and so forth. But if you could then say, in addition to all that, "They also are dangerous, they can kill this, they can cause this kind of damage, and they can affect the ecosystem and so forth," all of a sudden, a whole world of opportunities opens up to you that aren't there if the organisms aren't toxic or dangerous. So, you can do some fundamental biological oceanography, but you have a better chance to do it because the funding is there. One of the things that's actually interesting to characterize our field is that if I were just a general phytoplankton ecologist and I was worrying about primary production and so forth, I could do that without ever worrying too much about species or individual species. You worry about the community of cells that are out there and how active they are and so forth. That doesn't work in my field. We've got to focus on individual species. So, as a result, we have made – we have had to develop techniques that are species specific. They give us a way of either rapidly counting just this one species and not confusing it with anything else or trying to figure out what's the metabolism, just all these different characteristics of that organism. Here, it's in there in this assemblage with hundreds of other species and organisms, but we have to see just that one. So, we've had to develop methods and a mindset that focuses on that, and that's led to a lot of new technologies and molecular probes and other sort of fancy ways of counting and identifying these cells. It's just a subset of the fact that these are dangerous organisms. They're a risk to public health. In order to study them we need to do this, this, and this. It has led to a variety of technologies, a variety of approaches that all are there because it's that one organism that we care about.

FT: It is interesting. We are living in a time where there are several catch words – none of them boding well for the population of the Earth. We care about climate change, certainly, red tide. I

know, after reading an article about you, I have been very leery about – in Europe when they come out with a big plate with fish on it, for me to select one, [laughter] whether I am going to eat that fish or not. Most people have not had a lot of experience in third-world countries and know what the conditions are actually like. But it seems to me this kind of work is really important because of that public health aspect. There is a lot of the world that does not have the advantages that we have here.

DA: First thing, not just here, but in Europe, I don't hesitate to eat seafood in Europe, because they do have a very good and sophisticated safety net monitoring programs and so forth. But it's in these third-world countries that you do worry about it, where you just see that they don't monitor for whether it's bacterial pollution or any of these marine biotoxins from toxicology. So, there is a concern – and a genuine concern. That's where, as I said, my vision for the future, in part, is that all of these countries will ultimately then have good programs, good safety nets, will understand the importance of it, will be able to learn how to do it, how to do these right sort of monitoring programs and research programs. That's just a growth of the field, so that someday, you will be able to sit down and have shellfish in some country that's currently developing and eat it with confidence, where you can't do that now. I should also say that another aspect of a vision for the future – though, it's not a very good one – is that we will continue to see problems with red tides getting worse and escalating in certain parts of the world. I think developed countries, the United States, Europe, and so forth, we will see periodic outbreaks of these different organisms. Most of them, the ones we've already known about, the problems we're already aware of, and they're going to fluctuate. They'll have good years, bad years, and so forth. I'm not saying anything about climate change right now. It's just sort of much more global change – the development pressures, the pollution from not only the point sources, the cities, and industries and so forth, but also all the non-point source from agriculture and so forth that's washing nutrients into the coastal ocean. Well, that is leading to red tides of various types all over the world. In some of the countries, and China is an example, where they are polluting very heavily, where they've just got huge numbers of red tides. It doesn't seem like it's going to slow down in any sort of foreseeable future. Then a lot of other countries are going to join that situation as they begin to develop more. So, this world vision would be of countries that are much more in control of their coastal waters and their pollution and so forth, where they're sort of living with a problem that is not going away, but it's not getting dramatically worse. But other parts of the world where it actually is increasing in scale, and then affecting fisheries and public health and so forth much more than it does now. Then I guess to that, you could add the climate change scenario, which is a tough one. It'd be interesting, if somebody's listening to this twenty to thirty years from now, to know what they're experiencing at that point in my field in particular, because right now, there's very little we can say with any credibility about what climate change might mean for this red tide or HAB field. One of the few things we can say is that there will be range expansions. In other words, species that occur from here to here are going to move. They will now be occurring from there to there because the waters are going to change their temperature, their circulation characteristics, and so forth. What that means is that some areas that have problems may not have them. So, it may actually be a positive. Other areas that don't have them, though, are likely to get them, and that is clear. We know that whether it's phytoplankton or animals or trees or whatever, that there's going to be shifts of species as the climate warms. What's much, much harder to do is to say, "Are there going to be conditions and situations in which some of these species suddenly become dominant or emerge

in large numbers because the environment has gotten conditions that are just perfect for them?" That's a very hard scenario to actually demonstrate or even to predict, because these are very complex phenomena. There are phytoplankton cells that are eaten by little zooplankton, and the zooplankton have their own predators. Then there's all of the currents and the rainfall and the sun, and there's not only small-scale meteorology, but large global-scale meteorology, all driving this. To take a particular area and to run some climate model that says, "In fifty years, these will be the conditions," then what's it going to do to the red tide, it's exceedingly difficult. I don't think we have the models, the understanding, to be able to do a credible job of that right now. So, when people ask me these days what will happen with global warming and red tides, I will say what I just did about range expansion, and I'll say, "Beyond that, I really don't know." I mean, we've been taking major research programs, major collaborative efforts with [inaudible] all types to try to address that, as well as all of these other organisms that are co-occurring with different types of diseases.

FT: [laughter] I listen to this, and I say, "In my own life, Darwin is alive and well [laughter] and still moving on." It is just an absolutely massive problem. I have spent considerable amounts of time down in the Carolinas, on the Outer Banks, and of course, you have got Albemarle and Pamlico Sound behind that The changes I have seen in those sounds over the years as the area has developed, as more and more fertilizers are dissolved more, because there is more pig farms and put a couple of those but it has just changed the whole area enormously. So, I fully recognize the scope of the problem that you are talking about here. Have you given any thought to where you are going personally? You are not going to retire. Someone asked me – in fact, it was my doctor not too long ago – "When are you going to sit back and enjoy retirement, Frank? I said, "I have too much fun with what I am doing. I am not going to retire." That is something that is very much a characteristic of the WHOI scientist. Don Anderson retired. He is retired? Because the only difference is you might be coming in twenty minutes later or something like that. [inaudible] So, we had got to the point where I had asked you about the fact that I do not think you are probably ever going to retire, [laughter] and you were carrying on from that point.

DA: Well, one of the things that I think of, I do think about retirement. People ask me the same question. You're right, I don't see it in the near future. There's a number of reasons, but one of them is that I don't think of it as just what's good for me, because I think of my team here. There's people here who have literally grown up with me. They've got married. They've had kids. They've bought houses. They're a few years behind me in seniority, in terms of retirement program, and so forth. Frankly, if I leave or if I just retired, I think many of them would find it difficult to find another position. Because they're seniors, they've got certain training – their age, whatever it might be. So, I don't take it lightly. I take it as a responsibility because they've helped me get to where I am. You don't make a personal decision without taking them all into account. They all say, of course, I shouldn't worry about such things. I should just worry about myself. But at the same time, I do think of it. I do think of it that way. It is a group. It is a team. It is a family. On the other side of it, I also, though, can't really imagine getting up in the morning and not either thinking about work or coming to work or doing emails or something related to the things that are going on. I just know that a lot of that would continue, invitations to go to different parts of the world, to help here or there, to be on this committee or that committee. Even if I officially retired, I think it would just be coming in and doing a lot of the same things, maybe without funding pressures and so forth. But I still don't see that as

happening for quite a while. There's a lot of good research going on now, research questions, research programs that have some longevity to them, where we have funding into the future for. So, that, I don't see as changing. For some people, one of the motivations around here, at least for retirement, is when your funding runs out, when it gets to be too difficult or just impossible to get more funding to support yourself or people. Then the decision's made. I don't see that for a while, at least. Then another aspect, though, that if I look ahead and say, "What do I envision for myself," it's likely to be more administration at the institution level. I started that a few years ago by agreeing to be director of the Coastal Ocean Institute for like four years.

FT: Do you actually get to take a team in a certain direction? I mean, as director of that institute, what do you do?

DA: It depends on the resources the institution gives and the direction that the institutes choose to take. Some of the institute directors chose to say, "I want to take a particular topic." Let's just take abrupt climate change as one example of a topic that has received quite a bit of funding within one of the institutes here. You can make that program grow and get a small group of people funding and then have it turn into something much bigger, and that your money is focused and it really helps to get something launched. I and several other institute directors took a different approach. We'd much rather have our institutes be broad, provide smaller level of money to more people so that everybody gets a chance to get seed money to do certain projects that then help them to get funding down the line. If you only choose a single topic, you only help a few people. It's another way you help. Well, in the first place, you help a few people by giving them fairly substantial amounts of money. In the second model, you help more people, giving them less. That's the way that I ran the coastal institute when I was director. Now, the idea, though, is that one takes on those responsibilities. They do take away your time from your own research, from your own people, your own team. But it is a problem that senior people at this institution face, is that their salaries are higher with the overhead structure we have, with the people that work for you, their salaries are higher, that have been with you a long time. Yet, the pressures for funding are alleviated if you actually take on some internal administration. I've done that once. It worked well. We kept the lab going and functioning just fine. So, that's what I envision is very possible in the coming years, is taking on some level of administration responsibility within the institution, whether it's being department chairman or a center director or something like that. Hopefully, being able to do that without sacrificing any of the productivity of this group. As I said earlier, I think that's doable just because it's a strong and independent team that needs only occasional, direct, strong oversight. But most of the time, the level of guidance that one could give, even half your time is spent doing something else.

FT: But they do need that occasional guidance and direction. Will there be a point that you are going to start to mentor or train someone to replace you?

DA: I think about that all the time. I just wonder. I'm looking out there in the ranks, is there a young scientist somewhere coming up who could step in and basically inherit all of this? But for it to be, it has to be a certain type of person, not only to be able to take on the different kinds of programs that we have here – again, everything from oceanography to genetics – but also someone who can thrive in the Woods Hole environment. So far, I haven't found that person. But I am aware of it. It would be very nice to bring in a junior colleague as a post-doc, have

them here for a number of years, and then basically, say, "At some point here, there's some grants that are still funded. Here's some people that are trained. You can run with this." But like I say, I haven't seen the person. I haven't seen that opportunity, but I am watching for it.

FT: Actually, that becomes a very difficult decision in that it will be very hard to separate your years of wisdom and accumulated knowledge and see someone that has that same potential coming along. I run a team that corrects the teacher test in subject fields, and I run the Earth sciences and the chemistry. One of the biggest problems we have with these old, retired teachers that are doing this correcting, that each have thirty-five, forty years of accumulated knowledge, is as they read the papers to put themselves back in the position of someone that has just gotten out of school, who does not have all this accumulated knowledge they do.

DA: Yes.

FT: So, it is kind of an issue. Well, we have covered a lot of things. There are some things I have not covered. You have won numerous awards. You have taught in many different places and many different lands. That is all a matter of your public record, your CV. So, I did not concentrate on that. Is there anything through this oral history that we should have talked about that we did not talk about?

DA: Well, let's see. If I think back on some memorable things – either memorable moments in science or memorable activities or projects – one that comes to mind – not because we ever even got a paper out of it or anything, but it was just something that I enjoyed doing so much and wish everybody could experience – was taking an expedition down into Antarctica and trying to find toxic algae down there. We took about a month. Unfortunately, the time of the year we wanted to go wasn't possible because of ship construction issues, and we were there instead in the – sort of towards the beginning of the wintertime. It would be like looking for algae here in the fall rather than in the spring where we'd like to find them. So, we didn't find anything conclusive. But nevertheless, it was one of the most extraordinary scientific experiences I've had, because you truly felt like an explorer. Here was this ship. It was a big ship. It was 250 feet, but it was so tiny in the – on the scale of things down there in Antarctica, with the massive waves as you go across the Drake's Passage, and the icebergs, the glaciers coming down the water. This is right along the Antarctic Peninsula. The scenery was spectacular. The weather was spectacular. But humans or man is so tiny down there. That's an extraordinary feeling to have, just how remote you can be, how much the power of nature, the power all around you, it was really extraordinary. Then, also, the feeling, though, that we were going into places that virtually no one had ever gone into before, and that we were looking at samples, looking at things that no one had ever seen before. That whole level of exploration is hard to find these days. It's hard to find in science, but I was fortunate to experience that.

FT: It is wonderful the way you are also affected by the romance of the field.

DA: Oh, yes. I would do that at the drop of a hat. I'd go down there again. I mean, I send most of my – most of the cruises we have, it's people in the lab that go out. Because it takes several weeks of time from here. I mean, there's an awful lot going on, and I often can't find that time. But if there was a one-month cruise to go down there again, I'd drop everything to do it again.

So, that's just one example of something that's memorable. I think that when I look back and think of all the countries I have been to, it is an extraordinary list of countries. I don't even know how many, honestly, but certainly, every continent, multiple countries on every continent, and multiple times to many of them. That's been one of the blessings, if you will, of this career. The world is familiar to me. The world is a small place, or whatever you want to say. For a lot of people the chances to go to this country or that country are a real special opportunity. If you've done it a lot, it just starts to become not so much different than just going down the – to the mall on the weekend to get – to buy something. It's not obviously that simple, but it's like you start to realize that that you've got this vision of the world that, because of all these trips and all these experiences, has made my world very different from what most people have experienced. That is a very special thing to me.

FT: When you think you were a kid out of Marin County that had not been anywhere –

DA: Yes.

FT: – up to that point, and when you actually get to the point that you have a favorite restaurant in Barcelona or something like that, that is pretty neat.

DA: Oh, it is, or you have friends all over the world that you can visit, or that when you see them at meetings, friends, students, former people that have come through the lab, there's this whole network out there and that you are known and you know people in all these distant places. I never ever would have foreseen, when I started into this field, that that international dimension was going to be there. Now that I do, I tell my own son, when he's trying to figure out what career he might go into, that the academic career, one of the big pluses is, in fact, this idea of traveling and seeing the world as part of what you do. I don't know how many times I have jokingly said to my colleagues the old, "It's another tough day at the office." I'm saying that while we're sitting at a table on a sidewalk of Paris having lunch, during a conference that's there, or I'm down in the Antarctic looking at a sunrise over the mountains and the glaciers and so forth, or I'm someplace in Namibia on these monstrous sand dunes, looking out at the ocean that we're studying. I mean, you just keep saying it, "It's another day at the office." You're joking because it's a wonderful day at the office.

FT: I am going to ask you a really tough question which you can decline to answer. But you put together over the years, over your career, what a lot of people would see as an ideal situation. Now, I am sure there are downtimes in all of this. However, the overall picture is a very, very good and positive one. Have you ever given any thought to what personality trait you have that allowed that to develop? Because it did not just fall on you. I mean, it had to be a way of progressing.

DA: I have thought about that, and what I say to people – and I've used the word earlier in this discussion – serendipity, that there's been a lot of opportunities that have just – I never would have anticipated that fell in front of me. But I also will say that being able to recognize them, to grab them, and then to move forward with them is a character trait. It's not just resting and saying, "Thank you. Thank you for having this fall into my lap," but then say, "All right. I'm going to move forward from here until the next opportunity falls in your lap." So, the ability to

see or to take advantage of good timing or fortuitous events or whatever – the red tide that occurred in 1972, just at the time I'm trying to decide what my thesis is going to be on, that's luck. But then being able to do a good thesis on it is not luck, and there's a lot of examples like that. Another character trait is being able to see a little bit about the future areas of science that I need to branch into enough in advance that I'm one of the first ones there in my field and can get the funding and start to make headway that others then join on and can carry on. By the time the bandwagon starts to get crowded, you've already seen another one, and you're sort of moving over there. You're keeping some activity in that one area, but you're now then shifting here. Whether it's vision or awareness or something, I've done that well. I'm not sure exactly what character trait makes me able to do that, but I think I have looked ahead and had a number of these different bandwagons that I have helped to start for the –

FT: Well, let me give you a characteristic then that I think this represents, and I think it is a natural inquisitiveness. I kind of had the feeling that if you went to the mall up in Mashpee, and they were having a display of postage stamp collection or something like that, even though you may have nothing to do with it, if you said, "Oh, and you mean this little watermark means it is new? That is interesting. Now, how did you locate this?" I just have the feeling –

DA: Yes.

FT: – that that is you.

DA: There's no doubt that that's true. One of my favorite books used to be this two-volume set called *The Way Things Work.* I just always loved looking through it. It's just the way I am. I like to know the way things work or get into things at some deeper level. You're right. That is part of it too. Back to how else you put all this together, another trait is people told me that I take things in stride well, that somebody could walk in here – and in fact, it happens all the time. I get a call that said, "Sorry, your proposal is not funded." All right. That proposal is not funded. We'll move on. We'll do something else. I don't get angry. I don't get depressed. You just go with the flow. There's a lot of a lot of things that come at you in lots of different ways that if you let them get to you too much, then you probably burn a lot of extra energy and you lose focus and so forth, but I don't. I also know that that works with my staff, the personnel, because we will have issues where they'll make a mistake on this or that, there'll be something, and they'll feel sort of badly about it. It's usually, "Well, that's all right. That happens. Let's move on." So, we don't have major clashes and a lot of confrontations and so forth. That makes this place move much more smoothly.

FT: I think there is another area too. I think you have a kind of an innate way of reinventing yourself as time goes on.

DA: Yes, that's true.

FT: Modeling, numerical modeling.

DA: Molecular biology.

FT: It is opening new pages on books for you.

DA: Yes.

FT: Then the natural curiosity comes in. It is an interesting –

DA: That's why, again, I'm not sure. I hope it's just some level of curiosity or just some level of intelligence that allows me to pick up something new and not be intimidated by it and to understand it well enough to at least begin to be conversant in it. That's been very important in a place – I will not disagree one bit that that reinventing yourself – or adding dimensions to yourself is another way to put it – allows you to keep a program going for this length of time. If we went back to character traits that have helped to make all this happen, another is that, at least early on, I realized that a leader was needed. I don't know how to say this without it sounding – whatever, egotistical or something. But in a number of situations, I find leading to be fairly easy. Walk into a room of people in a conference, a little workshop or something like that, sometimes, it's very hard to sit there and watch someone else lead the group when it's sort of stumbling and fumbling and spinning wheels and so forth, because you can see that that there's a way to get people to move in a direction. If I'm running a meeting, oftentimes, that comes fairly easily and naturally. So, that then translates into being in positions where you can actually help your field, make it grow, and so forth. Coming with that character trait would be one that is a willingness to give your own time to help your field, to help others. There's one or two colleagues I have who have never understood that, and maybe it's because they're just not like me. They've always tried to give some ulterior motive, that this is all selfish. "This is empire building."

FT: [laughter]

DA: "All the stuff you're doing for the national, for the international community, there's something negative about it." But I honestly do feel like I do things willingly because that makes the program grow for everyone. Like I say, I do well at the same time as everyone else does. It's not like it's completely something that I do out of altruism. I create programs that we compete and can get money from, but lots of other people compete and get money too. I sometimes jokingly call it being a martyr. It's like somebody has to step up, be the one to write the reports, take the time, spend the extra time away from their research to run these meetings, to do things, to push that. For some people, they don't want to do that. For me, it was part of being a Woods Hole scientist.

FT: I walk into lots of different laboratories here, and you get certain feelings as you walk in. When I walk in here and I see some younger folk, at least from my viewpoint, who are doing their work, they kind of look at me, and I can see in their eyes, "I wonder who he is and what he is doing." But everything is functioning and it is smooth operating. It is a very comfortable place to be.

DA: Yes. What you would have seen as you came in this time is over the last – I don't know how many years – we've brought in a lot of interns, co-op students from Northeastern University – and several comments there. One is that it's a reflection of the stresses we have here. So often we write grants to do something, and then can't put enough personnel time on the budget to

accomplish that work, because people – again, their salaries through all these years are high, and my technicians and so forth. So, what do you do? You have to find some other way to do it. So, we bring in these cooperative students who are looking for a semester of experience. We pay them housing and subsistence and so forth, and they get a wonderful experience for six months working with us, working right here on the front lines, going out on cruises, and they love it. Then they go back, and the next semester, we look for more, and the word is around. So, we constantly have anywhere from two to four of these cooperative students here. That brings in some real youth because they're undergraduates. They have a great time. Then I also have – at any given time right now, there's like three or four, I guess, foreign post-docs or visitors that are senior-level people who have gotten either, let's say, a post-doc, a fellowship from Finland or from Brazil or something like that, for a couple years to spend here. Others are faculty that have gotten a year or two off, like a sabbatical, who will come here. This is a bit of a – well, it's a nice lab. I'm getting a lot of requests over time. "Can I come and spend a year or two," whatever. When I do find people that fit well with our group, then I will accept them, and then we have this whole international feeling out there too. I mean, right now, if I think about it, we've got Finland, China. We have Brazil. We just had someone from Spain that was here that has now just gone back. Oh, there is another Spanish woman here as well now who's also here at this time. So, in a year, we'd have a different mix of people. So, there's a nice feeling of sort of international and youth and so forth here. It's a fun lab.

FT: I have always found one of the best byproducts of having young people around is that you are always comparing yourself against the young person, so it keeps you very mentally young. I say, "Am I gaining weight?" I would be looking at some eighteen-year-old as my comparison kind of thing, so it is wonderful.

DA: We've always had a bit of a joke here in the lab that for whatever reason, I have very few gray hairs.

FT: [laughter]

DA: But until, I don't know, five years ago, maybe, I had none. Yet, every one of my graduate students that had come through here, for quite a while, they all had gray hair before they got their PhDs. That became the joke, is that they couldn't get their PhD until they had the gray hair, and then, of course, I was not going to ever get any. People always – "What's that mean? You're putting people under too much stress," or whatever. I've just been fortunate. They all think that I dye my hair or something, but I absolutely do not. It's on the record.

FT: [laughter] Well, Dr. Anderson, I have long anticipated this particular interview. It has been very enjoyable for me. I have learned a lot. I learned a lot about red tide that I did not know, and I will pass some of that information along to other people in this institution. I will tell you what I tell everybody when we finish up, is that if somewhere down the road, you say, "Gee, there is something we really should have talked about here but we did not," I am just a phone call away.

DA: Okay.

FT: We can come in and it has happened. We have done that with people. As so often happens with the oral histories, when we decide we are finished, two minutes later, we think, "Well, we really should have said something about –" this is one of those situations. So, why do not we talk about this issue?

DA: It's just more of a perspective that I wanted to offer of how a research program in this region, on the red tides in this region, has grown in complexity. But it's interesting to start and look at it from the beginning to the end. I've mentioned bits and pieces of it throughout this, but what I'm trying to paint a picture of is start with a rowboat in a salt pond here, not far from the institution, and using the tiniest equipment you can imagine, to sample the bottom and what's in the water and so forth. Then move from there to a single – maybe, say, a fifty-foot boat running a single line of stations off of Portsmouth, New Hampshire, watching water go by, and trying to figure out what's happening there, and then realizing that instead of the cells moving from offshore to onshore like we thought, they were actually crossing that line. They were coming from the north. So, then we have to add more of these transects. So, then you add another ten or twelve transects up and down the coast. You start picking up this coastal current and understanding, "Wow, this distribution is much larger than we thought, and it's traveling from north to south." Then get yet another funding element where you stretch those lines from Massachusetts Bay all the way up to the Canadian border, but all in those nearshore waters. As if you've really answered all of those questions, build the computer models to handle that. Then you realize that even then, it's not enough. You realize that there's toxicity out on Georgia's bank and down around Nantucket Shoals. So, now, you have to stretch that field program way offshore and down to the south further. But still, keep it running all the way up to Canada. So, you're running big vessels now for two weeks at a stretch to get them to cover that whole region, and the models have to be expanded so that looking back, I have no conception whatsoever of the scale of the phenomena that I now sort of take for granted, that they occur throughout that region, that we need that type of oceanography to understand it over that scale. But it has all grown step by step through having the students that were helping make these transitions with the different technologies or strengths that they brought in or willingness to participate in certain kinds of new areas, to involving other colleagues, from being able to engage physicists that found this to be an interesting problem, to engage modelers, and so forth. But now, we have, I think, justifiably, the best-understood, the best-studied regional red tide phenomenon in the world. It all started from very humble roots and a humble beginning, and it grew. There's no way that I anticipated that. You look back and you can say, "Isn't this what you thought was going to come?" The answer is absolutely not. I did not think way back then how big the phenomenon was, how it happened. I had my blinders on. It was focused on the small scale and trying to understand that. In fact, I don't think I wanted to think very much about the large scale, because back then, it would have been un-fundable. How do you get the resources when the grants are so small to do that? But as we built up the national program, as the question that I was seeing grew bigger and bigger, we had to generate the resources. So, that's why you go down to Washington and help build up the government support, the program support, that then provides money for a lot of the big oceanography that's needed. So, you'd never have envisioned that in the beginning, that it was even doable, because of the scale of it. But looking back, then, it all follows. It's been a logical progression. A progression of science on the one side, going from small to the very, very large scale, but on the other side, a progression of funding and program development, starting from very, very small – just whatever's available, to actually building

programs and helping to create the resources to address these big questions. When I look back then, something that took concerted effort on both fronts to get things to the scale that they are. But it's been a very steady development that required growth in the funding side and the program development side, as well as growth on the science side.

FT: Hang on. I am left with the thought that I wonder if you are ever in a dark corner almost sucking your thumb, saying, "What have I done? What have I created here?"

DA: I'm proud of what I've created here. As I said, I think that the world community is – very much respects the type of science we've done here in the Gulf of Maine region, the models we've built, the capabilities we've built, the understanding we have of the phenomenon. I'm proud of that. Beside this, we have a legacy of papers. We've got a legacy of our students and the students that they have trained and that all continues. We're all very proud of that. But another big part of it is the actual scientific understanding that's out there that is solid, and that I don't think is going to be refuted in a significant way. I'm very proud of that.

FT: But is not it neat that something that started in a rowboat in a local pond has become a part of our general vocabulary? Red tide is in just about everybody's vocabulary.

DA: Yes. I mean, it would have done it by itself in many ways, because it's a problem that's growing. The field needed a spokesman at times, someone to go down and talk with whatever news agencies or with Congress and I've been fortunate to be that person in many cases. It's a fine line to walk. You want to both tell people about the problem and make them understand that it's serious and make them aware that it needs support and so forth without being overly – whatever the word is, just by overemphasizing the scale of the problem or just being too sensationalistic or something like that. That's been a line you have to walk carefully. People understand the nature of the red tide problem now better than they did before, and I think it's a very solid awareness. I don't think there's a lot of unnecessary concern out there. I think the concern people have is justified.

[end of transcript]