

MC.0356

Interviews of the Margaret MacVicar Memorial AMITA Oral History Project

Bertha M. Ryan – Class of 1955

(interviewed by Jennifer B. Krishnan)

June 26, 2001

Interview with Bertha Ryan
by Jennifer Krishman
Ridgecrest, California
June 26, 2001

Jennifer: Today is June 26, 2001. My name is Jennifer Krishman, and I'm in the class of 2004, and I'm here in Ridgecrest, California, in the home of Bertha Ryan.

Bertha: I'm Bertha Ryan and I graduated with an M.S. in February 1955.

Jennifer: Thank you. So, could you tell me a little bit about ... what your childhood was like?

Bertha: I grew up in Newton, not too far from Cambridge, and went to the Newton schools, and I had three brothers, all older. My father died when I was three, and my poor mother was left with four children to bring up, but she did okay, I think. Then I went to Emmanuel College in Boston, and from there to MIT.

Jennifer: So, as a child, what were your plans for the future? What were your goals?

Bertha: Well, at first I wanted to be lawyer because that's what my father had been, but I don't believe I really wanted that, because I began to be attracted by airplanes. Specifically, Amelia Earhart was flying at that time and so airplanes fascinated me. I still can recall the first airplane that I ever saw, which must have been when I was three years old, because we were going to the beach with my father, and we stopped at an airport. My three brothers who are older don't remember stopping, but I do and I remember the airplane and I was able to find one, years later, just like it. Then I heard that if you were interested in aviation, you should study math. So that's why I emphasized the math because I enjoyed the subject.

Jennifer: Did the Depression have any effect on your goals or your outlook or anything like that?

Bertha: No, because I was very much protected from it. The only thing I can recall is going for a walk with my mom one day and we went by this house and she told me that the man there had lost everything and committed suicide. But she shielded us from all this. I don't know how she did it, because she was a single mom by then, raising four children by herself, ages three to thirteen, but she managed and did a pretty good job, I think. The point here is that I was raised by a mother who was a very strong person. She made it seem

normal and natural that a woman could do all these tasks alone and do them well under difficult circumstances.

Jennifer: What was it like during the war?

Bertha: That was very interesting because the three boys did go off to the service. There was rationing and the beach was covered with debris if we'd get to the beach, and things were scarce. For me personally, I don't think it really affected me that much, except we'd have drills in case there was a bombing or an attack, which we probably wouldn't have had, being so far from the main conflict, but we prepared for it. They darkened the State House dome so that the subs going by wouldn't see ships in silhouette, so they tried to keep the coastal areas dark. And, of course, gasoline was rationed, which didn't make any difference since we didn't have a car. But one of my brothers, when he would come home on leave, he did have a car which he kept stored while he was away, but the neighbors would all save their gas ration stamps and give them to him when he came home, and that's how we'd get to go on drives down to the beach and so forth when he came home. Also I knew some young children who had been sent from England by their parents to be away from the bombing. One of my closest friends was a girl whose family had escaped from Germany after being threatened with imprisonment because they were Jewish.

Jennifer: What was your mother's attitude about school and higher education?

Bertha: Very positive. She felt very strongly that people should get a good education and she expected us all to study hard and to go on to college. Her plans, however, were to put the first one through college and then have each one pay for the next one, but of course World War II interfered with that. She liked the idea of math, but she didn't understand engineering, and she was not in favor of that. She was born in 1884, which is a whole different century and culture. Things changed in her lifetime.

Jennifer: So did she have any sort of college education?

Bertha: Yes, she was born in Prince Edward Island, Canada, and went to schools there and then came down to Boston and I believe she attended college, but not anything science. There were no engineers or scientists in my family.

Jennifer: What classes did you enjoy in high school?

Bertha: Math.

Jennifer: Was that mostly because you were told that this was going to help you—

Bertha: No, it was because I liked math very much.

Jennifer: What did you like about it?

Bertha: I'm not sure. I might ask you that, since you're a math major. I think it's because it was, in a sense, predictable. If you solved an equation, you solved an equation, but of course, as you go on, that isn't always true because there are assumptions involved, too, but I think that was the aspect I liked.

Jennifer: When you finished high school, did you consider entering the work force at all, or getting married, or something?

Bertha: I never considered getting married. In fact, I never wanted to, which distressed my mom also. She thought people should get married. Other than that, she was a very smart person. [laughter] But no, I just sort of assumed all along that I'd go on to college. I graduated from high school in 1946, and there were a lot of returning service people, so the colleges were all very crowded, and we didn't always have the choice that we would want. Actually, the college I chose, I didn't really want, but I'm very glad I went there. Emmanuel College, in Boston—it turned out to be a very good choice.

Jennifer: What was that like?

Bertha: It was small, which was a contrast. My high school had about a thousand in the graduating class, plus a group of veterans that had come back to complete high school, and my undergraduate college had 176, so there was a big difference in size. And Emmanuel was an all women college at the time. Also, the high school that I went to was a very good one and gave me a better preparation than most of the people who went to the college. So my first year there really was somewhat of a review, but it was still very worthwhile and I'm glad I went.

I had a partial scholarship from Emmanuel and a cash scholarship from a woman's club in Newton. Also a part time job in the chemistry department at the school and a mostly weekend, but some evenings, job at the Star Market—as well as some pick-up jobs now and then for extra money. I had a low interest loan for graduate school which I paid off within ten years. The

year I graduated from high school, I looked for a summer job but was unable to find one because I always told them I was going to college in the fall. At last it seemed I would not go to college if I did not have a job, so I told the Star Market that I wanted a permanent job. At that time they had only one store—Watertown. They were very good to me even though I told them in the fall that I was going back to school. They let me work Thursday and Friday evenings and all day Saturday during the school year and full time in the summer and school vacations. There were great advantages of working there in a time of shortages—butter, soap, meat, etc. I will never forget the sight of women screaming by the door trying to get the soap they so desperately needed. I was able to buy those things easily because I worked there. We were excited when the next store opened in Newtonville and I worked there also. At the end of my college years, they offered me a permanent job in the office. I didn't accept, of course because I had other plans more closely tied to the field of aviation. But I will always be grateful to the Mugar family who owned the stores at the time, particularly Helen Mugar. They were very good to me during the four years I worked for them.

Jennifer: And after you finished at Emmanuel, what happened then?

Bertha: Well, to partially answer a previous question, where you said “did I think of working?”—when I got partway through Emmanuel, I did think of working because it seemed like I wasn't getting any closer to airplanes, which was my goal. So I thought of quitting school and going to work or studying to be an aircraft mechanic or something like that, but I looked at the jobs that I could get and decided that wasn't a smart thing to do. Wouldn't get me closer to my goal. So I continued there and then decided to go to MIT for graduate work to get closer to something related to aviation.

Jennifer: What do you think your life would have been like if you had entered the work force after graduating from Emmanuel?

Bertha: Entirely different than it was. I wouldn't have had the same doors opened to me. The first job that I took after I left MIT, the personnel person took a look at the assignment and the salary and said, “You must have gone to MIT.” So my life would have been entirely different and nowhere near as satisfactory, so I owe a lot to having gone to MIT.

Jennifer: Whose idea was it to go to MIT?

Bertha: Mine ... I didn't know any better. [laughter]

Jennifer: Did most of your college classmates go straight into the work force, or did many of them go into graduate work?

Bertha: I think very few of them went to graduate work. There was actually one other woman that went on to MIT from there, as I recall, and some of them went on to other graduate schools, but mostly they would go into teaching or even secretarial work.

Jennifer: When did you decide that you wanted to do research and design instead of just flying airplanes and building airplanes?

Bertha: Well, I think I always knew that I didn't want to be a professional pilot. I loved to fly, and my goal was to be associated with flying, but I didn't really want to be a professional pilot, just my own pilot. But I wanted to be associated with aviation and all of the work that went along with it, and I think it slowly dawned on me that that's what aeronautical engineering, as we called it at the time, was. That's why I kept getting closer to that goal.

Jennifer: What do you remember most about your experience at MIT?

Bertha: I guess the fact that I started in the math department and kept taking engineering courses to catch up, to be able to transfer to the aeronautical engineering department, and the fact that I could sort of come in the back door that way. I'm not sure MIT caught on to what I was doing until it was too late.

Jennifer: What was your life like at MIT?

Bertha: It was very good. There was a lot of work, but in a sense, not so much as the other people because I couldn't really afford to go full time. It was expensive then, and I guess it's even more so now. Except for the very first semester and the very last semester before I got my degree, I worked full time and was called a "special student," as they called it at that time. While I worked full time and took maybe two courses at a time, it was certainly easier than the full time students, I think. Plus, my job was mostly related to my studies, so that made it really worthwhile. It was a good experience to spend five years doing one year's worth of work.

Jennifer: Do you think your life as a woman at MIT was any different from the life of a man at MIT?

Bertha: Probably, but I don't really know how because I wasn't a man at MIT. But I said to a friend one time ... something about it being great that we were all there doing this type of work together and he said, "You know, you wouldn't be my friend if you weren't a woman." So I think there were certain advantages to being what was very few at that time.

Jennifer: Did you feel like you were completely incorporated into the academic community?

Bertha: Well, as much as I could be, working full time. Probably not as much as I should have been because I should have been working with my fellow students more, and I wasn't doing that because I was working full time.

Jennifer: What kind of living arrangements did you have?

Bertha: I lived at home, actually. We had originally lived in Newton, but then we moved to Boston, and I lived in an apartment there in Boston with my mother until my last year or so, when I was in an apartment by myself or sharing one with a physics doctoral candidate, Diane Fournet Davis.

Jennifer: Did you ever consider living on campus?

Bertha: No. I'm not sure it was available. I don't recall that it was available. It may have been, but I don't think so.

Jennifer: What sorts of activities were you involved in?

Bertha: I was involved in the MIT Glider Club, which at the time was called the Aeronautical Engineering Society, and I was involved in the MIT Flying Club, and I was involved in the student Institute of Aeronautical Sciences, IAS, which became the AIAA [American Institute of Aeronautics and Astronautics].

Jennifer: Did you feel that there were any barriers you had to break through, as a woman?

Bertha: No, not really. There may have been, because how do you know that they don't like you because you have blue eyes or something? You don't really know that. But I didn't feel there were any barriers, except the ones I had to overcome to get into engineering from having been in math.

Jennifer: How was the math department different from the engineering department? Was it any different working in an engineering department than a pure science department?

Bertha: I think so. I think it's true throughout the professions. I think engineers are a little more practical than pure scientists, so it seemed like there was a little less formality in the engineering. Of course, there was some hands-on work, too—there was some wind tunnel testing and this kind of thing, and in the math department, you really don't get much testing.

Jennifer: You mentioned that you didn't receive your degree at your graduation ceremony.

Bertha: I don't like formal occasions. I'm more of a loner, which was partly what was the problem when you asked "did I interact with other students?" and I didn't that much, and I should have more. The same thing at the graduation, I just didn't want to go to a ceremony, so I went to the registrar's office and asked for my degree, and the gal gave it to me and said "congratulations," and I said "thank you." But I wanted to go to the ceremony that June, which would have been the one I would have attended if I had picked up my degree that way. At first they weren't going to let me, because apparently it's very hard to get tickets to graduation, and I said, "Well, I'll just go and stand in the back of the room," and so finally they let me go in and stand in the back of the room ...

Jennifer: How many of the grad students at MIT at that time were women?

Bertha: I honestly don't know. There was, I think, a bigger percentage in the grad school than in the undergraduate school. If I remember a number of one class of the undergraduates or the whole school, something like thirteen. For the graduate school, I know it was bigger percentage, but I don't know the percentage. There weren't many, though, especially in engineering.

Jennifer: And what about among the instructors?

Bertha: I don't remember any. I don't recall thinking so much in those distinctions, though. Once I got involved, it was just a professor or a student. Although we still had the Margaret Cheney Room back them.

Jennifer: Did you go there a lot?

Bertha: I didn't go there a lot because, once again, I was working full time.

Jennifer: Did most people that you knew spend a lot of time there?

Bertha: I think a lot of the women students did spend a lot of time there.

Jennifer: Describe some of the reactions that you get from people or that you used to get from people when they find out you're from MIT.

Bertha: I still get strange reactions on that around here. I think there's only one other person here in this city that went to MIT—except for the Sloan School, which I don't really count because that's sort of different. So, yeah, you get reactions. I think that everyone that went to MIT gets reactions from people ...

Jennifer: Do you think it was more the name of MIT or the actual education you received that helped propel you forward?

Bertha: Oh, the name wouldn't mean a thing if I didn't have the education to back it up. The name opens the door, but what you learned there allows you to continue on.

Jennifer: So, after you got your degree from MIT, did you consider pursuing a doctorate?

Bertha: Yes, I did consider that, but I thought it would be wise to work a while. You get sort of burned out after five years of hard work, of both studying and working. So it seemed like it would be wise to take a year or two off. If I had been really serious about it, it would have been smart to go back after a couple of years. I waited to do that for about eleven or twelve years and considered Stanford, and actually got accepted there, but decided that at this stage, I preferred to continue with the work I was doing, and that's when I came to work at China Lake.

Jennifer: So instead you went to Douglas Aircraft?

Bertha: When I left MIT, yes, I went to work for Douglas Aircraft, in Santa Monica. Of course, there's no longer a Douglas in Santa Monica, and there's no longer a Douglas.

Jennifer: At the time that you entered, what was their situation? What was it like at Douglas?

Bertha: I was very fortunate in that there was a small group that was part of a bigger branch. The branch members all sat out in a great big room. I guess they called it a "bullpen." The desks were lined up and all the engineers sat at those desks. But our small group had a small office for the four of us, I think, so we had very good working conditions. Of course, we didn't have the computer system and so forth that's so available now.

Jennifer: At that time, was Douglas employing many women?

Bertha: I had the very good fortune to have been preceded by two women who were really very sharp: Beverly Beane, who became Beverly Graham, and Rose Marie Pratt, who became Rose Marie Licher. They had been at MIT before I had been there. Beverly was actually there during World War II and got her degree in something like two and two-thirds years on an accelerated basis. Both of them came out to work for Douglas in this group before I came. Douglas had the idea that they should hire all the MIT women they could get [laughter], and so when I came, that's the group I went to.

Jennifer: Did that encourage you to work at Douglas, the fact that these other two women were there?

Bertha: Well, it was encouraging in that they were friends. I was pleased to come 3000 miles from home to work with friends. Also, I knew other people from school who had moved out West. There were a whole group of us who came from MIT to the Los Angeles area because that's where a lot of the aeronautical engineering work was done.

Jennifer: Was it challenging to be a woman in that environment?

Bertha: Well, work is challenging, so once again, is it challenging because you're a person or a woman or ...

Jennifer: Were there any different expectations of you?

Bertha: I think they thought I was going to be smart because of the two that had preceded me, and I doubt if I was as smart as they were, but it all worked out okay.

Jennifer: Did you work closely with them? Were they in your group of four people?

Bertha: Yes, but we all had our own projects. We worked on separate things, although I think I did a report or two with Beverly. But we worked on our

own projects in general, which were studies, not anything testing or practical—analytical studies.

Jennifer: So is that mostly what you did at Douglas?

Bertha: Yes.

Jennifer: And when did you leave?

Bertha: I left in ... let me see ... I went to work for NASA on December 31, 1959, which is a bad day to start a new job, arriving on New Year's Eve. But that's when I left Douglas and went to work for NASA, at Edwards Air Force Base.

Jennifer: How did you choose NASA?

Bertha: I chose them because when I was interviewing people back at MIT, I wanted to work for NASA, which at the time was called NACA, and I talked to a representative from Langley. I told him I wanted to work at Edwards, and he said, "You don't want to work at Edwards, it's way out in the desert!" But I did, and I didn't want to work at Langley, so I went to work at Douglas, and then, when the time seemed right, I transferred to work at Edwards for NASA. In the desert.

Jennifer: What was it like working for NASA?

Bertha: It was very interesting because there were always things going on that would be reported in the news—for example, flying new types of airplanes. I learned just recently that I was there at apparently a transition time. It had been rather remote and small shortly before I got there, but then it started changing. When I went to work there, there were 360 people, and it later grew, but apparently was much more primitive, if that's the word, shortly before I got there. But I had no idea; I thought it had always been the way it was when I came.

Jennifer: What was your favorite thing about working for NASA?

Bertha: Well ... a lot of what we did was like the weekend all week long. I had become a glider pilot by that time, and we had a project at NASA called the lifting body project, for which we used a lot of glider technology. The first lightweight one, called the M2-F1, was constructed like an old-fashioned glider. It had a chromoly steel tube structure, around which they built a wooden shape, which was actually built by a glider manufacturer who had

experience in building wooden aircraft. We operated it in the way that you would a glider: we car-towed it first, for the first few flights, and then we actually aero-towed it behind an R4-D, which is better known as either a DC-3 or a C-47. So ... all the things we did on weekends, we did during the week, and vice versa. And a lot of the people that I worked with were glider pilots, too.

Jennifer: So you did a lot more testing than you had done ...

Bertha: Yes, that was one of the nice things about the job: the fact that you could work on the theory, and you could work on analysis, and you could work on flight simulation and work on the wind tunnel to get the data, and then you actually flew the vehicle and could compare your results with what you had gotten from the wind tunnel and what you had calculated. The pilot could tell you if flying the real thing was like flying the simulator. So it was satisfying that way, to be able to see if what you predicted actually came true. ... And to see something you worked on actually fly, to spend a lot of time in a wind tunnel getting data, and on a computer or calculator making calculations, and on a simulator, and then actually seeing the vehicle fly.

Jennifer: And what did you like least about working at NASA?

Bertha: The fact that it was 35 or 40 miles from home. I had to take the bus, and I got on the bus at some very early hour and slept till I got there. Then, at exactly closing time—people were either in carpools or the bus—so if there was a meeting, or if there was a discussion or something, everything just stopped cold and everybody left. I didn't like that. That was the beauty of here, where I was so close to work at China Lake that I could go in and stay as long or as short as I wanted. I could go in weekends with no problem. I could do anything I wanted with my time.

Jennifer: And why did you decide to leave NASA?

Bertha: Well, I very much enjoyed my work at NASA, but I almost felt guilty because it was like the weekend all week long and I was having a lot of fun, which is a good thing, but I thought that I should try to get back into more theoretical work. More like what I had started out planning to do. ... So when I came to work at China Lake, you would have thought I would have gone to the aerodynamic branch, since I was an aerodynamicist, but I was more

interested in the fluid flow aspect of aerodynamics, and it seemed like the aerothermodynamics branch did more of that. The flow across the various shapes causes aerodynamic heating and you have to study the flow field for that. My particular interest is boundary layer transition, where the flow goes from being smooth across the wing or the shape to being turbulent. At that point, there can be some high heating that you need to know if your design is to be successful.

Bertha: It wasn't as very interesting all the time as NASA was, because the things we worked on at NASA were being reported in the news all the time—you know, the new flight of the latest thing. We didn't have that kind of thing at China Lake, as you might expect, because some of the things that we worked on were highly classified. We were also in a comparatively remote area. The group that I worked in, we tended to have our own exploratory development projects that we worked on about half time, developing techniques for solving problems and studying flow fields. The other half of the time, we'd solve problems that the projects might have, where the electronics get too hot or something like that.

Jennifer: And at this time, you were living on the Navy base?

Bertha: Yes, when I first came to China Lake, it was essentially a government town. In fact, our phone numbers were base extensions. So I lived on base in a one-bedroom apartment, which was government housing. It was rather low cost. In three years here, I saved enough to buy an airplane! That was in 1967, and then about 1974, people started to move out into town. Apparently there was some sort of a federal loan agreement for housing that became available. Apparently they're not available in remote areas, but they finally decided they would be available at China Lake. So people started buying homes out in town, and I joined the group and bought a condo. Then, after four years, I sold that and bought a house, where I still live.

Jennifer: How did the dynamic of the group you were working in change between when you were living on the base and living off base?

Bertha: There was probably a significant change which is both an advantage and a disadvantage to the government, I think. When we were all on base, everybody you associated with was somebody you worked with, so you'd be talking business 24 hours a day, essentially. You'd go into work at all hours.

If you thought of an idea, you'd go in and work on it, or something like that. So the work was really your complete life, and even though Ridgecrest was right outside the gate, my first about six years here, I didn't even go into the town of Ridgecrest. And if people would come and visit you, they'd have to come sign in at the gate and get permission to come aboard to see you. Of course, when we moved out in town, people began to mow their lawns and take care of their houses and not go into work at odd hours, and you met more different types of people, so you weren't always talking work. So I think there's both advantages and disadvantages to the Navy. We were all there working hard then, but it's probably better to have a more normal situation for people to live more normal lives, and they probably are more productive, so you can look at it both ways.

Jennifer: How many of the people living on the base at the time that you were living there were civilians, like you?

Bertha: The great majority of them. Of, say, 5000, probably 3500 were civilian. And we hardly ever saw the Navy. They were mostly at the airfield. But in a sense, they were our customers. They would tell us their operational needs, and we would try to serve them.

Jennifer: What all happened at the base? What all was being done at the time? I guess there was research going on, but what else was there?

Bertha: Well, when I came, it was during the Vietnam War, and we were very much involved supporting the people that were there. Because we were so isolated, we had no idea how the rest of the country was objecting to such things. We were just trying to do the best we could to make the things we worked on work and to try to help the service people that were over there.

Jennifer: And you came in and started working on missiles instead of airplanes?

Bertha: Yes, except that the exploratory development programs would apply to anything. My first work concerned the heating that you would get from aerodynamic interference, and you can get this on airplanes or weapons. But, of course, the application of my work was definitely towards the weapons.

Jennifer: Did it feel weird that you were going away from airplanes themselves and more towards weapons?

Bertha: Yeah, I kept thinking in terms of airplanes when I'd be working on weapons. Some of the aerodynamic coefficients, you use different constants in them, and so it took me a while to adjust, with simple things like that, but the overall effort is, of course, the fluid flow, and it flows around airplanes like it flows around missiles.

Jennifer: What was your favorite part about working for the Navy?

Bertha: Being able to do the exploratory development work—to have my own project that I was responsible for.

Jennifer: And what did you like least about the Navy?

Bertha: In general, what I like least about civil service is that it's hard to fire people. While there were a lot of very excellent people, there are also some that are just there, and they just get in the way. Industry has layoffs, which can serve a certain purpose at times, and I wish that civil service had a way that they could either find the right place for these people to be so that they could enjoy their work, or that they could let them go easily. But apparently it's very difficult. It's possible, because they've done it, but it is difficult. Sounds cruel, doesn't it?

Jennifer: A little. [laughter] What was your favorite project that you did during your time at the Navy?

Bertha: The last one I worked on, which I continued working on as a contractor after I retired from the civil service. It was called the National Aerospace Plane, and was after that called the X-30. It never flew and never will fly, but it was fascinating to work on. It was a horizontal take-off, single stage to orbit, and horizontal landing. There were a lot of challenges in it. I liked it when I could work on parts of the problem myself, but it was also very interesting when we'd go to the contractors and be evaluating the work that they did because I learned a lot from that. I guess I was supposed to be evaluating them, but I was learning from them, too, so that was very interesting. There were a lot of challenging aspects to it, perhaps one of the most challenging was, where did boundary layer transition take place? The project, when I joined it, had people from the Navy—a few, not very many—and from the Air Force, NASA, and even the Army working on it, and it had five contractors. It's rather difficult to design an airplane by committee, and I think that may have been

one of its problems. Besides, there were some technical problems that they couldn't overcome at the time. Also, you can't take giant steps—you've got to take little steps. They could have started with a Mach-10 or a Mach-12 airplane and then go to a Mach-25, which is what you need to get to orbit. If they were really serious, they should have down-selected the contractors. It was very interesting to see the contractors working together when they were really in competition with each other. Which, incidentally, is one thing good about working for the civil service—you get to see the overall project, not just what the one contractor's working on. But the good thing about that project was that it bridged the gap—the X-15 had been the last hypersonic airplane, really, and the people that had worked on practical hypersonic problems were about to retire and to leave the government and the industry, and the new generation coming along, if they hadn't had the NASP or the X-30 to work on, there would have been a gap there. So I think it served a very valuable purpose of having the contact between older people, who had worked on those things, and the newer people, who would work on them in the future.

Jennifer: When did you stop working for the Navy?

Bertha: I believe I stopped working for the Navy in 1991, and I worked for a contractor, DCS Corporation, which is based in Virginia but has an office here. And I brought my own funding with me to work with them, and essentially, still did the same work, with different names.

Jennifer: Until when?

Bertha: I worked there about a year. I worked half time, which I found a very good way to phase out, because I loved my job, and to cut it off suddenly I think wouldn't have been good for me or the Navy. So by working part time, it was obvious to them that I was leaving, and that they should get other people working on these projects. When there were things that they couldn't find, or something like that, I was still there to call. In fact, they kept calling me for a few years after I retired, even, to ask about things. But I think that was a good way to phase out, and I enjoyed the contractor. They seemed like a pretty good outfit. Although I didn't see them much—I was still working at the same office, because I'd work on base.

Jennifer: So, for all three of your jobs, did you feel prepared, going in? Did you feel like you had enough experience and training?

Bertha: I actually had six professional jobs: two at MIT (math department and Aeroelasticity and Structures Research Lab), Douglas, NASA, Navy, DCS. In any job I've had, I've never felt that. They've always been learning experiences, and I wouldn't have stayed with them if they hadn't been learning experiences. I had a good background, but if I knew everything about the job, I wouldn't have taken it.

Jennifer: So now that you're retired, what are you doing?

Bertha: Well, I'm catching up on the things I didn't have time to do when I was working. and I've been doing some travelling, and I have my airplane and my sailplane, and I've been doing some flying and work with them, and I've been writing articles for some magazines. It's been sort of fun. Sort of lay articles—one the magazine actually called technical, but I wouldn't have called it a technical article. It's been for the popular aviation-type magazine. Mostly for one called *Woman Pilot*.

Jennifer: Why did you decide to start writing to a more general audience?

Bertha: Well, let's see. I had written a couple of articles before I retired, just for fun, that got published, so I just continued. But at a Soaring Society convention that I went to in Seattle, I bumped into this lady, and as far as I knew, she was just a curious onlooker, but it turned out she was starting a magazine. ... She started the magazine, and she said that the publisher had said, "Well, you'll probably only put out one or two issues, and then you'll have run through all the interesting things you want to talk about, as far as women and aviation"—this was something like 1993. And then I got the first issue of it through the mail, and I subscribed and wrote her and congratulated her for starting it, and then she wrote back and said, would I write some articles? So I started writing some, and I've been doing it off and on since then. The magazine that wasn't supposed to last more than a couple of issues is still going strong. So there was a lot more going on than some people thought.

Jennifer: So this magazine, I guess it caters specifically to women?

Bertha: Women pilots.

Jennifer: Women pilots. What's different for women pilots?

Bertha: Nothing, really. It was maybe just a good excuse to start a magazine. I guess what's different is that when I started, while women could be engineers

and all those things, they couldn't, at the time, be airline pilots, and they couldn't be Navy pilots or Air Force pilots or test pilots. Well, there were some that were test pilots. But of course now, they can, and so they just started to present some of their stories and some other things in this magazine. It's a lot about people, but I wrote about the lifting body project, for example, and I wrote about the wave that forms when the wind blows across the mountain, and how it can be utilized by people that fly airplanes, as well as people who fly gliders.

Jennifer: Do you mostly write about stuff that you already know, or do you find new things to write articles about?

Bertha: Well, it's mostly been stuff that I know, but I might have to research a little more about it. Like the one about the wave—I knew that a wave existed, but some of the details I needed to look up. I'm not doing any engineering work, though. I've been approached about that, but I've chosen not to continue with that.

Jennifer: Why not?

Bertha: I just want to try something new. But there's really a lot of technical work involved with sailplanes, in particular, and the way you fly them has a lot of bearing on aerodynamics, and I've been involved with that kind of thing occasionally. I did one article that told how soaring has changed, how technology has changed soaring, and it has continued to. It's changing the sailplane, but it's changing the instruments in the sailplane and how you utilize them, and the way that you fly. I'm trying to do comparisons, to show how those changes have taken place and what results they've had and the accomplishments people have made—how the technical developments have made the accomplishments come about.

Jennifer: What else are you doing right now? You mentioned you were thinking of writing a book?

Bertha: Well, yeah. I just sort of described it in my résumé. I wouldn't publish it. If I did, there'd be a very small audience for it. But I don't think I'd publish it, because when you publish a book—oh, incidentally, you don't make money writing articles. They pay you, but it's not something that you live on. If you want to do that, you have to write a book. But you also have to promote a

book, and I don't think that would be fun, so I wouldn't do that. I might write the book, but I wouldn't publish it.

Jennifer: So if you wrote such a book, would it be a technical book?

Bertha: It'd be semi-technical.

Jennifer: And once you had written it, what would you do with it?

Bertha: Expand on it, or write another chapter, or put it away on a bookcase. Something like that.

Jennifer: Do you have any other projects?

Bertha: One of the books that I thought I would like to write—I thought it would be fun to either fly an airplane or a motorglider around the country and hit all 48 states and possibly the 49th, Alaska. I found when I travel that serendipity always takes over, and I thought if one flew from state to state, one might get all sorts of interesting adventures that might be fun to write about.

Jennifer: That would be a good book to read. So, what was the biggest lesson you learned at MIT?

Bertha: I guess not to give up. I was on the edge a lot of the time. Like I say, I first started by sneaking in the back door. Half the time, I didn't know what I was doing, so I was on the edge a lot, but I stuck to it and got through it, and it was a good thing.

Jennifer: How would you characterize life as a woman engineer?

Bertha: Great! Especially if you're the only one. When there starts to be more, it changes a little bit. I had a long chat with some engineers from Ames one time—NASA Ames, up your way—and it appeared that that was true. When there's just one woman, there doesn't seem to be any kind of problem. You're accepted, I guess maybe because one person isn't a threat. But when there get to be three or four or more, some of them felt they weren't receiving the best reception they could. One in particular was a very talented person who went on to do great things, so it wasn't because she wasn't a good engineer. The feeling she had, and the only conclusion I could come to, was that life is easier for just one, but it gets a little more difficult when there are two or three or more. Maybe they think you're ganging up on them or something. [laughter]

Jennifer: What were the biggest challenges that you faced in the pursuit of your career?

Bertha: Trying to figure out what was going on. Trying to solve the problems.

Jennifer: You talked a little bit about, in this [résumé] that you sent me, that you were using ARPANet, which you said was a predecessor of the Internet. That made me wonder what kind of technological developments you've seen over your lifetime and how that's affected your work and your career.

Bertha: When I was a MIT, there was a building devoted to a computer. You could probably do more with a device in the palm of your hand now than you could do with that computer. The output was an oscilloscope that they took Polaroid pictures of.

When I went to Douglas, we had "computers," and they were a bunch of women in a room using Fridens (or could be Marchants) [Interviewee's note: These are mechanical machines that take about a square foot of desk space and work by pulling a handle after you input the number. Mostly they add and subtract, divide and multiply. The fancy ones could take square roots!] and following columns that you would label at the top, with this number, and then divide it by this ... and they were the "computers." I tried to get one of them once, she was a very nice gal—they were always women; the guys were smarter, they didn't get into that line of work. But she was a very sharp young lady, and I thought "why don't I try to explain this to her and it'll be more interesting to her?" She didn't want to hear it. She just wanted to work on her columns. And then the next one would do the same thing and put a check: "I got the same answer." So that was that way. We were starting to get computers then, too, the non-human type.

And then when I got to NASA, my big delight there was a 20-inch slide rule, because it would do so much more. Do you know what a slide rule is?

Jennifer: I've seen one, I think. [laughter]

Bertha: And also, then they started to get a computer, but it was like a closed shop. The engineers couldn't write their own programs. They'd have to bring it to the computer person—back then, programs were smaller, too. I didn't like that, because I didn't have the direct contact, but that was the way they did it. Whether it was time or location—I think it was mostly time—when I came

up to China Lake, then the engineers wrote their own programs and wrote them the way they wanted them. Then, of course, as time went on the programs got so large that it was hard to know every detail of the program, so you'd check it out by doing test cases. Every time I worked on a problem with one of these large computer codes, I would also get an approximate answer, to make certain things were coming out right. That's been the changes—very, very big.

The Internet itself started in either the '60s or the '70s with the universities, but ARPA—the Advanced Research Projects Agency—was funding it. The project that I got involved with in 1980 was to use several different CFD codes—computational fluid dynamics codes—and compare the results on various dome-like shapes compared with the experimental data that we had. The computer that I used was a Cray at Ames, and I had to use the ARPAnet to get to that Cray to do my work. There wasn't a Web, but it was the forerunner of the Internet.

Cray was a very high speed super computer, the best for its time. The follow-on after the Cray, mostly as I was getting near the end of my structured working life, was that computer power got to be so much that you had smaller but more powerful computers that could do the work you needed right in your own office area. Eventually, the work could be done on a desk top computer! That was phasing in as I was leaving.

Jennifer: You mentioned that the project that you were working on, right before you retired—

Bertha: The National Aerospace Plane.

Jennifer: —you said that that'll never fly. You don't think that it could be picked up now and ...

Bertha: Oh, it is being done. That particular airplane won't fly, but they're starting on a smaller scale, and they're first going to lower Mach numbers, and they're doing them in steps more. They're doing them with some unmanned vehicles also. So yes, this will come to pass. We were just a little early, but yeah, I think it still is important that it be done. I think we learned a lot.

Jennifer: Would you say that you learned how to be a scientist at MIT, or that you came in as a scientist already?

Bertha: I think I learned how there. My undergraduate school wasn't aiming especially towards engineers and scientists. But it was a school that I'm glad that I went to. I think it was a very good foundation for life, and enough of a foundation to get me into the math department, and from there into engineering.

Jennifer: Do you ever wish you had been born 50 years later, and—

Bertha: No.

Jennifer: Why not?

Bertha: Because the timing was right for what I wanted to do and for what I was interested in. There are many interesting things coming that I would love to be involved with (exploring Mars, learning about the universe, etc.). But my timing was right for me: In general I could always find a way to do most of the things I wanted to do. Now there are many more restrictions, requirements and complications imposed by other people.

One thing that was important that I didn't mention before—my mom always told me I could do anything that I wanted to if I worked hard enough, and that's important to know. She also said, "Don't be afraid to be different." I think those two things are important.

Jennifer: Do you ever wish it had been a little bit easier for you to walk through the life that you were walking through?

Bertha: I might have at the time, but I think in general you respond better when things are hard. I think life is easier if you have challenges, and I think that kids growing up now and going to school and are affluent and theoretically have a very easy time of it, I think it's actually much more difficult for them to keep focused and to keep doing what they want to do.

Jennifer: If you could give some advice to current and future MIT students, what'd it be?

Bertha: I would say that they should find a goal and something they're passionate about, and then pursue that in spite of all obstacles, and if they have obstacles, not to worry, because those obstacles just make them work harder to get where they want to go. So they should welcome obstacles.

[END OF INTERVIEW]