

An Interview with
SEYMOUR E. GOODMAN

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Conducted by Thomas J. Misa

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Abstract

In this oral history, Seymour Goodman describes his career in computing, beginning with his education including undergraduate work at Columbia University and earning a Ph.D. in mathematical physics at California Institute of Technology. Facing the downturn in physics employment around 1970, he took a position at the University of Virginia and transformed himself into a computer scientist specializing in algorithms. While on a sabbatical leave at Princeton University, he became interested in the social and political analysis of computers, especially in the Soviet Union and other East Bloc states. While at Princeton he began what developed into the MOSAIC project (unrelated to the web browser of that name) which flourished with his move to the University of Arizona. MOSAIC staff collected available information on Soviet computing and conducted numerous study tours to investigate the state of Soviet Bloc computing. (Reports from many of these study tours are available at CBI.) This work supported U.S. government efforts in export control policy and implementation. After the 1989-91 political transitions, Goodman's group began another series of international visitations and field research on the global diffusion of the internet.

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Misa: My name is Thomas Misa, it is the 6th of August 2013, and I am in the office of Seymour Goodman, at Georgia Institute of Technology. He is Professor of International Affairs and Computing and co-director of both the Center for International Strategy, Technology and Policy (CISTP) and the Georgia Tech Information Security Center (GTISC). So Sy, can you start by describing your educational background both at Columbia University and at California Institute of Technology? You had a notable background beginning there.

Goodman: I was something of an intellectual spastic. I don't know how notable that is. I went to Columbia at least partly because New York was a bigger, more interesting city than Chicago, with all due respect to Chicago. I was born in Chicago and grew up there. I went to Columbia thinking I would become a transportation engineer. Instead, I became an aspiring English major as a freshman. Columbia actually didn't have an undergraduate program in either city planning or transportation engineering. I didn't even bother to look at the catalog before I decided to go there. I became an aspiring city planner in their graduate program as a sophomore and then a civil engineer as a junior, and then focused on theoretical and applied mechanics, or engineering mechanics, as a senior. I stayed on for another year because of Diane Samuel — she was one class further back than mine — who would become my wife for the next 47+ years. That was a good reason for staying. I then went to Caltech where I became a mathematical physicist. It was at Caltech where I was first exposed to the history of science and technology, simply because of the people who were there. The principals in my dissertation area were Phil Saffman, who gives me academic lineage via Trinity College at Cambridge University that goes all the way back

to Isaac Newton, Hans Liepmann, who gives me some academic lineage to Theodore von Kármán and Prandtl, and Dick Feynman, who was more interested in the history of physics than most people realize. So they were all history conscious. Many people of historical consequence would come through Caltech, including some great Soviet scientists. A large part of my dissertation, roughly half, was fathered by Lev Landau, the greatest theoretical physicist in Soviet history, and other Soviets, notably Pyotr Kapitsa who visited us and told us about how he got Landau out of the Lubyanka [Prison]. This is where I picked up a serious interest in Soviet science and technology. The other half was fathered by Dick. But the end result was that for the most important half of the dissertation (the Landau half) my theory and the experiments did not agree. That does happen. But people like Saffman, Feynman, and Liepmann understood that. Eugene Wigner wrote a paper I read to console myself on the “unreasonable effectiveness” of mathematics in describing the physical world. [Laughs] They gave me the degree anyway. They said I had done everything that could be expected of a Ph.D. student. I was a fast Ph.D., two and a half years; getting out of Caltech with a Ph.D. in two and a half years means something. Most people think it’s because you’re a genius. In my case, it was because I wanted to get out of there as soon as possible with a wife and kid. Then I had to decide either to continue in mathematical physics or find a new direction. Every word in my dissertation, plus another paper I wrote the following year, was published in three articles in three physics journals, but 1970 was a difficult time for jobs, particularly in physics. There were hundreds of applications for every job. The University of Virginia, among other places, was interested in me and offered me a job if I would stop being a

mathematical physicist and become something that they needed more. That turned out to be a computer scientist; so I had to make a conversion there in a period of 2-3 years.

Misa: Can I just ask whether you had any contacts at Columbia? Of course, they had a strong Russian studies group there.

Goodman: No, that was later. Ultimately, I became a full-fledged member of the Soviet/Eastern European studies community, as did many of the students who went through the MOSAIC program. I spent a fair amount of time with those people at Columbia, notably Marshall Shulman and Loren Graham, but mostly in the 1980s.

Misa: So Caltech was really the connection to history and then specifically, because of the technical connections, to the world of Russian science.

Goodman: Soviet science. There is a distinction. A lot of it took place outside of the Russian republic. There was an extraordinary consumer group for our research, including policy makers and implementers, which is quite rare for area studies and research. It wasn't history at the time; we were studying a very, very live and large part of the world's computing community that, given the demise of the USSR, has now all become history. As a Columbia undergrad, in retrospect, a notable person that I was exposed to, but basically as a student working in the physics department breaking down and building experiments, was Isidor Rabi. He has become my exemplary model of citizen scientist,

sort of along the lines of Ben Franklin (a hero to Rabi), whom I now use to, hopefully, help inspire students around here.

Misa: That's quite a notable collection of faculty then.

Goodman: Yes. At Columbia I was exposed to all kinds of people, but interestingly enough, not the Soviet and Eastern European studies people. In fact, none of the international area studies people, but lots of people in engineering and science. Columbia has a rather small but potent engineering school. For me, a kid who came out of a crappy inner city neighborhood in Chicago, Columbia brought me into a marvelous intellectual world. I bought hook, line, and sinker into this "whole man" concept of someone who should be interested in everything. So with my four aspiring majors in four years, or quasi majors in four years, I was interested in about as much as I could handle. I graduated in four years, plus the additional time to get a Master of Science in Engineering and get married.

Misa: Did I understand correctly that your Caltech Ph.D. was in 1970, so it was 1970 or 1971 when physics had this collapse in employment?

Goodman: Yes, the time when I was looking for a job. It was sad because I would apply and I would get a letter saying that I had made the cut from hundreds to a much smaller, but still hopeless, number. It was a tough time. It was compounded in late 1969 by something else. One of the two neighborhoods I grew up in Chicago was about three

blocks from Wrigley Field, and my elementary school was about a block and half from Wrigley Field, all on Waveland Avenue. In the fall of 1969, while I was writing up my dissertation, the Cubs blew a nine-game lead to the New York Mets, of all teams. I've never forgiven them, and it was from that point on that I essentially stopped being a professional sports fan. As someone who started at age two being a Cubs fan that was just more than I could take. Between that and the job situation, it was a bad time for me.

Misa: So from Caltech you went on to University of Virginia?

Goodman: That is correct.

Misa: And when they hired you, did they term it "computer science" at the time? 1968 is the ACM model curriculum; there are many different names for what we now understand to be computer science.

Goodman: I'm not sure what term was used. It may have been computer science. It was computer science, certainly, before I left, and they had actually awarded degrees in computer science before I got there. Bill Wulf was one of the Ph.Ds. out of UVA in computer science, or whatever we called it at the time. He finished before I got there. There was a small group of computer scientists. Many universities that had any semblance of computer science tended to have either an electrical engineering aspect to it, as was the case at Caltech with Carver Mead, or there tended to an applied math, particularly a numerical analysis aspect to it, as it was at UVA. In fact, my computing

experience at Caltech was largely in the form of what was then called numerical analysis. I had a number of nonlinear equations to work on and I would beat up on them using some fairly advanced numerical analysis techniques. I had these nonlinear partial differential equation systems and I used to carry cards over to an IBM 360-91, and sit there and wait for printouts. That was really numerical analysis and if I did anything with computing while I was a student, it was that. I was mostly a user, not a developer of numerical analysis.

Misa: Would you describe your Ph.D. at Caltech as being mathematical physics?

Goodman: Yes.

Misa: And what was the specific topic?

Goodman: I think people called it quantum kinetic theory. But I was specifically concerned with some of the macroscopic dimensions of superfluid helium, which is an area of physics that has attracted enormous attention among some of the world's great physicists for a very long time because it was a visible macroscopic phenomenon that was totally quantum mechanically based. There were two aspects of it in the two parts to my dissertation, one of which earned Landau his Nobel Prize for work he did in 1941. Landau was this skinny little Jewish guy who never had a good hair day in his life, who had been released from the Lubyanka Prison a couple years earlier, and 160+ German divisions had just invaded the USSR in 1941. He did his Nobel Prize-winning work in

this very exotic area of theory, and that was the basis for half my dissertation. And Kapitsa and other Soviet scientists did much of the experimental work. It was a big part of Kapitsa's Nobel Prize. The second half of my dissertation was based on Dick Feynman's work on quantized vorticity. Most people don't realize it — Dick probably wrote as many papers on the subject of liquid helium and quantum fluids than he did on any other subject. He was a major player in developing quantized vortex theory. This half required a lot of computer work because I was doing scattering of elementary excitations called rotons off of quantized vortices and the equations were too nonlinear to work out with anything other than numerical methods. So that's my dissertation.

Misa: Okay, so there's a prominent Russian Soviet connection?

Goodman: Yes, it was very prominent. Interestingly enough, I became quite interested in Soviet science, partly because of the very difficult circumstances in which these people worked. Caltech was, and still is, a mecca for people to visit. All sorts of people came when I was there. Kapitsa was one of them and told us about the working conditions before, during, and after the war when Stalin was beating up on everyone. Solzhenitsyn came out with what to this day remains my favorite novel, *The First Circle*. Technically, I think he won his Nobel Prize for *One Day in the Life of Ivan Denisovich*, which I also read then. Three of his books came out in those two-and-a-half years while I was a grad student at Caltech. *One Day in the Life of Ivan Denisovich*, *Cancer Ward* and *First Circle*. *First Circle*, an analogy with Dante's *Inferno*, was set in sort of the top level of the *gulag* where various people with technical and scientific backgrounds had been

thrown into a prison camp in relatively comfortable circumstances. Certainly comfortable compared to digging in mines in Kolyma or chopping down trees in Siberia, but in camps within the Moscow area. The duties of these people were to solve technical problems and come up with technical innovations that the state could use. Interestingly enough in retrospect, I've just recently been giving talks on "Ubiquitous Data Collection and Surveillance," before the Snowden thing. Electronic surveillance and data collection has been going on for a long time. But the key thread of the story of *The First Circle* involves electronic surveillance. A rising young diplomat in the Soviet Foreign Ministry learns that his beloved professor was being targeted for pickup in 1948, in one of the Stalinist roundups. He tried to warn his professor by making an anonymous phone call. The whole thing gets botched and sure enough, the KGB or the NKVD, or whatever they were called in the year this was supposed to be taking place, recorded the phone conversation. They gave that recording to these poor souls in the *sharashka*, a First Circle camp for scientists and engineers, and they tasked them to find out who had made this phone call. So they have all these people working on this problem throughout the course of this long novel. Just like many Russian or Soviet novels of any real quality, it has a list of characters in the glossary so the reader can keep checking on who's who, sort of in the Tolstoy tradition. Anyway, so they spend a fair amount of the rest of the book solving this problem. The irony being, of course, that the *zeks*, these prisoners, were essentially aiding the state to identify and ultimately destroy a person who had a little bit of soul left in himself and who had tried to save at least one person from the Stalinist maw. They ultimately succeed — these poor souls who were serving 10-, 15-, 20-year sentences for doing virtually nothing — in identifying the guy. The novel ends with this young

upward-bound diplomat being thrown in the Lubyanka. He goes from being a high flyer to becoming ultimately completely debased and thrown into the *gulag*. At that time I was feeling enormous pressure at Caltech and I took a certain solace in reading about people who had it worse off, much worse off. [Laughter]

Misa: It doesn't get much more serious than that. You came directly from Caltech to University of Virginia?

Goodman: That's right.

Misa: So that would be 1971 or something?

Goodman: Yes, 1970. They told me to find something to do that they could really use, and within two years I was a publishing computer scientist and teaching my way through computer science courses.

Misa: It was in 1977 that you published this book on algorithms?

Goodman: Yes. I was a design and analysis of algorithms person.

Misa: That's more or less the title of your book, too, *Introduction to the Design and Analysis of Algorithms*.

Goodman: That's correct. I wrote a whole bunch of papers on the subject that I no longer list in my CV. I think I only list the last one from 1977 as a kind of vestigial remnant for most of the 1970s. I no longer list my physics papers. Basically, I taught the sequence of courses that a student would take if they were going to be a computer science major at UVA. I just went one year after another teaching those courses and somehow that's the way I became a computer scientist. It wasn't unusual at the time, although there were computer science Ph.Ds. — Bill Wulf having earned one of them — that were being offered. The best description for me, essentially as a mathematician, is to be what today is called a theoretical computer scientist.

Misa: May I just read? In the preface to the algorithms book it says, "Representative Stanford undergraduate computer science courses would include the following," with various titles, there are 10 of them including Introduction to Computing, which most often would be a FORTRAN, BASIC, or PL/1 Assembly Language course, Programming Languages, Data Structures, Discrete Mathematics, and so on. Were those all topics that you had taught, then, at UVA?

Goodman: Yes, at that time, right.

Misa: So you were teaching those?

Goodman: I had never taken any courses in those subjects nor, in fact, a course in numerical analysis, which I also taught at UVA. Yes, I taught most of those classes as part of my route to becoming a computer scientist.

Misa: Don Knuth's one-word answer to what is the core of computer science was "algorithms."

Goodman: That's right. You can spend a whole lot of time living in Knuth's books. Don was also a Caltech grad and I still have his books. There are a number of books that have some of my blood distributed throughout the pages and I managed to hang onto them for the last 40 or 45 years. And Knuth's books, which I studied as part of my conversion, are still there in the shelf right behind you.

Misa: So the chapters and the topics in your 1977 book, those were basically the courses that you were offering at UVA?

Goodman: Mostly. By the time that book was written, that had become my particular niche in the teaching and research spectrum at UVA. I also taught a lot of probability and statistics because they were short-handed and thought that my background in statistical mechanics qualified me.

Misa: Do you recall how that happened? I mean, you could have done data structures or you could have done something else.

Goodman: Because this was more mathematical, I was just more comfortable making the conversion from a partial differential equations guy to a discrete mathematics guy. It was easier than writing code for operating systems or writing compilers; that never appealed. So this was a natural for me and UVA (mostly Bob Owens, Gordon Latta, and Alan Batson) was quite happy with that. They gave me tenure early. I published a lot of papers; it wasn't a gift. They were pleased that I had basically taken their requirement to convert to something useful seriously. Those were actually interesting and good years. I was a survivor. This is while all sorts of other people who had earned hard science degrees around that time were getting trashed.

Misa: It was a challenging couple of years, particularly for the physics community.

Goodman: Indeed.

Misa: I remember the charts showing that the physics drop-off was really sharp and a little bit earlier than some of the other technical fields.

Goodman: Exactly right. And I was right there then, with an awkward dissertation. They looked at me with a mixed view. I was the one who discovered that the theory and the experiments did not agree — at least for the first half of the thesis — which was supposed to solve a really important problem. Even Dick thought we had gotten it. When I plotted the first data point against the experiment, it was a perfect fit. The trouble was

that one curve went like this and the other curve went like this, and right where they crossed, just by accident, happened to be the first data point. As I started working out the other points it became clear that if anything, I had discovered a lower order phenomenon than the one I was trying to explain. They didn't hold it against me. But I had this tremendous disadvantage compared to anyone else looking for an academic job in physics. The advantage was that I had Caltech and this lineage. I mean, there just never were many of us; there still aren't many of us. Under the circumstances, even though the journals were perfectly happy to publish everything I wrote, the future of doing this was limited. So one way or another I was going to have to start over again. And so when possibilities did come up, either do a post-doc in physics or go with an assistant professorship in applied math and eventually computer science, I went with the latter because, hell, I had a kid and a wife. My wife, Dee, who worked for the Navy Undersea Warfare Center in Pasadena, actually made more money than my NSF fellowship. When Rick was born, she basically told me that it was my turn to go to work, and a post-doc wasn't going to cut it. UVA was very attractive in that regard, although I was the lowest paid assistant professor they had. It was a statement to the effect that right then, I was not worth that much to them.

Misa: And you got tenure there in . . . ?

Goodman: 1975.

Misa: You could have imagined yourself staying — you didn't — but you could have imagined a perfectly fine career doing work in the burgeoning field of computer science where there were many different problems?

Goodman: There was that kind of promise, but I'll tell you how I got out of that business, although I was doing quite well. I was publishing a lot. Everything on paper was looking good, but one year I was teaching a class — just because I found the subject interesting — on mathematics in the non-physics-based sciences. We had a unit in the class — I really enjoyed doing this — on biology. The class examined biology from the late nineteenth century into the twentieth century and the mathematical basis for genetics and evolution. This is a junior level course at UVA. One of the aspects of the class that I liked to highlight was how some of these theories — the biology portion was maybe 30 or 40 percent of the course --- actually had major social and political impact. For example, the whole evolutionary thing, whether we came from monkeys or the religious bit, and the use of evolutionary theory to justify colonial policies of Europeans versus natives. On the genetics side, the example that I chose to illustrate the impact of science in larger sociopolitical context was the Lysenko affair, which as a historian of science and technology, I'm sure you're familiar with. Basically, there was this scientist of sorts, T. D. Lysenko, in the Soviet Union. He became a favorite of Stalin and others because he put together a theory that essentially claimed that one could build the new socialist man, quickly, not through mutations of genes, but through working hard the way the “great leader” worked. One can make a New Soviet Man, and those traits can supposedly be passed on. It is more complicated than that, but that was essentially it. This revived my

interest in Soviet science. I read up on the subject and the teaching of certain aspects of evolutionary theory and found that a whole lot of genetics was essentially suppressed by the Stalinist regime. There happened to be a faculty member, an economic historian who studied Russia and the USSR, sitting in on the class. Fred Carstensen, a professor in the history department, suggested that I might be interested to know that in ways similar to what happened with the suppression of genetics under Stalin, the early development of computing was also suppressed. I thought that was indeed interesting. By then I had become a computer person, but I had this lingering interest in how people did science in the Soviet Union from my dissertation days. I went back to my office and I was going through an issue of the *SIAM Journal on Computing*. This is a major theoretical journal.

Misa: The Society for Industrial and Applied Math.

Goodman: Yes, they have a computing journal. It was one of the premier theory journals of the time, in the mid-1970s. I was frankly getting bored proving theorems about algorithms, it was rather sterile, and it didn't have some of the excitement that chasing after rotons in liquid helium had, which was a physical thing. Anyway, I was looking through the table of contents of this issue of the *SIAM Journal on Computing*, and I was staring at it trying to force myself to read some of these papers. I must have been staring at it for a good 15 minutes before I realized one of my own papers was in that issue and I didn't recognize it. At that point I figured I needed to do something different.

Misa: Oh boy.

Goodman: So I just flipped the journal across my office and started walking around, and decided to do some investigative reporting of what Fred brought up in that class. And that was to find the extent to which Stalin had suppressed computing; was there a Lysenko-type story in there? It actually turned out that this was something of a myth that was perpetuated by both the Soviets and the West. Frankly, by the time Stalin died in 1953, the Soviet computing effort, particularly that by Lebedev, had reached a level that was fairly close to the West. The leaders at the time, in the early 1950s, were the U.S. and Great Britain, with the classic stories of Turing and what they did out at Bletchley Park and what we did with the ENIAC and some of the more mixed breed computers at Harvard. The Soviets actually had a quite incredible program — given their circumstances — and we went through some of this in great detail in that long article we wrote many years later in 1994.

Misa: In *Annals of the History of Computing*.

Goodman: In the *Annals* with Greg Crowe on the MESM, yes. But from a technical standpoint, in terms of operating machines, the Soviets were closer to us in the early 1950s than they ever were since. This was a time when Stalin was winding up for another series of purges. Stalin, in the early 1950s, was not a nice guy. He had his ups and downs; they were always down by most people's standards, by normal society's standards. He was winding up for another big time purge, but he didn't suppress computing, and despite this, people like Lebedev were working under very, very difficult

circumstances with good results. I regard Lebedev as one of the great early pioneers of computing, even though most of the rest of the world didn't know he existed. In fact, the last article I wrote on the history of computing was published in 2003 in the *CACM*, entitled "The Origins of Digital Computing in Europe." I made a copy for you here, if you're interested. I pointed out in the article that there are three pioneers who were separated from the pack. They were really isolated. They were separated from the pack that is usually associated with early digital computing by time, or language, or politics. The three were Lebedev, Babbage, and Zuse. What is usually associated with the origins of modern digital computing is what came out of the U.S. and Great Britain in the late 1940s and 1950s. Few people knew what they did during the war in Bletchley Park until much later.

Misa: The 1970s.

Goodman: People like Turing obviously used what he learned even though he didn't reveal his Bletchley work. Turing's post-war grief with the classified world, of course, has now become a source of great shame for the British, but nevertheless, that was mainline computing. So there were these other three early pioneers. Babbage was separated by time. The history of computing people have tried to include Babbage but he was really isolated. Hardly anybody really came around to digital computing again for another hundred years, and to his work, specifically, until after World War II.

Misa: Howard Aiken may have taken some tiny bit of inspiration from him.

Goodman: This is tiny; and stretching it. When I wrote that article I was asking people like Doron Swade, whom I came to know in Britain, who said basically that nobody in computing had paid any attention to the substance of Babbage, Howard Aiken included. Now I think Doran knows better than most people. I could find no evidence of it. The 1970s are not that far removed from the 1950s and there was no real reference, but the history of computing people want to reach back as far as they can.

Misa: To claim those early ancestors.

Goodman: That's exactly right. In order to add greater legitimacy to their business, they need to give it that kind of historical ancestry. Interestingly, I just saw something on American History TV about the new location of the California Computer Museum, which when I was out at Stanford was still located at Moffett Field in a crappy building. It now has its own building. The curator was pointing out this object from the Greco-Roman era that was sort of a computing thing; it's called the Antikythera Mechanism. He said it is the first known computer. It was a mechanical device that could predict certain astronomical events by turning dials.

Misa: Yes, that's been in the news exactly because it's an early, early precursor.

Goodman: People keep reaching back for as much legitimacy as they can get, and this is totally understandable. Anyway in the 2003 *CACM* article there was Babbage, who was

separated by time, and there were Zuse and Lebedev, who were separated by politics and language. Of the three it was Lebedev who did the most and who had the most direct influence over the longer term. No one was his advocate as a pioneer, not even people in the Soviet Union, frankly, until they celebrated his 100th birth anniversary. I wrote that article, after coming back from the symposium that they had in Kiev on Lebedev. I think I was the only person who actually wrote anything that was prominently published about him afterwards. All these people, in my opinion, were true pioneers, technically, because they worked under difficult circumstances. Zuse was running around Germany with whatever machine that was still surviving at the time trying to avoid Allied bombs. Lebedev was working in this expropriated church near Kiev. Kiev is one of the places on this planet that suffered more than just about any place else before and during World War II. Kiev went through this incredibly long nightmare from 1941 when the Germans first arrived until they were pushed out, and it continued when Stalin came back in. Stalin didn't trust anybody who somehow survived the German occupation. All of the *kulaks* and church people in Ukraine in the 1930s were targeted and sent to the *gulag*. Kiev and Ukraine more generally had 10 or 15 years of total nightmare. One of the churches that Stalin depopulated was turned over to Lebedev. They didn't have paved roads going out there, much less electricity, and he built the MESM, a programmable, electronic, digital computer using Soviet-made vacuum tubes. It was quite remarkable.

Misa: He describes going out in this rickety truck and getting stuck in the mud.

Goodman: It was terrible.

Misa: Yes, especially for a high tech . . .

Goodman: In any case, I pursued this little investigative reporting thing and came to the conclusion that actually two things happened. One is that Lebedev and others were building computers for very hardcore kinds of engineering applications such as to do calculations for nuclear weapons and power grid distribution, so there was hardly any opposition to computing. The place where that myth or story comes from was in the application of computing for large scale economic planning. They had people in the Soviet Union at the time, people like Kantorovich, who were developing linear programming. I may be off now remembering some of these details; I haven't, frankly, thought about this for a really long time. The economy of the USSR was supposedly the most scientifically planned economy in history. It's part of the whole Soviet *schtick* of scientifically based political theory, scientifically based economy, and large scale detailed centralized planning for optimization of just about everything imaginable. There were people who were thinking that since they were building these computers that could do all these calculations, why not apply them to large scale resource distribution problems? This is what linear programming and other forms of mathematical optimization are all about. There were people who were prepared to pursue this, but this was Stalinist Soviet Union. Control of the economic planning process was enormous power for the Communist Party and the State. It was total control of the economy and how everything gets allocated. That --- if you don't try to be scientific and automate it and just turn input into output and then just go with the output --- is the source of much of the power of the

State and the party. If allocation had been automated then it would have put them out of their jobs, or at least cut back on their influence. If the equations and the number crunching indicate that resources should be allocated in a certain way, and it goes against what party politics would like to have, then doesn't that make the party look sort of bad? It makes them look corrupt. It makes them look self-serving. It makes them look power-hungry. They couldn't have any of that. So that's the part of computing that was viewed with some considerable misgivings by the people in power. It wasn't people like Lebedev who were affected because they were doing the engineering calculations and that was never a problem.

Misa: Your interest in Lebedev, an absolutely fascinating sort of character, did that take you to a fellowship at Princeton in the late 1970s?

Goodman: No. [It] wasn't a fellowship. I was there for, I think, three years. I went there initially on an NSF fellowship sabbatical and I had by this time, in 1976 or 1977, more than just an investigative reporting interest in this particular problem. Here was the other superpower and all of its minions putting together the second largest computing domain on the planet, and hardly anyone took notice. It struck me that that would be an interesting thing to study. I was making that transition at that time at Princeton. I actually went to Princeton originally in the math department.

Misa: In math?

Goodman: Yes.

Misa: I want to talk about your *World Politics* article and your view of international studies.

Goodman: That first year at Princeton was total divergence . . .

Misa: It looks like it was a sabbatical year, and then something that became a different direction.

Goodman: . . . that continued, yes. I went to the math department at Princeton, but I was really in the process of changing so I walked over to the Woodrow Wilson School and I said, “This is what I’m interested in.” There were people who did Soviet studies including Cy Black, in particular, and also nearby, Loren Graham, who was at Columbia. I pointed out, “For people who are interested in computing, people who are interested in Soviet and East European studies, there is something going on over there that has been going on, frankly, since the end of World War II that hardly anybody is studying. These technologies are in the process of having an enormous impact and its impact is only going to grow. It’s going to be a big part of the total military/political/economic competition between the two superpowers and all of their affiliated nations.” Most people couldn’t see it at the time. My point was that change in the economy was going to increasingly depend on information technology. Anyway, the people over at the Woodrow Wilson School said, “Hmmm, yes, why don’t you come over here?” I packed

up and left Fine Hall, which is where the math department is. I had a huge office there and I could spend the entire day there without hearing a human voice; the only thing I could hear were little taps on the board with chalk. [Laughs] When I went over to the Woodrow Wilson School, I had all sorts of interesting people to talk to. That's where I became really serious about this thing and that *World Politics* article. There were smaller articles, I gave talks actually starting in 1976, but the first big, major article was the one with Norm Davis in 1978 in *Computing Surveys*.

Misa: Let me see if I've got that. I went through the papers that we got from you.

Goodman: That's it.

Misa: Would that be this one here?

Goodman: Yes. That made quite a fuss because of my co-author.

Misa: Now this comes earlier than the *World Politics*.

Goodman: Yes. *ACM* in 1978; *World Politics* in 1979.

Misa: Well, could you say a bit about your own affiliations here, which were the Department of Mathematics and the Woodrow Wilson School at Princeton . . .

Goodman: I was technically still with both.

Misa: . . . also the Department of Applied Mathematics and Computer Science, and the Center for Russian and East European Studies at University of Virginia.

Goodman: I had all those appointments, that is correct.

Misa: Norm Davis, N.C. Davis, was with the Office of Scientific Intelligence, working for the CIA. Of course, then, the other question is your work relationship to the intelligence agencies. This was quite controversial, so if you could help us understand this that would be great.

Goodman: Norm didn't write any of this but Norm actually served, in many ways, as my mentor as I was getting into this. The CIA didn't fund it or have any other institutional role. I felt that here's this guy who's been buried all these years, an extremely bright guy, just what you would think a CIA analyst ideally should be. He was from southern Illinois; he pretended to be a hick. He had to get a job without completing a Ph.D. program at University of Illinois shortly after the Korean War. He had kids. He went with the Agency, and he was a very conscientious analyst who really tried to understand the larger context, which is something we also tried to get across here. The *World Politics* article gets into the larger social economic domain but the *ACM Computing Surveys* article actually does a fair amount of this in ways that no one had ever seen before, in terms of writing about computing development in a completely different social/political/economic

system. I was writing all sorts of stuff my last year at Virginia and the first year at Princeton; and this actually went through the usual review process so it took a year to appear. In certain circles it made quite a splash.

Misa: Can you say a bit about what circles those were and what kind of a splash it was?

Goodman: First of all, it made a lot of people conscious of the fact that there was this enormous computing effort going on in the Soviet Union and Eastern Europe, which was not widely appreciated in any community, whether it was the Soviet studies community, or any academic community, frankly. It was not widely appreciated in industry, either, or any place in the world other than there. It essentially made the case that this was an important domain worthy of much more attention. People would study oil production or nuclear weapons in the Soviet Union. They were studying energy, and all kinds of things that the other superpower and all of its affiliated countries --- whether they were strongly affiliated like the Warsaw Pact countries or more weakly affiliated like Vietnam --- were doing. They were all, to a greater or lesser extent, connected. In fact, the Soviets had put together, in parallel, the members of the joint computing effort, which we call the Soviet Bloc — that's actually an oversimplification but it worked for the title — that was more extensive than the Warsaw Pact membership. There were a whole lot of people in the U.S. government who were worried about this because we were becoming much more dependent on the information technologies for everything, including nuclear activities. These technologies were becoming pervasive, not like they are now, but it was on the way. I was one of the people running around saying that it was coming and that the

Soviets were realizing it, too. And it was extremely relevant to export control policies among the NATO countries and a few others, including Japan. We can get into export control things, if you'd like.

Misa: I would, frankly, because you said that was another good part of your work.

Goodman: Yes, in fact, it was export control considerations that in many ways kept the MOSAIC Group funded for a long time. I made a list of all the sources who funded us over the roughly 20 years that we were in existence. There are no surprises there, except perhaps that the CIA is not among them.

Misa: How did you get connected to Norm Davis, then? You said he actively mentored you.

Goodman: He had children that were going to UVA. In Charlottesville, there was this organization that's actually mentioned here explicitly, the Army Foreign Science and Technology Center. It's still there, although the name has changed. All of the services had centers for studying foreign technology: Air Force, Navy, and the Army. The Army center was in Charlottesville and once they got wind that I was interested in Soviet computing, I was brought over there as a consultant. They let me see all the unclassified computing-related information that they had there because they were basically set up to worry about Soviet tanks and artillery. This is what you would think the Army would care about. The USAF counterpart out at Wright Patterson Air Force Base was largely

concerned with Soviet aircraft and missiles. But as time went on, and certainly by the time I got there, they were really concerned about such things as command and control issues - command and control and communication (C3), which has since become C4ISR. This was becoming central to military technological competition between the two superpowers and all of their minions. C3 had become a big deal. There were all sorts of people thinking about all sorts of things other than an all-or-nothing thermonuclear holocaust. Anyway, the people at the Army FSTC told some of their counterparts up at the Agency that they've got this guy who's interested in this stuff, and that's when I got a call from Norm. We became good friends and collaborators in a totally unclassified environment.

Misa: So that was back in UVA days?

Goodman: Those were UVA days, yes.

Misa: Predating your three years at Princeton.

Goodman: That's right. I learned a lot from Norm. People thought, "An academic, hell, with a Ph.D. from Caltech, what's he going to learn in terms of doing serious studies from a guy without a Ph.D.?" Nonsense. There are some really bright people out there who learned a whole lot from *doing*, and Norm was one of those people. He actually didn't want to be a co-author on the 1978 paper but I insisted. This is the only paper I've ever written that actually got vetted because of his presence created worries that there

may be leakage of classified information. So when I finished writing this – and Norm really deserved to have his name on this even though, technically, I wrote all of it – he had to actually put it through a process to make sure that he didn't, in his conversations with me, leak classified information. But hell, the Soviets were writing all kinds of stuff. I mean, look at all the references here [pause]...

Misa: I don't think I've gathered all the references; just a copy I brought for my own reference. We have the original, of course, at CBI.

Goodman: They go on. It turns out that these people couldn't be doing this stuff in secret, not on the scale in which it was happening. They had to talk to each other about it. There were all kinds of evidence for what they were doing; one didn't have to get into classified information. David Holloway, later an academic colleague at Stanford, wrote about Stalin and the bomb, right? It was one of the great books ever written on Soviet S&T, and there was nothing more secret than that subject. Dealing with the Soviets was not like dealing with Hitler's Germany. They published information; you could go talk to people, particularly after Stalin died. It wasn't the totally closed society that many people imagined it was.

Misa: The series of trip reports are eloquent testimony to the Soviet interest in facilitating cross-border, cross-superpower contacts, but I have a question about the sources, because this was before your more extensive involvement with trip reports and the Soviet Union.

Goodman: That's correct, this is before . . .

Misa: so the sources?

Goodman: This is at the beginning, when we started to travel. The sources were all largely unclassified stuff that was picked up and was available. The people at FSTC used to go out and get it for me. It was there. Norm had been reading it for years. The Agency used to collect this stuff, just the way the Soviets collected our newspapers or the way we collected their newspapers. You could buy all these books and all these user manuals; it was all out there for anyone who wanted to deal with it. This is how we ended up with a room twice this size with hundreds of linear feet of shelf space and hundreds of drawers of paper.

Misa: This is the MOSAIC Group's haul over the years.

Goodman: Right. It started back in about 1976, when I started doing this investigative reporting thing. It included finding articles in *Pravda*. They would write about computers. It was a big deal, an increasingly big deal, just like you could find articles about U.S. companies in the *Wall Street Journal*. It was there to be worked on in spite of the fact that it was a strategic technology and they were really uptight about it. They couldn't do it in secret; just like they couldn't do what other people were studying - energy in the Soviet Union or the automobile industry - in secret. People were studying

all kinds of things in this huge, powerful country. There was a whole subfield of Soviet studies concerned with economics and industry in the Soviet Union. When I went for my sabbatical at the University of Chicago, I was invited there by Arkadius Kahan, who was in the economics department. Kahan's specialty was agriculture in the Soviet Union. That was a strategic technology, too. [Laughs] There were all kinds of reasons for Soviet studies, not only because we wanted to understand how things worked in a different social, political, and economic environment from a purely academic standpoint, but because it mattered to world trade and it mattered to international security. Export controls, by the way, also apply to agricultural goods. People don't realize how important and how pervasive export controls were during the entire Cold War. And so we had people studying the Soviet economy, why not have some people studying the Soviet computer industry and its spread throughout the economy? And like it was happening here, these computers were working their way into all kinds of stuff. More generally, we were interested the social, political, behavioral and economic context in how computing was developed and absorbed. Of particular concern to the U.S. was what it was doing for Soviet command and control, and their space program, etc. I'm a child, literally, of Sputnik. You think STEM is a big motivating thing now; it's nothing by comparison. I was in sixth or seventh grade when Sputnik went up. I was at that time thinking I was going to become a historian. By the way, my Soviet interests actually go back to before World War II when my parents got out. They're from Eastern Europe; they both got out separately just before they would have been turned into ashes. Something like sixty members of their families were turned into ashes. I became aware at a very, very young age—I was two years old when World War II ended—that a whole lot of World War II

took place on the so-called Eastern Front. World War II was a big thing when I was a little kid in the late 1940s. I became really aware and some of my earliest intellectual memories was the discovery that somehow we were allied with the Soviets against Hitler. I was aware that Hitler was the worst of the two evils and that the Soviet and East European people were caught between them, and that they ultimately went with the guy who spoke their language. When the war ended and the common enemy was defeated — somehow, we became enemies with an important ally that we had during the war.

Misa: 1945, 1946 and 1947 is a confusing switch.

Goodman: The ally that did more to pulverize the Nazis than anybody had become our primary enemy. I understood that Stalin's Soviet Union was not a happy place. I was very conscious of this. The Korean War also expanded my international awareness in this regard. I wanted to become a military historian as a little kid, because of this.

Misa: Which country did your family come from?

Goodman: My mother was from what is today Belarus. Actually, the Soviet republic was also Belarus. My father came from a little *shtetl* in eastern Czechoslovakia in what is today Slovakia. I thought that it had probably been absorbed into Ukraine at the end of the war, but apparently it's still in Slovakia. We have another faculty member here who was born around there; he was born within almost walking distance of my father's *shtetl*. He looked it up and it still has the same population of about 40 people, or 40 families,

something like that, but obviously of a completely different make-up. So in any case, I was very conscious of the Soviet Union and I was trying to wrestle with these problems as a little kid. I was also interested in the Civil War back then. I was in Chicago, the Land of Lincoln. After Sputnik went up in 1957, there was enormous pressure for us to “catch up” with the Soviets in science and engineering, although we were never seriously behind. Most people today can’t fully appreciate it — this STEM thing today is nothing — the US went nuts after 1957. When Sputnik went up, I was the only person I knew who had actually given any thought to the Soviet Union. There was all this pressure for us to go into science and technology. My whole time in high school and especially at Columbia, I was trying to resist that with thoughts of being an historian, or English major, or a city planner. Ultimately, I caved in and went off to Caltech where I became a real hardcore scientist, just in time to be very hard to employ.

Misa: Right, some ironies of history there.

Goodman: Am I going on too long, here?

Misa: No, it’s fascinating. I’m just mindful that there are so many things that I’d like to make sure that we record.

Goodman: There are a couple of other things about this paper that are worth noting.

Misa: Okay. Do tell us. Is this the article, “The Soviet Bloc’s Unified System of Computers” with Norm Davis?

Goodman: Yes. It was the first time anybody in this office at CIA had ever gone public. That was a big deal. It took a long time for the paper to get released because some people at the Agency asked: can we let this guy go public? They finally decided to do so and they were eventually pleased they did. People over there were asking for my autograph on copies of the paper.

Misa: Oh really?

Goodman: Yes. And they have since created an NIO, a National Intelligence Office for science and technology; and the first guy who became this National Intelligence Officer was Norm’s division chief, Julian Nall, who became a good friend. Again, I’ve never actually worked for these people directly, but they were interested in anything I came up with. Two other things of note with this paper, with regard to stories, if you’d like -- one day in my office at the Woodrow Wilson School I received a call from a student reporter on the *Daily Princetonian*. She said that she wanted to come over and talk to me. I said, “What about?” This was shortly after this article appeared. She said, “Well, I’ll tell you when I get there.” Well, I had a pretty good idea what this was going to be all about. This real left wing reporter from the *Daily Princetonian* came over expecting some sort of great exposé and asked me if I was an agent of the CIA. So I patiently explained to her the entire history of this paper, with all the analogies of all the people elsewhere on that

campus who also studied the Soviet Union and politics, economics, and energy, so why not study computing? By the time I finished, she was so bored...

Misa: There was no exposé there, it collapsed.

Goodman: Yes. There was nothing hidden and she never wrote a word. Some of the administrators at the Woodrow Wilson School, however, always held me in a certain amount of suspicion. Some of these people actually worked for the government, notably the Department of State, and most likely did classified work while in government, but connections with the CIA were something that was of great concern. Cy Black was not one of them. He was very supportive. I eventually left Princeton partly because of that reason.

Misa: That reason being the suspicion that . . . ?

Goodman: I had a dean, in particular, who was really disturbed that I would be openly identified with anything to do with the CIA even though this guy had had a partial career in government. That would have been far more than I ever did.

Misa: Right. It wasn't something that Princeton wanted to openly acknowledge, but there was this Princeton group and many different contacts. It was more or less below the table, we now understand. But this was above board; this was being openly published with the CIA.

Goodman: That's right. And somehow, this would get a *Daily Princetonian* reporter interested but such a person never went over to any of these other people at Princeton who *had* to have been involved in ways that I never was. Another thing about this paper is that this was extensively read in the Soviet Union because no one over there had ever written something like this.

Misa: Because you were pulling things together that they might have?

Goodman: It took a whole lot to put it together. You know, you had all these different people — if you want to call this the “elephant” — feeling different parts of the elephant over there, but they had never seen the elephant. None of them could find problems with my view of any part of the elephant. This served, either directly or indirectly, as a business card for when I started going over there to events in computing where there was a large audience and all sorts of things going on. People would be talking about what they were doing, and the latest machines or applications, or the various institutes of cybernetics that they put together. They had a whole institutional infrastructure out there that was absolutely necessary to deal with anything on this kind of scale. They had design bureaus, manufacturing, and service. Basically, it was developing and diffusing computers in the second largest economy on the planet, depending on how you measure it. In terms of geography and population, industrial base, and military capabilities - all the Cold War stuff that mattered - this was quite an undertaking. There were hundreds of facilities, and bureaus, and ministers involved. Part of what we did was sort out all this

institutional stuff. There were occasions when there would be some Soviet up there talking about what they were doing and citing this *Computing Surveys* article as their authority. These same people sometimes would not make the connection between this guy who wrote the paper, and the one they had just met and who was sitting in the audience.

Misa: Oh, that S.E. Goodman.

Goodman: It was a kind of peculiar out of body experience.

Misa: To hear yourself referred to . . .

Goodman: In a very positive sense. Not once during the entire time — as a subgroup of MOSAIC, or me personally — was there ever a nasty word, saying we were totally off base, or we were totally full of crap, or anything like that about anything that we wrote in that and in all of our other publications. There were occasions when the Soviets would come up to me and ask privately about my sense of the working conditions and the bureaucracy over there, [saying it] was uncanny for someone who had not grown up as part of Soviet society -- people who specialize in studying the bureaucracy and the politics – to understand their situation. By that time I had had enough exposure to how the U.S. government worked to understand and sympathize with them, so I simply told them that. I was sensitive to their working environment because I could see what was

going on over here, at least within the government. But of course there were important differences as well.

Misa: The *ACM Computing Surveys* article had a big impact in computer science but I think it's this *World Politics* piece that had a big impact in area studies and international relations. Can you say something about that piece? Was it something that you submitted because it appeared at about that same time -- it says 1979 -- but it's that same moment when you're at Princeton? It was in a Princeton journal, as well, I believe.

Goodman: That's correct. Klaus Knorr as the editor-in-chief, if I remember correctly. People over at the Wilson School and the Department of Politics, and some of the economists were becoming interested in what I was doing. I think within the Soviet studies community, as was the case within the computer science community, what I was doing tended to polarize people. There were computer scientists who said basically, "You are no longer one of us. You do things that we don't do, that we're not trained to do and that we don't train other people to do. Therefore, you're no longer part of the computer science community." Within the area studies communities, the Soviet and Eastern European studies community, I had all sorts of people who said, "You are not trained by us or like us. Therefore, you cannot be part of this community." Hell, I still suffer from that in all sorts of ways. It's been that way with all eight of the universities I've been at, except for the University of Chicago, but I was there for such a short time I didn't get that much exposure. Within the Soviet studies community, there were people, Loren Graham, Cy Black, and Murray Feshbach, in particular, who were very interested in the subject

and seemed to understand that computing was become an extraordinarily important technology, and were encouraging. Cy died some years ago, and Murray is retired and I'm sorry to say I have not been in contact with him for many years. Loren is still writing about Soviet S&T today.

Misa: I believe so.

Goodman: I just reconnected with him after a number of years. He used to run a small group. He had a bit of money and a core group of people concerned with Soviet science, and he ran it for about nine years, and I was one of the core people. Great guy; Loren is just a wonderful person and he welcomed me with open arms while various other people said, "You are not one of us."

Misa: For this *World Politics* piece, though, did the editor commission the work?

Goodman: No. They encouraged me to write and submit. They said, "You're doing stuff that we're interested in and we think you have the potential to write an article on that," and so I did. It went through peer review. They actually made it something of an accelerated review. They knew they had something interesting and quite different, and it got the number of reviews they needed. They didn't give me a free ride by any means. They came back and said that they would love to publish. They also said that they would like me to do more of this kind of stuff. But I never did so again. I left Princeton for a variety of reasons, partly because I didn't like living in New Jersey. I went back to

Virginia for a short time, where I was treated with a great deal of hostility by a couple of people, but the area studies people at Virginia were very positive and receptive. That's when I went to Arizona and became part of the MIS community. They didn't value articles in *World Politics*.

Misa: So that was 1979 or 1980?

Goodman: It was 1980.

Misa: And you were at UVA for a partial year?

Goodman: Just one year. I realized that there was some ugliness there that I'll not go into, and I became a lightning rod for a disagreement within the department.

Misa: Could I just ask a couple of questions about the "Soviet Computing and Technology Transfer" paper? It says it was partially supported by the NSF Science Faculty Fellowship while the author was a member of the Center for International Studies, so that's clearly part of your Princeton time.

Goodman: That's right, and all of my Chicago time.

Misa: And your Chicago time, also.

Goodman: I received a multi-year fellowship. In addition, the first year at Princeton was also supported by some sort of Sesquicentennial Fellowship from UVA for a sabbatical. Then I was awarded this multi-year NSF fellowship, which was encouraging people get into new fields and get out of their comfort zones. Part of the appeal and one of the reasons I think I was awarded the fellowship — you can imagine NSF fellowships were quite competitive --- was that I was getting out of a combination of applied math and computer science. I was actually dual titled. Computer science had changed quite a bit over the course of the 1970s. So the computer science people eventually became, and are to this day, a whole separate department. I would have gone with them had I stayed at Virginia but there was a fair amount of contention. People who were very supportive of me because they remembered what I used to be thought, "Hey, this guy is not like the rest of us but he's really studying computing," and other people said, "He no longer proves theorems -- he's no longer like us." Frankly, this made my life miserable. So I moved over to Arizona in Management Information Systems, one of the best MIS departments in the country, because MIS differs from computer science, as you probably appreciate since Minnesota has a very strong MIS department. MIS always thinks about computing in some sort of organizational context. That's the sense and the definition of MIS versus computer science.

Misa: And computer science is . . .

Goodman: Algorithms and . . .

Misa: . . . somehow just the opposite.

Goodman: It's really much more narrowly technically defined. So my organizational context was whole countries and they didn't have a problem with that. Plus, my wife was prepared to move there. I mean, there were a number of places that were interested in me when I decided to make the move. I really had trouble going back to New Jersey because we had trouble living in New Jersey, to be perfectly honest. Being at Princeton was wonderful, even though a few people there were very suspicious of me, too. But nevertheless, there were plenty of people who were not, and I could have been comfortable forever in the Woodrow Wilson School. Minnesota was out, but Minnesota had some attractiveness, partly due to the Babbage Institute.

Misa: This search for a Babbage director is occurring in 1980, in the middle of a tumultuous time for you.

Goodman: Indeed. And there were people at Princeton who wanted me to stay there and keep doing this kind of work, but I still felt I needed some sort of technical connection. Minnesota was offering --- the dean there was really very, supportive, I forget his name -- - but he was perfectly happy to offer me a real appointment in computer science even though there were some computer scientists there who did not think I fit. Because of the organizational context and the international interest, there were people at Babbage who were concerned because I wasn't an officially educated historian.

Misa: That's right.

Goodman: I was a person studying the kinds of things that historians are interested in which is, frankly, why you're here today.

Misa: Yes.

Goodman: It wasn't history at that time. So I was a weird candidate for the Babbage Institute directorship, but Paul Armer was very supportive, as were a number of other people. It never came to a decision because I withdrew once my wife said, "You go to such a cold place without me." I certainly, as 47 years have proven, was not about to do that. But it was interesting because I found, potentially, a tolerant atmosphere in Minnesota. The computer companies there seemed quite happy to have me because, for example, I had the potential to write the kind of book that looks at computing in a larger organizational, political/economic context. I still preferred whole countries but I could have done a whole state.

Misa: You could've done a state, I'm sure.

Goodman: But I probably wouldn't have done that because I was really interested in another part of the world.

Misa: Sy, I'm wondering how we should approach explaining how the MOSAIC Group was organized and founded. Our finding guide at the Babbage Institute has it being formed at Princeton; you told me that it was better understood as being part of Virginia.

Goodman: Both

Misa: And of course, it has its most notable long run . . .

Goodman: At Arizona.

Misa: . . . at Arizona. So how . . .

Goodman: And it also had a residual, modified form, at Stanford.

Misa: At Stanford, too. So, do you want to try to pull those first three pieces together?

Goodman: Okay. We were in our various incarnations. It began with me basically doing it alone, actually, in very short order also with Norm [Davis] from about 1976. Ultimately the last thing we did as a group was in 2001. For a variety of reasons, all of which are understandable, we had our ups and downs, which often had to do with how welcome I felt at different institutions. We really got going at Princeton, in the sense that I started taking on students to work on this. So it became more than me, in a normal academic sense, i.e., a professor with students. I had some marvelous students at Princeton. One of

whom, Bill McHenry, was with me as an undergraduate, graduate, and then faculty member. But the MOSAIC Group really had two lives, defined by two main lines of study. And both came to a natural, positive end. It is very unusual to have a natural end to an academic line of study, as academics are largely in the business of perpetuating ourselves. But we had two lines come to a natural end. The first was the study of computing in all of the communist countries, not just the Soviet Union. This started in 1975 or 1976, was practiced at Virginia, Princeton, and Arizona, and came to a natural end with the end of the USSR and CMEA/Warsaw Pact by 1991-92. The second line of work was the study of the global diffusion of the Internet, what we called the GDIFF period, and ran from about 1989 until the Internet had diffused to every country and semi-sovereign territory, about 2005-06. That was a natural end to that line, and we pursued that at Arizona and, in a more distributed way, at Stanford. It was more distributed in that most of the participants had obtained their PhDs at UA MIS and were assistant professors elsewhere. For example, Bill [McHenry] was at Georgetown and Peter Wolcott at UNO. What both lines of study had in common, of course, was the study of the development and absorption of computing in difference social, political, and economic environments.

Misa: Bill was another connection to the Babbage Institute because we ended up supporting him through part of his training as well.

Goodman: That's exactly right. In fact, I have Babbage on that list of funders.

Supporting somebody for a whole year is respectable and earns a place on the list. There you are --- Babbage WKM.

Misa: Okay.

Goodman: You have some sort of role with the *Annals*, now? I seem to recall.

Misa: My personal role is modest, but my associate director, Jeff Yost, was Editor-in-Chief...

Goodman: Yost, that's right.

Misa: ...for four years. He stepped out of that role recently. Lars Heide is presently Editor-in-Chief, but Yost was the immediate past Editor-in-Chief of *Annals*.

Goodman: Understood. It's Yost whose name I was mixing up with yours, but your name appeared in some of the discussion. Basically, I've been nagging Steve Lukasik, who is a member of the Stanford group I had. Yost was the editor who handled Steve's paper on the defense origins of the ARPANET. Steve was Deputy Director and then Director of ARPA during that period. He was a very active member of the CRISP group I directed at Stanford.

Misa: Were you with him in the last month or so, perchance?

Goodman: I'm going to see him next week.

Misa: It's very curious; this is one of those little sidebars that we don't have to follow, but our present archivist, Arvid Nelsen, has been trying to get in touch with Stephen Lukasik for the past five years. In the last month he finally had a chance to talk to him and he's very excited about transferring some of his papers to CBI.

Goodman: Steve was really quite a close friend and colleague, particularly at Stanford but we knew each other before that. I've been nagging him for years to write that article.

Ultimately, you guys made it the cover article, which is very nice. By the way,

McHenry's dissertation is the cover article of that issue of *Communications of the ACM*.

[Pointing to a framed copy on the wall.]

Misa: Oh, cool.

Goodman: Basically, he wrote about computing getting into database management systems, MIS systems, within the Soviet economy. But I really nagged Steve into that *Annals* article over the course of many years. I had him come out here, he was a fellow at this center after I left Stanford and he left California. We used to have him come down

here. We actually have a poster of him giving that talk before he wrote the article. I kept working on him, working on him, and working on him.

Misa: Good for you. Can we return to the MOSAIC work, because there's an important leg, if you will, at Princeton, there's a second leg at Virginia, and then an important column or pillar at Arizona. Maybe you could help us understand how those three pieces came together?

Goodman: The start of group work with students was at Princeton, not just with, but most prominently with, Bill McHenry. McHenry was a very bright young guy who was very interested in the Soviet Union — he was an engineering student at Princeton with an abiding interest in Russian language and in the Soviet Union — but had no idea how to put them together. He wrote his senior thesis with me, and he just was really thrilled at how to put them together. I took him back with me to Virginia, where we started to form a larger group for the single year that I was back there. Another member of that group was David Mundie, who is now with the Software Engineering Institute at Carnegie Mellon. When our situation became difficult at Virginia, we went to Arizona. David had graduated with a master's degree. Bill picked up a master's degree and went to Arizona with me. He really was absolutely crucial to building the group. He was essentially, not just a graduate student, but he was essentially the assistant professor who worked with all the others. Ultimately, we had about 50 people go through the Arizona rendition of this, in all sorts of capacities.

Misa: I don't know whether this is published, but you had three faculty members, three staff, and then somewhere between 12 and 18 students, I take it, at any moment in time. So this is "International Development in the Information Technologies," the MOSAIC Group, at the University of Arizona.

Goodman: Ah, yes. That was one of the student papers.

Misa: It was a long time ago, and I couldn't find a place that it got published.

Goodman: You can have that.

Misa: Okay, splendid. Then that pins down that it was reprinted from Proceedings of the Twenty-third Annual Hawaii Conference on Systems Sciences, IEEE Conference publication in Hawaii, January 2-5, 1990.

Goodman: We actually delivered three papers in at HCSS in 1990. One of the things that Bill started is this research line since we were inundated with so many people and so much information, particularly as we started to travel. We started to travel in the late 1970s, but then really got very serious about it once we got to Arizona. I would take three trips a year to either the Soviet Union or Eastern Europe, for a variety of purposes, and then other trips elsewhere and figured that they might relate to export control kinds of things. So "MOSAIC" actually stands for the computer system we built. It's the Multi-

User Online System for the Analysis of International Computing. Ross Stapleton coined the acronym.

Misa: MOSAIC.

Goodman: Ross Stapleton actually came up with the name. He *post facto* named the system, which really had no name. The system was actually started in 1981, by Bill. Basically, we started building a database management system. Today it would be called a knowledge-based management system. We were real pioneers 30 years ago for putting together collaborative, shared knowledge based information systems. If you'd like, I can make copies of the other two papers that we delivered at that conference that were both concerned with the system.

Misa: Do I understand correctly that MOSAIC was — I don't know the right way of putting it, but — an application of an instance of this AAIS . . . ?

Goodman: No, AAIS was the second rendition.

Misa: Second rendition, okay.

Goodman: The Arizona Analyst Information System produced multiple degrees, including two Ph.Ds. for people who rebuilt the system and converted it into something

more than poor Bill was able to do by himself. So somewhere here, I have this kind of paper. This is another HCSS paper.

Misa: Can I ask you about CARAT as well?

Goodman: That's the third rendition. We developed a whole research line in collaborative, large scale information systems.

Misa: Independent from the specific topic and independent from the specific research, you were also building a tool.

Goodman: That's right, but it was built primarily to support the international research. Joel is a technical star of the first magnitude.

Misa: That would be Joel M. Snyder?

Goodman: Yes. Joel went off after graduation and made a fortune as a roving troubleshooting consultant. He retired some time ago; he could make all the money he wanted, but had a certain lifestyle that he liked. He's a native Tucsonan and just liked the desert, and not being boss of anybody, and not having anybody being his boss. So he and his significant other formed a two-person company. She was one of the systems people we had at Arizona. Joel's one of these people who could sit down and touch a keyboard and miracles would happen.

Misa: Wow.

Goodman: He was interested in the Soviet stuff, too. We'd take him to all sorts of places and he would be a role model for young people we met. I remember taking him to Cuba once. We were doing a study of what was going on in Cuba, their interest in the internet, and what they were and were not doing about connectivity. The young Cubans were very friendly to us and they all wanted to be like Joel. He would sit down and he would do things on the net and they would just stand there with their mouths open. He played games with this server here, and that host there, and this node, and bounced things through the Soviet Union, and whatever. We would get young people to talk to us and it was completely open. The older Cuban officials were a different story.

Misa: The other co-author for this, "Requirements for Integrated Collaborative Research Systems," besides Joel Snyder and you, is Kevin Lynch?

Goodman: Yes, he was another Ph.D. student.

Misa: So both of them worked under you?

Goodman: That's right. And both did their Ph.Ds. on the system; actually, Joel was mixed. Joel did his dissertation on networking in the Soviet Union and the early mapping, node mappings of the kind that has since become very common. It was a good

dissertation but he never took it any further. Once he got his degree, he became what he has been doing so successfully. Almost all of the students, for good reasons — I'm not saying this in any pejorative way — basically followed their personal lives rather than sacrificing everything for some sort of academic career. That even goes for McHenry, who got a very good tenure-track appointment at Georgetown, and then just quit because of personal considerations and moved to Ohio to be with his significant other. He's now with the University of Akron. But he's personally much happier than he used to be.

Misa: I notice the last author here is Lance M. Hoopes?

Goodman: Yes, he was another student at Arizona.

Misa: At Arizona. He's listed here at Los Alamos National Laboratory.

Goodman: I think he went there. Lance was an undergraduate and then a graduate student with us. He must have had some sort of interlude at Los Alamos at the time this was written. I frankly don't remember; but Lance is still at Arizona.

Misa: Still at Arizona.

Goodman: Yes. Lance is noteworthy in his personal transformation. Lance was a pretty wild guy and he used to drive a white Corvette. One day, going too fast out in the boondocks of Arizona, he hit a cow and destroyed the Corvette and the cow. He became a

different person the day after [laughs]; he became this great family man. He got married, had kids, and held a job. He took that he survived as an actual . . . [pause]

Misa: For a good cause or something.

Goodman: Something like that. Yes, Lance was a good fellow, but he was basically an undergraduate and a master's level assistant to the other two guys. There's another guy who appears on a number of the systems publication, perhaps not this one. That is a fellow named Hsinchun Chen.

Misa: Can you spell that name please?

Goodman: That is C-H-E-N H-S-I-N C-H-U-N, who is a faculty member who got involved with us very seriously on the systems development side. He has stayed at Arizona and actually built a whole program on the systems side. He is the inheritor of the system stuff, and has gone much further. He is now a distinguished professor at Arizona.

Misa: How did it happen that you, individually, with this group of students, ended up moving to the MIS department in Arizona? How did that happen?

Goodman: Bill was the only one who came with me. There was a second, Scott McIntyre, but he ended up doing his PhD in a more traditional area. Sadly, he passed away at a young age.

Misa: Oh, Bill was the only one.

Goodman: All the other students we found there. We built the system. We had our own laboratory. We had a large number of people. Bill wrote a summary of the systems efforts for you, because I mentioned that you were coming and he has positive feelings about the Babbage Institute. There are a bunch of errors because he just put it together overnight. He uses his experience from his knowledge management days back in the early 1980s with some of his classes that he teaches now.

Misa: It says 4 August 2013, so this is very recent.

Goodman: He did it and sent it to me. I asked if I should give it to you and he said, "Sure."

Misa: Oh, that is splendid. Thanks.

Goodman: He didn't think about it. I mean, frankly, I poked a few of the people when you said you'd like to come over and talk to the group. We're all dispersed. I'll tell you about how that happened, as well. Peter Wolcott, who also wrote an *Annals* article, among other things, was our Soviet high performance computer person. He said he still has a good deal of material he used. He's at the University of Nebraska at Omaha [UNO],

which is the branch of the University of Nebraska that has a College of Informatics with MIS, computer science and library science. Peter is now a department chair there.

Misa: So he still has some materials?

Goodman: He still has a lot. Peter is a very bright guy; all these people are. Bill was an undergraduate at Princeton, Peter at Dartmouth, Peter's wife, who did China analysis for us, was an undergraduate at Yale. They were the first marriage within the group.

[Laughs] They all were people who had computer science interests but also had international and foreign language interests, and they had no idea how they could make them fit together. So they would find me and I was happy to have them; they were really good folks. Peter asked me to note for you that not only does he have all this high performance computing stuff still left but he would be happy to meet with you and pass them along. Another was Ross Stapleton who was an undergrad at the University of Michigan — Ross mostly covered Eastern Europe.

Misa: Ross Stapleton.

Goodman: Yes, Ross fell in love with Bulgaria. One of Peter's daughters is going to be going to St. Olaf College in Minnesota. He's of Norwegian descent. He said that if you are interested in pursuing the Soviet high performance computing stuff, that he would be glad to stop in, maybe when his daughter starts. She's actually doing a year in Norway;

it's part of a family tradition. When she comes back she'll be starting at St. Olaf. He could stop in to see you when he takes her to school there.

Misa: That's Peter Wolcott. I'll definitely take that up.

Goodman: Yes. Peter is a very bright guy. He got out of the international business. I think he was looking for an excuse to think about it again. Peter developed a lot of friendships in the Soviet Union, as did Bill, and was quite marvelous in his trips. Most of these people were excellent. We were going over there, snooping around in all kinds of stuff, and none of these students ever got in trouble. We once got some young Cubans in trouble but I don't think it was serious. We always worried about getting them in trouble. I never had any fears during the Soviet days that anything would happen to our people. After the Soviet era ended, then I started to worry. I had one student from Stanford who was beaten up and left in a gutter. The place became indifferent to the personal safety of Westerners. Once it stopped being the Soviet Union it became, frankly, more dangerous.

Misa: I think I asked you . . .

Goodman: Peter, I think, would be glad to talk to you if you want to sort of build something on high performance computing.

Misa: That would be splendid.

Goodman: He would go over there and run LINPAC and other benchmarks which is how we rate high performance computers. I mean, you're from Cray country, right? You should know how that's done. And so, particularly during the export control days, export control had a bigger footprint on all sorts of things.

Misa: Let's make sure we have a chance to cover that because I think that's important.

Goodman: But in any case, most people still run various packages of inverting or solving big matrices of linear equations, to see how fast the computer can do those kinds of calculations, and that establishes a rating. Peter went over there and he ran some of these things on some Soviet high performance computers with their total cooperation. They said, "Oh good, you're going to come and do that."

Misa: We'll get a measure.

Goodman: So he may still have some of our trip reports. The reports could well describe those kinds of activities that we did over there. We were quite serious in what we did. But in any case, getting back to our years at Arizona...

Misa: How did you land in Arizona?

Goodman: Because my wife was willing to go there and the MIS [pause]...

Misa: Was there a faculty position that opened up?

Goodman: They made one for me.

Misa: They knew of your interests and had an interest in hiring you.

Goodman: Yes. There was professor there named Benn Konsynski, who was at that time an assistant professor, and he was following some of what we did. He's now at Emory, although I haven't seen him in years. They were recruiting, and the department was growing quickly. In going over there, I made the MIS case that the organizations I was interested in were whole countries. Arizona was not the place to go for Soviet studies, although it is the place to go for Middle Eastern studies. But we did fine there, and we helped create a Center for Russian and Soviet with a very active Russian department. One of Loren Graham's students later went there as a history professor, so there was that kind of interest. We at least had a broader Soviet studies group there, but for some time they were quite hospitable to our group at least partly because we brought in a fair amount of money. They allowed our people to earn Ph.Ds. doing this research, so we had a good match. Later, when we went into our GDIFF phase, when we studied the global diffusion of the Internet, the Middle East was of serious interest to us, we became involved with the University of Arizona center for Middle East studies, in particular with Jerrold Green, who was then the director.

Misa: Did you teach classes as you had done earlier? You have an extensive computer background teaching computer programming, did you teach any of the more technical aspects?

Goodman: Yes, when I first got there I would teach courses related to design and analysis of information systems. I used to do a great deal of that, but gradually, I stopped. The international studies became more than a full time effort and I essentially used a fair part of my teaching load as the seminar on international computing. Towards the end of my time there, after the USSR split up, I started teaching courses in computer security. Hsinchun Chen has since picked that up as part of what his group does there.

Misa: You said that you had this list of the different funding sources you've drawn on. Maybe we could go through that.

Goodman: You can have that.

Misa: Yes, but could you just . . .

Goodman: There's nothing secret about it.

Misa: I'd just like to know how your work related to their interests. I appreciate the piece of paper but it's your reflections on the piece of paper that would be just as valuable.

Goodman: There is a full spectrum of support here, some of which are individual fellowships, like the Babbage support for McHenry and some of our NSF support, a significant part of it was the faculty fellowship that I had for two or three years. I can go through some of these other things. The Army center that I told you about, they supported us.

Misa: That was at UVA.

Goodman: That was at UVA. That was mostly in-kind. They would acquire all sorts of unclassified material for us and they would support travel to Washington for various purposes. They had a shuttle that ran up and down the coast. All of these things saved money so they're worth having. I'll go through some of the smaller ones first, and then some of the bigger ones. In particular, one that was primary to our efforts, the largest supporter at Arizona was Los Alamos National Laboratory. Another was the Prince Foundation. It was a Chicago-based foundation. They wanted us to do a study on robotics in the Soviet Union, which one of my former Princeton students, John Dolan, largely did. Another was the Center for Strategic International Studies, then affiliated with Georgetown University. The CSIS and Georgetown are now separated. We created SovCetb with them. This was in the late 1980s; we put together a kind of internet for the Soviet studies community, which we called SovCETb. CETb is the Russian word for network.

Misa: Would that be internet or something more like listserv, or . . . ?

Goodman: More than that, it had e-mail and we could upload documents. We had hundreds of people on it. This is before the internet as we now know it. [Shuffling papers] This pile is for you, by the way.

Misa: Oh, splendid, thank you so much.

Goodman: That's the little article on Zuse, and . . .

Misa: Oh, the Internet; this is the article, "Origins of Digital Computing in Europe," that we were talking about earlier.

Goodman: Yes. It was our membership. Everybody who was anybody in the late 1980s in Soviet studies was a member. Some used it more than others. That was supported by CSIS, the Center for Strategic International Studies in Washington, whose Chairman of the Board now is Sam Nunn, who is a faculty member here at his namesake school.

Misa: That's right, yes.

Goodman: The National Council for Soviet and East European Research was another funder at Arizona. They would have RFPs for proposals to study all sorts of things in the USSR and Eastern Europe, and selection was very competitive. For us, they funded a multi-year study of the integration of the East European industries with the Soviet

industry. Then there's the Department of Commerce. For decades, the three primary agencies that were involved in managing export controls of advanced technology and reviewing license applications, were the Department of Commerce, the Department of Defense, and the Department of State. They managed everything from export controls on dual use technologies to the munitions list. In any case, for the dual use technology export controls, the Department of Commerce was the lead agency, and I served on various advisory committees for that agency. They funded some of our research, partly because, in addition to the usual academic consuming audiences that all these journals are supposedly read by, the government and industry stakeholders in export controls was a big consumer of what we did. I can explain this in more detail later if you want, but there are aspects of export controls concerned with foreign availability which are fundamental to the whole export control regime and to issues of technology transfer. We were in the most significant technologies that were troublesome for export controls for decades, which were computing and the related technologies, and we gave a lot of thought and work on what was going on in all the countries that were the targets of export controls. .

Misa: That's right.

Goodman: And so all sorts of funding, particularly the database stuff; that was our most expensive thing, all the people doing the database stuff. Various organizations, most notably, Los Alamos National Lab, took us on, as part of the whole export control regime. One of the major National Academy studies that I worked on talked about just how huge the footprint of export controls was during the Cold War. Export controls were

a fundamental policy of the Cold War that most people don't appreciate. If you want to talk about technology in the Cold War, I would be glad to talk about that. In any case, we were a regular feed into the process, dealing with both the policy makers and the implementers of the policies from the mid-1970s to the late 1990s. We not only studied what they would call foreign availability in details, but we tried to understand the forms, value, and effectiveness of international and domestic technology transfer for computing.

Misa: Yes. Oh, splendid.

Goodman: So they wanted a lot of information on foreign availability, so that everybody from the top level policy makers, including the White House, and the National Security Council, down to the licensing officers in the Department of Commerce and the DoD reviewers could look at a license application and see if foreign availability issues applied. It was supposed to be one of the fundamental decision points for granting licenses or not. One of the things we tried to do in this world computing database --- or at least the Soviet and East European part of that database --- which Bill describes in that little paper I gave you, was to put that together and ship it off to Los Alamos who made it available to the licensing officers. The higher level policy people would tend to talk to us directly. We also used to give talks to licensing officers. We wrote things like this, which were relevant to policy decisions on what to control or not.

Misa: Sy, you're just pointing there to Goodman, Wolcott, and Patrick Homer on "High Performance Computing National Security Applications and Expert Control Policy at the Close of the Twentieth Century" from Stanford.

Goodman: Yes. All of us were MOSAIC people, but by then we had stopped using the name. The Arizona stage basically lasted the entire decade of the 1980s, or at least the Soviet part of the Arizona stage, and essentially ceased when the Soviet Union stopped being the Soviet Union in 1991. At this point, that part of our research came to a natural end, and by then we were already studying the global diffusion of the internet. I was in the Soviet Union with a National Academies group for a few weeks when the USSR ceased to be. We were the last group to be hosted by the Soviet Academy of Sciences, and the first group to be hosted by the Russian Academy of Sciences. We were watching this transition happen, and we wrote and spoke about it. We briefed people in Washington about how things were changing, the *perestroika* and *glasnost* periods, but it became clear that once the Soviet Union stopped being the Soviet Union and the Cold War was over, that we had to find something else to do, or we *should* find something else to do. In a very real sense there was closure on our whole subject. We could have written the definitive history of computing in the Soviet Union but I don't think anybody was interested in that, and we weren't going to get funded. All the sponsors I've been telling you about weren't going to continue to fund a group to do that. We could've done the sort of thing that they did at the [MIT] Rad Lab on their radar work as soon as World War II ended.

Misa: Oh, that Henry Guerlach did for some years, I gathered.

Goodman: A number of people basically started writing up everything they did when they stopped working, when the war ended. We didn't do that. We just didn't have the resources. Between Peter, Bill and myself, we have just barely managed to just keep most of our trip reports. In some ways that is sad, as we have a unique place in the history of computing during the Cold War. This is twofold: we covered a great deal of what the other side was doing, and we had a unique perspective, as academics, on one the two primary strategies of the West vis a vis the communist countries. The two strategies were to run faster and don't help the other side, the latter being implemented primarily through export controls

Misa: Did you go through the list of funding agencies?

Goodman: No, I'm not finished.

Misa: Good, I just didn't want to lose that because that's important.

Goodman: We've been wandering around here.

Misa: Right, so long as we come back to the thread, I'm happy with that.

Goodman: Let me see what I have. There was Los Alamos. They were our biggest funder throughout the 1980s.

Misa: The largest funder.

Goodman: Yes. NSA was the primary funder at Stanford, and completely open. It was the best money we ever had. There was no classified information. There were no constraints, just work on whatever we thought we should work on. Some colleagues at Stanford were freaking out because I was taking NSA money and there was going to be this kind of stain that people worried about. It would taint the foundation money from all these liberal foundations that they were getting money from, and they feared our funders would run away from us because of the NSA. I reminded them that the NSA was giving us this money with no strings attached, no classified anything, not even telling us what to study. It was the best money I've ever gotten. I said, "Your foundations have a bias. You guys tend to lean towards those biases." Let's face it, academics are like that. The NSA was, in spite of what's going on today, back in the 1990s they us no-strings-attached money. Essentially, they said, "Do whatever you want and every so often stop by and tell us what you're doing." I should note that this funding only indirectly benefitted the MOSAIC efforts. At Stanford, the group I directed under CISAC was known as CRISP.

Misa: What do you think they thought about your group? I mean, there are lots of different reasons for funding research, and one is to develop and sustain competence in a particular area, the other is to have policy objectives or advocacy or something like that;

but it sounds like NSA had more of the former. That is to say, this is an important area and we want to have somebody to have expertise in this capacity.

Goodman: That's essentially all there was to it. It's a big agency, and one of their senior people liked us and had the wherewithal to support us.

Misa: "The Internet in Turkey and Pakistan: a Comparative Analysis" is again from your Stanford years?

Goodman: Yes, but it's still Peter.

Misa: That's right, Peter Wolcott.

Goodman: Well, I'm getting ahead of things. Let me get back to Arizona. So after the Soviet Union ended and we figured this was a good closure, what do we do now? We decided to think about computing every place else in the world where we couldn't drink the water. The refocus at this point was, what we would call, our GDiff phase, Global Diffusion of the Internet.

Misa: So this is about 1989, 1990, or 1991?

Goodman: Right. We were still very much Soviet until the wall came down. We used to spend a lot of time in East Germany by the way; we had some truly unpleasant

experiences along the Berlin wall, on the East German side. This is 1989. This is before the World Wide Web, so picture the internet [pause].

Misa: There was an internet but not the internet that we would recognize today.

Goodman: That's right. I was part of the Defense Science Board group that recommended that the ARPANET be broken loose from the defense community — this is in 1983 or 1984 — and be allowed to find its way in the world. It was initially turned over to the National Science Foundation, so it became NSFnet. This Defense Science Board group met for two years, which is very unusual for Defense Science Board work, and we were tasked with making recommendations for networking all of the Department of Defense. One of the things that we recommended was that the ARPANET, as it was originally created, had served its purpose. We recognized that the technology could be used in other contexts. The reason it was created, basically, was to bring researchers together so it made sense that it needed to be turned loose. It needed to be taken out of the DoD world so that it didn't mix at all with any classified stuff and other operational traffic. ARPA --- the name was later changed to DARPA --- is still a classified organization. This is one of the recommendations that DoD picked up on. They didn't take up everything we recommended, but this is one they did. Either immediately or in short order, it was turned over to the NSF to run. At the point we decided to make that recommendation, we took a little poll among the group members. There were maybe a dozen of us on the committee, I don't remember exactly. I was there as the international guy. [Laughs]

Misa: Yes, okay.

Goodman: But in any case, we took a poll. We asked, by the turn of the century — remember this is 1983 or 1984 — by the turn of the century, how many countries would be connected? One of the things we did was sort of check on how different countries came on to the ARPANET. They were mostly NATO countries, as you might guess; the first one, by the way, being Norway.

Misa: There were other internet-like networks.

Goodman: Not like the ARPANET with the use of packet switching. There was a French [pause]...

Misa: Cyclades in France that was quite close.

Goodman: No, no. I don't think--- different protocol --- was that Minitel?

Misa: No, Minitel was something different, but Louis Pouzin is the one that Bob Kahn will say invented the concept of datagrams.

Goodman: Yes, there were things going on in France; but the French effort, if I remember correctly, was [pause]...

Misa: Minitel was something else.

Goodman: Yes, you're right. Minitel was like a phone book. Simon Nora and Alain Minc wrote a book about it in the 1970s, which I may or may not still have, called *The Computerization of Society*. God only knows what I have from that period.

Misa: Come to the Babbage Institute, we've got a copy. Actually, I was looking at that recently, on the information society.

Goodman: They always talked about networking, and it was at that time that I learned something about the French effort. But in any case, we took a rough poll for guessing how many countries would be connected to whatever the ARPANET was going to become by the turn of the century.

Misa: Looking forward to 2000.

Goodman: 2000, okay, end of the century. Everybody was sitting there wondering, on what sort of economic base would a country need to use something like ARPANET? And so we all voted. My guess was at least double anyone else's. I guessed 60 countries and I was off by a factor of three. Could've been off by more, but there are just a finite number of countries, right, so I couldn't be off [interrupted]...

Misa: 180 is sort of one of those upper bounds, you can't go too much over that.

Goodman: Right. But I was the only one there who thought that a whole bunch of countries that you just don't think of, would have anything to do with computing. Remember what computing was like in 1983; it was not what we're carrying in our pockets today or the old thing that I have on my desk. When I said 60 and tried to make the case that numerous countries outside of Europe and Japan --- because if you start counting in 1983 past roughly 30, you get into some pretty less-developed places --- would be on by the end of the century, I was off by a factor of three. Not by three or 30 percent, I was off by 300 percent! And I was the forward-looking one. We had all sorts of people associated with that committee. We had people like Bob Kahn come in and talk to us in great detail. No one, no one thought [pause]...

Misa: So that consulting work in 1982, 1983, 1984, was a part of the Arizona years and must have interacted with the type of funding you were able to arrange.

Goodman: Indeed. I would bring information to these people because it was related to foreign availability and other things as well. There was a big consuming community for this. We wouldn't talk about the whole business of export control; I keep bringing this up. It needs, I think, a separate discussion in its own right. But we were kept solvent by that. When applications were made for licenses, including those for computers, but lots of other things as well, the licensing offices would often go to the national labs that were tasked to talk about whether this sale would be of perhaps some risk to U.S. national

security interests. The national labs were all heavily involved in this kind of stuff, and computing was getting more and more involved with all sorts of things. One of the grave concerns of the national labs, in particular, with regard to computing was its use for nuclear weapons and their delivery vehicles since these computers were used to design bombs and to simulate testing bombs. Remember, we stopped testing real bombs and started simulating tests on computers, and all the national labs were among — particularly the three that most people think of with regard to nuclear weapons, Livermore, Los Alamos, and Sandia — the most potent computing centers in the entire country. They were doing the sort of thing we didn't want the Soviets to do with those computers. So they had this big interest, or tasking, to help make good decisions with regard to export controls, both on what should be controlled and also specific license requirements. We were very much in support of that effort. They were the people who financed most of the systems work we did because we were putting information in forms that they could transfer directly. We were doing a lot more than that, mostly for our own research but it proved useful to these folks as well. Bill talks a little bit about how we did that then, but it was Los Alamos that was our primary funder. Parts of DoD were also interested in our work because it helped them understand possible Warsaw Pact capabilities in other military and industrial applications of computing.; For years, it was the money from the national labs and some of the military services that supported most of the 50 or so people we had working the different projects at Arizona. These were the people who worked on building and maintaining our systems and doing information collection and analysis. We also worked within other contexts, for example the National Research Council. The first big study that the Computer Science and

Telecommunications Board (originally called the Computer Science and Technology Board) did was a study I chaired on export controls and what was going on worldwide in computing. I don't know if you've seen that, but I can pluck it out of the shelves, if you want. Export controls were really a big deal and so government would fund these studies, and we would help do them.

Misa: You've got *Global Trends in Computer Technology and Their Impact on Export Control*.

Goodman: That's our business! And there have been others. I can pull out a half a dozen National Academy studies that were tasked. The State Department, basically, tasked this particular one. State also funded other things. On some of our travels we would be supported by State. State used to have and still has science attachés at embassies. We would go do country studies. They would support us by saying that their science attachés didn't really have a good idea of what they were doing, and ask us to let them hang out with us. We would help them make arrangements and appointments and they would learn how to do a country study. We did that for a couple of years. All this adds up to support; there's nothing secret about it. All this, when you think about it, makes a great deal of sense. All of these things were relatively short lived, except for the Los Alamos and DoD support and the CSIS support for SovCETb. They were short lived because they would have a change of personnel in one of these places and their priorities would change. This happens with the government. We worked via a funding portfolio, never dependent on a single sponsor.

Misa: Then the CSIS and Los Alamos were of longer duration?

Goodman: Yes, they also supported the systems work that we did--- the AAIS, MOSAIC, CARAT, and the SovCETb network. None of this was secret; all of it was completely above board, and we published a lot on what we did. Not one, with the exception of that one paper that Norm was coauthor on and that was only vetted through the classified people because his name was on it and they just wanted to be careful about leakage, was classified. I made a point of never learning anything secret so that I couldn't leak anything of that sort.

Misa: [Laughs] That is one version of [pause]...

Goodman: So none of us carried clearances of any significance that could be directly attributed to something that we would write as a form of leakage. Also by not carrying those clearances we didn't have any controls on our travel. If you have high level clearance, especially back then, you had to do God-knows-what to get permission to travel.

Misa: Security risks.

Goodman: We didn't have that because we weren't exposed to anybody's classified information. . At least we didn't know anything that we could leak other than things

people were interested in. We didn't know the secrets of the intelligence community because we were not part of the classified community.

Misa: You have this early paper that you collaborated on with Norm. Did you have a continuing relationship with him as well?

Goodman: Yes, until we moved out to Arizona. He was very sick, and he retired to South Carolina. Julian Nall, who was the first National Intelligence Officer for S&T, and I once tried to visit Norm in South Carolina. I used to take students down to see Norm when we were still at Virginia and Princeton. He was still very sharp, but he retired because he *had* to retire; he physically couldn't continue. He moved to some itty bitty town in South Carolina, and Julian and I once tried to go down and see him. Something happened, a weather event or something, I forget exactly what it was, and Norm went into the hospital. He came out of it. He was a much underappreciated guy. His one moment of public exposure, if you like, was that paper, which was eminently deserved.

Misa: Can I have you say a few words about the trip reports themselves, because from a historian's point of view today, they are really a singular source. They stretch back a number of years and come after the reports that we have from Willis Ware; it's a unique level of documentation.

Goodman: Willis came back planning to publish those early reports, the 1950s stuff. He always was planning to do that. We never did.. Our trip reports were basically feeders

into our own studies. They were much too detailed and specialized to find outlets in journals. And we didn't have the resources to systematically turn them into archived departmental reports. Academic papers were constrained in length, so our trip reports were part of the raw material we used to write these things, and it was awkward to even reference them. We hardly ever formally referenced our own trip reports.

Misa: We noticed that when we were going through the papers, the existence of the trip reports could not be deduced or inferred from the papers themselves.

Goodman: That's right. [But it should now be noted that I have since found a long buried set of single copies of a fair fraction of our trip reports.]

Misa: And, of course, historians always like to cite their sources.

Goodman: I understand that, but there are reasons for that, academic niceties notwithstanding. There are two reasons. One, frankly, we didn't want people asking for these things. And one of the reasons for that — also the larger reason — is that we were very specific about who we talked to and many of these people were very forthcoming with us, with at least an implicit understanding that they would not be identified as sources. We were in an adversarial relationship with most of the countries that we were studying and we — and they — didn't want some of the things that people said to us to be attributed to them. We didn't write the trip reports until we came out of the country we were studying. If we had passed out the trip reports, we might have put them at risk.

Misa: There was concern for the informant then.

Goodman: Informant. I don't like the term informant, it sounds too spooky. These were people talking professionally with us, but people in their intelligence communities might not have appreciated what they were telling us.

Misa: Well, colleagues then?

Goodman: In many ways, they were colleagues. They were people we met. They were people who were proud of what they were doing and wanted to talk about it. They were also some people who were conscious of the export controls and the roles played by foreign availability — again it keeps popping up — and people who knew what we were doing. I mean, look, people *knew* what I was about because of all of the publications, and so they would try to influence my perceptions. They knew we had influence on things like foreign availability perceptions and decisions. They were trying to convince us that they were doing better than they actually were. We were playing this little game. This wasn't uniformly the case; this happened more often with the official kinds of people we met as opposed to the people we found working at repairing computers in little shops on back streets in Moscow or Novosibirsk. We tried to talk to all kinds of people. There were games being played, but we didn't want to do any direct attribution. We didn't feel that we were terribly vulnerable because if anybody screwed with us, if the KGB screwed with us, none of their people could ever have come over here. They were getting more

from their people coming here than we were getting by going over there. So if we had been seriously hassled, the people who were interested in what we were coming back with could have retaliated. We didn't have diplomatic immunity; we were academics, we weren't working in any official US government capacity, but people would have noticed if we had been hassled.

Misa: You said that when you were in the Soviet Union you never had a concern for your own safety.

Goodman: None, none whatsoever. Other than drunk drivers and flying, Aeroflot being what it was, that's the kind of physical safety concerns we had. We didn't have concerns about being thrown in prison or even being thrown out of the country. This was the Soviet Union in the 1970s and 1980s, not Nazi Germany or North Korea. We were never threatened, although people were suspicious of what we were doing. Some people, actually many people, received us partly to impress us and to establish contacts with the West. There was one great incident I remember in particular. The primary East German computer manufacturing company was Robotron. They were probably, pound for pound, the best single computer maker in the entire Communist world. Suspicions, perhaps more than suspicions, were that they had a direct technology transfer link into IBM Deutschland. Unofficial and unapproved, they did a better job than anybody with regard to the functional duplicates of the IBM 360/370 machines. This is, in fact, what that 1978 article was mainly all about. The export control regime during most of the 1980s also had a particular focus on Digital VAXes. Remember VAXes?

Misa: The DEC computers, yes.

Goodman: Yes, right. Digital.

Misa: They did the PDPs and then [interrupted]...

Goodman: Yes. The VAX was of particular interest partly because the Soviets and East Europeans wanted them so badly, and they were export controlled. The makers of what were called “minicomputers” — it’s such a quaint term these days but that’s what they were called back in the 1980s — in the targeted countries were always trying to convince all sorts of people, including us, that they had VAX equivalents, so that we would de-control VAXes. That was part of the game that we would play. I forget what year it was but we went to Leipzig, where Robotron was going to unveil the Robotron whatever. I forget what it was called, but it was supposed to be a VAX750 equivalent. This was during the Reagan administration that much I remember because of some of the speeches that were made there. Three or four of us went to this whole day event. Joel, me, and Gary Geipel, a Columbia PhD student fluent in German who joined Mosaic, They had this huge show, and all the senior Robotron people were there, along with all sorts of people from U.S. industry and others from all over Europe. This was the unveiling of the Robotron VAX750 equivalent. It looked nice. It had a nice exterior. They did things with it that were pretty convincing that it was really a VAX750 equivalent running there. They had several speeches, anti-Reagan speeches about how U.S. export controls were stupid,

that they were hurting U.S. industry, that they were stimulating Soviet and East European companies to rise to new heights of self sufficiency, and people from U.S. industry were sitting there eating it up, including at least one Minnesota company.

Misa: Yes, of course.

Goodman: Honeywell and CDC were just . . .

Misa: Yes, because they were very intent on finding export . . .

Goodman: CDC was one of the companies that was pushing against export controls. So when it was all over, and all the dignitaries went off to enjoy their wine and cheese, we stayed behind with the guys who were actually running the machine. Joel was “Mr. VAX”; Digital was amazed that a nonemployee knew VAXs as well as he did. I took Joel along particularly for this purpose. He started talking to these guys about their machines. Joel was looking very carefully at all kinds of output that they were producing for us and he said, this is more than a functional duplicate, which is different than a clone, by the way.

Misa: This is Joel Snyder.

Goodman: Yes. He said, “I think this *is* a VAX750.”

Misa: Oops.

Goodman: Yes. [Laughs] So we're walking around the machine. We could touch it and feel it. These guys were really proud of what they were showing. They were a particularly arrogant group of East Germans. They were prancing around and Joel was saying, "ooh and ahh," and all the rest of us were there looking at this thing and admiring this and that. Then Joel got down on his knees and he pulled out the motherboards for the CPU.

Misa: So you could see the chips.

Goodman: Yes. They were taken directly from a 750. They had scratched out all the DEC numbers on the boards. Joel knew all the numbers and they had scratched out all of the DEC numbers and put in their own. So the Robotron 750 equivalent was more than an equivalent, and if they were going to make a whole lot of these, they had to illegally get a whole lot of real 750s for every one that they made. So there is a prime example. That one was particularly enjoyable, in many ways, because going to East Germany was always a tougher place than most other places, in terms of our reception. So we came back home and we wrote a trip report on what happened, but we didn't want to get these guys in trouble. We weren't going to share that trip report with anybody but we did tell the folks in the US government not to believe that they had a VAX750 equivalent. From an export control policy standpoint for approving licenses, we gave them pretty strong evidence that Robotron did not have that equivalent machine, and that any claims to that

level of foreign availability should be rejected. Our government did reject export licensing which pissed off American companies. I'm not sure it pissed off DEC, in particular, but it pissed off others because it would have established a certain kind of level that other companies would have found useful. Speaking of VAXs, by the way, and speaking of support for the group, there was a VAX that was being shipped to the Soviet Union through South Africa. The U.S. caught it and impounded it. At that point it was essentially contraband. They didn't quite know what to do with it so they gave it to us.
[Laughs]

Misa: Oh, because you said you had two VAXs that you ran the database [interrupted]...

Goodman: Yes.

Misa: So you had a contraband VAX. . .

Goodman: One of our, if you'd like, forms of support was a confiscated, illegally shipped VAX.

Misa: And this is a U.S. Customs Service warning that this is held for examination.

Goodman: It is off of one of the boxes that contained our VAX. The VAX was an issue for a long time.

Misa: August something, maybe August 6, 1982.

Goodman: This was one of the machines that the MOSAIC system, or AAIS, was running on. I don't remember the exact date it was delivered, but one day, a whole bunch of boxes showed up with these labels. We each cut off one of these labels; this one is mine. Nobody knows what the hell it's all about. You're the first person I've talked to about this in God knows how long. They felt that, well, rather than you know, do a *Raiders of the Lost Ark* warehousing thing with this machine, they would put it to good use, and good use was us!

Misa: That's funny.

Goodman: Yes. So we built a significant part of the database on top of this.

Misa: This machine from South Africa.

Goodman: Well, it was an American machine, it was just being transshipped. Getting an illegal shipment of computing equipment required a huge price penalty on acquisition on the part of the prospective illegal recipient. I think it varied from occasion to occasion, and it was greater for the larger, more complicated machines. I remember we once found a whole mini-supercomputer in the Yakovlev aircraft factory complex that had been illegally acquired. They could never get it to work properly. This is what we did over there; we discovered these things and usually not with the assistance of the people who

acquired them illegally. So among the reasons that we never cited our own trip reports, or distributed them, was this wariness. This came up when the lady came down from the Babbage Institute to get our stuff. We had all these tapes; these people let us tape them. I expressed concerns, at least in regard to the reports [pause]...

Misa: You have all these conversations in Russian, then, instead of English?

Goodman: Both. English is truly the universal language for computing and my Russian was quite weak. I can get along on the street, and I could read this stuff, but people like McHenry and Wolcott were first rate. Either as part of the group or when they went alone, they didn't have trouble with the language. We asked the lady who came down [from the Babbage Institute] how we could protect the people we dealt with. We're forgetting all the stuff that we just piled up and trashed. But we were concerned about all this after stuff. After East Germany fell there was all this stuff about who cooperated with the Stasi, the secret police of East Germany. There are repercussions still going on today. We didn't want to get any of these people in trouble. I personally never made friends over there for that reason because the assumption was, that we were working for US intelligence, even though it wasn't true, but that paper with Norm Davis perhaps didn't dispel the image that [pause]...

Misa: That they were spies.

Goodman: Yes. Most people understood what we were doing, but a number of people, particularly more official kinds of people, made that assumption. This includes all the Academy stuff. This is the kind of thing I wrote up; this was an Academy trip. By the way, it is very likely that in certain countries anybody who talked to us got interviewed later by their security and intelligence people. In particular, that was almost certainly true in the GDR. I didn't want any of these people to get to know us too well.

Misa: Trip report: Taiwan, Hong Kong, Macau, South Korea, and Japan; yourself; University of Arizona, March 12, 1990; so it was a trip duration of . . .

Goodman: This was export control related for a National Academy of Sciences study that I was part of. I was there in terms of foreign availability and the issues of how computer technologies from these countries might go to places they weren't supposed to go, because these countries by 1990 were making a bunch of stuff themselves. In the older days, the 1950s, export control was easy because most computers were made here. By 1990, all those countries you listed were making a lot of computer equipment themselves.

Misa: Taiwan for instance, South Korea, Japan.

Goodman: This was the late *perestroika*. When we would go — during the *perestroika* period — to places like this in terms of foreign availability we wouldn't show up in any scheduled way. We did a whole bunch of stuff when we went to the Robotron event, for

example, because it was a formal event. But we were quite facile in getting around the Warsaw Pact countries, and we'd wander around looking for evidence for significant foreign availability. One form of foreign availability that we were seeing was not foreign availability on the part of the Soviets or East Europeans themselves, but they were bringing in truckloads of PCs from South Korea and Taiwan. We would show up at some university and we would see a truck unloading dozens of these things. It's not like they were doing it for our benefit; nobody knew we were there or were going to be there. We would come to conclusions to the effect that that level of foreign availability was supposedly provided by our closest allies who are on the front lines. Japan and South Korea are a lot closer to the Soviet Union, or to Soviet threats even via North Korea, than we were, right? But they were selling them like crazy. These weren't being smuggled in one at a time! Someone was paying for these things by the truckload. So one of our investigative trips — and this was sponsored by the National Academies — was to go to these countries and get some sense of what was going on, and we learned a great deal. We were quite blunt. This is after a number of bad things had happened. Some of these countries had sent equipment to the Soviet Union that among other things, made their submarines much quieter. This was a big deal.

Misa: Which had impact, of course, on whether we would be able to locate the submarines [interrupted]...

Goodman: That's right. These SLBMs on big boomer subs were 20 minutes off of the coasts of the United States with a dozen or more nuclear-tipped missiles. And now we

were going to have a much more difficult time finding and tracking them. This was a *really* big deal. This was the kind of thing that justified concerns about export controls. Sometimes these things happen. One of the intents of export controls was to at least delay it. But this is an ugly incident, and one that involved espionage by US citizens among other things? And we were part of a National Academy group to go over there and see what was going on. The objective was to find out if the Japanese or the South Koreans were involved in this — I think it was the Japanese — if they knew what they were doing, whether they felt bad about it, and whether the U.S. government should impose some sort of penalty. This was a big deal because we knew where all their boomers were. If war broke out, we'd wipe out their — not completely, of course — but we would take out a whole lot of their submarine-based nuclear missiles. Then when they got quiet, we couldn't do that anymore. We may have compensated in some ways, but it was an expensive disaster for us. It could have had much greater consequences which, of course, never happened. But we were into interesting things. We talked with the South Koreans, we told them bluntly, "We have been seeing Samsung stuff coming out by the truckload in the Soviet Union, and you are supposed to be our supporting ally. After all, we're here and North Korea is on the other side of the DMZ and one of the reasons why North Korea is still over there is because people from the U.S. are over here." So I had some very interesting discussions, which we never wrote up; we had all kinds of things we never wrote up. We wrote up stuff that would get academic publication, but we did a lot of work that was not reported.

Misa: You acknowledge in one of your papers you talked about the briefings, the National Academy reports, you gave briefings to the German foreign office, you gave briefings actually to the Soviets as well, I think.

Goodman: Yes.

Misa: Classified briefings, so there was a realm [interrupted]...

Goodman: We would talk to all kinds of people. But certainly not classified briefings to the Soviets or East Europeans. They would ask about our impressions and analyses of what they were doing. We told them what we wrote up in our publications. Some times we would learn a good deal if they disagreed with us, and also when they explained some things to us.

Misa: Your knowledge got mobilized for that kind of policy support?

Goodman: Yes, indeed, without ever taking credit. Nor did we ever run around talking about our influence. Nor did we have the right to do so; we weren't elected or appointed officials. We had neither authority nor responsibility. We just shared our information, assessments, and theories. It was a long term example of academics informing and advising policy makers and implementers. One of the interesting discussions on that particular trip that, again, we never wrote up, was a different South Korean view. We thought it was purely commercial; so they sell computers to the Soviet Union and the

South Koreans, who in some cases were quite aggressive, would make the money at the expense of the U.S. companies. But one of the ROK government people we talked to said privately, “Look, you point out that we’re on the front lines with North Korea.” On that trip we actually got a cook’s tour of the DMZ. North Korea is not a happy place. I wouldn’t want North Korea in my backyard. Anyway he said, “What we see happening and what we think is happening now is that we can get the Soviet Union to be more interested in us than in supporting the North Koreans. And if the Soviets don’t support the North Koreans, the North Koreans are much less of a threat to us.” It is also possible that the Gorbachev-era USSR and post-USSR Russia would just as well not deal so much with and expend resources on the DPRK.

Misa: It’s subtle, yes.

Goodman: If the Soviets don’t arm the North Koreans, or help them with the sophisticated weaponry that the North Koreans themselves would have trouble acquiring, or help them prop up their economy, then the South Koreans are less threatened. By the way, in the post-Soviet era, when we were talking to Russians — in fact, we went over there to talk to them about putting together their own export control regimes — we met a retired general who used to fly MiG-15s against us in the Korean War, which was always rumored. It’s really true; the Soviets had a lot of really good World War II pilots and some continued to fly those MiGs, the evidence for that was incontrovertible. But since the Soviets screwed up in letting us get into Korea in 1950 with the UN in the first place, they sent the North Koreans a few pilots. And this provided the Soviet Air Force with

valuable jet-age combat experience at the time. The Soviet Union in late *perestroika* had no use for — and this is after the wall had fallen in 1989, this is 1990 — maintaining a phony kind of militarized Eastern Europe. Most of them knew that if it ever came to war, by that point most of the Eastern Europeans would be shooting at the Russians, not us. The South Koreans were saying, “You know if the Soviet Union sort of abandoned North Korea, it would be much less of a threat for us, plus we could make money.” From a national security point of view, the biggest threat to South Korea from the Soviet Union was their arming, and continuing to arm North Korea. Our main worry about the Soviet Union was a thermonuclear holocaust or — imagine, by 1990 it was ridiculous — something like a push of masses of Soviet tanks to the English Channel. I don’t know if I wrote that part of it up in that trip report — but it’s an example of trip reports where I don’t have the sensitivity. I don’t even remember who we talked to in the Soviet Union anymore. I was in Russia once with another National Academy group in 2003 and once in 1993. Those were the only two times since the fall of the Soviet Union that I’ve been there. We would get into this kind of discussion, and almost never write it up, but in whatever context we were informing policymakers, we would tell them about it. That’s part of what we were doing with these National Academy studies. In addition to doing the studies, we were briefing the people who stood up the studies. Look at the model for the National Research Council, which is actually the part of the National Academy that does the studies.

Misa: Right.

Goodman: It was created in 1863. They had their 150th anniversary, the Sesquicentennial, this year. Abraham Lincoln signed off on it, and a primary purpose was to provide scientific and technical advice to support the Union war effort. It was to inform and provide independent advice on S&T matters to the policymakers who asked the NAS/NRC to do these studies. Most of these studies were to inform policymakers. But not everything that we do on these studies shows up in the studies themselves.

Misa: Some is unpublished, or non-public, even. Not even published in that type of form.

Goodman: Sure. I could've written about something like that in an independent academic paper, this thing that we're giving you here, "Export Control Policy at the Close of the Century," we could have put that in there. If you talk to Peter you will find out all sorts of things, or Bill, or the people who stuck with it most closely. We were among the earliest people to appreciate that Eastern Europe was really ripe to pull away from the USSR in the mid-to-late 1980s. I could tell you stories about talking to policymakers about that, too.

Misa: And when you say ripe, you mean . . .

Goodman: They just couldn't wait to distance themselves from the Soviets. They were already pushing past earlier lines on their behavior. It was while they were still there — this is the late 1980s — the impression we had was that these people were certainly not going to be a military threat to us. That guy over there [pointing to a photo], Viktor

Kulikov, was Marshal of the Soviet Union and the last commander of the Warsaw Pact countries. The number one . . .

Misa: The man shaking your hand there.

Goodman: Yes. He had just given this vicious anti-NATO talk and didn't realize that I was in the audience. [Laughs] The civilian is a vice president of the Soviet Academy. I forget what year that was. I was smiling there because the marshal's pin in his tie had something like 20 karats of diamonds in it. It was very cool. But he was what you'd expect, a hard line commander of all the Warsaw Pact countries. But here we were, going back home in this period, in the late 1980s, and saying that Eastern Europe was no threat to us. We said to take all kinds of commodity information technology like PCs and let the East Europeans have it all. And not to worry about some of this being leaked into the Soviet Union. The people there who worried us the most were getting this anyway, from Taiwan or South Korea. These were the times when *samizdat* and Xerox machines were all the big fuss. We said to parachute the stuff in for free. Give the East Europeans anything they want, short of the high performance kinds of computers. Whether they ship a little of it off or the KGB picks some of it up doesn't mean a goddamn thing. They're getting it from South Korea anyway. Give it to the East Europeans. They will use it to turn their societies into more normal societies and they will use it in a form of resistance of continued Communist rule of their countries, much less Soviet presence. I won't even tell you the levels that I tried to make this case — this is the Reagan administration still

— and they were ready to buy off on it. I said to completely reverse export control policies at this point on most commodity information technologies to the East Europeans.

Misa: Can you say a bit about what you thought about the Gorbachev era, the so-called personal computer modernization? That seems to be almost surreal when we look back now.

Goodman: They started making their own stuff. We actually brought some of those back.

Misa: They had these immense numbers that they were promising, 50,000 or 100,000 of something like a functional equivalent of an Apple II, and they would use that as a lever to make their society over as a modern information society.

Goodman: Yes, yes. And the scientific technological revolution, and all that sort of stuff to modernize the military and economy more generally

Misa: Yes.

Goodman: There's a picture of some of that stuff, by the way. The one picture I won't give you is this one --- we were in some back alley and this sign says Café Mosaica. We spent a lot of time in back alleys like this. We could learn a lot about what they were making by finding these little repair shops and seeing if they had a computer in there, and getting some feeling for people who ran these little repair shops in ordinary

neighborhoods. There was enough computing of their own manufacturing coming out that they would show up in ordinary neighborhoods. We'd look for serial numbers on these machines; we'd get some sense from talking to these people how frequently they broke down, and all this kind of stuff. We worked on all levels. Students are good at this kind of stuff. This is just peculiar because it's Café Mosaica, but this is what much of Moscow and many other larger cities looked like.

Misa: Not Red Square.

Goodman: We would also visit technology and military exhibitions over the weekends when we had nothing else to do. Here are some of the photos. In Vietnam, our pilots would talk about having telephone poles shot at them, this is the SAM 2 shown in the photo; this is what they were talking about. This is the Red Army Museum, this is totally open. Here is the Hind helicopter gunship which became famous in its own right for what it did in Afghanistan. This is a peculiar little tank from the Russian Civil War. It's a little bitty thing.

Misa: Looks like a little portable.

Goodman: It's from their Civil War, around 1920, and the big armored train behind it is similar to the train in *Dr. Zhivago*.

Misa: Yes, there's a train like that.

Goodman: ...the big armored train...

Misa: It was frightening.

Goodman: There's one of those trains, except the one in the movie is more frightening than this thing. This picture is of a Soviet department store. We would go to these places to see if in fact they were bringing computing into the cash registers or onto the store shelves. We were trying to get some sense — it was during this *perestroika* period — trying to get some sense of what they were delivering beyond what they were talking about. We would try to see if there was anything that was happening. If there were things happening like they were describing, you would have seen them in the major department stores and offices and small enterprises in Moscow. God knows what was happening in the boondocks. We'd also go out to the boondocks. We couldn't find anything in the boondocks. Not even much in the formerly closed cities. We'd go out to the little towns and villages and there would be nothing, I mean nothing! No telephones, not anything out there. Whatever they were talking about wasn't making it to there. Every so often we just saw something we had to take a picture of. I have no idea what that is.

Misa: Beautiful car.

Goodman: Maybe that's why we took the picture.

Misa: That's not a Soviet car, either. That looks like an American car.

Goodman: No, I don't think that's an American car.

Misa: No?

Goodman: No. If we had a magnifying glass you can read on the front. Can you read?

Right there is what it is.

Misa: I can't quite resolve the letters. I can't quite see them.

Goodman: The last letter is an "L" or the second to last letter is an "L." And I think before that is an "E." It's an Opel. God, I can read that! I never tried to read that before; it is an Opel. Why would they have an Opel in Moscow? A German car. That's Bill McHenry when the Soviets were first coming out with hand held calculators. This is a big mock-up for training purposes. They were showing things off. This is their satellite communications pavilion or at least an exhibit of one of the pavilions. We'd go right in there and no one would bother us. Some of these things are mock-ups; some of these things are real. We'd go in there and we would take pictures galore.

Misa: Somehow, you were able to get around that Intourist guide, the shadowers, and all the hassles that people oftentimes reported.

Goodman: We never had any of them. We didn't have any, nah, none of that. Although, we did had to live with the *djornaya* on each hotel floor who would report our ins and outs. We were very conscious that all the rooms were bugged. In fact, a couple of our students — I forget which hotel it was — accidentally walked in the taping room in the hotel, with all these guys sitting with these tapes, recording. Our people knew exactly what they had stumbled into. I think the Soviets there probably understood that our people knew. Everyone just let it go. We once stumbled into Castro's Bay of Pigs villa by accident, too. The guards thought it was rather funny. They just redirected us to where we wanted to go.

Misa: In Cuba?

Goodman: In Cuba, yes. We wrote an article on Cuba, one of the *CACM* articles was on Cuba in the immediate post-Soviet era. No, actually, Cuba was *during* the Soviet era. Right at the very end of that period we went to Cuba and one of the reasons we went there was because they were holding an international computing conference. So they couldn't stop us from going. Our Treasury Department didn't stop us from going either, because we were academics, and we weren't trying to sell anything there. We wanted to go and do a study in Cuba and it was at the end of the Soviet period. In fact, the Soviet embassy was closing down this big complex, like the U.S. has all over the world; the Soviets had one in Cuba. It was sort of interesting, to see it largely abandoned and having all these Russians and Bulgarians packing up. When they found out we were American, they asked us if we could think of ways they could stay there and not have to go home.

Anyway there was a day off and we were trying to figure out what to do. We had a car and we were driving all over Cuba. We decided to go snorkeling. Cuba has nice beaches and areas where there [are] good coral and underwater plants. Joel, in particular, is a serious scuba diver. We were told to see the monuments when we went to the Bay of Pigs. It's really sort of pitiful but it helped legitimize and define the Castro regime. We drove out to find a good place to dive. We went down this road and we could see the bay to one side. We were looking for a road to cut across to get to the bay and then walk down and get into the water. So we found this road and we just turned onto it and started heading towards the water. All of a sudden we were surrounded by these people with submachine guns, and we said, "What's happening?" We always had a good local language speaker among us, and he told them that we were looking to go scuba diving. He explained that we were an American group, part of a conference and that we were meeting people all over their country to understand this and that about the information technologies. He told them that we wanted to go scuba diving since we had this day off. We were just visiting. They all started laughing. I mean, it's not like the Mongolian security troops, for example, who never laughed — although they do today, but not back then — and they said, "Oh, no, no, no, this is not what you want to do. This is El Jefe's [Castro's] personal residence [laughs] and you're going to have to turn around." They weren't nasty or anything. They said, "No, no, no, no-- - right idea, wrong place. Just go back out and turn right, and go down about half a mile." They were trying to get us out of there. They said, "Do the same thing as you just tried to do and that road will take you down to the beaches." And that is from that trip. You see that purple sea fan? That's from El Jefe's back yard. One of the students plucked that out of the place where we were

doing the snorkeling and had it mounted for me. It is from Cuba, February 1992; it is fan coral from Playa something-or-other, the Bay of Pigs. The something-or-other is the Spanish word for pig. [Laughs] It has kept some of its color. It was bright purple, but in 20 years of being mounted like this it has faded a bit. It's one of our great little MOSAIC Group mementos. We're a peculiar organization.

Misa: Can you say something about MOSAIC on tour?

Goodman: This is the back of a t-shirt.

Misa: Right, this is the image that you sent me of your t-shirt, "MOSAIC Tour 1989-1990."

Goodman: We have four t-shirts and every couple of years, we — you know like bands that go on tour and they do all the cities — well, we got the idea from them. During each period we visited scores of places. What was nice about this is that one of our students went to the trouble of dragging out from all of us the city names in their original languages.

Misa: There are several scripts there that I can't decipher, not for the life of me. I assume that is part of its special charm.

Goodman: Yes, we went to a whole lot of effort to do this. A number of these things are Korean, Chinese, that is Hebrew, this is Cyrillic, Russian, Spanish...who went to Merida? We would stick pins in a map like the one back there. It was part of the spirit and the culture of the group. There's Istanbul, with the Turkish "I".

Misa: Antarctic Peninsula.

Goodman: Yes. I went there, and found computers.

Misa: Well, it's an international place.

Goodman: Yes, so we put it on tour. I mean, we stretched things a little bit.

Misa: This is extremely impressive. This would be across like two calendar years, 24 months?

Goodman: That is correct.

Misa: Each of these cities, then, you would have a delegation of at least two people?

Goodman: We would have people go there for some purpose.

Misa: It could be for a conference or it could be one of your study visits, as well?

Goodman: Yes. And the Antarctic one, which is probably the iffiest thing up there, I was actually doing an alumni tour. This is when export control kinds of purposes had concerns about the Argentines and the Brazilians building bombs. Just coincidentally, the Caltech and Harvard Alumni Associations had one of these — this was unusual back then, it's quite common now — had one of these alumni tours, a trip to Antarctica. So I brought my wife and young son. We took him out of his freshman year in high school. We thought they would give us trouble. We told his high school people in Tucson, “We're taking our kid to Antarctica, give him his homework. Can you deny him this for an educational experience?” Not the slightest problem. In fact, he came back ahead of all the other students because he actually did everything they told him to do, and the kids back in Tucson didn't get through all of it. So we went to Antarctica with the Caltech and Harvard alumni. Imagine the people who were there. We had the ex-head of the Coast and Geodetic Survey telling us about all the glaciers. One of the people who came, whom you would probably recognize, was I. Bernard Cohen.

Misa: Oh, of course.

Goodman: It's the way they made fun of him at Harvard, because he had that kind of an ego. But he was a good guy and he would lecture us about Darwin futzing around down there. It was a significant educational experience, and it turned out later, years later, Bernard Cohen was the associate editor who handled the review of the Lebedev article for the *Annals*.

Misa: I.B. Cohen had a very strong interest in the history of computing.

Goodman: He had a strong interest in lots of subjects; he's written some great stuff.

Misa: He wrote two books on Howard Aiken.

Goodman: Oh, is that right? This I didn't know.

Misa: Well, it's funny, but Aiken, prior to I.B. Cohen's books, always got like one sentence; blah-blah-blah, Harvard's Mark I. That's it. He was also, I believe, one of the founding directors of the M.I.T. Press *History of Computing* series with Bill Aspray.

Goodman: I know Bill. Bill is a good guy.

Misa: Oh yes.

Goodman: Cohen was, it turned out --- we didn't know it at the time but when it was all over and the Lebedev paper had been accepted for the *Annals* --- it turned out he was the managing editor, or associate editor, or whoever was in charge of the whole reviewing process. I've run into him in other ways. He was supposedly not that friendly, but when you're stuck in a little boat that holds 100 people in Antarctica, and they're all Harvard or Caltech people, everybody was very friendly with everyone else. One of the other people

there was the guy, ex-head, now retired, of the whole nuclear weapons program at Los Alamos. We had all these great conversations and we just stuck with each other when we were traipsing around on the ice. In my recent Civil War studies, — and I love talking about that, by the way — the information technologies in the Civil War, I found an article by Cohen from 1945. I forget exactly where it was or what it was on, but I was surprised to see it. Cohen, essentially, was writing on some kind of technology used during the Civil War, which doesn't surprise me. His knowledge of the history of science and technology, especially technology, was quite awesome. He gave great lectures on what Darwin was doing around Antarctica. We traipsed around Tierra del Fuego and the Palmer Peninsula. The way computers came into this was that we visited these scientific stations, and it was interesting to see the different countries and what sort of computer facilities they had there. Hence, . . .

Misa: Antarctica is part of your world tour.

Goodman: Another one that is sort of odd is Adak. Do you know where Adak is?

Misa: No.

Goodman: Adak is an American island in the Bering Strait, about as close to the Soviet Union as you can get. NSA has a listening post there.

Misa: It's American soil but close to Russia.

Goodman: Yes. We have a listening post there. They have a listening post for us in that area as well. This is a great circle route where submarines with missiles travel. One of our students was on active duty; she was in the Navy Reserve, and they would send her out there for a whole summer for her reserve duty. I figured that counted.

Misa: It's stretching a little bit, but I'd count it.

Goodman: Why not? We had no trouble counting it because she was doing IT work with regard to the Soviets. Of course, she couldn't tell us the details. I don't remember most of these other things but Adak was sort of peculiar. You won't find that on anyone else's t-shirt. That's Alma-Ata [Almaty] in Kazakhstan. Our people went all over the place. We were getting very involved in our GDIFF phase. Places like Brasilia showed up because I did that whole thing with high performance computing and whether the Brazilians were doing nuclear work using high performance computing on that trip with Antarctica. Was it this trip to Brazil? There were two trips to Brazil. One was a full-fledged study of computing in that country, and one was very much export control concerned. I forget. But these things all show up. Come to think of it there was a third trip that included Brazil. This one was concerned with computing in the emerging MercoSur and the Brazilian protectionist policies.

Misa: We have not by any stretch of the imagination, exhausted the topics we might talk about but I think we need to take a break.

Goodman: This is fun. God only knows what you're going to make out of it, but I enjoyed it. It brought back memories that have been dormant for a couple decades.