

An interview with
Anthony Ralston

Conducted by Bernard de Neumann and William Aspray
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ABSTRACT

Anthony Ralston received his Ph.D. from the Massachusetts Institute of Technology in 1956 under the direction of M. Eric Reissner. As a graduate student, he worked for Ferranti (an electrical engineering company in England famous for developing the second commercial computer – the Ferranti Mark I). He joined the American Cyanamid Company after his PhD. He subsequently took a faculty position at Stevens Institute of Technology, and then joined the faculty of the State University of New York at Buffalo where he held the position of Director of the Computing Center and Professor of Mathematics. In this interview, Ralston discusses his work in numerical analysis, computer science, discrete mathematics and mathematics education. He talks about the books he wrote or edited in all of these subjects and his experiences as an officer of the Association for Computing Machinery (ACM) and the Mathematical Association of America (MAA).

ASPRAY: You spent four and a half years I guess it was at Stevens Institute of Technology. Why did you decide to leave? What did you want to do? And what did you do?

RALSTON: I didn't decide to go. I had good years at Stevens. I got promoted. I had regular consulting at a company that you may know, Keuffel & Esser, famed for slide-rules, but I did my consulting with them on ray trace programs. So that was all fine. I had a nice life out in Montclair, New Jersey. By that time I had three kids.

But I got offered the job in Buffalo. A guy who I later got to know very well, but that I hadn't known at all before, was the Vice President of Research there. He contacted me, and why did I take it? Yes, it was a fair amount more money. But since I had already left the American Cyanamid Company for a much lower-paying position at Stevens, that couldn't have been my only motivation. Well, having three kids does change your outlook on these things. Anyhow, at that time SUNY (State University of New York) looked like a place to go. Those were the years when Buffalo just started talking about itself as the "Berkeley of the east". I mean, that was always nonsense, but at least it was a very rapidly growing, very rapidly improving university. Five years before I went there, Buffalo had become part of the state university. It was part of Nelson Rockefeller's plan to build himself a monument. New York was one of the last states in the U.S. to have a state university. Before that it had normal schools, teachers colleges, things like that, and Rockefeller decided that they were going to have a state university. Perhaps they started building Binghamton in those days, or took over what had been Harpur College as Binghamton. I'm not sure exactly when that happened, but New York State decided that it needed a university center in western New York. So one possibility was to build one; another possibility was to shop around for one. And they found a good old second-line private university, the University of Buffalo. So they went and offered them a deal—a lot more money, all sorts of things. Well, like most academics, those at the University of Buffalo didn't think they wanted to be taken over by the State of New York, and so they didn't make a decision, or they said no, or whatever. Then New York State came up with the clincher. Namely, "Well if you don't do this we'll put up a big university right next to you," and that clinched the deal. And so what had been the University of Buffalo became the State University of New York at Buffalo. In the five years before I went, the budget quintupled. So there was a lot of growth, and they got a lot of very good people in. So Buffalo looked like a place to go to, and so I did.

ASPRAY: And your appointments were where in Buffalo?

RALSTON: I was Director of the Computing Center and Professor of Mathematics.

ASPRAY: Was there a computing program within mathematics at the time?

RALSTON: There was essentially none. One of my charges was also to start a computer science program. You can't do these things at universities these days. I went there in the autumn of '65. And the Department of Computer Science started operating in the autumn of '67. So two years to write proposals, to get it through all the faculty committees, to hire staff, and to start---you can't do that kind of thing anymore.

ASPRAY: What did you find? What did you build? Buffalo: tell us about that.

RALSTON: Well, of course, first I built a much bigger computing facility than what was there when I went. When I went there was, I think, an IBM-704. One of the first things I did when I went there was to plan to upgrade that to a more major computer. Well, my colleagues and I, but it was mostly my

decision, shopped around for what we wanted, and we ordered a CDC-6400. It is a machine you probably remember. But there's an amusing story attached to that too, namely that at both Albany and Binghamton, which by then were university centers, they were also looking for new computers. Albany got some CDC machine, but I think it was a 1604 because Albany was much smaller in those days. Binghamton ordered a CDC machine, also a 1604 I think. But Binghamton was right across the street from the large IBM facility at Endicott, and IBM swung a lot of weight in Albany in those days. So the result was that the Director of the Computing Center got himself fired. But in Buffalo I had my way, and we got a 6400.

ASPRAY: Was there pressure from IBM there too?

RALSTON: Not on me. Whether there was pressure on other levels I don't know, but I never felt it. It was never transmitted to me. I had had a quite good relationship previously with the IBM office in Buffalo and with the guy (Henry Bryce) who headed it, and I'm sure he was chagrined, but there it was.

So we got a 6400, and that at least made us a fairly major computing center. We built a fairly sizable staff from almost nothing when I arrived. And I started the Computer Science Department in those years also, and thought unreasonably that I could both run the computing center and chair the Department of Computer Science. I stuck with that unreason for, I guess, three years; or two years, but anyhow I did it for three years. But after a couple of years I realized it wasn't doable in any reasonable sense.

ASPRAY: And you moved over to the Department?

RALSTON: Yes, right. I decided that since I'd been running computing centers by then for about ten years, maybe I'd had enough of doing that.

ASPRAY: Would you have been welcomed and would you have felt comfortable to have stayed in the Math Department?

RALSTON: I would have been welcomed I think, and I would have felt comfortable in the sense that it was a quite reasonable department getting a lot better. In those days, as many departments did, it housed both mathematics and math education, although some years later math education, as it did in most places, split off into the School of Education. But that was a tiny part of the department, so it was a nice place to be. I would have been quite happy there. But it was part of my charter to start a Department of Computer Science, and I believed in Departments of Computer Science, then as now. I retained my appointment in mathematics, although I made no use of it, for the remaining 30-odd years I was there.

ASPRAY: How hard was it to recruit faculty?

RALSTON: It was fairly hard, but not as hard as it became some years later. So we started off with four or five people. The only one you might know is Nick Findler, who later went to Arizona and is recently retired. Among the people who started out, who else besides Nick do I even remember? A couple of young people who probably didn't stay with us very long. Oh, we recruited one numerical analyst. Was he with the department originally? Well, nearly so, anyhow. An interesting man, Arthur Stroud. You know the name?

DE NEUMANN: Oh yes, yes.

RALSTON: Art Stroud was in numerical integration, and he was very good, but he was that very rare beast—a mathematician in a university department without a Ph. D. I consider it one of the better things that I did while I was there that I got him promoted to full professor despite not having a PhD, because he was very good and had published a lot of very good stuff. And he may have been one of the original faculty in the Department. I'm not sure of that any more. So I recruited four or five people, and that was enough to start with. Then over the next ten years we recruited quite a number of people, good people. The Department got a quite good rating in the first rating of computer science departments that was done in the U.S. There weren't all that many then, but we were rated in the top fifteen of maybe thirty to forty departments, something like that. And the prospects were good I think. I mean, it was always hard to recruit in Buffalo, right? So if you know Buffalo, it's not the most attractive of American cities, particularly this time of year (January). So it was a hard place to recruit to, but we did pretty well.

We never got as well supported by the University, I think, as we deserved. So in fact the department at the end of the '70s still only had ten or eleven people in it, which wasn't really enough any more. But those were the years in which the great budget growth of Buffalo had not just slowed down but stopped. And maybe I didn't play the game of threatening the administrators with one thing or another as well as I might have, but it became a real drag by the end of the '60s. So in 1980 I finally resigned as chair.

ASPRAY: Yes. But stayed on as a faculty member?

RALSTON: But stayed on as a faculty member, oh yes, for a long, long time. Parenthetically I might note that in those years Buffalo was not only growing very fast, but it was paying some of the best salaries among universities anywhere in the U.S. One year, at least, full professorial salaries at Buffalo were better than at Harvard. This has long since ceased to be true, although the State University of New York still pays well. In those days it paid *very* well.

ASPRAY: What did the Department become strong in?

RALSTON: Well, in one sense it wasn't a big enough department to be strong in particular areas. The thing that we became best known for, for a few years, was computer tomography because we had one person in the department that you may know, Gabor Herman, who is now at the University of Pennsylvania—well, he's now at City University I guess in the graduate center, but he went to the University of Pennsylvania. But he became very well known in computer tomography, built up a quite good group of his own with lots of grant funds, and it was probably the best known group in the world at the time he left, which of course was why he was so heavily recruited, with his group, by the University of Pennsylvania. So that was the thing we were best known for.

In other areas we only had typically one or two people because it was such a small department. We had people like Bob Rosin in software systems and we had Nick Findler who was well known in artificial intelligence. Who did we have in Theory of Computing? John Case, who later went to Delaware. So we had one or two good people in a lot of areas, but you wouldn't call it strong in those areas.

ASPRAY: Why don't you just take the reins and run and tell us about the rest of your career.

RALSTON: Well, one of the things I tell people is that I've always had a short attention span. So I spent ten years or so after I got my Ph.D. being a numerical analyst. Then having done a second edition of my numerical analysis book with Phil Rabinowitz [First Course in Numerical Analysis, McGraw Hill, 2nd ed., 1978] That came about in an amusing way. I was at the IFIP Congress in 1974

in Stockholm, and there was a reception at the City Hall in Stockholm. There were hundreds maybe thousands of people milling around, and Phil came up to me there and said, “How about you and I doing a second edition of your book?” And that’s how it came about. So I spent ten plus years as a numerical analyst. I then did computer science for the next ten years or so. I wrote a few papers and programming languages and things like that. I then spent ten or so years as a discrete mathematician, combinatorics and things like that. And finally, I have spent the last, it must be fifteen years now—I’ve been doing it too long—in math education. So those are the four big periods of my professional career, and I probably never stayed as long as I might have in any one of them. But no regrets. I’ve had fun.

ASPRAY: We’ll come back on the technical side of this in a minute, but why don’t you talk about organizational things, jobs, retirement, move to England, and so on.

RALSTON: Well, I was chair of my department until 1980. It was in 1968, I guess, that George Forsythe, who I had come to know, called me up one day and asked me how I’d like to become more active in ACM. Because I really hadn’t been active at all except for journal editing and that kind of thing. I said, “Well, that might be fun.” So he had me nominated as a candidate for Northeast Regional Representative. Now ACM, as opposed to most professional societies worldwide, has really competitive elections. In most societies, even if there’s a veneer of competitiveness, the thing has been decided ahead of time. But not in ACM. So I ran for Northeast Regional Representative, and who did I run against? Jean Sammet, and I won. In those days women weren’t getting elected to things. Nowadays she would just clobber me. She has become a very good friend over the years. So that was my first involvement for ACM.

Then only two years later, for reasons which are obscure to me and perhaps obscure to the people who suggested it, I got nominated for Vice President and won that election too. Who did I run against? Maybe it was for Vice President when I ran against Jean. It makes more sense that I ran against her for Vice President than for Northeast Regional Rep because she was somewhere in Maryland or something like that. So it was probably the Vice Presidential election when I ran against her. I don’t remember who I ran against as Northeast Regional Rep. It was a natural progression at ACM for the Vice President to be nominated for President, but not necessarily to win, although you had a leg up, of course. I did win that. So those were my six years of big association with ACM, and then two years as Past President on the Council and things like that. I have done some things for ACM since then, but I disassociated pretty much after I left Council as Past President.

Those are things I look back on with great pleasure. Someone once asked me if anyone had asked me would I have run for another term as President, and I said, “No. Being President of ACM is something I wouldn’t have forgone for the world, but not something I would have ever done again for the world either.” It was a very strenuous two years. The number of planes I took at seven o’clock in the morning from Buffalo to New York and coming back on eleven p.m. planes that night are more than I care to remember.

ASPRAY: Let me come back and ask you a lot of more detailed questions about that a little later. Let me get finished with your career material right now.

RALSTON: Sure. So I got involved with AFIPS in those days too. I guess during my time as Northeast Regional Rep, Bernie Galler was President of ACM, and he invited me to be the ACM representative on the AFIPS Executive Committee. So I did that. I guess I like those things. You can lower the rating of my intelligence as much as you want, but I guess I like those things, and so I did that. I guess I stayed on the Executive Committee for some time: while Walter Carlson was President of ACM, while I was President myself? I don’t remember. But anyhow, at some point I was invited to

run for President of AFIPS, and did. AFIPS didn't have very competitive elections. It was just an election by the Executive Committee, or Board of Directors, or whatever it was. So I became President of AFIPS in '75, and that was normally something which ran for two years; except in my case it didn't, and the reason it didn't was because it was at that time that I proposed to AFIPS that it publish a magazine which later was called *Abacus*, because at that time almost all of AFIPS's income was from the then joint Computer Conferences and later the National Computer Conference. I thought it a bad idea to have all of your income from just one conference like that. Events in some sense proved me right because the National Computer Conference collapsed at some point when some of these various branches of the computer industry organized conferences.

So I proposed that AFIPS publish a general interest computing magazine. And that got me into a big fight. A lot of people opposed that. It never got approved by AFIPS, but in fact it created enough ill feeling so that there was a lot of opposition to my running for President for a second year. You had to be elected again. In fact, before the election I withdrew my name. What would have happened if I hadn't is a little hard to say. But anyhow, so I had one year as President of AFIPS, and that really was my last involvement with professional societies in the U.S.

ASPRAY: You did journal things, right?

RALSTON: Yes, journal kinds of things, but nothing else -- Well, I should take that back. I did serve one term on the Council of the Math Association of America. I served one term as the representative from computer science.

ASPRAY: Were you active in SIAM?

RALSTON: I was never active in SIAM. I used to go the SIAM meetings, I knew a lot of people in SIAM, but I was never active in SIAM. At least not that I recall.

Yes so academically I went through those various phases, and I kept publishing some papers, but mostly I kept writing books and editing books and things like that.

ASPRAY: So why don't you talk about that?

RALSTON: Well, after the numerical analysis book, I did publish one introductory computer science book, which was something of a bomb, but not entirely. I thought it was an interesting idea. It wasn't a bad idea to write a comparative language book, so I wrote a book which gave all examples in four languages: Fortran, PL1, COBOL, and-- it wasn't APL because I didn't know APL. What was the fourth?

DE NEUMANN: ALGOL?

RALSTON: ALGOL maybe, ALGOL perhaps. I think you're right. [Actually it was ALGOL.] One of the people I got to know as a graduate student, he was a few years ahead of me at MIT, and got to know much better later, was Al Perlis. ALGOL reminded me of that.

So I wrote this introductory text. And I co-edited (with Herb Wilf) three volumes of *Mathematical Methods* for Digital Computers. But I guess the next important thing or at least major thing I did was the *Encyclopedia of Computer Science*. That was something that was not my idea. I wish I could take credit for it, but it was Isaac Auerbach's idea. He knew me from AFIPS generally, and he called me up and suggested this idea to me. I picked up on it, and it went from there. So the first edition was published in '76. I remember starting work on it on a sabbatical in London in '71-'72, I think. But like all of these things, I have never been very good at estimating how much work was

required. It was a lot more work than I had anticipated. I did get to work with a young man, Chester Meek, who I had hired originally as Assistant Director at the Computing Center at Buffalo, and he was a very hard worker and very good, and that helped a lot. But it was a lot of work, I mean, getting after all of those deadbeat authors who promised you things and -- well, if you've edited books yourself, you'll know about that --- here we had two or three hundred authors — it was a lot of work.

But it turned out to have been a very successful project in terms of how it was viewed and how many copies it sold and things like that. So I've done three more editions of it. The most successful was the second because those were the days of the heyday of book clubs in the U.S., and this book was picked up by the Library of Computer and Information Science as one of their lead-ins. You paid \$4.95, or whatever it was, and you got a copy, whatever your commitment to buy more books was. The authors, the editors didn't get a lot; I think it may only have been a dollar or two a copy, but they sold through that book club over a hundred thousand copies of that edition. It was just amazing. Well, book clubs have always amazed me because I know people buy things from these books clubs that they have no intention of reading, that they have no ability in many cases to read. Going back again, I remember the first volume of *Mathematical Methods for Digital Computers*. It was picked up by the then Library of Computer Science the first year it was published, I guess, and they bought 25 copies of it, and I can still remember the royalty check—it was something like \$5.62, and that was that. But then about a year and a half to two years after it was published it was picked up by the then Library of Science of which the Library of Computer Science had been an offshoot, and they put it on that list. This book was now two years old. It was relatively obsolete at the rate computing was going in those days. And yet within a period of a few months they sold three thousand copies of the book. I know it was bought by people who thought it would look pretty on their bookshelves, and for no other very good reason. That's the way these book clubs work.

ASPRAY: Yes. How did your colleagues feel about your spending your time working on textbooks and encyclopedias and such?

RALSTON: Well, I don't think they had a problem with this, or at least if they did they didn't tell me. In part that was because I was doing my job as chair of the Department I think reasonably intensively. I've always put in a lot of hours, so I had enough hours for that. I was teaching probably one course a semester while I was chair. I was doing the recruiting thing pretty well. So I don't think there was a problem with that. In fact most of my colleagues in the Department were contributors; maybe they thought they had to be; I don't know. But I didn't have any, certainly no overt problems with that.

So I did four editions of that, and those four editions certainly kept me busy at the high point of each for a year to a year and a half, probably, from the period of the early '70s until, could it be 2000? Well, maybe. Maybe it was more than just a year, eighteen months to two years. Although of course, for the second edition I had an associate editor who became coeditor for the third edition, and for the fourth edition I had two coeditors. A fifth edition there probably will never be, but I can go into that later if you want. So I guess in the planning and everything, each of them took three or four or five years, not all of it intensive but some of it yes, although I have to say on the fourth edition I didn't do a lot myself. First of all, I was already too obsolete to do much of it, so my other two coeditors did the work. But the other three I certainly worked hard on. And there were other books you'll see on that list, for example, the *AFIPS Taxonomy* [Taxonomy of Computer Science and Engineering, AFIPS Press, 1980] that I edited..

ASPRAY: Looking back on the encyclopedia what value do you think it brought to the profession or to students or to the general public?

RALSTON: Well, I think the value to the profession is as it's perceived by people outside the profession, "Oh, here's a discipline that must have arrived in some sense." So in that sense it was a sign of computer science coming of age, so I think it was useful from that point of view. Lots of people have told me how they use it, and students have told me this, too. I was just involved in something recently where someone was telling about how a lot of people gave him a good opinion of something, and it recalled to me that I often said that, after you've given a lecture, people sometimes come up and tell you, "Gee that was a good lecture." But of course no one ever comes up and tells you that it was a lousy lecture. So I got a lot of praise for it, and not much of the other kind, but I don't think that means so much in itself. It has gotten good reviews. It had only had one really negative review, as I remember. That was Bob Patrick's review in *Datamation*, of one of the editions. I forget what he didn't like. He had some good criticisms. Of course, all of the reviews had criticisms—in a book that big there are bound to be things you can criticize. But they were generally good reviews.

ASPRAY: Did you get good people to write for you?

RALSTON: Yes. I think through all four editions, yes, but early on, certainly. Because back in the early '70s when we were producing the first edition and I was Vice President, then President of ACM and computer science was much smaller than it is now, I effectively knew everyone, so I knew who to ask and they knew me. And it wasn't that I leaned on people particularly because I didn't have much in the way of sanctions, but I got people to write. There were always people who refused to write, and sometimes there were people who agreed and then just didn't do it. But I always remember my good friend Herb Grosch refusing to write because we weren't offering enough money. I think for the first edition we offered two cents a word, and he said he wouldn't do anything for less than ten cents a word, or something like that. But most computer scientists, although I think computer scientists are not as good at this as mathematicians and other scientists in feeling an obligation to the profession, still you can ask them to do ridiculous things for small amounts of money and they'll do them. Computer scientists are less good at that, but still, a lot of them will do it, particularly if they knew you and they were friends and things like that. So it wasn't so hard to get people to write; it was much harder to get them to come through sometimes.

ASPRAY: Did the set of topics, and how you thought about organizing what the topics were for the volumes, change over time?

RALSTON: Oh, sure.

ASPRAY: I mean, not just in the sense that this new technology was there so you had to write about it, but did you have a different philosophy about organizing the book?

RALSTON: Not very. If you look in each of the four volumes you will find that in the front of the volume there's a taxonomy of the discipline which includes all the articles in it and some things that aren't in it. I organized it originally I think under eight different headings but now under nine different headings, and if you ask me what the difference is I can't pull it out. But that taxonomy was always there.

ASPRAY: And it was fairly continuous?

RALSTON: It was fairly continuous. I should just interrupt for a second to say that taxonomy grew out of the AFIPS *Taxonomy*.

ASPRAY: Yes the one that you'd worked on before?

RALSTON: The one that I worked on before.

ASPRAY: And since we're talking about that, how did that come about?

RALSTON: How did that come about? Well, it came about I suppose because the Computing Reviews classification system, which had been there unchanged since day one of Computing Reviews, was badly out of date and needed redoing. So someone, I don't know if it was me, I don't know if it was Aaron Finerman, I don't really know who it was, thought that not only did it need redoing, but doing the taxonomy of this discipline as part of that would be useful. So I agreed to chair the committee.

DE NEUMANN: Yes. And it resulted in a book that was published by AFIPS?

RALSTON: By AFIPS.

DE NEUMANN: On the encyclopedias did they get used the way you anticipated they were going to get used?

RALSTON: I don't know that I anticipated, Bernard. I mean, we all use encyclopedias from time to time of all kinds. I mean, I find that I use this one not infrequently to look up terms whose meanings I have forgotten or historical things which I want a date for. So I think probably the way I use it is probably the way most people used it. I think, particularly as the discipline has grown, all professionals of computer science know there are large gaps in their knowledge of the discipline, and to have a single volume which purports at least to cover the entire discipline is useful to have on your bookshelf to pull down from time to time.

DE NEUMANN: Yes. And how did you manage the question of getting appropriate authors as the field had grown by the time you were in the last couple of editions?

RALSTON: Well, one answer for that is that for the last edition, at least, which is the one I remember best in this sense, when David Hemmendinger became one of the coeditors, he is quite widely knowledgeable in computer science, so he was a very good source of names. We also, except for the last edition, where we didn't have one, had editorial board, and I asked those editorial boards for input on possible authors. For the last edition we decided we could dispense with an editorial board, but we did get the publisher to fork up some money so that we could do reviews of the previous edition and what new articles were needed and who might write the articles. And that works with some people, though it doesn't work so well with others, but it got us a lot of article names most of which we had thought about. But what it did get us certainly was a lot of names to ask to write the articles.

DE NEUMANN: If you had it to do over again -- well, in sort of a way you did because you did all of these editions, what would you have done differently?

RALSTON: Had more help on getting it done. You know, there probably should be a good answer to that that I would give you, but actually I can't. I would have chosen different publishers in a couple of instances. Did you see my paper in the annals about the encyclopedia?

ASPRAY: I haven't looked at it recently.

RALSTON: I wrote about it in a paper for the Annals [of the History of Computing], Bernard, whose title was “Four Editions and Eight Publishers: A History of the Encyclopedia of Computer Science”. So you can infer from that that a lot of the publishers didn’t work out so well. [Laughter]

ASPRAY: Tell me a bit about some of the other books that you’ve published.

RALSTON: So I’ve talked about some, but I haven’t talked about all of them. I’ve talked about the *Mathematical Methods* series. At the same time as I published that introductory computer science book, I published a little thing on Fortran IV programming. It doesn’t really count as a book, but it’s there. The Taxonomy we mentioned. Oh I did a book, which I edited with a mathematician named Gail Young, a quite well known mathematician, but he wouldn’t be known to applied mathematicians or computer scientists, which was called *The Future of College Mathematics*. I ran a conference at Williams College. The book was published in ’83; the conference was probably in ’81 or ’82. The conference was on the future of college mathematics, because one of the best-known papers that I’ve ever written, certainly in the mathematics community, was one called “Computer Science, Mathematics, and the Undergraduate Curricula in Both,” and that was published in *The American Mathematical Monthly* in 1981, and that was my first foray, I guess, into education *per se*. I sometimes tell people that, like most professors at research universities, I was never very interested in education for a long time. That paper got quite well known. You were asking me about the other books, and so I was talking about this conference at Williams College on the future of college mathematics, and that conference in 1983 grew out of, at least in my mind, that paper. I proposed at some point, I guess, to the Sloan Foundation, that they support a conference like this and they did, and that led to this book. Well, then of course listed here is a book called *The Sabbatical Book* with my wife. I thought I was an expert on sabbaticals, having taken four of them, albeit all to England, and we wrote this little book of advice for people who were going to have sabbaticals. I thought this is going to be a big seller—every academic was going to buy it. But then I made a crucial mistake; we decided to publish it ourselves rather than give it to a commercial publisher, and that was not a wise move. In any case well, it hasn’t happened recently, but I used to get requests for it occasionally from academics who had heard about it.

So then I edited a book on discrete mathematics for the Math Association Notes. Well, the next book of some importance was the book I wrote with Steve Maurer called *Discrete Algorithmic Mathematics*. That was during my discrete mathematics phase. Steve and I wrote this book, although we knew it was too hard for most of the courses being taught at the undergraduate level but which nevertheless has been well reviewed and has done fairly well. We published the third edition of this book (the second edition was really just correcting typos) in 2004.

I’ve edited various books. Here’s one done for ICMI [the International Commission for Mathematics Instruction], *The Influence of Computers and Informatics on Mathematics and Its Teaching*, which was done in 1993. ICMI is about to do another in this study series on the same subject, actually. I did a little book called *Teaching Yourself Algorithms* for a publisher in London, Hodder and Stoughton. You must know of this “Teach Yourself” series—there were probably a hundred and fifty books in it. So a colleague of mine, Hugh Neill, he was at one time Chief Mathematical Officer for the Inner London Educational Authority, and I wrote this little book on teaching yourself algorithms. I did a book on a conference called *A Zero-Based Mathematics Curriculum*. One of the papers you’ll find here is a paper on a zero-based curriculum. I got this idea from the obvious source, namely zero-based budgeting. I mean, supposing there was no mathematics education now and we had to invent it, what would it look like? The point being that, (a), there would be a lot more discrete mathematics *vis-à-vis* calculus at the university level, and (b) there would be a lot more technology at the elementary and secondary levels. These are still controversial topics. [In fact I’m going to my last hurrah, I suspect, as part of a two-person debate at the International Congress of

Mathematicians this August (2006) in Madrid on the subject of the reform mathematic curriculum, me being on the side of big changes and hopefully most of my audience being on the other side. I said to someone recently it's not fun preaching to the converted. It's much more fun to talk to a hostile audience.] So anyhow this book was on a conference based on that idea. And I guess that's it in books. It's enough.

DE NEUMANN: Yes, that's a lot.

RALSTON: It's too much.

ASPRAY: So why don't we go back through your career and talk about those four areas you've contributed to, having you talk about what major things you were, that you did, who you worked with, what the context was for them.

RALSTON: Shall I talk or shall I let Bernard...?

DE NEUMANN: Just talk and I'll join you.

RALSTON: Well, I mean, the first one was certainly numerical analysis. I don't think any of the papers I wrote were so important they need to be mentioned. The book was certainly the thing I'm best known for.

DE NEUMANN: Yes. Was there anything that drove you to think that numerical analysis was gaining in importance when you were still an undergraduate? I'm trying to say it from my perspective. I've picked up and run with all kinds of things in my life for no particular reason other than curiosity and then suddenly they became very interesting to everybody.

RALSTON: Yes. My perspective was certainly that computers were going to be very important and that this was the mathematics you needed for computing and that's what got me into numerical analysis. In this course I took from Kopal we used to do these great calculations, integration, ordinary differential equations on these vast pieces of paper where you would do differences and things like that. So it was fairly obvious that that kind of mathematics was going to be very important in computing. But it was computing that drove me into it.

DE NEUMANN: Yes. When you chose the numerical methods that would appear in your book was there any sort of guiding principle to that? Or was it a sort of, I'm not being rude, but a sort of cookbook of techniques that you knew of?

RALSTON: Yes. Well, the question was, what did I leave out?

DE NEUMANN: Yes.

RALSTON: I mean, one of the things I left out was partial differential equations. And I suppose, although look I mean, anything one says in an interview like that when you're going back forty years or so, should be taken with a grain of salt. But I think the reason for that was that that was the advanced edge of numerical analysis, and even though I was trying to write a book for, say, a first year graduate course, that typically didn't include partial differential equations. Now what else did I leave out?

DE NEUMANN: Well, you did a very comprehensive job. The thing that got me to your book was eigenvalues and eigenvectors. You did a very comprehensive coverage on that.

RALSTON: Yes. I did one chapter on numerical linear algebra and one chapter on eigenvalues and eigenvectors. At just the time, by the way, that the latter was changing a lot, because I hardly had QR and things like that in it.

DE NEUMANN: It mentioned it, though. That's one of the draws to it, because I couldn't find it in anybody else's work.

ASPRAY: How did you balance techniques, theory, and applications?

RALSTON: Well, there are almost no applications in the usual meaning of that word, except to solving problems in numerical analysis, not applications to real world problems. There may be a few, but there certainly are very few. My intent was to write a mathematically sound book. Not a theorem-proof book but a book that didn't leave things out in that sense. So it was always intended to be mathematically sound, and I think generally speaking it probably was. There are a lot of examples, many with computations, all of which I did myself, I think. Is that possible? Maybe it is. There aren't so many computations. They would have been easy to program. I remember one of those flattering things in my life about that book. I spent a month in Rangoon (now Yangon - to me it will always be Rangoon in Burma - I wouldn't give those miserable generals in Burma the satisfaction of ever using one of their words!) in the mid '70s at a UNDP project. Harry Huskey invited me to do that because he was involved with those things. And I taught numerical analysis. I gave lectures on numerical analysis. I didn't teach from the book so much, oh maybe I did, but I don't remember anymore. But I still remember one of the students there, a young Burmese girl, who had been spending, it must have been most of her life but I suppose it actually wasn't, doing all the problems in that book. Because one of the things that book has is lots of problems, and most of them are not computational. Most of them are theoretical mathematical kinds of problems. So I thought it was so flattering that this kid had been doing that, and she came to ask me a question about one or a couple of them at some point while I was there. So it was meant to be a mathematics book, although very much oriented towards actual computation.

DE NEUMANN: I think that's really what made it work for me, because I came from my quite pure mathematical background into an industrial research lab, trying to solve real problems and wanting to know about numerical analysis, and your book I found a particularly good book to pick it up from.

RALSTON: Nice to hear that. You know, I opened that book for the first time in ages yesterday. It had nothing to do with coming here today. But there was a thing on this math education listserv I'm involved with in the U.S. on significant figures and significant digits, so I quoted something from the book. [Chuckles]

ASPRAY: When the book first came out, a lot of the students who would have been seeing it were still mathematics students, but as time went on there would be more and more graduate students in computers science who might have had more of a computing background than a mathematics background. How accessible was the book to the computer scientist?

RALSTON: Well, I think by the time that might have happened, Bill, even though the second edition would have been published by that time, that the book was fairly obsolete. Even when the second edition was published it was in some ways obsolete, I think, so it's very hard to answer that question.

In the early days lots of computer science students took numerical analysis but almost always in computer science departments because that's where the numerical analysts were in the early days. And then gradually numerical analysis migrated back to mathematics departments, and, as that was happening, this book was becoming obsolete, so I can't really answer that question.

DE NEUMANN: So for me, though not the sort of work I did, I felt very much towards building or assembling methods that other people could use on computers to solve their problems with. So lots of effort that I spent was on trying to find ways of computing functions, and quite sophisticated functions, and solving quite sophisticated optimization problems and things. Did you see, when you wrote the book, that that was the sort of direction that things were going in that you in a way tried producing an automatic procedure for people to use computers themselves to solve their problems without the intervention of a numerical analyst?

RALSTON: Or to put in another way, perhaps, was I thinking about mathematical software?

DE NEUMANN: Yes.

RALSTON: I think the answer is no. I think I should have been, but I wasn't. Obviously I thought about providing things that people could program and use on computers, but I didn't think about large packages to do a whole class of problems.

DE NEUMANN: Yes, I guess that was sort of the next generation of things that came in as all this stuff became automated.

RALSTON: I think it would have been reasonable to have thought about that; I just didn't.

DE NEUMANN: Well, things have moved on in such strange ways since my day as well.

RALSTON: By the way, if you can get hold of it, just what you were talking about, get hold of the first volume of *Mathematical Methods for Digital Computers* and read the first chapter in it. It's about calculating functions on computers, but typically elementary functions. But it's a very idiosyncratic chapter written by a man who worked for IBM whose name you probably don't know, E. G. Kogbetliantz [Ervand G. Kobetliantz]. He spent a lot of his career doing this kind of thing for early IBM computers. So there's stuff about rational approximations and things like that, but it's sort of fun to read not, because you'll learn anything per say, but...

DE NEUMANN: Yes.

ASPRAY: You have so much experience as a textbook writer. What makes for a good textbook?

RALSTON: Well, I mean, they haven't all been very successful, Bill, so I'm not sure I'm a good person to answer that! You know, I never thought about writing successful books in that sense. Obviously I wanted people to buy them, et cetera, and wanted to send my kids to college on them and things like that. But I think one has to be careful with how one uses language. My coauthor for the discrete math book, Steve Maurer, is I think a significantly better writer than I am and did a lot more for our discrete mathematics books to make it readable by students than I did. I think I write fairly well, but Steve writes very well. And he has a lot of insight into what's hard for students and what's not. I think about this when I write—what's hard for students and what's not, what's likely to be hard—but I don't think I have a theory behind textbook writing at all.

DE NEUMANN: Would you think that good teachers write good books - good textbooks I mean? That's something that sort of occurs to me from time to time.

RALSTON: I don't know. I don't think particularly. I think maybe you have to be a good teacher... No, maybe you don't. There are a lot of personality requirements to being a good teacher. I used to think when I was recruiting for my department that one of the things I could judge very accurately, when we interviewed a candidate, with probably no major errors, was whether that person would be a good teacher. I couldn't infer whether the person would be good at preparation, do the preparation, all that, but I could infer whether the person had the personality to connect with students. Textbooks aren't quite like that, I don't think. There's some of that in textbooks. I think you always have to think about whether what you're writing is going to be easy or hard for the reader, and I always think about that, sometimes effectively, sometimes perhaps less so.

DE NEUMANN: And there's always the question of, in regard to publication, who did you write it for? You talk about graduate students and so on, and I on occasion found on some of the research things that I've done that it's next to impossible to describe it to anybody other than somebody that's working with me. In that respect, it's very difficult to write anything where people can learn from it.

RALSTON: Well, but it was true, for example, back in the '60s when writing the textbook for a first year graduate course in computer science, it was pretty clear, I think what topics you should cover. And the more I think about it—you asked the question earlier—I think I probably covered most of it, except partial differential equations. And you also know quite well what the mathematical background of the students coming to such a course would be. I think nowadays one perhaps knows less about the mathematical background of students coming to courses, particularly courses taught at the undergraduate level. But in those days at the senior-graduate level, one knew what mathematics they had studied. So in that sense one could tell where what one was writing was something that they were likely to have seen before, whether there were proofs of the kinds of things that they would understand from proofs they had seen before. Now you don't know if the students have ever seen a proof at all.

DE NEUMANN: Actually I was watching the screens down in the foyer down there, and they were coming to the proof of something, running through somebody's paper, just as a background wallpaper, I think. But I was intrigued to see a line that came up with outline of the proof, and then they cut it off straight away, the one bit I would have been interested to see. [Laughter]

ASPRAY: Did you teach from your textbook?

RALSTON: Yes. Not many times, but sometimes. I taught from various of my textbooks, and regret only one thing, which I corrected but not until towards the end of my career. I thought always when you use your own textbook in a course, you should kick back the royalty to the students. I used to do that the last few years I taught, but I didn't do it in the early years. And I don't think many people do it, but I think you should do it.

ASPRAY: Did you learn from that for making corrections in next editions and so on?

RALSTON: Well, I'm sure I found errors that way. I don't think I worked hard enough myself on the second edition to be able to say that my teaching of the first edition had made me glean a lot. Maybe I told Phil some things. He did most of the work on the second edition, the changes from the first

edition, and maybe some of the things I told him I thought were necessary, were a result of my teaching. But yes, I haven't done second editions of other books, even when I could have, because I always thought it was boring. Writing the book is interesting, but updating it isn't nearly so much fun. The *Encyclopedia* was different because so much had changed from one edition to the next on the one hand, and so much just stayed the same because it was historical things, biographies which didn't change, so that could still be fun. But just writing a new edition of a textbook, I never thought that was nearly as much fun.

DE NEUMANN: I think new editions are almost hopeless.

RALSTON: Well, I guess it's fair to say that one of my guiding principles, if I can be said to have any, in how I structured my career is at least in the last twenty five years or so, whatever I did had to be fun. Whatever else it was going to be, it had to be fun.

DE NEUMANN: Actually I thought that my motive for most of my career was just choosing things that looked interesting and then moving into them. It was good fun.

RALSTON: Well, at some point I had to earn a living, Bernard. I had to send kids to these pricey American universities. [Chuckles]

ASPRAY: So when you finished with your numerical analysis texts, was it because the fields had moved on, the balances in computing had changed, you were just tired with it? You were interested in something else? What was the transition to the next stage in your career? What caused that?

RALSTON: Well, I think first of all I probably decided I had done about as much as I reasonably could do in numerical analysis. I guess I could have written some more papers and things like this, but they were things I wasn't that interested in doing. At some point, anyhow, by the time the second edition came, the field had moved past me, so I was ready to do something else. When did I say I did that? About 1970. That was long before the second edition. Yes, I guess I was just ready to move on. I had gotten interested in computer science *per se*, or at least in programming languages. I had never been convinced, probably wrongly, but maybe not, that all this business about new languages was worth it, really, considering the upset it caused. I recognized the deficiencies of languages like Fortran, but I still thought that you could do most of what you wanted to do with them, and I think lots of scientists still feel that way. I still remember a meeting I spoke at in Switzerland where I gave the opening talk, talking about structured Fortran or some such ludicrous title, and the last talk in the meeting was given by Klaus Wirth, who had his chance to clobber me for what I said in the first talk. [Laughter]

ASPRAY: So how would you characterize your contributions to programming languages?

RALSTON: Oh, very limited. I wrote some things which people read; I did some things in Fortran which have led to other things; I wrote a paper with a colleague called "Structured Fortran", and that colleague took this on to other things, and the newer versions of Fortran have incorporated some of those things, I think. But I couldn't say more than that. I think my introductory book, trying to do a comparative study of programming languages, was in theory a useful way to look at this kind of thing, but I don't think it had a lot of effect.

DE NEUMANN: The languages, are well, I've just given up with trying to keep up with any languages. I'm one of those horrible people that sticks to Fortran, and I would go along with you—everything I wanted to do can be done in Fortran.

RALSTON: Well, I'm on a listserv that I'm a totally passive member of, which is run from the State University College at Geneseo in central New York State, and this is about teaching introductory computer science, which I was obviously interested in at one time and still stay on the listserv, although I have to say I don't even read most of the messages. But there has been a lot of talk recently in relation to which programming languages to be using. Which version of Java or Scheme or whatever, and these things are just beyond me now. I'm just not interested enough anymore.

ASPRAY: What was it that attracted you to look into programming languages in the first place?

RALSTON: Well, again, I'm not sure what the answer to that is, Bill. I did publish this book on Fortran in connection with my introductory book in computer science, so I had always been interested in that sense. I taught them quite a bit. I never taught programming languages as such, but I used to teach a programming language in connection with introductory computer science courses, so I was always interested in them from that point of view. So it was an area in which I had a sort of background interest in.

ASPRAY: And it was a period of time where there was a lot of interest in these issues, right?

RALSTON: Yes I had one member of my department, Bob Rosin, who was an early and continuing proponent of PL1, and I think was quite chagrined that it never went further than it did. We undoubtedly had lots of discussions about this, although I don't remember any as such. So that kept my interest going in programming languages. One of the things, by the way, that got me out of a love of teaching in the last 10, 15, or 20 years I did it, was the attitude of students towards these things. Although I probably didn't do it the last ten years I was a faculty member, I did it a fair amount before that teaching introductory computer science. In those days there was always a programming language that was part of that course. To me, it was always a vehicle to teach about computer science; to the students, it was their meal ticket when they got out of the university, and that was depressing. I mean, they couldn't have cared less about my talking, as I perhaps used to in those days when we got to a certain kind of data structure like a graph, about the Königsberg Bridge problem—they couldn't have been less interested. [Laughter] And just their general lack of interest in anything except the meal ticket kind of stuff, that was depressing. Do you find that now?

ASPRAY: Yes.

DE NEUMANN: Probably it's true. It seemed to me talking about computer languages, that the one thing it knew it needed to do was to be able to grow with the domain that you were trying to work in. And so things like PL1 seem like a good idea, but really, everything I ever wanted to do you can do in Fortran.

RALSTON: Yes, there were some good ideas in PL1; it just wasn't the right thing for the market at that time, and it was too complicated.

ASPRAY: So what moved you to become interested in discrete mathematics?

RALSTON: Well, I think the answer to that question is, first, that I knew I was never going to do a lot in mainstream computer science by the end of the '70s and early '80s. Discrete mathematics is fairly close to numerical analysis in a lot of ways, I mean, that's what numerical analysis is—it's discretizing continuous mathematics. So I got interested in a couple of problems. One problem I got interested in, which I've called when I've written about it, although it has other names, is the Baltimore Hilton Problem. It used to be true that when you went to the Baltimore Hilton Hotel, it's now true almost everywhere you go, that instead of having a key you got something else. Now it's usually a card, but in the early days there was often a dial on the door and you had to dial a four-digit number to get into your room. The Baltimore Hilton Problem was that, if you were a burglar and you wanted to break into a room, what is the least number of digits you would have to dial to make sure that you'll get in? This was a classical problem in graph theory (the de Bruijn sequence problem). I got interested in it, and actually came up with a fairly nice solution to one aspect of it. I wrote a paper about it. I guess that was my spur to doing more in discrete mathematics. There was graph theory, there was combinatorics—those are the guts of discrete mathematics, anyhow, in a lot of ways. So yes, that's what I got into. And I had gotten in contact with Steve Maurer when he invited me to come to Swarthmore to talk about the Baltimore Hilton Problem because he was interested in it too, and we stayed in contact and decided to write this book.

ASPRAY: So I know that there were lots of educational discussions about discrete mathematics and what role it should play in the computer science curriculum and so on. Can we talk about your position and your role in these debates?

RALSTON: Yes, I would say that that has not been one of my major successes, although it has been successful in some sense. I wrote this paper for the [American Mathematical] Monthly in which I proposed that discrete mathematics should play a coequal role to calculus in university mathematics. Well, it certainly doesn't yet, although one result of that, well not just of that paper, but in the ensuing 10 or 15 years there were at least 50 discrete mathematics books published, and it became a staple course in every computer science department. So how much influence I had in bringing that about I don't know, but that paper had some influence on that. Mathematicians are a hard nut to crack—as I'm going to find out in Madrid this summer—they are very slow to adopt new things. I don't for a moment belittle the importance of calculus. As I often say when I am talking about this, calculus is one of the great artifacts of humankind, and no educated person should not know something about it. But that doesn't mean that it should be the course that is the entrée of all of university mathematics. I happen to think, although I did a study of Math Reviews a few years ago, which didn't really bear out my thesis, I really think that an increasing fraction of mathematical problems will come from discrete mathematics, you know applied mathematics problems. There is probably some truth that that has happened, but not a lot if you look at Math Reviews, because mathematicians are still publishing their same old, ordinary differential or partial differential equations papers. But I really believed that discrete math was going to be at least as much an engine of new mathematics generally as continuous mathematics. Math departments certainly haven't bought that yet, although math departments tend to teach discrete mathematics now, too.

DE NEUMANN: I think there was some evidence from a few years back that discrete mathematics should start to appear in electronic engineering mathematics courses because of digital filter systems.

RALSTON: Sure. Absolutely. Because so much of what EE is these days, I mean, it's not power engineering anymore, is it?

DE NEUMANN: No, but I certainly took part in discussions about what mathematics should be taught to engineers, and we felt that that was a very reasonable thing--

RALSTON: Where was this?

DE NEUMANN: This was a national thing that the (UK) Institute of Mathematics and Its Applications, was trying to decide.

RALSTON: Well, I mean, there are lots of things that you do that don't come about for many, many years after you first do them, and probably not until you're dead. I've written a paper which proposes that all kindergartners be given calculators, although I'm not in favor at all of dumbing down mathematics or making it easy; quite the contrary. The title of the paper was "Let's Abolish Pencil and Paper Arithmetic." I really think this is going to happen, but not in my lifetime. Abolish in the sense of it not being the thing that kids spend hours and hours grinding away at. Of course, they need to know what arithmetic is, but not that way. But still I'm quite happy to have that picked up in 2050.

DE NEUMANN: Well, any education really ought to be recognizing the tools that people are going to be using, whatever they might be, which naturally now includes computers.

RALSTON: Well, what they need to realize is, getting to the last part, the math education part, is that the worst thing you can do for students is teach them something which the better among them know is useless to them. All this drill and practice of paper and pencil arithmetic has to be one of those things. So it's not a question of whether you can get them prepared for later mathematics with that, because you can, but you're going to lose a lot of mathematical talent. And maybe there are other and better ways of doing that preparation. Still I have no anticipation that everyone in Madrid is going to jump up and hooray when I say that in my talk.

ASPRAY: So can you characterize your positions and opposing positions on some of these educational issues?

RALSTON: Well, I got to saying what I just said because of something you said earlier about mathematicians using computers and things. Mathematicians have been very slow to come to technology generally. Many of them, particularly the younger ones, embrace it wholeheartedly now, particularly through computer algebra systems. But they were very slow coming to it, and I think they're still very slow in recognizing the impact it's having on what is important in mathematics. That's the important thing. What is important in primary school? I have to be careful, you know, in England the words are different from here. Primary school in England is elementary school in the U.S., and when you say primary school in the U.S., you mean just grades one through three.

DE NEUMANN: Well, you can use American terms in this because this is for an American audience.

RALSTON: Well, Bill knows about that, no doubt. So they had been slow to come to it. Even now they're very slow to adopt it in their teaching, I think, although I'm sure younger mathematicians use computer algebra systems in their teaching a fair amount. I don't think senior mathematicians do it a lot, although that's pure guesswork on my part. So my position has been that you've got to do it, not because I can prove to you that what I want to do, which is just very briefly a combination of calculators and mental arithmetic to take the place of pencil and paper arithmetic; not because I can prove to you that that will do as well as pencil and paper arithmetic has done, not that it's ever done all that well, if the truth be told; But because I think you have to try something. There are people who say

well you're going to do lots of damage to kids if you try what I suggest and it doesn't work. My response to that is you're doing terrible damage to kids now, and nothing I propose could do much worse. This listserv in which I am involved in the U.S. has lots of very senior National Academy mathematicians involved with it who don't buy these arguments at all. So I'm essentially coming to this as a trained mathematician, but as someone who spent most of my life in computing and then coming back to mathematics and mathematics education, whereas the people on the other side have been mathematicians all their lives. I don't want to make that sound pejorative; it just is two different ways of approaching a particular aspect of education.

ASPRAY: Let me shift gears. Why did you stay at Buffalo for all those years?

RALSTON: Yes I ask that question because you think, well, gee, couldn't you have gone to a better place than Buffalo? [Chuckles] Well, in the first place, Buffalo was and still is a quite good university. It's as good as the poorer big ten universities, without naming any names.

ASPRAY: I know some of those names. [Laughter]

RALSTON: Well, I know you know the big ten.

ASPRAY: Well, I'm at one of those schools.

RALSTON: Bernard, you know what the "Big Ten" means? It's the big eleven now, isn't it? Penn State has joined. It's a football designation, but it includes some of the best state universities in the middle of the U.S., ones which you will know.

So why did I stay at Buffalo? Well, first of all, it was perfectly good place to be. Secondly, I was very well paid. Thirdly, there were some personal reasons that kept me there, although my wife was very glad to leave Buffalo when we finally did. It was a very good place for us at one period in our lives. Our youngest child is deaf. Buffalo had very good facilities. This is a young woman now of...how old will she be this year? She'll be 39 this year, and who if you met her you perhaps would not know that she's deaf, she talks so well, but she's profoundly deaf. So she's done very well, and the education she got in Buffalo, particularly from the time she was eleven months old until she started school, was very, very good. So I wouldn't have left for any place that didn't have facilities that appeared to be at least as good as that while she was growing up. So that kept me there.

The places I could have left for -- I said earlier that I thought my major talent was in administration, although I have said and continue to say very negative things about university administrators. I've told my wife that what I want on my gravestone is "Down with administrators." I nevertheless think that I do it very well. So I thought about—dumbly, I have to say dumbly—becoming a high university administrator. And so I could have been dean here or there, but the places that I might have gone to were ones where I didn't get the offer. There are all sorts of reasons one doesn't get offers. In two cases I was a wrong candidate for the job because of being a computer scientist. But anyhow, this was about the time I'd realized that anyone who wants to be a university administrator in these times has to be half crazy. The jobs are so bad, even though now, for example, they pay them much better than they did 20-25 years ago, but they are still terrible jobs in the U.S., just dreadful jobs. The measure of success in university administration in the U.S. is the absence of failure, because the economics are not good. But anyhow that's not what we came here to discuss. But I lost my desire for that kind of job, and at some point one doesn't become so moveable anymore, so I stayed in Buffalo.

ASPRAY: Okay. Why did you take all of your sabbaticals in England?

RALSTON: Well, I spent two summers in England when I was a graduate student. The first one working for Ferranti, and the second just for travel. I grew to love England from the first time I came here, and I've never stopped. People ask me still why do you live in London, and my simple answer is that it's the nicest place in the world to live! Of course, I'm not unique in thinking this, but not everyone thinks this either. But it is a lovely place to live, particularly for someone like me who was born and raised in Manhattan and who misses things about New York. But the things I miss about New York I have in London, usually better. Theater and music are better; museums may not be, but they aren't much worse either. And the things which I don't miss about New York—crime, dirt, all those things—may not be getting worse in New York, but they're not as bad in London. So London to me, as a very urban person, is a very nice place to live. Also, it's right next to Europe where most of the places I want to go are.

DE NEUMANN: Yes so you can get to them very easily now.

RALSTON: So it's as simple as that. It certainly isn't because it's cheap!

ASPRAY: Shifting gears again, I want to take a little while on behalf of ACM, not only to talk about your personal story, but to talk about that piece of ACM's history that you know about from your volunteer activities. So let's go back and talk a little bit about that. When you came to run for President of the organization, did you have an agenda in mind? Or when you were elected, did you have an agenda in mind?

RALSTON: Yes I had an agenda, but the agenda was very simply to get the organization on some kind of reasonable financial footing, because it had come not so very far from going bankrupt in the fairly recent past. And I accomplished that, I think. I think some people would disagree with my diagnosis, but I think most people who know about it would agree that I did good things for ACM from that point of view. One of the things I had done in ACM as Vice President was to take a mélange of committees—there must have been forty or so of them—and restructure this as Boards, the SIG Board and the Education Board and all those boards. That was something I did as Vice President. It was a major thing, which has lasted pretty much unchanged. I mean, a committee changed here or there, but the structure has lasted for the last 30 years. So I didn't have an organizational agenda. I didn't have a membership agenda either. My predecessor used to talk about the aim to have 100,000 members in ACM.

ASPRAY: Who was that?

RALSTON: Walter Carlson. I never thought that was realistic in any geologic time scale. I don't know what it is now but it's not so very far short of that now.

ASPRAY: But it's not there.

RALSTON: It's not there. You know that? You know the numbers?

ASPRAY: It's in the upper 80s.

RALSTON: I see. Okay. Well, when I was Vice President or President it was about 30. I also had a hidden agenda, which I never mentioned to anyone and which I made no progress on really, and it was to play down the chapters aspect of ACM. I never believed the chapters did a lot of good in the

organization - student chapters or regular chapters. A lot of people disagreed with me about that and still do. But I never did anything as President to strengthen the chapter movement, anyhow. I was, of course, from my history with the publications always very much in favor of the publications. I think perhaps, like all scientific publications, it's been overdone, but they were then and they are now strong publications and that's all very good. So I didn't have to do much as far as publications were concerned, and I didn't do very much, I don't think. I don't have much recollection of it. So my agenda tended to be organizational.

ASPRAY: What had been the problem that had caused the financial concerns, and what did you do to fix it?

RALSTON: [I think you are just going to have to delete the portion in brackets. Just too sensitive even though the executive director in question is dead now.] [Well, unfortunately you're not going to be able to put this in your transcript, but you can try! A lot of mismanagement: hiring the wrong executive director who was a man of great charm and ability in certain directions but was a disaster as far as management of the organization was concerned; having previous executive directors who weren't all that strong organizationally,] Well, particularly at a time when the organization was growing fairly rapidly and therefore needed particularly good organizational skills, it didn't have them. As I tell people, I just did one thing right as ACM President: I hired the right executive director.

ASPRAY: Who did you hire?

RALSTON: His name is Joe Cunningham.

ASPRAY: That's a name I know, but I don't know him.

RALSTON: Joe was just right. I hoped when I hired him he was just right, but I can certainly not say that I would have expected him to be as effective as he was. And in the two years that I was President, 18 months of which probably (I don't remember exactly when he became executive director) he was executive director and the thing was fixed.

ASPRAY: And what did he do?

RALSTON: Oh, what did he do? He got the headquarters staff under control financially, he put in financial controls on how and when you could spend money. You know all the things that any good manager does. It wasn't rocket science.

ASPRAY: Just basic business.

RALSTON: Just basic, yes. And that I still think is my main legacy to the organization.

ASPRAY: Were you actively involved with the Education Board?

RALSTON: I used to serve on the Education Board before, maybe after I was President, too. The thing I remember most about the Education Board is the good restaurant in Atlantic City we used to have dinner at after meetings at -- was it the fall or the spring we went to Atlantic City? I never remember, one of the joint computer conferences in Atlantic City. The Education Board, while I had anything to do with it, didn't do very much, Bill. It may have done significantly more in the years since then; I just don't know enough.

ASPRAY: What was the attitude at the time towards policy issues? National policy issues related to computing.

RALSTON: Well, most of the people in ACM at the time I got active were not very interested in public policy beyond the organizations itself, or in the others kinds of issues that I got involved with. One of the things I did in ACM, one of the best things I think, was to establish the Committee on Scientific Freedom and Human Rights, and we got quite involved with refusenik scientists in the Soviet Union, for example, and other related kinds of things. That was something I got involved with through the Committee of Concerned Scientists in Manhattan. It was something I felt strongly about personally, and it was just at the time when computer scientists like all other scientists in the Soviet Union were in big trouble, and it was a very good time to try and lend support to them. I made a trip to Moscow in February of 1980, not the usual tourist time to go to Moscow, to meet the refusenik scientists who were under particular pressure, under the auspices not of ACM but this group in New York. Although the person who deserves most credit for ACM's activities in this area is Jack Minker, not me. It was I who got the committee established and Jack was chair of it for many years. I didn't do a lot with the Public Policy Committee, but I think I made it more active than it had been in the past. It's certainly a lot more active now than it was when I was there because Barbara Simons was very interested in that area and geared it up quite a bit. But I did some things to get in more active than it had been. This was an area I thought ACM should be in. I tried very hard to establish a Washington office. The Association was not so much in favor of that generally, though it did get established finally after my term as President. I also was the one who got established the European region at ACM, because when I was Northeast Regional Representative the northeast region was not only the northeast part of the United States but almost all the rest of the world including, in particular, all of Europe, and that was obviously ridiculous. But it's not easy to get organizations to change things like that, but that was changed while I was Vice President or President, I forget which.

ASPRAY: Did ACM then start to hold meetings in Europe?

RALSTON: Well, ACM had let its chapters in Europe hold meetings before that, and they still do as far as I know; I know very little about it now. ACM has had chapters in Europe for a long time, since well before the European region was formed. That region had chapters when it was still part of the northeast region. Those chapters I don't think are very active these days, but I don't know that as a fact. I would probably get mail or email as a member living in Europe if any of the chapters were active. There used to be a fairly active British chapter. I was involved in a lot of those things in my years in Vice President or President or Northeast Regional Rep since they were things that interested me particularly.

ASPRAY: You know in recent years there has been a lot of discussion about how to balance the needs for different kinds of members, academic members versus professional members.

RALSTON: It goes back a long way, Bill.

ASPRAY: Yes. How did that play out during your time of activity?

RALSTON: Early on, ACM was dominated by academics just in the number of members—that's where they came from. By the time that I got very active, academic members may still have been a majority, but it didn't last for long. The ones from business and industry were becoming much more important and were becoming members, but the academic establishment still ran the organization. Not

entirely. Walter Carlson worked for IBM, Jean Sammet worked for IBM. So it was changing, but the academics still had most of the important positions. The question was really—and it's still a question in my mind; I don't in some sense know what's happened—what would happen when the non-academics became the dominant force in the organization as they did in the '80s and '90s, although there's an academic as President now. So it's a balance that needs to be kept somehow. As long as the publications are strong, I don't think the academics will complain very much. And they have remained strong. I don't know what the actual membership balance is between them now. If you say 80,000 total members, it's sure as hell true that the majority of those are not academics.

ASPRAY: It is significantly higher for non-academics.

RALSTON: Yes but of course most of the non-academics are not senior people, the way a lot of the academics are.

ASPRAY: Right. On a different subject, I noticed that you served for a period of a time on the Computer Science and Technology Board.

RALSTON: I did actually. Right, I haven't mentioned that.

ASPRAY: Do you want to talk about that?

RALSTON: Do I remember enough to talk about it?

ASPRAY: Was that during Tony Oettinger's time?

RALSTON: I don't think so. I know Tony Oettinger. Of course he was President of ACM just before I got active, just before Bernie Galler I think. There were two boards. The one I was on is called what? Computer Science and Technology Board?

ASPRAY: Telecommunications Board.

RALSTON: Oh that may be what it is now.

ASPRAY: It was different then?

RALSTON: The Telecommunications Board did not, I think, exist then.

ASPRAY: Right.

RALSTON: But there was a prior one called perhaps just the Computer Science Board, I don't remember. I think that was the one that Tony was involved with. That had a short, I think painful history, which I don't know much about. Do you know about it?

ASPRAY: Yes. It was disbanded partly because there was a claim of undue industrial influence.

RALSTON: Oh, is that right? Well, anyhow, that was I think the one Tony was involved in probably. It was disbanded for some years, but not a lot of years, and then the NRC realized they needed something in computing, so they reestablished this board, which I was on for its first two years I guess.

ASPRAY: Joe Traub came back the next time around I think and led it.

RALSTON: Yes Joe Traub, who I have known for many, many years and is a good friend, I don't think he was highly involved when I was on it. He may have been on it; I don't recall that. I don't recall who was chair either.

ASPRAY: He was the first chair after it was reconstituted.

RALSTON: Was he? So maybe he was chair while I was on it and I'd just forgotten it.

ASPRAY: So were you on it when Margory Blumenthal was the Executive Director?

RALSTON: No.

ASPRAY: Okay. You would have remembered Margory. She's a very strong person.

RALSTON: Who was the Executive Director while I was on it? I don't know. I don't think I contributed much to that organization. I went to its meetings I suppose, but I don't remember serving on any committees or doing anything very much, so I really don't have much recollection of it. I don't have much recollection that it did very much.

ASPRAY: I think it only started doing a lot when Margory Blumenthal became the Executive Director.

RALSTON: Do you know when that was?

ASPRAY: It was about 13 years ago maybe 14 years ago.

RALSTON: Oh, well that was long after I served.

ASPRAY: Something like that.

RALSTON: Yes. Well, when did I serve on it? It says. But I would suspect it was in the early '80s.

ASPRAY: Computer Science and Technology Board '77-'79.

RALSTON: Okay, so really long before her time. I assume it had an executive director because I later served on the Math Sciences Education Board, of which Marcia Sward was the Executive Director.

ASPRAY: Oh yes, right. So I'm at a point where I have asked you most of the things that I want to know about. I don't know about Bernard.

DE NEUMANN: Yes.

ASPRAY: So now you can talk about anything you'd like.

RALSTON: Well, you know what I should do? I should take this CV and go through it. Because I'm not interested in the positions I held or the papers I published from this perspective, but maybe some of the other activities that I haven't mentioned and might want to. I've got a lot of things on the ACM

here. Well, but most of it is not significant that I haven't talked about. I mentioned that I was a member of the MAA Board of Governors. That was sort of fun. At one point I told someone one of my ambitions was to become the only person in history to be both President of ACM and the MAA. But quite aside from whether I had any chance of that ever happening, I spoke up rather too much while I was there.

ASPRAY: In a way I sort of did a parallel thing. You know, I was Executive Director of CRA, and I was the runner up candidate to be the executive director of MAA.

RALSTON: Oh were you? Who got it?

ASPRAY: Oh, I've forgotten. The woman from Georgia that's been it recently for the last five--

RALSTON: Anyhow John Thorpe's or Linda Rosen's successor, I guess.

ASPRAY: Yes, that's right.

RALSTON: Because I knew Linda well from the NRC also. I don't know whoever it is now. Well, I can't say if I think you're well out of it or not—I just don't know enough. [Laughter]

Well, I've done a few directorships on boards. They were fun I suppose. Not as lucrative as those things can be, however, I'm sorry to say. The first of those is a company that's now listed on the New York Stock Exchange called Computer Task Group (you won't know it as a company I don't think) but was started in Buffalo by a guy who had been our IBM salesman when I first went there. So, the fact that it's on the New York Stock Exchange tells you he did pretty well. So he invited me on the first Board of Directors, which consisted of about a dozen people, all but two of whom were industrial millionaires of one kind or another and all of whom were expected to contribute \$50 or \$100 grand, for which, of course, they got stock in the company. The Dean of Engineering in Buffalo and I were the only two people of a different type. We weren't expected to contribute anything, but we got a little stock. Well, it was so little that it mattered not at all. So it was interesting sitting on this Board of Directors with all these millionaires and me and Karl Willenbrock. But then the company went public three, four, or five years later and they had to have a more normal kind of board, so at that point I was bounced.

So what else? I was on the original board for the Graduate Record Exam in computer science. You learn how hard it is to make up good multiple choice questions.

ASPRAY: I can imagine.

RALSTON: It's very hard. We had good people on that board. Who do I remember? I remember Jeff Ullman. There were at least a couple of the people as distinguished as he is on it, but I forget who they were now. It was fun. I did that for what, how long? Does it say here? It suggests seven years. Maybe that's right. Sounds like a long time to me.

Not very interesting, but I was on the Visiting Committee to the MIT Department of Electrical Engineering for three years in the late '70s. That was fun, also. There were also about a dozen people of whom all except for two were industrial millionaires of one kind or another. Ken Olsen of DEC was the chair, and Bob Noyce was on it. Some other people I bet you would remember if I dredged the names up. Then there was a guy from the medical school at Stanford and me. And it was just sort of interesting to see how those guys think. We didn't talk about anything very important. You know, you were there to have people from the department come and talk to you about what they're doing and make suggestions about what they might do, but that department was probably the best department in

the world then as it is now, so there wasn't much you could suggest. And the students came and talked to us, so it was fun listening to them. I remember the thing that amazed me most the whole time was one of the students, who was taking an operating systems course without using a computer, because for some reason the status of the computers at MIT at that time didn't allow a reasonable computer to be used for this. So I thought an operating systems course and no computer—that's amazing. Only MIT could get away with that! So yes I served on that for one term; that was fun. Oh, I've been on the Advisory Board for CPSR for a long time, but I don't do anything. That follows naturally some of the other things I have said to you, but I didn't do anything for them. And I've been on the Advisory Board at the University of Chicago's school math project, but that was a long time ago. And a Maryland -Penn State Advisory Group; that doesn't count for much either. The Committee of UME Trends, which is a publication on undergraduate mathematics education. No, nothing else that I haven't just said in the last few minutes.

I hope that one of you got some of this! I was happy to do it, but I don't want to do it again!

ASPRAY: That's why we used two machines.