CARNEGIE CORPORATION OF NEW YORK ORAL HISTORY PROJECT

The Reminiscences of

Bruce M. Alberts

Columbia Center for Oral History

Columbia University

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PREFACE

The following oral history is the result of a recorded interview with Bruce M. Alberts conducted by Myron A. Farber on April 26, 2012. This interview is part of the Carnegie Corporation of New York Oral History Project.

The reader is asked to bear in mind that s/he is reading a verbatim transcript of the spoken word, rather than written prose.

3PM | Session #1

Interviewee: Bruce M. Alberts | Location: New York, NY

Interviewer: Myron A. Farber | Date: April 26, 2012

Q: This is Myron Farber on April 26, 2012, interviewing Dr. Bruce [M.] Alberts at the Carnegie Corporation of New York for the oral history of the Carnegie Corporation. This is session one. Dr. Alberts, you were a trustee of the Carnegie Corporation from 2001 to 2009?

Alberts: I think that's right. Something close to that.

Q: Okay. What is your current position?

Alberts: I'm an emeritus professor at the University of California in San Francisco [UCSF], where I have an office and a secretary.

Q: Professor of—?

Alberts: Of biochemistry and biophysics. I first went there in 1976 from Princeton University and so I've been there for quite a while. I was department chairman. I left for twelve years to go to the National Academy of Sciences.

Q: Let me come to that. But your current position is—?

Alberts: Yes, an emeritus professor there. And I have a half-time job as editor-in-chief of *Science* magazine, run by the AAAS [American Association for the Advancement of Science] in Washington, D.C.

Q: Right, which you've been doing since—?

Alberts: Since March of 2008.

Q: And you were born in Illinois, were you not?

Alberts: Yes, Chicago.

Q: And went to schools there?

Alberts: Yes. I lived in Glencoe, Illinois, a north shore suburb of Chicago. I moved there when I was two and then I left only when I went to college to Harvard [University]. And I went to all the local, public schools, ending up at New Trier High School.

Q: Oh, you did go to New Trier?

Alberts: Yes.

Q: You graduated from there?

Alberts: Yes. I graduated from New Trier in 1956.

Q: There's a story, I believe, that you told somewhere about an experience you had—it must have been in the Glencoe public schools, maybe eighth grade or so—about a television set.

Alberts: Oh, yes. Yes, it's basically my—

Q: I'd like you to tell that story.

Alberts: If I look back on what I remember from my own schooling—and this has, of course, affected the way I think about education—what I can remember most vividly, by far, are the things that I had to do by myself. For example, even in grammar school we had major projects every year where you chose some topic and wrote a report, did some investigation, went as a seventh grader to the Chicago Public Library, and things like that. It was my first real contact with knowledge outside of school—because one of the problems with school is that people think that knowledge is this boxed-up stuff that you get in textbooks and have no idea what the rest of the world is like or where knowledge comes from or what the new opportunities are. I was very fortunate that sixth, seventh and eighth grade, at the end of the year we had a major project. My first major project, I think in sixth grade, was writing about the railroads and development of the railroads in the United States and the change that that brought. I can't remember much about anything else I did in school but I can remember these three projects. The second project was about farming in America and trying to understand why we paid farmers not to grow food, which

is incredibly interesting. You know, these are the kind of things that make kids aware that the world is interesting and complicated and not boring the way it sounds in textbooks and that there are opportunities to create change, even for young people when you get out of school.

And, of course, that's a wonderful thing about the United States. I just came back from Egypt, where they admire the fact that in the United States, you can fail. And you can fail multiple times and still have a chance to succeed. Many people are enormously successful, only are successful, after their third business fails. And then their fourth one is Google or something. [Laughter] But they point out in most cultures, including Egypt, failure is a disgrace and you can't recover. It's very hard to recover. Families don't want their children to go into anything that has risk.

Q: That's sometimes true of the European mentality.

Alberts: Yes, it's not only Egypt. It's many other places.

Q: Right. I was astonished once upon reading the extraordinarily high percentage of graduates of—I think it was French schools—whose ambition was to go into the civil service, get a civil service job, from which they could retire in their fifties or something, without, you know—just sitting there almost waiting.

But let me go back to—I won't let you escape the television.

Alberts: Okay. So the television example was—it certainly wasn't eighth grade, it may have been seventh grade—where everybody in science class was supposed to choose some topic and then explain it to the rest of the class, basically as an example of a general truth—that you learn by teaching. And I can still remember, I chose television. Television was new. And of course I couldn't ever explain how the television works now because they're so complicated. [Laughter] But these were fairly simple black-and-white television sets and you could explain how they worked. It was very inspiring, in a sense that, again, it connected me to the real world of invention and you could see where things come from.

One of the major problems in our society is people buy an iPhone, they have no idea what is inside and just take it for granted. They fail to see the challenges and the nature, really, of life and civilization because they don't know how anything develops.

Q: But in this case, you were in a science class in seventh or eighth grade and you—

Alberts: Yes, all of us were assigned to present, for one period, about something. So that was our class project, yes.

Q: And what did you do with this television? You just talked about it? Or what did you—?

Alberts: Yes, I didn't bring—I don't think we owned a television. [Laughs] Maybe we did. But anyway, I went to encyclopedias. I had to figure out how a television worked. They didn't give us stuff to read. They said, go find out, go to the library and find out how a television works. So

whenever you do that, you come across things that are—you see how complicated the real world is. There are many things that I read that I couldn't understand. But again, that's important, to see that. I still remember those experiences of being surprised. I think the general feeling about schooling without that kind of in-depth, project-based education is that you think that what you read in the textbooks is all that is known about that subject. At least you have no idea about the real nature of humanity from those textbooks, particularly about science. We're teaching kids to memorize all these boring facts about cells or whatever other topic—you know, memorize all the words and the concepts that scientists have learned—but they have no idea where that comes from and they hate it. [Laughs]

Q: Let me come to that. Did New Trier High School ordinarily draw from Glencoe?

Alberts: Yes, it draws from not only Glencoe. It's a whole area.

Q: It's in Winnetka, isn't that correct?

Alberts: Yes, it's in Winnetka.

Q: And it's regarded as one of the best high schools in the country at that time, would you say?

Alberts: It has a very good reputation, but it's partly because, of course, the students have parents who want them to learn. They had a very good science department and I've visited them

subsequently. They have a science chair. They have a whole room for the science teachers to sit at their desks where they interact with each other. Pretty unusual, I see, in retrospect.

Q: Right. And this is a public school, of course?

Alberts: Yes, it's a public school, yes.

Q: And I think you went on to Harvard and graduated in '65 or something like that?

Alberts: No, I graduated in 1960. I got my Ph.D. in '65.

Q: At Harvard also?

Alberts: Yes, so undergraduate was 1960.

Q: At some point in your career, you became—correct me if I'm wrong here—the lead author of the textbook, *Molecular Biology of the Cell*?

Alberts: Well, they called me the lead author because my name starts with an A. It was very much a collaborative endeavor. I did get assigned to be the authors' representative with the publisher and all that stuff by my colleagues.

Q: At what point in your career was that?

Alberts: Pardon?

Q: At what point in your career was that, that that book came out?

Alberts: It started with a telephone call in spring of 1978, when I had recently moved to UCSF.

Q: After teaching at Princeton for, what, a decade?

Alberts: Ten years, yes. And it was a call from [James] Jim [D.] Watson, who I knew from my undergraduate days at Harvard, a very famous scientist.

Q: The double helix James Watson?

Alberts: Yes. And he had had what turned out to be a brilliant idea—that now was the time to unify two fields. One was previously called cell biology, which was a centuries-old field in which scientists looked at cells and carefully described what they saw, either with a light microscope originally but subsequently with also higher power microscopes, electron microscopes. It was a whole, well-developed field but not molecular at all. The second was molecular biology, which since 1953 had developed extensively, so that one could try to write a textbook that would try to explain what you see in the microscope, bringing together what the microscopists, the cell biologists, knew with what the molecular biologists knew.

It was funny because back at Princeton, maybe five years earlier, I had tried to figure out what cell biology was and I bought the then best-selling cell biology textbook. It was a very small book on a subject that wasn't much taught. It wasn't taught at all at Princeton. And I had a very hard time making any sense of it. It didn't seem very interesting. [Laughs]

But anyway, the major point is that these two different scientific endeavors had not yet been connected. Watson had the brilliant idea that this was the right time to do that because we knew enough in both fields. So this textbook would be as much an intellectual endeavor to try to scope out a new view of a scientific field as it would be a textbook. That's why it was so tedious to produce and took so long. [Laughs] Although Watson always—still—is wildly optimistic about how easy anything is. He told me when he called that it would take one month the next summer, meeting, the authors together, plus a month the summer after that.

Q: He was already a Nobelist at that time.

Alberts: Oh, yes, sure.

Q: And it was at Cold Spring Harbor?

Alberts: He was then at Cold Spring Harbor. In fact, in 1963, I think it was, I was invited to his Nobel Prize party at Harvard because it was given in my professor Paul Doty's house. I was one of the few young people at his Nobel Prize party. But I had interacted with Watson a lot. He was very accessible to the young scientists, even when I was an undergraduate. At any rate—

Q: He says it will take a month?

Alberts: No, two months' time. Two months. In the end, one of my colleagues kept track of how many days we worked together. These were twelve to sixteen hour days, all the authors in one room, most of it in England, some of it at Cold Spring Harbor. And it was over 365 days. And I missed Thanksgiving, and Christmas, because we tried to do it on vacations, so we'd have like two months in the summer, a month over Christmas and then two weeks other times throughout the years. Most of the meetings were in England because the other authors were there.

Q: Of course, is it fair to say it became the standard textbook in the field?

Alberts: Well, yes. So the first edition was an enormous success, in the sense that we got huge numbers of the best scientists writing us that they had read it from cover to cover. It was not only a textbook for students but it helped shape what scientists were doing. This had happened earlier in the field called biochemistry when Albert [L.] Lehninger had written a famous biochemistry textbook much earlier. Perhaps Jim Watson had that in mind when he got the idea for the cell biology textbook.

Q: Did he stay with the project, Watson?

Alberts: Well, he stayed for the first edition. He was trying to work on the first edition. When he realized how much work it was, he didn't put in as much time as everybody else. [Laughs]

Q: Well, is his name on the first edition?

Alberts: Oh, yes, sure.

Q: And on subsequent editions?

Alberts: It's not on the recent editions, but it was on at least the first two editions because he did write substantial material for the first edition, which was also in the second edition. There's a tradition of leaving your name on a book for an edition after you're not actually working on it since your contributions are still in the book.

Q: What edition is it now?

Alberts: We have five editions of the large book published and we're in the middle of producing the sixth edition of the big book. Starting in, oh, I don't know, maybe 1993 or so, we produced a smaller version called *Essential Cell Biology*. I can't remember when it first came out, maybe a little later than that. But it's got twenty-five percent as many words. And we have three editions of that and we're working on the fourth edition. That book now sells as many copies as the big book.

Q: Right. In simplistic terms, at least for this occasion, how would you rank Watson as among the leading scientists in the 20th century? Clearly there?

Alberts: Oh, yes. He inherited Cold Spring Harbor when it was a sleepy little village. I had been there before—it was deteriorating. And now it's a major scientific center and it's only because of his vision and his energy and his fundraising. He's a terrific fundraiser, which is surprising to some extent because his personality is kind of shy and awkward, but he turned out to be a very effective fundraiser. And most importantly, as in this example, he has visions of things that people think we're not ready for. [Laughs] And he pushes them forward nevertheless. Usually he turns out to be right, but it always takes a lot more time and energy than he thinks.

Q: Well, he was involved in something of a controversy a few years ago.

Alberts: Oh yes, that's a different issue.

Q: Was that surprising to you?

Alberts: He gave several speeches where, as he's gotten older, he—first of all, he never prepares his talks. [Laughs] Even when I had him as a professor at Harvard, teaching, he rambled all over the place and some of his rambles take him to these creative ideas, speculative ideas, about everything. But this one that he got in trouble about was that different races have different abilities. He'll say things about Irish, Jews, Blacks, Orientals, the kind of things that normal people would never say and most people don't even think about. But he is incredibly creative so he's always trying to shape something in new ways. Not only for that but for other things such as cancer treatment. He's been very controversial on many areas. [Laughs]

Q: Well, what he said on that occasion was he was not sanguine about Africa because blacks have a lesser intelligence than whites. There's no—is there scientific basis for that?

Alberts: No.

Q: Right. And it caused him quite a—well, it put a dent in his reputation, wouldn't you say?

Alberts: No, well, he was just talking. He likes to speculate about everything. He's got all kinds of ideas and some of them should be kept to himself, given who he is. I mean, if he was just anybody else, nobody would pay attention.

Q: Right. So after Princeton you moved to San Francisco, at the University of California in San Francisco. During the '80s, your wife was active in the PTA [Parent-Teacher Association], was she not, in San Francisco?

Alberts: So all my children—I have three children who went to public schools in San Francisco as soon as we moved there—of course, we had gone to public schools in Princeton as well. And my wife's very energetic and she got involved with helping. First of all, if you're going to navigate the public schools in San Francisco, one parent has to know what's going on—there's so many choices and all this stuff. And so she learned all this information initially that helped our children and then she got involved as president of the Parent-Teacher Association, which she was actively involved in, first in the academic high school, Lowell High School. She played a

major role, actually, in getting them a library and all kinds of issues that they needed and was very effective in getting things done with the school board and the administration and then became the president of the San Francisco PTA, which is the whole city's organization, which at that time was a very active, strong organization. As such, she would speak at every school board meeting, which was every second Tuesday night. It was broadcast on the radio at that time and sometimes it would start at eight o'clock and go until two in the morning. But now it's both on the radio and television. But anyway, so since she was speaking, I had to listen to this. [Laughs]

Q: But your wife's name is—?

Alberts: Betty Alberts.

Q: So you would listen. But what I'm getting at is, was it through that avenue that you became mindful of how science was being taught in the San Francisco schools?

Alberts: No, I knew how science was being taught because my children were getting it. It was an optional subject, at least in middle school. You could either take music, woodshop or science. [Laughs]

Q: That seems hard to believe—

Alberts: Although I was upset by that, I was so busy, I had no idea what was going on. And my kids were doing fine and they liked school. But when my wife became PTA president, when I

listened to how the school district was governed by the school board, then I realized we had a real problem, because it's an elected school board and you never heard anything on the radio that had to do with academic improvement. It was all about politics. Each member was trying to run––in general, not everyone—but most of them seemed to be like they were running for a higher office. In fact, that's been a stepping stone to a higher office. One of them is now the state senator and so on. So they represent constituencies—the Asians constituency, the Hispanic constituency—and it was all about jobs for adults. And of course, my wife understood that better than I did.

So I also recognized that our university was like a first world country with first world resources in the middle of San Francisco, UCSF, surrounded by a school system at lower levels that had third world resources. Basically, talking to teachers, you realized that they had no science equipment, they had no access to anything they wanted like frogs, fruit flies, worms. If they had any budget at all to buy that stuff, they had to order it a year ahead. It was all kinds of crazy bureaucratic stuff and very little attention paid to science. So that led us to form the Science Education Partnership. I guess it was 1987, something like that.

Q: To do what?

Alberts: To bring the resources of the university to the school system, to connect directly. And it started by every six months or so, we would have a big party where we'd bring out all the equipment that we were not going to use anymore—which normally would go into storage in a warehouse, scientific equipment—and have a little raffle where the teachers each—it's like a

football draft. They had a ticket to pick their first thing, their second thing. And so the teachers would come and get equipment. Also, it was a mixer for the teachers to find a partner at UCSF who would work with them in the future. We had all these one-on-one partnerships. That has now developed into an office that employs ten people. At first it was only my secretary working half-time. [Laughs]

Q: And I think it was 1993, you became president of the National Academy of Sciences, while still holding your post in San Francisco?

Alberts: Still holding my post in San Francisco but I had to take a leave.

Q: Is that a full-time job, the president?

Alberts: Being the president of the Academy is a full-time job. I had to move to Washington. And although it was an option to keep my lab going, I didn't have time. And I thought it would be irresponsible. So after two years, my lab closed. These academic labs have no permanent people and they're all people rotating through. I had a technician who was "permanent." But after enough people left, the whole thing—we had three people left or something. The other people all moved elsewhere at UCSF.

Q: For the record here, if you would just say what the National Academy of Sciences is.

Alberts: Well, the National Academy of Sciences is an honorary body created by Abraham Lincoln in 1863. Every private organization needed a charter to exist in Washington at that time, any company, anything. So we needed a charter. We got a charter that said you can exist as an honorary association of the country's best scientists but in payment for this charter, you must advise the government on any matter of science and technology, when asked. And you will not get any money for this service. [Laughs] So it led to this great volunteer tradition.

Under the same charter, we now have two other honorary organizations, the National Academy of Engineering and Institute of Medicine. And finally, a fourth arm, which is called the operating arm of the National Research Council, which allows the advice given to government to include not only members of the Academy but teachers, lawyers, all kinds of people with other expertise who are, of course, needed for many studies. And in fact, a minority of the members of any one committee at any one time are members of any of the academies now. We have something like six hundred committees working at any one time and not enough academy members to staff them. In fact, the payment business—which no money shall be paid to the Academy—it turned out that what the government does is pay for the cost of the staff work and for flying the committee members to Washington and putting them in hotels. But the people who work on these committees, all that time they spend, they get no honorarium or anything. So it's a great volunteer tradition. We have some six thousand people working on committees at any one time, something like that.

Q: At the time you came and until now, I suppose, you would advise the government when asked, right?

Alberts: Oh yes, we do.

Q: Right.

Alberts: Well, we reserve the right, if it's a question that has no—it has to have some basis. In other words, in order to accept the charge that we're asked by the government, the rules say that the governing board of the academies must approve. So almost always what happens, we negotiate the question so it makes sense, because we can't do a study if there's no science behind it—and we don't do new research. We only look up and advise based on what science has been done before. So if there's no scientific information about the question being asked, we can't do it.

Q: But was the presidency that you took on in '93 a paid position?

Alberts: Yes, that's a paid position.

Q: That was a paid position?

Alberts: Oh, yes. It's full-time. Otherwise you can't—many other academies are half-time positions, not paid. And I think if you want an academy to really be effective, you need a full-time person.

Q: Right. And when you came there, didn't you have in mind being what you later called an "education president?"

Alberts: Yes.

Q: What did that mean?

Alberts: Basically, they have a committee of members who meet for about a year to try to choose a president. They had called me early on in the process. I said I didn't want to be a candidate because I didn't want to close down my lab, recognizing it was a full-time job that I had to move to Washington for, and my lab's on the other coast. But then, when they offered me the job they knew I was interested in science education. And they pitched it that way and said this is your chance to do something with the Academy, a very prestigious organization, on this issue you care so much about. In fact, that's the same pitch they made to me at *Science* magazine, under the same circumstances.

Q: Later on?

Alberts: Later on. Yes, much later.

Q: Much later on. I mean, they knew you were interested in science education. And you were interested in science education growing out of your experience in San Francisco?

Alberts: Right, the Science and Health Education Partnership. I had been doing other things in the interim on education. The reason they offered me the job though was because I had chaired the Genome Committee for them in 1987. They had asked me to be the chair of this very important study, very contentious at the time, whether there should be a special project to map and sequence the human genome in the United States. Most biological scientists were against it. They had already set up the committee and they said they wanted somebody to chair it who hadn't even thought about the project. It was just me. [Laughter] And so the fact that I was able to bring this group to a consensus in the study had a huge impact. The recommendations were immediately adapted by the government. That gave me a reputation of being able to do science policy even though that was the first time I had ever done any science policy. It was basically just about managing people.

Q: Where does that stand today?

Alberts: Well, it's a huge project. The whole thing was viewed as a success. In my opinion, it should have ended. Well, at least five years ago they should have ended it because it was done. But like everything else, now they have a whole Genome Institute doing more stuff, which I think many people feel should be blended in with other things.

Q: But one of the things that you got involved in when you became president was something you inherited, was it not? It had to do with education standards.

Alberts: Yes but I had already been on the committee for that.

Q: What was—?

Alberts: That was 1989. The governors meeting in Virginia, led by then-governor [William J.] Clinton, had asked famously—

Q: I'm sorry, Clinton?

Alberts: Clinton was the governor of Arkansas at the time, yes.

Q: I thought you said Virginia.

Alberts: Bill Clinton, yes.

Q: I'm sorry.

Alberts: So the fifty governors had asked for national voluntary standards in the major academic subjects—English, history, science, math—based largely on the ideas that were expressed in the 1983 "Nation at Risk [The Imperative For Educational Reform]" report arguing that we were falling behind other countries. Because education is a states-rights issue, for there to be national standards of any kind it has to be requested from the governors. Otherwise, it's not going to work because the states have their own prerogatives in education according to our Constitution. So the governors asked for these national standards. The Academy got assigned in 1991 the job of

producing the science standards, first ever science education standards in the United States. I was put on the standards committee by President Frank Press. So I was spending a lot time on that. And I had been writing to him repeatedly how—

Q: You mean the president previous to you?

Alberts: Yes, yes. I had been very unhappy about many of the things that were happening. They weren't being well run. And I was sending him letters. So I was deeply involved with the National Science Education standards at the time they offered me the job of being president. And so part of the incentive for me was clear—I could help make that project a success. I thought it was going to fail. And in fact, in my first two years I spent half my time on that project. Presidents usually don't work on things. [Laughter] But actually, I had to replace the person who was heading it, who was the vice president of the Academy at the time—Frank Press's vice president, not mine. I had to appoint somebody new. I appointed Richard Klausner, who was great. He was subsequently going to be head of the National Cancer Institute, but at that point was just a lab head at National Institutes of Health, very interested in education. He and I would meet every weekend and, in my apartment usually, work on the standards. So I wrote a lot. He and I wrote a lot, actually. This is not what happens, usually, in the Academy reports. In the end, it was the hardest report we ever did. We had a huge amount of money to do it. We had too many people when I got there. It was just off track, too many cooks.

Q: You had a huge amount of money to do it? From whom?

Alberts: The Department of Education and National Science Foundation. It's the usual thing. They ramped up, hired lots of people. It was chaos.

Q: It's when you said before according to the charter, the Academy didn't get money.

Alberts: Yes.

Q: They do get money, right?

Alberts: They get money. But how the charter's now interpreted, it has been for years, is that the people who work on the committees, the experts, get nothing. We do not get even ten dollars a day.

Q: Right. But to do such a thing as the Science—

Alberts: But you have to fly them in. First of all, you can't do anything with volunteers unless you have a staff member to hold the volunteers together and it has to be a very talented staff member. These are hard things to do. So the way we ran our committees—which is different than the way Carnegie ran its committees when I was on it—is that the people on the committee actually write the report. But the staff member has to make sure that they get their bits in in time, organize all that writing, fill in the gaps—there's always gaps connected to the material—rewrite things. To be a staff member of the Academy is an incredibly demanding job.

Q: Okay. But when the Education Department gives you money—

Alberts: They pay for that staff member.

Q: Okay.

Alberts: The staff member, and they pay for the travel. We couldn't get six thousand volunteers if they had to pay their own way to Washington and pay for their own hotel.

Q: Right. And you did produce a report of the standards, did you not?

Alberts: Yes. It was 1996, actually late 1995. And 250 pages, reviewed by eighteen thousand people. We had a year-long review process. Most reports are reviewed by eighteen people.

Q: Did you say eighteen thousand?

Alberts: Yes. It was put on the web and anybody could submit comments. We had eighteen thousand reviews. It took us a year to deal with those. It was the hardest report we've ever produced and I think it was a very good report.

Q: These were science standards for K-12?

Alberts: Yes, K-12.

Q: And it's a 250-page report. Is there a simple way of saying what they concluded?

Alberts: Well, we had chapters on everything. My favorite chapter is the one on teaching. What is teaching like? Was does it require? All the politicians should read that because they don't have any idea how hard teaching is. But it had content standards, it had assessment standards, it had program and system standards, it had all kinds of pieces. The fundamental issue was to define science education in a way that made heavy use of inquiry—active science learning, what we call science learning by inquiry. Students doing science at appropriate level, not just memorizing words, not just learning from textbooks what scientists have done. In retrospect, it didn't really take hold very well because of many reasons. Teaching science by inquiry is harder than having kids memorize stuff. Secondly, it requires skills of the teachers that the teachers often don't have because the way we teach college science doesn't involve inquiry, and you can't teach what you've never done. So now we recognize—that's what we're working on now, very hard, at *Science* magazine and elsewhere is that we need to change the nature of first-year science courses so they are focused on inquiry, so that we redefine science education in a way that will allow the lower-level science also to be redefined.

When I came to the Academy, many of my members said we'd love to have better science education. They knew I came there to be an education president, but they didn't think that the Academy had any role because it's everybody else's fault—we don't teach lower-level school, it's the textbook writers, it's the unions, it's the school boards, you name it. But in fact, what I

learned in those twelve years from all the experiences—and we produced some 150 education reports over those twelve years—

Q: Twelve years?

Alberts: Yes, I was president for twelve years.

Q: From ‘93 to ‘05?

Alberts: 2005, yes.

Q: Right.

Alberts: My major take-up lesson is that the way we step up to the task of changing science education at the lower levels is by changing what we do in college.

Q: Right, I want to come to that. I will come to that. What happened to that report? Did you say that for this to be done, the governors needed to be for it being done?

Alberts: Right. So of course, the governors change all the time. But then when the report came out, there was a different group of governors. Each state was supposed to use those national standards as voluntary guidelines for producing their own standards. The idea was that it’s a state’s right to produce its own standards. Of course, if you’re in California, you want to include

the ocean and put more emphasis on things that are in California, and if you're in Minnesota, you've got lakes and forests and other things. It makes sense that the standards should be slightly different from state to state, even in science, in the sense of what you focus on. But what actually happened was that in many states, some very active minority of people who thought they understood science education better than the Academy got involved and local politics got involved. Many states, such as California, basically ignored the science standards and made their own very terrible standards.

Q: Before these standards came out, '96, this report had the states standards?

Alberts: Some of them had some things that you might call standards, yes.

Q: Now, in fact, weren't you in something of a pitched battle in '98 in California, even as you're president of the National Academy of Sciences, that you lost with the school board?

Alberts: Well, so I was still at the Academy when—

Q: Over the California state—?

Alberts: The California state standards. So our report came out in 1996, California produced their own standards in 1998. I went to testify in Sacramento against them. I was part of an effort to organize CEOs from California to write a letter to the school board about the most egregious

parts of them—the most egregious part because the group that wrote the standards very much felt that everybody should memorize all these facts.

Q: You mean that wrote the California standards?

Alberts: California. The most egregious thing is they didn't want to waste time on inquiry, just the opposite of what the Academy said. So the original state standards said something like, no more than fifteen percent—I don't remember exactly the percent—of the students' time should be spent on inquiry. So the net result of this letter—it was organized by the CEO of Genentech, Art Levinson, and we had maybe ten other CEOs and university presidents signing it—was that the school board changed it from "no more" to "no less." That was a very minor victory because there were many other things wrong with the California science education standard. So now it says the student should spend no less than fifteen percent of the time—maybe twenty percent—I can't remember what the exact number is. So that was the result of this massive effort. It was pretty late in the game.

And I still remember going to Sacramento. Actually, I flew from Washington just for that purpose and I got in at three in the morning or something. The next day we had this meeting with all these opponents of the national standards there [laughter] and basically their attitude was that the California standards are much tougher, much more rigorous, than the national standards. The national standards are too easy.

I think another part of it is that they wanted to hold teachers accountable. They discredited the teachers completely. And they said we've got to tell them exactly what to do, every year. And so, for example, we have the periodic table in fifth grade and memorizing many parts of the cell in seventh grade. All those things that the Academy committees have carefully thought about and rejected. So the net result has been a disaster. The students in California hate science. It's been a total failure. Predictable.

Q: You mean, up to this time?

Alberts: Yes, up to this time. But it's complicated also by No Child Left Behind [Act of 2001], which came in afterwards.

Q: Let me come to that, for sure.

At that time, in the late '90s, had you any connection at all to the Carnegie Corporation of New York?

Alberts: Yes. There was a committee, chaired by Shirley [M.] Malcom and Admiral [James D.] Watkins, that produced the report "Years of Promise [A Comprehensive Learning Strategy for America's Children]." I just looked it up. It was established in 1994 and the report came out, I think, in 1996 and it was a culminating report on what we should do about education for kids. I think it went through middle school. It had a bunch of distinguished people on it. We had lots of meetings. But it was run completely differently than the Academy because they had staff

members writing. We would meet and talk and staff members would write everything. We didn't write anything, except in the end, I insisted on writing. [Laughs] I still remember, I was on vacation in Hawaii—my wife is from Hawaii and has her mother's home. I was working there on some sections of the report because I wasn't happy with them. I mean, what was happening was they were writing everything and they'd send us the stuff to approve and so I got involved in some sections of that report.

Q: Can you remember the name of the report?

Alberts: If you Google "Years of Promise"—I got it right here. I also learned a lot of something else which was surprising—it had wonderful people on it who were deeply involved in education, but in the meetings, I was disappointed to learn that so many of them were pushing their own programs rather than thinking broadly about the United States. I've seen this before.

Q: This is a panel that was supported by the Carnegie Corporation?

Alberts: Yes.

Q: And at that time, David [A.] Hamburg was president?

Alberts: Yes. David Hamburg set it up and he was at every meeting.

Q: And "Years of Promise" was not the report, not what you were working on but something later?

Alberts: No, it was what I was working on. I was confused. I thought it was later but—

Q: Well, when you mentioned "A Nation at Risk" before, back in the early '80s—

Alberts: Yes, yes.

Q: —that was also supported by Hamburg and the Carnegie Corporation.

Alberts: Was it? I don't know.

Q: I think so.

Alberts: At that time, I wasn't involved.

Q: Right. That was part of the Carnegie Council on Adolescent Development, I think. Then they produced three reports, ending with grade transitions. They produced "A Nation Prepared" in 1987, "What Matters Most" in 1996, "Science for All Americans" in '89, "Benchmarks" in '89. All I want to do is try to isolate the one that you worked on.

Alberts: Yes, that was "Years of Promise" and I knew about "Benchmarks," but I wasn't involved in it. That was, of course, the precursor to the Academy's work. We incorporated a lot of that into the standards.

Q: Okay. You incorporated it into standards of the Academy?

Alberts: Yes.

Q: Right.

Alberts: We view that as sort of the first edition of the standards, something like that.

Q: Right. So under David Hamburg, the Corporation was very much interested in education and adolescent development. Isn't that correct?

Alberts: Yes. Not specifically, though, science education.

Q: Right, although there was a focus to some extent, later, on the science education.

Alberts: Well, now there is a big focus.

Q: Yes. But at that time—so you worked on "Years of Promise?"

Alberts: Yes, so here's the title, "Years of Promise: a Comprehensive Learning Strategy for America's Children."

Q: That's right.

Alberts: That's the name of the report.

Q: Right. And your experience with that was, as you say, it was a little unusual for you in the sense that the staff were writing this thing and you and the other panel members, many distinguished people—

Alberts: Right.

Q: —were sort of approving it or stamping it or something?

Alberts: Yes, yes. And some people probably did nothing but come to meetings and miss most of the meetings anyway.

Q: Right. But that wasn't your style.

Alberts: Well, that's not the Academy's style. I had been involved in many other reports with a different style, yes.

Q: And looking back on it now, do you recall what the burden of its conclusions was?

Alberts: Well, it was a very broad—there was nothing wrong with the report. How much effect it had is another question. I mean, there's so many education reports and I think my conclusion—unless it has a very specific set of a few highlighted recommendations, it has a very little chance of having much effect. And this report didn't. It had broad recommendations and a large number of them. When the Academy produced, for example, its very high-impact report—in 2007, "Rising Above the Gathering Storm"—the charge to that committee was to come up with four recommendations. Don't have a laundry list of twenty-five recommendations because nobody is going to pay attention to them. That report, in fact, had a powerful impact—or at least was much more powerful than it would have been. In subsequent reports whose committees I've been on in this area, including "The Opportunity Equation [Transforming Mathematics and Science Education for Citizenship and the Global Economy]" from Carnegie, and the President's Council of Advisors of Science and Technology [PCAST] report on K-12 education that came shortly after that (Prepare and Inspire), I always pushed the point that less recommendations is more effective. It's often hard to get that to happen because everybody wants their thing in.

Q: Right. Then later on, around 1999, Vartan Gregorian became president of the Carnegie Corporation, succeeding David Hamburg.

Alberts: Right.

Q: And you became a trustee of this corporation a year afterward. Is that correct? How did that come about?

Alberts: I got a letter.

Q: Did you know Vartan Gregorian?

Alberts: I had met Vartan because he was running an Annenberg [Foundation] project on education. Annenberg put money in and I was complaining about how the money was being spent. [Laughs] I remember talking about that. And I was right! [Laughs] But anyway, the Annenberg money didn't have much effect. But I think I had met him in several different places. But at any rate, I got an invitation from him to join the board. When you consider such things, you not only think about the organization but you see who your colleagues are going to be on the board. The board contained an incredible group of people, many of them with strong interest and experience in things that I was interested in. So of course I was pleased to join the board.

Q: Well, you were also pretty occupied with the National Academy of Sciences, no?

Alberts: Of course. But the board doesn't take much time really. I missed some meetings because I was out of the country but I tried to attend whenever at all possible. In particular, Governor [James B.] Hunt [Jr.] has been an incredible figure in American education, two-time governor—four-time governor, really, of North Carolina, sixteen years—and just an incredible education advocate. I had already met him because I had gone to North Carolina to talk to him about

science education earlier. Governor [Richard W.] Riley from South Carolina, likewise—I mean, just heroes of American education from a very different perspective than I had. If only those two people had been on the board, I would have accepted because there was a chance—and I did, I got to know those people and learn from them. It was terrific. And the board, in general, was a mixture of all kinds of different people with different perspectives. I found it fascinating. Any organization needs a diversity of viewpoints and people and the Corporation did a great job of—I guess it has a long tradition of that—of getting people who can provide a mixture of perspectives on any one issue. I think the net result is stronger than if you have just a bunch of academics, for example.

Q: What made Governor Hunt and Governor Riley exceptional, in terms of education?

Alberts: Well, both of them had devoted a lot of their careers to try and do something about education—something major about education—improving it in their state, North Carolina and South Carolina, respectively.

Q: Did you know that they had succeeded?

Alberts: Oh yes, yes. I knew about them. I'd been reading about them. I had actually gone to North Carolina and visited some of the schools of North Carolina, met with Governor Hunt, read things that Riley had written. Of course, as an academic trying to change the system by writing standards and other reports, you realize that it's not going to happen just with academics writing

about it. You have people like these governors whom you connect with and you learn from—how to make this happen in other states.

Probably since 1988 or so my primary motivation in life has been trying to do something about science education in schools or education more broadly because it's clearly an important, critical issue for the next generation and for the United States. So when I was at the Academy and now when I'm at *Science* magazine, I don't view myself simply as the head of those organizations. My major motivation is trying to do something with those organizations, take advantage of those organizations and their resources and advantages, to try to do something about education in the United States. So obviously, I think it's true that being on the Carnegie board and talking and listening to them talk, talking to them in private—all those discussions help me understand how I could be more effective than I could be just as an academic. I sometimes get frustrated with academics. They want to publish things, write reports—but to me the report's useless unless something happens afterwards.

Q: And that requires politicians.

Alberts: Politicians and lots of other people of course.

Q: Right, right.

Alberts: It's not only politicians but strategies. It requires strategies. You can't just say we want science education to be focused on inquiry. You have to have a strategy for getting there. And politicians know about strategy.

Q: At the time you joined the board, you knew a little about the Carnegie Corporation through your work with the Hamburg group that you had mentioned?

Alberts: "Years of Promise."

Q: Did you know anything about Andrew Carnegie?

Alberts: Well, a little bit but I know a lot more now. [Laughs] We talked a lot about Andrew Carnegie on the board. I think both presidents whom I've known see it as their job to enact his vision. I mean, there is a lot of that in this foundation. We talk about Andrew Carnegie, they give us his writings, we'd discuss his vision for the foundation. I think there's a real sense, still, that we're trying to adhere to what he would have wanted.

Q: More so, you think, than they do at the Rockefeller Foundation?

Alberts: I don't know about Rockefeller.

Q: Or Ford?

Alberts: Well, I can't really compare with others. I would guess it's more than at the Ford Foundation. [Laughs]

Q: Well, you're saying his presence actually lingers here, Carnegie?

Alberts: Yes. Well, at almost every board meeting something would be said about him. Of course, there are still restrictions about what you can do, which countries you could work with, based on his "we should work with the Commonwealth countries" policy. Some of those are restrictive in ways that probably are reducing the potential impact of the foundation. Nevertheless, they're very much in everybody's mind.

Q: Right. During the times that you were on the board, how would you describe the degree of contact or interplay between board members like yourself and the staff of the place?

Alberts: Well, every board meeting, the staff would be there. We'd mix with them. We had lots of breaks and stuff. I'd often stay afterwards when I could and talk to some staff member about education. There was a lot of interaction with staff. I remember the lead staff did a lot of talking at board meetings. They would present their ideas of what they were going to go ahead and do, and many of the ideas were quite visionary. I still remember Michele Cahill, who is now a vice president, coming as a young staff member at Carnegie, before she went to a high position in the New York [City] public schools. She was trying to figure out, how do we do something about education? And she had a real vision. I remember this because it made an impact. She said that she had helped lead a study at Carnegie of what was really wrong with those high school

students who were dropping out in New York—it was almost all done in New York City. She concluded that school was not relevant to them, for one thing, and that many of them had no family support and no community and that these large high schools didn't give them any sense of community.

That was leading to the Carnegie's investment, along with others, in the small school movement. We met with some of the people from New York who were involved with that. We spent a lot of time—not only money—but we spent a lot of time at board meetings afterwards, discussing what was happening. And in fact, the board was very critical of what was happening and I think we were right. In retrospect, the small schools were seen as a magic bullet. We would be shown videotapes or little blurbs about what was happening at small schools in various parts of the country—they're doing this project or that project. But it was "let a thousand flowers bloom," [laughs] with no real curriculum being developed centrally and no real guiding help for these schools, as far as we could see. Even though foundations were bringing lots of money in, they were just saying, you have to have a small school. It was our sense that this was not going to be very effective because you needed to get some synergy between different small schools to build up best practices and try to share or develop or find curriculum that was really appropriate for these kinds of settings. As far as I could tell, as far as I know now, this never happened and so the small school thing, I think, was not that successful.

Q: But when you speak of the "small school thing," are you speaking of the high schools?

Alberts: High schools, yes.

Q: The high schools.

Alberts: This was taking a big high school and breaking it into four schools in the same building, for example.

Q: I beg your pardon?

Alberts: You take a big high school facility and divide it into four different schools, in the same building even. To basically make a community where there were a hundred kids per class, four hundred kids per school—I think that's the right number—and a set of teachers who knew all the students. Deborah Meier, for example, had produced this famous small school in New York City, of course. And there had been several other schools like that in New York that had been enormously successful. But you have to distinguish between what happened because the school was small and what happened because of a leader like Deborah Meier. [Laughs] So that, in fact, is the problem. Deborah Meier was an incredibly unique person who could make anything work. Small schools in her hands were fantastic. But I guess our feeling was, you can't find enough Deborah Meiers to run these small schools, so you have to have more help than that, than just saying the school's going to be small. A small school was a precondition that enabled Deborah Meier to do what she did and make a community of the kids, but it can't guarantee success without good leadership and help. I haven't read the formal evaluations, but this is now a very old project that I think was much less successful than everybody had hoped.

Q: But interestingly, apropos of what we were saying before about political leaders, it was supported by Mayor [Michael R.] Bloomberg, was it not?

Alberts: Yes. It was supported by the mayor, it was supported by [Bill & Melinda] Gates [Foundation]. It wasn't only Carnegie, it was a whole collaboration.

Q: Right.

Alberts: A lot of money went into this.

Q: Right. And many schools were closed, some were opened, all with the idea—well, not entirely all but very many with the idea—that smaller is better.

Alberts: I am very sympathetic to the idea that smaller is better in communities where the parents and the peer group are not able to supply the community support that every kid needs. And I think that covers a lot of New York. But I think the sense of the board was—not only me, people from business and lots of other people—was that it's not enough. It's a necessary condition to make a community but it's not sufficient to make it a true learning community. You need outstanding curricula, you need outstanding teachers, you need a great principal. And if we actually worked more on providing resources—at least a choice of really outstanding resources or programs that could be developed through this system that could be shared by all these schools—you give them the money, so you have some control. They have a choice—pick any one of these eight things—but just don't do anything random. It was our sense that if we had

been able to produce such aid or framework or support system for these small schools then they would have had much more success.

Q: Well, you point out the Gates Foundation was significantly involved in this effort—

Alberts: All around the country, in fact, not only in New York.

Q: —roughly from the time you came on the board until 2008, when the Gates Foundation pulled out of this program.

Alberts: Yes. And they viewed it as a failure.

Q: Well, Bill Gates himself was quoted in a 2008 speech as saying that the results were "disappointing." And Adam Tucker, a senior program officer at the Gates Foundation, was quoted as saying that the fund "moved away from small schools because it zeroed in on the goal of helping U.S. schools graduate eighty percent of students by the year 2025." And he was quoted as saying, "a small-schools-alone strategy didn't put us on a trajectory to meet those targets. We made a strategic decision in 2008 to focus less on the size of the school or the governance structure and more on what actually goes on in the classroom." Was that discussed here, that the Gates Foundation no longer wants to be part of that?

Alberts: We didn't discuss that. Well, I missed some board meetings, so it was not discussed when I was at a board meeting. But as I said, we had the same sense. Although, we weren't

disagreeing with the idea that small schools were an important tool to use in the kind of communities we were talking about. We just said it was never going to be sufficient. And that certainly agrees with what happened in the end. I don't know to what extent the Gates Foundation drove the program or whether Carnegie could've changed it because they were partners. But I felt that was a case where the board mechanism failed, in the sense that all the discussions had the same tone. I thought that whole project should've been be re-steered based on board feedback but it wasn't. Maybe because Gates was involved and it was so complicated, it wasn't possible for Carnegie alone to re-steer.

Q: When Vartan Gregorian took over he wrote a report on how he saw things were going to go here at the foundation. Then he would write, more or less, in the annual reports. And in the annual reports for 2004 or '05, he wrote about taking risks.

Alberts: Yes.

Q: And he says there that "foundations should be in the risk business a lot more than they are because ideas need to be tested. This is particularly important in the policy realm because 'solutions' have to be tested too." He goes on to say that foundations can be riskier than the government and "they can take a chance on a promising policy, project or idea that may in the end turn out to be a failure because analyzing failure is how to discover what works."

Alberts: I agree with that completely.

Q: But in your time here, was that the attitude? Did they not just tolerate failure, if failure was what was coming, but examine it or analyze it or try to—

Alberts: Well, my problem is, I think I missed a third of the board meetings because I was busy as president and out of town. So I don't know. I mean, you have to look that up. They have board records, with details of who presented.

I have a new, analogous position on the Board of the Gordon and Betty Moore Foundation. Gordon Moore, who is still there—he's the Board chair—wants metrics. To his great credit, he has decided that whenever the foundation has made a major investment in any program, it will have a real independent evaluation done every five years. He has spent a lot of money on this. They spent maybe three hundred million dollars trying to protect the Amazon basin, the whole Amazon, from deforestation and environmental disaster mostly by buying, with others, parks and reserves. And they must have spent at least a hundred thousand, maybe three hundred thousand dollars, to send this independent group of evaluators that they selected—it's one of these NGOs [non-governmental organizations], or maybe it's a company—to go and do an investigation and write a report. This group had something like eight people in the Amazon for six months. This is an incredibly expensive—it must have been three hundred thousand, five hundred thousand dollars. They spent a lot of money to do this thing. And in the end they not only wrote a report but they came and spent three hours with the board, telling us what they found. I think that is an enormously useful process. In this case they found, not surprisingly, that buying land is not enough. Just calling it a park will not protect it. You have to do much more. In the lingo now, it's

called consolidation. But basically, we were fooling ourselves about how much protection we were getting for our money.

Q: Where is that?

Alberts: In the Amazon.

Q: In the Amazon? Right, right.

Alberts: I never had that kind of experience at Carnegie. Although I missed Board meetings, I never had that experience after the small school projects or after other major failures.

I completely agree that Carnegie should have done this—trying to change education schools. Daniel Fallon, the head of education who has left the foundation now, his vision—we spent a lot of time on this, the board, hearing reports and plans. I think Carnegie invested a hundred million dollars in trying to change education schools—taking ten education schools, giving them ten million dollars each or something like that. There were a specific set of guidelines that they were supposed to agree to among them. For example, getting feedback from the graduates into the system. (It's amazing that the ed schools didn't do that already.) But basically, to find out from the graduates of these schools that just focus on producing teachers, what did they learn that wasn't useful? What did they not learn that would have been useful? That was supposed to be part of the agreement. And at any rate, my impression is that that very important, high-risk program also was not very successful.

I probably had left the board before I would have expected any report on either of these major education initiatives. But I think that this is a very important point that Vartan made: we must learn from failures. I would go further than that: we must advertise our failures and everyone what we learned because otherwise everybody else will make the same failures again. I don't know whether the board has done that or not. I mean, the World Bank does so many experiments, spends so much money, has lots of failures. But they, in the past, have basically hidden them. My general feeling about progress is we must advertise our failures and tell everybody what we learned from them. You don't have to call them a failure. So I would like, for example—I tried but it didn't happen—I wanted the Moore Foundation to publish that report on the Amazon. But it never got published in the way I thought it should have been published.

Q: You're on the board there, the Gordon and Betty Moore Foundation?

Alberts: Yes.

Q: Right. How long has that been?

Alberts: Oh, god, time is terrible. I've been on for quite a while. Since 2005.

Q: Okay. Now during your time here as a trustee, who was the chair of the board? Do you recall? Was it [Thomas] Tom [H.] Kean?

Alberts: It was Tom Kean at the end. But it was a woman—

Q: Helene [L.] Kaplan?

Alberts: Yes, yes.

Q: In your experience, did it make a difference who was chairman? Was there an equality among members, generally speaking, on the board?

Alberts: Yes. It was a chair among equals because they basically ran the meeting but the discussion was completely open. Chairs often didn't really steer the discussion or didn't say, here's the conclusion. It wasn't like a chair of some kinds of efforts where, at the end of the discussion, the chair tries to sum up and see what the board really thinks. Neither of the chairs did that. I don't know to what extent they made the agenda. I assume they had a lot to do with the agenda because we had a different agenda every time. It was incredibly educational, not only because of the board meeting's members but because we almost always had somebody presenting. We always had experts presenting. At the end, they were mostly people presenting from inside about a project, but often it would be people from outside. I remember we had a wonderful talk about income inequality in America way before this became a major issue.

Q: Well, do you recall whether the agenda of the board meetings was staff driven? And in your time, in your nine years on the board, do you remember any important initiatives here that sprung from the trustees as opposed to the staff?

Alberts: I think there were initiatives that came from the staff in a form that was definitely affected by what the board had said in early discussions. I think there was a clear sense of that. They'd bring projects early on, ideas, to the board and there'd be a lot of discussion. I think a lot of what the staff did incorporated board suggestions. I don't think they were necessarily originated by the board but they did incorporate board suggestions.

Q: Now also, in your nine years here, you served on not just the Education subcommittee, you served on the subcommittee on International Peace and Security, on the committee on trustees, on the subcommittee on International Development, on the subcommittee on—

Alberts: Actually, I went to every meeting. [Laughter] I mean, they had this strange thing where we could have come to half the meeting. A lot of us just went to everything. In other words, I could have gone and made telephone calls for an hour while the other board committee was meeting. But that didn't make any sense to me.

Q: No, no. What I'm trying to get at is—just the way they're structured was that there are board meetings where all the board are there, right?

Alberts: Yes.

Q: And then there are these subcommittees. And those are separate meetings? Those are subcommittee meetings?

Alberts: Well, you're going through different things. Subcommittee on trustees looks for new trustees. And that's a small thing. It happens usually on—

Q: No, let's say the subcommittee on International Peace and Security or the subcommittee on Democracy and Special Opportunities.

Alberts: Those were meetings of the staff concerned with that issue—a lot of people in the room—plus the trustees who were on that committee, plus all the other trustees who wanted to come. But they didn't overlap. They would start at eight o'clock. One would finish and then the other one started. So I always went to all of them.

Q: Were they on the same occasion as trustee meetings?

Alberts: Yes, same location, yes. The trustee meeting starts in the morning. It changed with time because the organization changed. Those subcommittees don't even exist anymore. But those subcommittees would be on the agenda and they would go in sequence—not all of them every time.

Q: In other words, you didn't have to run back and forth from Washington to go to subcommittee meetings?

Alberts: No, no. The final meeting was approving the grants and that was like from 12:00PM to 2:00PM or something. But all morning were these other committee meetings. So I didn't even think of them as different. I think most of us didn't. Most of us were there for the whole time.

Q: Was approval of the grants pro forma?

Alberts: Yes. You got a list and in that big meeting you'd check the ones that you have conflict with—it might be a grant to my institution, for example. And you could write the ones that you disagree with.

Q: Even at that stage?

Alberts: You have the opportunity. But I think you have to ask the foundation. I think most of us at this stage just either said we abstained because it was a conflict or you could abstain for another reason. So here are the ones I'm not voting on and here are the ones I'm voting on.

Q: Do you recall whether, during your time there, you ever encountered a proposed grant that either on the occasion of signing off on it or previously in some meeting you said, no, I don't agree with this.

Alberts: Not at the sign-off stage. That is too late. I think the vast majority of the trustees just approved everything that they didn't have a conflict with at that final stage. We all had had an opportunity earlier to make suggestions and express doubts. There was certainly not a tradition

of voting against it at that meeting in any public way, even if you put in your idea and it didn't get incorporated. I suppose that may have been a discussion with Vartan or something. But it wasn't the tradition to openly disagree in that final meeting.

Q: Do you recall having felt strongly about a grant that you thought should be made that wasn't made?

Alberts: Well, we don't see those that weren't made. In other words, there are all kinds of different grants—a lot of them are tiny things—and we mostly discussed the big ones. It must be, I would guess, ten to one people writing letters to the foundation with ideas that don't get any further. There's no regular way of seeing those. I'm not sure we'd want to see them. [Laughs] I don't recall any board meeting saying we have this proposal from Brookings [Institution] or someplace and we'd like you to read it before the meeting and tell us whether we should fund it. It wasn't done that way.

Q: Right, right.

Alberts: Basically, we would discuss the major proposals—and many of them we wouldn't ever discuss because there's too many. International Peace and Security—there were lots of professionals on the Board in that area—they'd give lots of feedback when they were having those discussions before the formal thing was changed. And to what extent those were changed because of that feedback—I know some people went offline. We were asked to talk to staff offline, afterwards. When I knew nothing about it, I really enjoyed hearing the other trustees put

their wisdom into the process, people who had been statesmen, for example. I felt that in education I had some expertise. But in many other places, I had no expertise. We were doing a lot of things in Russia, for example, at that time.

Q: Right.

Alberts: There's a whole effort to build better citizenship in America. Civil education, democracy—those were all major programs at that time. The discussions were fascinating. But they weren't of a form that says, "Brookings Institute would like to do this, please read this proposal that they sent us and tell us"—even offline I didn't get that—"whether you think it's a good grant or not."

So that's another way of using trustees. At the Moore Foundation, we have an electronic system that automatically alerts us to things that are being discussed. We can go in there if we have the time and put in our comments directly to the staff officer and say, I don't like this. And I've done that on occasion. But the fact is it's a huge list of stuff and I often am too busy to do that.

Q: Well, in the area here, for example, when you served on the subcommittee on International Development, for example or International Peace and Security, would you basically say that your job was more to listen than to advise?

Alberts: Yes. But I would insert things about science or what I knew from my work in the Academy.

Q: Right. Right.

Alberts: But just, basically, information for the staff and for the rest of the people.

Q: Right. Whereas [Samuel] Sam [A.] Nunn [Jr.], I presume he knew more about this than he did about education, maybe?

Alberts: Oh, yes. [Laughs] Sam was great. There were so many great people on the board, yes.

Q: Yes.

Alberts: In fact, I enjoyed talking to them. There is time in between meetings when they're having coffee—I could really talk to them about anything. So it was fascinating. Just wonderful people on the board with all kinds of background.

Q: Okay. Now just to finish off this particular session this morning, do you remember any Sturm und Drang between the board and the staff leadership, like Vartan Gregorian or David Hamburg even before him? Of course, you weren't on the board then—but how would you characterize the relationship over time, as you can divide it, between the staff helm and the board?

Alberts: I think it was very convivial, really. The main thing we'd complain about is Vartan wouldn't take a high enough salary. [Laughs] That's what we complained about—not in public–

–in the closed meeting. [Pauses] I mean, I would talk to—and I'm sure other people did—to staff offline about things. We had plenty of time to interact with staff in the halls, or pull them aside afterwards, and I would meet with them and tell them things. But in public, it was all quite positive. Actually, there was a staff member I thought was very mediocre. I told Vartan. But I didn't say that in public.

Q: Right. Hold on one sec.

[END OF SESSION]

3PM | Session #2

Interviewee: Bruce M. Alberts | Location: New York, NY

Interviewer: Myron A. Farber | Date: April 26, 2012

Q: This is Myron Farber continuing the interview with Dr. Bruce Alberts for the Carnegie Corporation oral history on April 26, 2012. This is session two. Dr. Alberts, I want you to try to tell me why, over the years, science education got to be below snuff? Got to be—as late as 2009 in an article in the proceedings of the National Academy of Sciences called *Issues*—what you called a caricature of science. What is taught in schools today is a caricature of science, you said. How did it get to be that way?

Alberts: Well, this is an extremely sad situation. I'm not sure it's ever been terrific. If you go around the world to other countries you find they have the same problem, so it's a generic issue. One way to think about it is that, as a chemist, I think of the world as being subject to the laws of thermodynamics, which leads to the concept of free energy—everything declines to its minimum free energy unless there's an external input of energy. The fact is that it's much easier to teach poorly—to teach science poorly, in particular—than to teach it well. It takes much less energy, it takes less skill, it takes less time on the part of the teacher and less effort on the part of the school system, which doesn't have to provide anything but a textbook. And maybe not even that. So what happens is that teachers are always stressed—especially elementary school teachers, who are supposed to be experts in everything. If they're going to teach science, they will teach it the easiest way and the way they know how, which is to give the students something to read or a ditto sheet. Then as homework—and I see this in my grandchildren today in San Francisco—

another ditto sheet with fill-in-the-blank spaces to put in the word that's missing, like, "the part of the cell that contains the genetic information is the—" and then you fill in the word.

This kind of teaching of any subject really cannot motivate children to learn. It sounds like you're preparing them for a quiz show rather than for life. Preparation for life is to learn how to learn and learn how to be wise, make decisions based on evidence, and use logic. Everybody's trying to fool you in the world—politicians, people trying to scam you for your money. Modern communications have made that much worse. You're constantly barraged by misinformation. People have a reason to give you misinformation. And a democracy cannot function—nor can a person function—effectively in life without being able to think like a scientist. That means we need to change the position of science in school from an optional fill-in-the-blanks word list memorization chore to a central position where students are learning how to think—how to think for democracy, how to think for a living, and how to think for their personal lives.

Q: But you, yourself, give the lie to that, don't you?

Alberts: So there are many scientists, actually, who survived. I was lucky because I had these in depth experiences, as I've told you in the earlier interview, where I got into something in depth simply because there was an assignment. For example, I had to teach how television works to a class. There are many scientists who will tell you the same thing: they became a scientist despite the fact that their science education was boring. And many of them will tell you they went to a museum or some other contact or they had a particular unusual teacher. One teacher will do it. It's actually quite interesting.

The other thing to say is that we're not simply talking about producing scientists here. We're talking much more broadly about the need for every individual in modern society to have scientific thinking and reasoning skills. They do not need to know all those names about science. They do not need to know the parts of the cell—what are the particles and the sub-particles in a nucleus—all these other things that my grandchildren are being forced to memorize right now, as they have very little meaning to them at that stage. But they need to understand what science is—the consensus position on science—such as the world is going to warm unless we do something about carbon emissions, greenhouse gas emission. They need to understand why they should listen to that and where that knowledge comes from.

Today, I know from various surveys that most people don't even understand that that's not just what one scientist believes. Instead, it has a strong basis in reality because of the way that science works. No one scientist can get away with making up any piece of knowledge. It's all going to get tested by some other skeptical scientists. And this whole idea of being skeptical and retesting other people's ideas and then building up a body of knowledge that is then reliable because it came from Science with a big S, the process of science, not from *a* scientist. Science is essential for driving civilizations forward. It's essential for everybody to understand that.

So that's one major goal of science education, I would say—to get everybody to understand where scientific knowledge comes from and that it's nothing like dogma. It comes from a process that involves thousands of different people retesting ideas, each one of them trying to find something wrong with the previous ideas. That's how science advances. So first of all,

citizens have to understand that. Second of all, they need to think like a scientist. They have to look for evidence for statements and learn how to use rational logic in making their own decisions. There's so little of that now in our society. People are being fooled all the time. Their money is getting taken by people who sell mortgages that will soon be underwater because they didn't understand or didn't look critically at what they were getting into. There are politicians promising simple answers for complicated issues—including education—one magic bullet after the other.

I would say that it's critical for the future of the globe, not only for the United States, that children everywhere start, at a very young age, learning how to think like a scientist. That is what I mean by science education. We have to redefine what the word means because we're so far off today. Most people would define science education today as learning to regurgitate what scientists have found out about the world, including all the words that scientists have invented to describe parts of the world, like endoplasmic reticulum and Golgi apparatus when you're referring to cells. And my grandchildren are learning this—but what's the point?

Q: In the article that I mentioned in *Issues* in 2009, you also say the source of the problem is college. "For the most part, those of us who are scientists have made a mess of science education." And you also point out how textbooks contribute to the problem. Explain that. I mean, you're responsible for the problem? You even wrote a textbook that is a standard textbook.

Alberts: I could never write a textbook for lower levels because of the nature of the requirement that you cover all these facts. It's impossible to have enough space to get into anything in enough depth. That's been a failure of the standards movement that I helped to start. States are requiring teachers to cover a little bit of everything in science and there's no time to do anything in depth—the kind of thing I did in my schooling when I had time to see how a television worked or did another project on spectroscopy. What was spectroscopy? How did that work? I would argue that the standards are part of the problem if they're taken too literally. I think part of the standards should be that every teacher should have a month during the year to teach the kids something in depth that the teacher is fascinated about in science. Probably, the same applies to everything—English, history and so on.

Q: Yes, but excuse me, why did you say in 2009 that the source of the problem is college? Then you go on to say, when asking yourself the question, how did this happen? You said "part of the answer to the first question lies in the fact that producing and selling textbooks is a big business and the prevailing market forces have invariably led to mediocrity." You still believe that?

Alberts: Yes. So the marketing forces mean you have to sell as many books as possible, which means, in the current climate of fifty different state standards for science, you need to satisfy the standards of multiple states. I would argue the textbooks have gotten worse since the standards movement because, had the states adopted the National Academy's view of standards, we could have had a common quality textbook. To judge a textbook, you have to open it up in the middle and read a chapter. You can't look at the pictures if you want to understand what we're subjecting our children to. So now Texas has got their adoption standards. California's got

different adoption standards. Nobody wants to produce a textbook for one state. It's not economical. The much wiser course from a business perspective is just to add more stuff so you cover everything. So the textbooks—as a result of the failed standards movement, after the Academy's effort—failed because the states didn't take the Academy's guidance sufficiently and made their own idiosyncratic sets of standards. Basically, we've ended up in a worse situation than before the standards.

Q: Aren't there different textbooks in the lower grades than are used in college?

Alberts: In California, for the lower grades, I would say we don't need textbooks. But the simplest way out is a textbook. So California—the textbooks have been produced for first graders, second graders and third graders and they're sold to schools. Those textbooks don't have any opportunity for students to actually do inquiries. A much better way to promote science in schools—and many schools have done this, but not enough—is to adopt not a set of textbooks but science kits like those produced by the National Science Resources Center at the Smithsonian or by the Lawrence Hall of Science (called the FOSS [full option science system] kits). But that's only part of the problem. In San Francisco, we adopted the FOSS kits but the district didn't provide any support for the teachers, so they couldn't use them. So this is getting to my initial point. Next time, San Francisco will probably say the FOSS kits were a failure because they didn't get used. But it's, of course, their fault because they didn't support the teachers either with equipment refurbishment or with enough professional development to enable the teachers to teach that way.

And so I guess my point of lowest free energy—the lowest free energy is to adopt a textbook. Then you don't have to do anything but to have the kids read it and spit back the information on a ditto sheet. But that should not be allowed to be defined as science education in my opinion.

Q: Well, not long after you came on board here at the Carnegie Corporation in 2000, a couple years later, all of a sudden we had No Child Left Behind [Act of 2001]. Now, wasn't that a help?

Alberts: No Child Left Behind was an absolute disaster. I think it was well-intentioned. But like all education policies produced by government, they can never fail [laughs]. Within a few years, we could tell that it was not going to work. People were cheating. Houston, for example—the way to get higher scores was to have the high school kids drop out who were not doing well. Dropout rates went way up. The idea of teaching to test is a failure because it demands—if you're going to do it—high quality, expensive tests with essays. The PCAST committee that I was on estimated that good—

Q: The what committee?

Alberts: The President's Council of Advisors on Science and Technology. I was on that committee that put out a report (Prepare and Inspire) about two years ago. It made all these points and it said that the cost of good tests would be forty-six dollars per kid. In fact, we spend one dollar per kid with a Scantron-graded multiple-choice test, to save forty-five dollars. All around the country we're throwing away the whole education system because you're holding teachers accountable to word memorization, fill-in-the-blanks science tests. Then, of course, the

teachers are forced to teach to that test and there's no way they're going to teach inquiry science education. They're going to teach "memorize all the words for the test." I see that happening all over the place. Beyond that, because English and math were stressed way over science, so many schools just stopped teaching science. I had a whole project in San Francisco where I trained a hundred lead teachers in an NSF [National Science Foundation] supported, major "City Science" program. Many of those teachers—

Q: The NSF?

Alberts: National Science Foundation. So that started in something like 1988 until 1993. We had terrific programs with science going in the schools. But now those teachers—because of the incentives placed on them—many of them are not even teaching science at all. These are elementary school teachers. So it's been a disaster, I think, for many subjects. But for science, it's been a special disaster because in most situations, science is not viewed as a high stakes accountability issue the way English and math are.

Q: No Child Left Behind, is that's still operative?

Alberts: It has not been re-authorized yet. The [President Barack H.] Obama administration is providing waivers. It's in a state of limbo. It's clear that it will be changed but it has been in effect for so long that it's had dramatically bad effects. Hopefully, it will be changed in ways that will remove the negative effects that this law has had over the last decade.

Q: Since 2002 or 2003. Right. Well, then along came Race to the Top that we started in 2009. Now, isn't it true that under Race to the Top, schools and state school systems get credit for emphasizing science and math education? Isn't that so?

Alberts: Race to the Top has tried to compensate for some of the failures of No Child Left Behind. It hasn't done enough in my opinion. It only applies to those states that have actually gotten major grants. I could tell you that, in California, it has had relatively little effect on science education. What promises to be more effective—if it actually pans out the way we hope––is the new movement towards common standards in science.

Q: Well, actually, many states, forty-some states at least, have adopted, I believe, common core standards in reading and math.

Alberts: That's right. But it remains to be seen how that plays out. The crunch comes when you see what they actually do. It's one thing to adopt; it's another thing to do. But at least now, it solved one problem. The publishers are spending lots of resources trying to produce curriculum materials for those common standards, and if they do that, that would be a big improvement from where we've been. Also, there's a movement to make much higher quality tests. I don't know how that's going to turn out.

The Obama administration put a lot of money into test development to replace the kind of tests we've been having, the inexpensive Scantron-graded tests. That's possible, of course—to develop a test with large amounts of federal money—because now the idea is to have one test for

all the states that adopt the common standards, which makes a large investment worthwhile. My friends who are experts say that, unfortunately, the process is being rushed because everything's rushed that's related to politics [laughs] for obvious reasons. They're worried that the quality of the test won't be nearly as good as it could be but, hopefully, it'll be a lot better than where we were before.

Science is way behind. I understand some twenty-six states have signed up for the common science standards but they haven't even been produced yet. So time will tell. And in science, we have this very sticky issue of evolution. No common set of the science standards are going to omit evolution. In fact, that's a very important part of science. We'll see whether some states who signed up already will be pushed by political forces to reject the common standards. I would hope that we'd have forty-six states signed up for the common science standards. It's certainly in their interest. They'll have a lot better economy and a lot better educated population if they do.

Q: Well, they'll also get more money, though, isn't that it?

Alberts: Well, that's the idea.

Q: Is it fair to say that the driving force behind forty-eight states or so adopting common standards for K-12 in reading and math has been their desire to compete in the Race to the Top money? Or has it been some revolution in thinking?

Alberts: Well, I think it's a combination of those things. There's always been people in favor of what I'm talking about. It's just a balance of power. To some extent, money changes the balance of power. We should talk about that in universities too because money causes changes in universities, and without money we're not going to change that level either.

Q: Well, as far as you're concerned, the verdict is in on No Child Left Behind. You think that was a disaster. The verdict is not in on Race to the Top.

Alberts: I think almost everybody thinks that No Child Left Behind was a disaster. It accomplished certain things. It certainly did a good thing by placing attention on the people who were not succeeding—making school districts pay attention to the impoverished populations of students who were really failing. On the other hand, you can't do only that in education. You have to pay attention to everybody else as well. So on balance, I think it was a disaster.

Q: Well, do you know the name Diane Ravitch? She used to be Assistant Secretary of Education. She's long been involved in writing about the schools and education in the United States. In the *Los Angeles Times* in an op-ed piece in 2010 she said, "Today there is empirical evidence, and it shows clearly that choice, competition and accountability as education reform levers are not working. But with confidence bordering on recklessness, the Obama administration is plunging ahead, pushing an aggressive program of school reform—codified in its signature Race to the Top program—that relies on the power of incentives and competition. This approach may well make schools worse, not better."

Alberts: Yes, I know that. Yes. One thing you could say about Diane: she's a person who changes her mind. She was a supporter, before, of No Child Left Behind. It's good when people change their mind. Most people—

Q: She actually says that—that she was once a supporter. But she doesn't seem to think it's going to change much. But what you said a moment ago, though—it was more than pregnant. You pointed out that even if standards are adopted, that doesn't tell you how or how well they're going to be carried out. For example, just if you stayed with this reading and math standards that have been adopted, does anybody know the degree to which they've been implemented or analyzed?

Alberts: One thing that everybody has to realize is that even with the best conditions, to change education is a multiple-year operation. If you want to teach teachers how to teach differently, you have to provide maybe forty hours of professional development. You need a substantial amount of professional development per teacher. We know that. And then they have to teach for a year and they have to come back. So it takes multiple years of them trying and discussing what didn't work. If you really want to change, you have to keep at it for five years. We rarely do that, so it's way too early to know really what's going to happen, although obviously it's going to be very uneven in different states.

Q: When Vartan Gregorian wrote the report I mentioned earlier in 1999 about what he'd like to do with the foundation, he talks about teacher education. He says "well-educated teachers are the key to successful school reform." Then he quotes a fellow named Bruce Alberts, the head of the

National Academy of Science, saying that to be a good science teacher, one needs focused preparation on how to teach science. You, yourself, in this science editorial in 2009, pointed out again how "the most important element of any education system is a highly skilled teacher." Now, to what degree, to your knowledge, has the Carnegie Corporation supported that effort, in the time you were here, particularly?

Alberts: Dan Fallon, the head of education when I was here, developed a major, incredibly risky and ambitious program to change the way teachers are prepared by working with, I think, ten education schools across the United States.

Q: Was that Teachers for a New Era?

Alberts: Yes. That's it. Teachers for a New Era. And changing education schools is a very difficult task. I have not seen a formal evaluation of that program, but talking to people who knew something about it, I think it was certainly a disappointing outcome. I wouldn't say they all failed but the fact is that individuals in academia, the people who teach teachers, respond to their incentives around them. The incentives in academia are to publish and be well known to your peers outside of your university. People are promoted for that. They're not promoted for how well they—in general, unfortunately—how well they prepare new courses and new programs that are successful in producing outstanding teachers. So when you try to change academia, you have to fight against the incentive system that's in academia. I'm involved in that now in another way. The Academy produced two reports that led directly to the formation of an NGO called the Strategic Education Research Partnership [SERP]. Carnegie has helped to support SERP. I'm

chair of the board. We're trying to get academics, people in education schools, to work on the real problems of the schooling—to study what happens in school districts by applying their expertise to trying new interventions and then honestly researching what happens to them. We recognize that many of these interventions are going to fail, but we need to learn from both successes and failures.

Q: What is this group called?

Alberts: SERP.

Q: Yes. You're the board chairman of that. Right.

Alberts: And we're fighting against academic traditions because a professor in education school is not going to be—like at the National Academy of Education—lionized by his or her colleagues for developing something that works in the school system in San Francisco, for example. All the incentives are, in fact, to publish articles that are cited. It's very different. To be effective in the kind of SERP work that I'm talking about, you have to work in collaboratives because the problems of school systems are so complicated that no one expertise is enough. If you're working on reading, you need people who are experts in data, people who are experts in school system management. It's been a terrific experience for me because we have these meetings with all these people with different skills, half of them are from academia and the other half are people who run the school system. It gives rise to an exciting mixture of ideas, much like the Carnegie board meetings.

Q: Weren't you, years ago in San Francisco—before you got lost in that thicket in Washington—trying to get professors from the University of California at San Francisco mixed up with the school teachers?

Alberts: Yes, we were trying to help. But these were scientists, not education people. The scientists, by spending a small amount of time on this, could do a lot to help but it's not the center of their profession. Their center of profession is doing their science. For education professors, we're trying to make the center of their profession working on the real problems of schools, researching and designing programs. Getting that to be a prestigious enterprise in an education school is going to take, if it succeeds, twenty years.

Q: Is the Moore Foundation promoting this also?

Alberts: The Moore Foundation is just starting to get involved in education. They hired a very outstanding former professor of science education, Janet Coffey, who as a young girl—age twenty-two or something—worked for me at the Academy on the standards project. I hadn't seen her for years. I didn't know what had happened to her. But she has been tasked with the assignment of trying to create a program in education that Moore Foundation would support. The Moore Foundation is very nervous about working in this area because there's been so many failed attempts to change school systems. School systems have a justified reputation of being fickle organizations which might commit to something for three or four years, but then a new superintendent comes in and everything changes. So I'm trying to help her. I am going to finish

my term as *Science* magazine editor-in-chief sometime in the middle of next year—a five-year term. I decided not to continue precisely because I'd like to focus much more of my effort simply on this issue.

Q: Right. Now, you've mentioned often enough the standards that were produced by the National Academy in 1996, but a decade later in 2007 the National Academy produced—I guess it's an update. You tell me.

Alberts: Yes, "Taking Science to School [Learning and Teaching Science in Grades K-8]."

Q: "Taking Science to School." And then in 2011, last year, one of its panels produced Next Generation Science [Standards] Conceptual Framework.

Alberts: That's right. That was with support of Carnegie, by the way.

Q: Now, combine those reports with the Carnegie Corporation's reports, let alone all the other foundations or whoever else is reporting—sounds like a lot of reporting. And yet, you haven't found nirvana.

Alberts: [Laughs] Well, in the world, we will never reach nirvana. And especially in education, we will never reach nirvana. Nevertheless, we could do a lot.

Q: Well, let me raise one thing and ask your assessment of that. This is supported by the Carnegie Corporation and the Institute for Advanced Study at Princeton, I believe, called Opportunity Equation. What do you know about that?

Alberts: I was on the panel, so I know a lot. I was on that board of trustees when Vartan suggested that we do something. I was very skeptical because there'd already been so many reports. I think I was wrong but I was wrong for a reason which I didn't appreciate—Carnegie not only did a report but they decided to put money behind the report and that makes a big difference. The fact is that when you produce a report and then put in money to try to enact it, that makes a huge difference. So I think I was wrong. The Opportunity Equation has had a substantial impact. It really is the reason why, I think, we have common science standards being developed. I think without that report, it would never have happened. And without Carnegie's support, it would never have happened. As I said, the jury's still out whether we're successful but I think it's a good try. It's based on "Taking Science to School." It's also based on the Academies Framework that is supposed to specifically guide the states in producing their standards. They're producing standards through the [National] Governors Association, enlisting an organization called Achieve [Inc.] to do the actual work. In fact, I'm a reviewer for that.

Q: To do the actual work of—

Alberts: —producing the common standards. And I am a reviewer. I reviewed the first set of standards maybe three months ago and they're about to be released in another month for more

review. I think the point would be to have at least the draft version of these "next generation science standards" out this December.

Q: For the benefit of the states? In other words, for adoption by states?

Alberts: Yes.

Q: Right. If you look at its overall plan, it isn't just to produce standards. For example, they call for new designs for schools. Do you understand what that is?

Alberts: New design of curriculum, communities of people who look at the problem of schooling and deeply understand it, unlike the textbook publishers who look at what they can sell mostly. But basically look at the role and nature of schools—and this is part of the SERP project—then design a product that could be an electronic product, a text product, a science kit, a teacher training, a mechanism, a set of videos for students, who knows—that experts think could make a big difference. So that's what a design is.

The whole essence of SERP is, I think, then you have to honestly do research on what happens when you do any intervention—knowing that it won't be perfect, knowing that it may be terrible—but nevertheless to learn from that experience in a public way, pushing in the open literature what actually happened and what you learned. That's in the Opportunity Equation report—basically the whole attitude that education is as complicated as cell biology. We would never think, as a scientist—I'm a cell biologist—to make a guess at how something works and

then every experiment would work. No. Education, when you do a design effort, it's got to be viewed as an experiment and honestly learned from. But this can't happen in our political system because every politician can never make a mistake. This is why the foundation world is so important, as Vartan said in his inaugural address.

Q: Yes, but you were saying before how important politicians are, too, to getting anything.

Alberts: We need to interface with politicians. I mean, politicians want the right thing. [Laughs] They certainly want their state to be successful in education. We need every politician to understand the nature of science, so they could see we could "make a science out of education" by doing the kinds of experiments I just described. We could then create the kind of continually improving education system that the United States needs. Right now, most politicians—of course, Governor Hunt and Governor Riley, they were incredibly skilled people, way ahead of most of the academics—don't have any idea really how to do it and how to improve the education in their state. They listen to the loudest voices and many of them have simple answers. We repeatedly get one magic bullet after another trying to fix education and, not surprisingly, fail.

Q: Just to go away from Opportunity Equation for a moment, were you not on the board of Teach For America for a while?

Alberts: Yes. I've been on every board [laughs].

Q: Have you been involved, or were you involved, through the Corporation or otherwise, with charter schools here or anywhere?

Alberts: Well, I've been peripherally involved with charter schools, not centrally.

Q: You talk about magic bullets—some people talked about charter schools that way also, did they not?

Alberts: Yes, they still think like that. Charter schools are like small schools.

Q: Yes, only below the high school level.

Alberts: It's a platform on which you could build something if you do it right. It's also a platform in which you could make a terrible mess. On average, charter schools are no better than regular schools. But many of them are outstanding so—

Q: So New Trier High School is outstanding too, right?

Alberts: Yes, it was outstanding. But New Trier High School is not dealing with inner-city populations. They have the strong support of parents. They have kids who have a good lunch and little or no turmoil in their lives.

Q: Okay. I was being facetious somewhat. As far as you're concerned, the charter schools, after all this time and talk, aren't demonstrably better across the board.

Alberts: They are not. We know they're not better across the board. We know that there are wonderful charter schools that we could learn from. There are wonderful charter schools that we could emulate. There are also terrible charter schools that if we had an honest system of research on what happened, we could learn a lot from what failed. But we don't have that system. We don't put enough money into studying education seriously. The amount of money in scientific research is enormously greater than the amount in education research.

If I was Education Secretary [laughs], I'd invest in a certain kind of education, a SERP kind of education research, that's actually meaningful. Can we move toward true excellence in education if we bring in the best expertise in the form of the most outstanding academics, look all around the world to harvest whatever everybody else is doing, and then design school-based experiments and honestly test what happens? That was the whole idea behind SERP. The SERP committees at the Academy were designed to answer the question of why knowledge is effectively used to continuously improve transportation, health and agriculture but not education. In fact, I think the idea came from [Thomas] Tom [D.] Larson—a wonderful man—who was at one time the highway administrator in our government. I met him when he was working with the Academies' Transportation and Research Board (TRB). They had produced an incredible system to get research knowledge used and research energized for improving the production of U.S. highways. I said, if we could do this for U.S. highways, why can't we do it for education? That was really the beginning of the SERP idea. The Academies produced two successive SERP reports that led

to the Strategic Education Researcher Program. Tom Larson came to the first meeting of the first SERP committee to tell them how the highway thing worked.

But at any rate, that kind of making a science of education—I would specifically have competitions in the federal government for that type of research, which I think is so essential for actually making progress through getting school systems to respect the knowledge of researchers and use what academics discover. What we learned in the SERP reports is most school systems think that the research done in education and academia is irrelevant because it's done in some esoteric environment of a laboratory, or because it doesn't have all the commotion and variables from the reality of research done in real classrooms.

Q: Well, one entity that hasn't come up in our conversation at all is teacher unions. Are they of any consequence?

Alberts: Yes, well, teacher unions have been a problem because they push for blue collar benefits only and they don't generally, with some exceptions, get involved in trying to get what teachers need—such as appropriate professional development and other excellent curriculum supports. The teacher unions are, by and large, like blue collar unions, only fighting with school system administrations for more money. They also have a very deleterious effect on the schools to the extent that they stress seniority rather than merit in teacher advancement. I'm a strong believer in merit-based systems. In fact, I was just in Egypt talking about this. Without merit-based systems, we cannot create the strong institutions that we urgently need in education. We need to reward our very best teachers, both paying them more and engaging them as teacher leaders. We have a

system that, basically, when the school budget goes down, you have to lay off the most junior teachers rather than the worst teachers. I see that all the time in San Francisco. They don't have a way of rewarding merit. It's a very discouraging profession to enter for teachers. In fact, we're never going to get the kind of teachers we need in large numbers into our school system until we change that situation.

Q: Well, I noticed that the Opportunity Equation, a report that came out in 2009—you say you served on that commission—they reduced themselves to four priority areas. That seems to dovetail with what you were saying.

Alberts: Yes, well, I was pushing for that. I was very obnoxious about that.

Q: You didn't want fourteen points.

Alberts: No.

Q: Right, right. But one of the four—apart from mobilizing the nation to pay attention and developing these standards and designing the schools properly—is this thing to improve teaching and professional learning. You say that you expect Carnegie to continue to put money behind this?

Alberts: I would expect Carnegie to continue to put money behind it because that's the only way it will work. I would hope other foundations would also put money behind it.

Q: Well, you know the term STEM teacher?

Alberts: Yes.

Q: That's science, technology—

Alberts: —engineering and math. And by the way, one of the revolutionary results of the academy's new Framework for science education is it includes engineering, which is a good change. Engineering was not part of the National Science education standards.

Q: Well, I think President Obama, in his State of the Union address perhaps—

Alberts: Yes. He talked about this, yes.

Q: Yes, well, that's a plus, is it not?

Alberts: Obama is actually a strong supporter of the kind of thing I'm talking about. Of course, he's got so many other agendas [laughs], he's got no time to spend on it. If we didn't have all these other problems in the world, I think he could really do something about education [laughs].

Q: You mentioned that you just came back from Cairo. You were there not long after the Arab Spring broke out, isn't that true?

Alberts: Yes.

Q: What was that like? And what were you doing there then?

Alberts: Well, I went there for the board meeting of the Library [of Alexandria]. I'm on the board but I miss most of my board meetings for most organizations—I'm on so many boards. But I've gone to the last two simply because there was an Arab Spring and because that affects a library in the sense that everybody in Egypt wants change. One of the changes that was pushed by a substantial number of employees at the Library was lifetime tenure for all staff. This is something that they have in all government positions—which I think is a disaster. I've been part of the last two board meetings where we've had break-out sessions where sub-groups of us meet with large numbers of staff. I keep on talking about the advantages of a merit-based system. The last time I said, you've probably seen American movies where the guy who comes in to shove boxes around in the corporation ends up as a CEO. I said, that actually happens in the United States. It could happen here. [Laughter] But so many people see only the disadvantages—that you're going to be evaluated every five years and might not have your job after five years.

Q: Had you been spending any time in Egypt before the Arab Spring?

Alberts: I had been a couple times, three times before that, yes.

Q: Right. And you've been there a couple times since. Is it palpably different?

Alberts: Yes. It's very different. There's an expectation that over the long run, this country will succeed. Right now, there are a lot of problems. The economy is in shambles because of all the disorganization. But people who are very wise whom I talk to feel that, over the long run, this will be of tremendous benefit. In ten years, it will be a very different place. Of course, it remains to be seen.

Q: Right. As far as libraries go, you also made a trip further south, to South Africa, I think, in 2007, with Vartan Gregorian and others.

Alberts: With Tom Kean.

Q: Yes. What was that about?

Alberts: That was basically to visit the projects that Carnegie had supported. The timing was set by the inauguration of the new library in Johannesburg—a big, beautiful new library that Carnegie had done a lot to help make possible. On the same visit, we went to Cape Town to visit the library in Cape Town that Carnegie had helped, and many other places actually—universities. It was a great trip in a sense that we were all learning a lot about different kinds of culture in each place we went. It was incredibly impressive to be with Vartan and Tom Kean too, great people. That was a wonderful experience. In every place, Vartan would have to give a speech, and every speech was different, and every one was typically appropriate and charming. I was very impressed. [Laughs]

Q: But these libraries are pretty important there, are they not?

Alberts: Yes. I think it's been a great—yes.

Q: Libraries everywhere. It certainly dovetails with the thought of Andrew Carnegie.

Alberts: Right. And Carnegie's provided some money to the Library of Alexandria, for example, for certain projects.

Q: Right. And one would certainly think of Vartan Gregorian as a great advocate of that kind of giving. But some people think of the library—in the old library, like the one in Chicago you went to when you were trying to impress your classmates in the seventh grade—as just a collection of books sitting there. Libraries today are connected to the technological world, to technology. And isn't that what they're trying to do in South Africa also?

Alberts: Well, the Library of Alexandria has got lots of books but it's fundamentally electronic—a free electronic access library for the Arab world and the rest of the world. It's been scanning all these important books written in Arabic from a long time ago and putting them up for free on the web—a tremendous number of electronic resources.

Q: Right. Of great consequence, no? Just the accessibility, globally.

Alberts: The problem is you have to connect all the people in the Arab world to the internet with some bandwidth—otherwise they can't get it. So that's the next step.

Q: Well, they weren't doing too badly in Maghreb during the Arab Spring, were they? In terms of social media, anyway.

Alberts: Somebody told me that, in fact, only about fifteen percent of the people are connected well, but that was enough [laughs]. It probably is a larger proportion of young people. No, but if you look at what the politicians are saying now, they're talking about—the presidents who are running, for example, are talking about when they have their administration, making sure they have forty-five year olds in important positions, which is very unusual for Egypt.

Q: Didn't President Obama name you and a couple others as envoys?

Alberts: Yes. I got assigned as a Science Envoy to Indonesia and Pakistan. I'd never been to either place. And Pakistan—

Q: When was this?

Alberts: Pakistan turned out to be impossible. I did only one thing with Pakistan, but with Indonesia I've been extensively involved. I'm going to be going for my fourth trip in a couple of months. That's been a very wonderful experience to see how science can do something for a

country like Indonesia. Great opportunities. The first three envoys took the job because we had no idea what an envoy was [laughs].

Q: What was the charge, though, to you?

Alberts: To use science for diplomacy.

Q: Use science.

Alberts: Yes, yes, yes, science. To try to build goodwill between Indonesia and the United States through science by helping Indonesia with their science and making personal connections between American and Indonesian scientists. We've been working our way through trying to figure out what this actually would mean and how to make it a much bigger program. In other words, it's not only important to Muslim-majority nations, and it's not only one senior scientist like myself that's needed per nation but multiple ones. The first three of us are going to supposedly write up what we learned, but the other two are even more busy than I am, so they sent me their PowerPoint slides and their essays. I'm supposed to be writing the first draft and I just haven't had the time.

Q: But when you were there in Indonesia, what are they looking for?

Alberts: Our job is to ask what they want and try to meet their needs. The first meeting was with young scientists selected by the Indonesian Academy president, my partner, Sangkot Marzuki,

who is a wonderful man. We spent three days in a remote island where he was asking the next generation of leaders what they wanted. So that was where we came up with this idea of helping them develop a competitive grant program for scientific research. They had no merit-based, competitive program. So we're about to produce a report, which is what the Indonesian Academy helped to do with the World Bank, on establishing a National Science Foundation kind of research grant system in Indonesia: a report that addresses why would you do this, and how would you do it? Otherwise, the best young people have no access to resources directly.

Q: How would you fund such a program?

Alberts: Well, the government wants to spend more money on science. They're spending very little.

Q: The Indonesian government.

Alberts: Yes.

Q: By the way, do you ever get tempted when you think of an idea to say, jeez, I'll pick up the phone and I'll call Vartan Gregorian because I was a trustee here. Ever get that feeling?

Alberts: [Laughs] Well, yes. I talk to Vartan. This morning, we talked about this science envoy idea. I have also talked to Vartan about a few things in the past. But I feel a little awkward about doing it. If Vartan sent an email to the trustees—"if you have a good idea how the foundation

could make investments that, in your world, would make a huge difference, please send it to me"—I would provide ideas much more effectively. In a sense, you feel like you're exploiting your former position. So that'd be an interesting idea but you don't want to exploit your personal relationships and your historical ties to the foundation to make people do things they don't think make sense.

Q: Well, by the way, when you're out in that part of the world, do you ever go by China?

Alberts: I go to China all the time.

Q: All the time?

Alberts: At least once a year.

Q: Doing what?

Alberts: *Science* magazine has an office in Beijing. I'm kind of doing science envoy things in China as well. I have lots of friends in senior positions because of my Academy days.

Q: Is the Carnegie Corporation involved, as far as you know, in—

Alberts: No. I don't think so. It's not a former Commonwealth country.

Q: In 2008, while you were on the board here and after you had left the Academy, you had an opportunity to sit down with Wen Jiabao, the Premier of China, didn't you?

Alberts: Well, yes. Not through Carnegie. For *Science* magazine.

Q: For *Science* magazine. Right, right.

Alberts: He's a scientist. He turns out to be the liberal faction of the politburo, as we've learned in recent years, yes.

Q: Well, recent days even. But I was interested in something he said in response to a question that you put to him. And he said, "We hold fast the policy of opening up to the outside world. To bring in the best brain power in scientific and technological talents through opening up is most important. From this perspective, scientists can leap over barriers of ideology and national boundaries to serve all of humanity. I can assure you that we will certainly create a good environment for scientists from the outside to work in China but I don't believe this is the main thing. They should feel that they have the right conditions to develop their careers in China, that they are respected by China, that the results of their work are respected by China. This will require us to protect their independent creative spirits and intellectual-property rights." Now, that sounds almost like he's asking American scientists to move to China.

Alberts: Well, there are American scientists moving to China but these are people born in China. I think it'd be hard to move to China unless you spoke Chinese [laughs]. It's a very complex,

interesting society but I think most American scientists who'd be tempted to move to China because of other reasons hesitate because they feel they'd be really cut off by the language issue.

The other thing about China, of course, is they continue to have two different warring factions, or at least two, and Wen Jiabao's on one end and others are on the other end—I don't even know who they are. So they keep on doing these crazy things, arresting people who are just speaking out trying to improve the country. So that human rights issue, broadly defined, makes it hard to attract scientists there from outside because those kinds of issues of free expression are going to be important for science and for scientists. And I'm sure that Wen Jiabao knows that and, presumably, he was partly referring to that. You hear the current leadership talking about that—others besides him—we have to do a better job on human rights. But my impression is that, as in this country, there's a real balance of power there. They're all arguing about whether they should arrest this guy or not and often the good guys lose.

Q: But in your time there representing science, do you get a sense that they are in a different realm than the West in terms of resources put to science or interest in—

Alberts: They have huge resources, much better than the resources a typical American scientist has. We had a very interesting editorial in *Science* by two leading Chinese scientists who spent their mid-career in the United States and went back—one is a dean at Beijing University and the other one's the dean at Tsinghua University, the two best and most famous universities in China. They're both deans of biology. They've been trying to fix some of the problems they see, the corruption really, in science funding and the spirit of Chinese science, which to a large extent is

based on who could get the most resources and the largest research group and the most prestige and the most publications—because they count publications. They point out many of the problems that China has now with its culture of science. A really interesting open question is whether they can really succeed while, at the same time, they have this ambiguous message they send about free expression. Scientists have to be able to criticize. There are scientists working on environmental issues. We had that situation in [President George W.] Bush's government here, where a government scientist was talking about climate change and the government wanted to quiet him. There was a huge uproar about that. And I think we fixed the problem. But what would have happened in China?

Q: Well, do you recall—among the many, many battles you've been in, you were co-chairman of something called the InterAcademy Council when it produced a report that I believe was chaired by Steven Chu, now the—

Alberts: Co-chaired.

Q: Co-chaired—now the Secretary of Energy, called—

Alberts: "Lighting the Future," I think.

Q: "Lighting the Way Toward a Sustainable Energy Future." Now, speaking of the fate of reports, this is a two hundred page report, including a lot of recommendations for long term research efforts, economic policies and initiatives in the private sector. "Increase the efficiency

of fossil fuel use, accelerate the development and testing of techniques to cheaply capture and store the billion tons of carbon dioxide generated by burning," et cetera, et cetera. "Sustainable energy is the equivalent of the U.S. moon shot," Dr. Chu said. And then you said that "the independent academies would now press the case for their proposal to the respective governments."

Alberts: Yes, they did. Many of them had national symposia. But of course, you're fighting strong economic interests here. You could see that in the United States. Even the Academy Council can only make reports and then help its member academies, a hundred academies, to try to mobilize them. And I think it's had an effect. One of its great effects is it really prepared Steve Chu for this job [laughs]. It prepared Steve Chu for his job as Secretary of Energy. He didn't have all those connections that he now has because of that report. He learned a lot from co-chairing that report and he also met leading experts around the world. So one of the important outcomes of that report was strengthening Steve Chu's ability to be effective as Secretary of Energy. It's interesting. I wonder whether he would have been given the job had he not been co-chair of that report.

Q: Right. You were in India just recently.

Alberts: Yes.

Q: And you said in India in March, "There are so many problems before us. We need to do intensive new kinds of work and new creative ideas to create new technologies for meeting

energy needs, both energy saving and energy harnessing," what we were just talking about. You go on to say, "We face a forecast of major food problems due to increasing population and wealth in the world. We have many different environmental problems, all needing scientific solutions, such as water shortages, how to use science to use water more efficiently. We also face health threats. As the world gets more crowded with people and animals the chance of major pandemics or infections increases. There are almost unlimited challenges to world science." Now, there are probably even more challenges to world science than there are reports [laughter]. When you tell this to these Indians, do you get the sense that they're ready to do something?

Alberts: The scientists in India?

Q: Yes.

Alberts: The scientists are terrific scientists and there is a terrific scientific community in India. But in most countries, I would say, including the United States, the scientists don't have enough influence on the politicians. Because of the public—you could see it in spades in the United States—the public doesn't understand enough to adequately discredit Governor [Rick] Perry's statement that the only reason why someone like me believes in climate change is that scientists can get grants by believing in climate change. How could you get away with that if you had an educated public who understood science? This problem in the United States is even greater in less developed countries. So we've got a real problem with the fact that we have democracy spreading around the world and a lack of appreciation for science. This is a huge issue. China can do better things than India can do because they don't have to listen to the public [laughs] and

they can't be manipulated in a way that Americans and Indians can be. I had an interview with the prime minister where we talked about the fact that they—

Q: Of?

Alberts: India—[Prime Minister] Manmohan Singh in *Science* magazine. He talked about his frustration over genetically modified crops. It's another issue in India. They developed their own modified eggplant. Their own scientists recommended it be allowed to go forward and the environment minister vetoed it. So Singh expressed his frustration at that. The only reason that could happen is that people are scared, they don't understand science, and it serves politicians' interests sometimes to speak in non-scientific ways.

Q: Just parenthetically, I appreciate what you said about the need to have a certain method of scientific thinking for everyone, especially in a democracy. I appreciate that. But when you enumerate a series of problems like that—everything from water to health and this and that—do you recall ever, while you were a trustee here at the Corporation, thinking, good God, we have to get involved more in this area of health or this or that that we're not doing, and raising it and not getting anywhere with it?

Alberts: They tried. I don't know what actually happened. They were planning to do something on water. I don't know whether that actually—

Q: It didn't go too far, I think.

Alberts: Yes.

Q: That was around the beginning of your term.

Alberts: Yes, yes. We've had a lot of discussion but I didn't see what happened.

Q: Something about it got overtaken—

Alberts: Part of the problem is that all these—it's like doing science. Giving away money is like being a scientist. There are all these wonderful things that you'd like to understand in science—many things, like human consciousness—but we don't know how to attack it directly. So what you do actually depends on developing a strategy that you think could make a difference, so you do something smaller than the whole thing. This is the way foundations also need to work. You can't just say, well, I want to solve world hunger and then devote your entire endowment to trying to do that because you need to have a sound strategy for doing that. It's one thing to want to do it. It's another to have a strategy that you think, with your resources, could make a big difference. I think foundations have got to behave like scientists. Everything depends on designing a strategy that really seems like it has a good chance of succeeding. That was the case, for example, when Carnegie, under Dan Fallon, tried to change the nature of education schools. It turns out that the strategy sounded good but it demanded that the education schools follow through on their obligations and I think many of them did not.

Q: Well, actually, let me ask you something about foundations before we close. This is a perpetual non-operating foundation in a sense that it is intended to go on and on, isn't that correct? And it doesn't run programs. It grants to people.

Alberts: It's different than Pew [Charitable Trusts] now.

Q: Different than Pew now. But there are all sorts of foundations now. In fact, in recent years, there's been a growth of something called "giving while living" and giving your money away. [Charles] Chuck [F.] Feeney, for example, is a prime example of that. I think even Bill Gates has said that he—

Alberts: Sure.

Q: And Warren Buffett.

Alberts: Warren Buffet, yes.

Q: That's right. Also, there are people—everyone from Bono to George Clooney to Angelina Jolie—throwing their hats into the philanthropic ring. You think that there are avenues created by these different kinds of people or efforts that could, if they zeroed in on a problem, make a difference? In fact, hasn't, for example, Gates made a difference in terms of malaria?

Alberts: Yes, they've made a difference. My criticism of Gates would be that they don't invest enough in capacity building, which is a long term effort. So the problem is that everybody's in a hurry. I think the Gates Foundation is in too big a hurry. And if you're in a hurry, like a politician, you often solve a short term problem but you don't do the best thing for getting the results that you want over the long term.

I think that's a fundamental problem everywhere in our society. Scientists are used to long term thinking but it often gets driven out by the short term—the need to maximize the number of lives you save in the next two years, for example. I think the Gates Foundation has done a lot of good but you could also take big money and do bad. If you put money in the wrong place you can empower the wrong people. So it's very tricky to be a good philanthropist. If you put money in the wrong pockets you could set things backwards. Giving away money is very difficult to do well. That's my conclusion from my years on different foundation boards..

I feel the same way at the Moore Foundation. We struggle with this all the time. They want to save the whole Amazon basin. The whole Amazon basin is almost that whole green thing you see on the map [laughs]. It's enormous. Should they have had a different strategy where they said they want to use Brazil as the example of what can be done to preserve the environment? Or maybe a smaller country, Colombia? So the question really is, just like a scientific problem, how do you actually have the most positive effect over the long term? What kind of investments will do that? Often it's not attacking the whole problem but a piece of it, even if at that time you can't see how the rest of it's going to be solved. And even if all of it needs to be solved to have the desired effect.

In education, we're talking at the Moore Foundation about maybe focusing on creating really high quality science assessments—tests that would drive good teaching and learning on the common core standards, trying to get a new community of outstanding scientists to work with outstanding experts in assessment to produce science tests that will actually test what we want students to know and, very importantly, emphasizing what was said in the Opportunity Equation. If teachers teach to the tests we need, they'll be teaching well and not poorly. Janet Coffey, the woman I'm talking about, that's kind of her hypothesis is at the moment. Her overall ambition is to change the nature of science education in the United States, but she's thinking that maybe that's the wedge that could most efficiently drive the process. But it's, of course, not going to be enough. You need other changes.

But that's the way you do science: I want to understand this but I can't understand all of it. Let me just try to understand this little piece, and maybe by the time I understand that little piece somebody else will have done something else, which will change the way I think for the next step. So scientists are optimists. I can work on science education with optimism because we see that that kind of step-by-step approach has provided such tremendous, unimaginable breakthroughs in science and technology.

Q: Right. But what you just now said a moment ago about tests, if I understand it correctly and I probably don't—beyond setting core standards, you have to have an appropriate array of tests to carry out those core standards to measure whether you're teaching and getting across.

Alberts: Yes.

Q: That would be, I assume, at this point, very embryonic. But it would almost seem to be as important as the standards themselves.

Alberts: Yes. Maybe more important because if you show what you're testing for, that defines what you're actually supposed to be teaching more than the standards do. So the problem is that—

Q: But is it Utopian to think that you could get away from the kinds of testing that you abhor that require filling in the blank? This past Monday, the *New York Times* had an article about a recently released study showing that computers are capable of scoring essays on standardized tests. Essays. Data collected from sixteen thousand schools can grade up to sixteen thousand essays in twenty seconds.

Alberts: I didn't see that. I've been in Cairo. [Laughs]

Q: Now you can have that. But the point is that, okay, let's say in the states they all figure out what these core standards are. Then somebody simultaneously goes to work on the test. You're living in a world where computers can do this thing a lot faster than humans.

Alberts: Yes, that's the hope. That's part of the effort that Janet's talking about. Because if it's too expensive—the more expensive the good exam is to give and grade, the less likely that

anybody is going to use it. So part of the effort is to try to figure out these kinds of things. How can we use computer technology? I think that's a basic assumption of any next generation assessment. It's going to be given on a computer. But how exactly to validate what the computer gives as a grade on an essay question? There are all these strategies that need to be worked out because you can't leave it to the computer alone at this point.

Q: You'll fall down either laughing or crying when you read this article in terms of the kinds of mistakes that computers can make. Here is a professor at MIT [Massachusetts Institute of Technology] I think, and he writes up these essays and they're fed to the computer. He puts crazy things in the essays and he shows how inept the computers are in figuring out what is really being said here. So we're not there. All I was really getting at is that, is it possible we still live in a world where a student is going to have the right standards set for him, where he's going to have a good test to measure what he's learning and where you're actually going to have qualified teachers who are going to read something comprehensible that the student has written? Are we beyond that? Is it still possible?

Alberts: It's possible. My daughter's a science teacher, by the way, so I know a lot about this. The amount of time they have to spend to do it well is enormous. And society does not appreciate it. Basically, the 1998 California science education standards said that the teachers are robots—we'll just tell them what they have to do. And that kind of teacher is not worth having.

Q: Is everyone in your family involved in science?

Alberts: My wife's in art history and she's a docent at the Asian Art Museum [of San Francisco]. So she's not a scientist. But my kids are all scientists of some kind.

Q: Right. You forced them into it, did you?

Alberts: No, no. They actually all went to college doing something else. I was writing a textbook and I was never there. They thought they didn't want to have anything to do with science. [Laughter]

Q: Okay. Before I let you go, the experience of having served as a trustee here, was it personally valuable in any way?

Alberts: Yes, it was very valuable. I met all kinds of wonderful people. I learned different ways of thinking. I still use some of my contacts from time to time. I gained an appreciation for what could come out of getting people together who have such different perspectives trying to work on a common issue and how these people would have very different ways of looking at a problem.

And this is a lesson for school systems. School systems are all run by administrators who were former teachers. They should have a mixture of people. You need a mixture of different kinds of people to really make the best institutions.

Being a trustee at Carnegie was just a unique experience. The people that I met were incredibly interesting. They have these events where they get trustees together for a dinner once every ten years or something. [Laughs]

Q: You mean the ones who are still alive?

Alberts: But I think we should have a two-day retreat [laughs] because a dinner is not enough.

Q: Right, right. Okay. Is there anything more you want to add?

Alberts: Not at all. Thank you very much. It's been great.

[END OF INTERVIEW]