

An Interview with

GENE GOLUB

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Conducted by Pamela McCorduck

on

16 May 1979

Stanford, CA

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Abstract

Golub discusses his career in computer science at Stanford University. In 1962, after working as a numerical analyst for the Space Technology Center, Golub was hired by George Forsythe for Stanford's new computer science program. Golub describes interactions and tensions between the mathematics department and new computer science faculty. He mentions the resistance Forsythe encountered in his attempts to increase revenues by selling computer time to private industry. Golub describes Forsythe's personality and his performance as an administrator.

GENE GOLUB INTERVIEW

DATE: May 16, 1979

INTERVIEWER: Pamela McCorduck

LOCATION: Stanford, CA

McCORDUCK: This is a conversation with Gene Golub on 16 May 1979. Gene, when did you come to Stanford, what were the circumstances?

GOLUB: I came in August of 1962 or late July. I had been working in LA at Space Technology Laboratory and I had decided that I would like a university career. Well, Space Technology Laboratory sent me to various places to do interviews. That is, I was supposed to interview people for jobs at STL and when I came back I got three job offers. I was recruiting and when I came back I got three job offers. One from Wisconsin, another from Case Western Reserve and I can't remember the other one, but I had known about Stanford and I had known Forsythe for many years. I knew him in Los Angeles from some work I had done one summer and I wrote him about the possibility of a job here. Nothing happened and I was rather disappointed and then I got a telephone call one day saying, why don't I answer my mail? I said "What mail?" and he said "Well, I sent you a letter with an offer." I said "Well, that sounds very exciting" and then he asked for my personal address and I got a second copy of that letter and I said that I'd come. And there were several possibilities. I could have come as a research associate or an acting assistant professor. I decided from the beginning to have some sort of academic title. So that's how that happened, and then almost from the beginning I started to travel because that very summer there was an IFIP conference in Munich and I was invited to give a talk there, so shortly after I arrived here I departed for Stockholm where the International Congress of Mathematicians had a meeting and from there I went on to Munich.

McCORDUCK: Now when this offer was made to you, was it made in the department of mathematics?

GOLUB: Yes, at that time there was a division of computer science. Although we were not in the math department physically. We were actually in Encina where they now have a lot of the administrative affairs. So that was really about the time I got settled, September of 1962 and it wasn't until January of 1963 that we moved over to Polya Hall.

McCORDUCK: But you were still a division of the mathematics department.

GOLUB: Oh yes, and Jack Herriot was on leave that year, he was on sabbatical in Grenoble, so his office which was a very nice office was shared by Ben Rosen, who is currently head of the Computer Science Department at the University of Minnesota, and Seymour Parter and myself. I don't remember all the people who were around at the time but it was the beginnings of our department. I don't remember where John McCarthy was in that building. But I thought he was there just about that time so we shared that nice office and already had the makings of a library. We had an unusual character by the name of Emilou Miller and among other things she took care of the library, and she had a very interesting card index system. Instead of giving a number like they do in the Library of Congress she gave the books positions in degrees, so you stood in the center of the room and there was a ray essentially to the book you wanted. And the computer was actually located in the basement of Encina and they had the Burroughs 220 and Bill McKeeman was around at that time, now in Santa Cruz, Cleve Moler was here and a lot of people were forming...

McCORDUCK: Was there talk that you might someday form into a department?

GOLUB: I don't recall. I was fairly junior at that time so if that was the thought, I didn't know much about it.

McCORDUCK: In other words, you weren't lured here by the notion that there would eventually be a computer science department?

GOLUB: No, I had come from a computer science department at the University of Illinois so it was very natural for me to be associated with a computing center. That's where I did most of my work as a graduate student -- that is, I was a research assistant in the digital computer laboratory at Illinois. So I liked that arrangement where you were next to the users of the computer who could be helpful. I guess I was pretty naive, I didn't know very much about the organization of a university at all. I had no real idea of who the dean was and what functions he performed.

McCORDUCK: How do you learn...you have to start digging?

GOLUB: Well, that's right. I try to talk to some of my students who I think will be academics about the line of command in the university. I felt I was extremely green. Harold Van Zoeren was here at the time and there was a nice group of people around.

McCORDUCK: What kind of work were you doing at the Space Technology Laboratory?

GOLUB: Well, I was functioning as a numerical analyst and I wrote one paper involving roundoff error and in numerical iterative procedures and another paper where I took some results that were well known by numerical analysts and I applied them to a problem in statistics. There is a famous inequality known as the Kantorovich inequality and I tried to point that out to the statisticians that the result which was about to appear in the statistical literature was actually known already in the numerical analysis literature. So, I guess I had a couple of papers under my belt. Peter Henrici was a consultant at STL and he had urged me to look at a little problem and I looked at it and solved it and wrote a paper on that too. I guess that has characterized my work. I like looking at problems and trying to solve them, more than having grandiose theories; I am more of a specialized problem-solver.

McCORDUCK: When you got here what was the attitude as far as you could tell of the math department toward you folks doing those funny things with the computers?

GOLUB: Well, then as now I have very little association with the math department. George and Jack Herriot were actually part of the math department so they must have had frequent contacts with people in the math department but for the rest of us there wasn't so much. There was a luncheon for all the faculty in the math department and each one of us was asked to get up and say something about themselves, but other than that I don't think I was invited to any functions or really participated in the mathematics department.

McCORDUCK: As one looks through the George Forsythe papers in the archives you get a sense of the math

department really rather hostile to what you people were doing and certainly hostile to the idea of a computer science department.

GOLUB: Well, he was brought in as a numerical analyst and he was in charge of the computation center. George was pretty aggressive in describing computing to people -- that is he went around the campus building business up and maybe that offended some people in mathematics since mathematics is generally more of a passive subject and people seldom sell their interests. Whereas George was actually doing that and he created a lot of the interest on the campus that people outside the university looked at the whole idea askance?

GOLUB: Not that I know of. I think just about that time a number of places were forming their own computer science department. And I think maybe Purdue had the first department, but it was in the wind at several places.

McCORDUCK: Although there appears to have been some resistance to it in the sense that...

GOLUB: The sixties were sort of a time of expansion. Not only was there a new Department of Computer Science but shortly after we had our department, Operations Research Department was formed, and in fact George Dantzig was brought to Stanford and he became part of the computer science department for two reasons. One was that he had an interest in computer science and there was no operations research department at the time so it was most reasonable for him to be associated with the computer science department. And he still seems to be very pleased with the association.

McCORDUCK: [Unclear statement] Do you remember any debates, any philosophical debates other whether there was such a thing as computer science, whether it had a right to emerge as a discipline?

GOLUB: There may have been but I'm not very personally inclined to be interested in such things. And it just seemed to me, from an opportunistic point of view that it was a good idea. For one thing, George was having a difficult time making the kinds of appointments that he wanted to make. Well, for instance, John McCarthy had been

here at Stanford in the Math Department, he had done work in pure mathematics, and then John left and went to MIT. Now George wanted to bring him back and people tend to have long memories. They remembered what he had done as a mathematician. Some of which was quite good, but they didn't feel he was of the caliber for the math department. I think that was a great incentive for George, who kept the department going so that he could make appointments independent of the math department.

McCORDUCK: Were there other such examples?

GOLUB: I don't know. Possibly myself. I'm not sure. I haven't been told about that. I don't know. Perhaps Jack Herriot would have a better recollection of that.

McCORDUCK: I was wondering how mathematicians would take to people who would be, say in programming languages or things like that.

GOLUB: I don't think they were very sympathetic. But I think the person in this department who has the best ties with the math department is Don Knuth. He does combinatorial mathematics and he's such a dominant figure in what he does, the math department is very pleased to have that association. There were some people in the early days, some students, who were sort of connected with mathematics and computer science. In fact, our earliest students were really in the math department or were in their own special program. For instance, Cleve Moler got his degree in mathematics because there was no computer science department and his thesis is actually quite mathematical. And Jim Varah was also in the mathematics department. And then there was a fellow by the name of Don Grace who I believe is at Oklahoma State now, Dean or possibly even the provost. And he wrote a thesis based on a problem suggested by Polya -- it was combinatorial problem. I don't remember it exactly but it was to compute all possible pairs of some sort. And he was in his own special program. You see, Stanford, especially then, allowed one to organize your own program. You can still do that but it's more formidable from the administrative point of view.

McCORDUCK: One of the continuing things you see as you go through these archives is the hustle -- there is no

other word for it -- the hustle to get funds for a machine. do you remember much about that?

GOLUB: Well, it's interesting the one golden rule that Forsythe enforced was that there should only be one place where computing is done. So he was trying to bring in funds from all over the campus just for one computing center. Of course, nowadays people don't have sympathy for that point of view. It's not so necessary. But he went around and tried to get as much support throughout the university for funds for a computer. In fact, up until a certain point there was a regulation within the university that if you spent money on computing it had to be towards a computer. And I don't think that is true any longer.

McCORDUCK: [Unclear statement]

GOLUB: And of course you can't control those things budgetarily as much as they could then. It's not quite so obvious all the time how money is being spent.

McCORDUCK: It struck me as I was looking at these papers how anomalous this thing must have looked. Here was this new discipline getting started, that was enough nerve already but there went all this money to these huge machines. so where did they get off? And I wonder if people ever approached you with that kind of attitude?

GOLUB: No, no. From a science and engineering faculty there was a lot of support for it, computing. So I never heard anyone point to that contradiction.

McCORDUCK: No, it was just something I noticed as I was reading through.

GOLUB: Where are the archives, actually?

McCORDUCK: In the library. When you look at them you sit in a lovely old room that was donated by one of Stanford's earliest benefactors. It's very fancy, curtains and a mantelpiece and whatnot and various living room

furniture. [Unclear statement] It's very nice.

GOLUB: And they are accessible to anyone?

McCORDUCK: Oh, yes. You sign a release saying you understand the laws of libel and why you are interested in looking at the archives. I think the archive has an editor there. There are George's files -- he had taken... [Unclear statement. Seems to be a description of what is in the archival collection.]

GOLUB: I see. Yes, well George was very good about putting things down on paper and I can't think of anybody else that I know of who has ever done that so frequently. His likes and dislikes were always expressed.

McCORDUCK: Yes, apparently he used to walk into his office after a meeting used to sit there and write himself a memo on the spot and stick it in his file [Unclear.]

GOLUB: I have access to some of his reprint files and often as you go there you can find the notes from a lecture in his scribbling and its very interesting -- there are as much as some 25 years previous...

McCORDUCK: What was George like to work with?

GOLUB: Well, very even tempered, very direct, reserved -- too reserved for my temperament. He was always correct. One time I remember he got quite angry at a faculty meeting and stormed out of the room and shortly he came to me and we talked. He never felt he couldn't go into another person's office. That is, I've seen some chairmen who stay in their office and expect people to come to them. But George had a pointed policy of going into other people's offices and talking to them. He was a very good man to work with. Well, a compulsive note-taker and letter-writer. But you knew things were going to be accomplished. It's a very different style from contemporary styles of people, that is, he certainly didn't hang loose. He wore a tie most of the time. That was just because of the period he was born in probably.

McCORDUCK: What kind of a working environment did he create for the faculty?

GOLUB: Well, he left people alone. I had probably more intellectual interests in common with him than other people. We were both interested in numerical analysis and even in particular matrix computation, and if something came through, a paper that I hadn't seen, he would pass it on to me. So he was very good about such things. He didn't necessarily provide new ideas, but he would suggest areas that one might want to work in. In particular, once Ben Rosen gave a talk on doing a pseudo-inverse calculation and at the end of that lecture he said, "Well, will somebody please work on figuring out how to compute the pseudo-inverse of a matrix?" and later on that's one of the things that I worked on, and actually that particular piece of work is one of the most well-known pieces of work that I ever did. So I don't know if I did it because of his comment; I just remember his having said that. It's amazing how I did work on that same problem that he had mentioned.

McCORDUCK: Do you know if that happened to other people?

GOLUB: Well, some of his students worked on specific problems. I don't know. Actually, I would say that one of the things was that I don't consider -- about the quality of his student's work -- I don't think some of the theses were as good as the people who have subsequently turned out. I don't know what the cause for that was. Well, just as a scientist, I don't think Forsythe was a very imaginative person. He knew lots of things. He was a deep scholar. But he was not someone with original ideas at all.

McCORDUCK: Yes, it seems that most of the things that he has been remembered for have been the organizational and the kind of missionary work that he was responsible for.

GOLUB: Yeah, missionary is the right word. But he was tremendously well liked. I don't know if you've noticed how many books have been dedicated to him. Well, I would say, there are at least four that I know of and some of them were even done in his lifetime. for instance, I believe it's Peter Henrici's book is dedicated to Forsythe and that book,

I actually remember showing to George, that is was dedicated to him and how surprised he was. He was very pleased. So altogether he was a very good man. I think all his students liked him, admired him, a correct man, a proper man, a little reserved.

McCORDUCK: Do you think that the department bears his stamp and if so, in what way?

GOLUB: No, I don't. That's one of the things that's amazed me. The stamp is in the faculty that he recruited and maybe that's the thing he would be most pleased with, with recruiting such people as McCarthy, Knuth, and Floyd and others. He's really been able to create -- he created this department. I don't think that the faculty has really changed substantially since he died in 1972. There are a few new people but it's basically the same department. What has fallen away is the administrative structure of the department. And it was much more, the administration was more carefully controlled when he was alive, and now it's much more...

END OF INTERVIEW