

RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY

NEW BRUNSWICK

AN INTERVIEW WITH SAMUEL GOLDFARB

FOR THE

RUTGERS ORAL HISTORY ARCHIVES

INTERVIEW CONDUCTED BY

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and

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PRINCETON, NEW JERSEY

OCTOBER 8, 2012

TRANSCRIPT BY

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Nicholas Molnar: This begins an interview with Mr. Samuel Goldfarb on October 8, 2012, in Princeton, New Jersey, with Nicholas Molnar and Jared Regner. Thank you, Mr. Goldfarb, for having us here again. During your time in Hawaii, you mentioned that you remember a tsunami that occurred, I believe in April of 1946. Could you talk about what you remember about that?

Samuel Goldfarb: Yes, certainly. I was at Pearl Harbor, which is on the east coast of Hawaii, if I remember correctly, and the tsunami hit on the west coast of the island of Oahu, on which Pearl Harbor is located. [Editor's Note: Pearl Harbor is located on the southern side of Oahu.] As a matter-of-fact, there at Pearl Harbor, we never knew that a tsunami hit the island until we heard it on the radio and saw it written up in the newspapers. So, at our first opportunity, we got in our jeep, a number of us, three of us, I guess, or four, and drove over to the, they call it the windward side, because that's the side that faces west, where the westerly winds come. We saw evidence of the damage that was done there and I took pictures. We had a Speed Graphic camera associated with our activity, so, we were able to take some nice pictures, of which I have some samples here. It didn't seem like a big deal to us. The damage was very visible and extensive, but, since we were in Pearl Harbor, where there was no damage, it didn't affect us directly. Well, a day later, or maybe two days later, I got a call from our commanding officer in the communications section of the naval district there in Pearl Harbor. He said, "Sam, call your mother." So, I managed to get a telephone call off to my mother--oh, it was a telegram. I got a telegram from my mother. "Are you safe?" because they read about the tsunami. They didn't know where, that Pearl Harbor was on one side and the tsunami was on the other, but my mother was worried about me. I guess I hadn't written in a couple of days. So, she sent me this telegram, which the Navy [relayed] through Navy channels, which was a little embarrassing, [laughter] but, in any event, I quickly flashed back to my mother that I was safe and that the tsunami didn't affect us. [Editor's Note: On April 1, 1946, an earthquake occurred ninety miles south of Unimak Island of the Aleutian Island chain. About five hours later, tsunami waves hit the northern coasts of the Hawaiian Islands.]

NM: During your time working with this equipment during the Bikini tests, did you know anything about the capabilities of atomic bombs? Was any of this information classified that you were working with?

SG: No, nothing was classified, because we were just relaying pictures from Bikini to the mainland. There was nothing in the content there that was classified, but my knowledge of physics, and so on, from college, I knew the potential energy in the binding energy of the atom and I was aware that it was enormous. The pictures were really very impressive, as you will see if I show you these pictures. [Editor's Note: The atomic tests conducted at the Bikini Atoll were codenamed Operation: CROSSROADS. On July 1, 1946, atomic bomb test ABLE was detonated at an altitude of 528 feet. On July 25, 1946, atomic bomb test BAKER was detonated ninety feet underwater. Both tests were conducted to observe the capabilities of nuclear weapons against naval ships and materiel.]

NM: One of the things that we did not get to in the initial interview was where you were when you heard the war had ended.

SG: Well, there were two parts to that, right.

NM: Okay.

SG: First came the Japanese surrender, and then, came, later, the German surrender. In the Japanese surrender, I was still in Navy school in Chicago. I didn't have liberty at that time. I was there on the base. So, it was a normal day for me, but my friends who were out on liberty in Chicago, with crowds were in the street, anybody in uniform was considered a dignitary. It was a big, big celebration. They came back with their uniforms ripped and drunk, and so on, because people were treating them to drinks, and so on. So, on V-E Day, see where was I on V-E Day? When was V-E Day? Do you remember?

NM: I think it was in May 1945. [Editor's Note: Victory in Europe Day, V-E Day, occurred on May 8, 1945.]

SG: May 1945.

NM: Then, Japan was in August 1945. [Editor's Note: Victory in Japan Day, V-J Day, when the Japanese announced their surrender, occurred on August 14, 1945. September 2, 1945, the date of the signing of the formal surrender, is sometimes also called V-J Day.]

SG: Oh, so, the Germans--that's right the Germans surrendered first. Okay, that was--I got it wrong. In Chicago, it was the German surrender and I was in school also, but I don't remember just where on V-E Day.

NM: What was your reaction to the second surrender?

SG: I was much happier when the Japanese surrender came, because I was in the Pacific. We were facing the Japanese and there were lots of risks involved and we met a lot of people, a lot of sailors, who had survived sinkings, and so forth. So, I was most impressed with the fighting in the Pacific. When the European surrender came, of course, I was delighted and looking forward to discharge, getting back to civilian life again, but it wasn't as personal as the Japanese surrender.

NM: You told us your story about the outgoing unit, how you learned to get things in writing.

SG: Oh, yes, certainly. [laughter]

NM: What were your plans initially after getting discharged?

SG: Well, while I was in Pearl Harbor and the war had ended and we were working on the Bikini pictures, my discharge was imminent. So, I gave it some thought, what I'd do when I got back to civilian life. I had been educated in electronics by the Navy. I had already had a mechanical engineering degree, but, now, electronics was much more appealing, it was much more exciting. So, I wanted to continue in electrical engineering and I thought also that it would be a nice way to get back into civilian life on campus, where things are a little more relaxed than in industry. So, I thought about going back and I already had my exposure to Rutgers. I thought,

"Gee, I'll go back and resume my life just where I left off. I'll go back to my old room in the fraternity house and things will be just like they were two years before when I had left for the Navy. It'll just be like an interval that had been blanked out." So, I hunted and pecked on our office typewriter and wrote a letter to the Dean of Engineering and introduced myself and told him that I was going to be discharged probably that spring or summer and I would like to be back for the fall semester. Could I be admitted in the Graduate School to get an electrical engineering degree? I already had my mechanical degree and I had an education in electronics in the Navy and would they admit me to the graduate program in electrical engineering? I got a letter back that said they were unwilling to have me start graduate electrical engineering with a mechanical undergraduate degree. They would prefer me to have an electrical undergraduate degree, and then, go to graduate school from there, but they would give me two years of credit for my Navy education. Then, I'd just have to take so many credits and get another bachelor's degree, in electrical engineering this time. That sounded attractive. So, I wrote back that as soon as I had word of my discharge date, I would be able to tell them exactly when I would be able to get back on campus, but I hoped it would be before the September semester opened, started up. That's what happened.

NM: Okay.

SG: I was discharged in August at Lido Beach in New York and came home. I found a message from my parents. My father had hay fever, so, every summer, they would go up to the White Mountains in New Hampshire, where the pollen count was much lower and my father could have a comfortable summer. So, they were up in New Hampshire and they left word for me to pack my duds and take a train up to, I guess it was Littleton, and let them know what train I was on, they would pick me up in Littleton. That's what I did, took the train up there, met my parents. They were in a hotel up in Bethlehem, New Hampshire, the White Mountains, and I stayed in that same hotel. There were a crowd of young returning veterans and girls and it was a wonderful couple of weeks there before I had to go back to the campus. I met fraternity brothers of mine who had also just been discharged. So, it was just a great way to get back into civilian life. [laughter] I had trouble with my clothes. In the Navy, you've got several uniforms. You have a summer uniform, you have a winter uniform, you have a work uniform, and so on. Every day, on a Navy base, or I guess on a ship, it was posted what the uniform of the day was, because they didn't want one guy wearing whites and the other guy wearing blues. Everybody was supposed to be in the same uniform. Now, if you were on a work detail, you might be wearing a work uniform, but they preferred to have a uniform of the day. When you woke up in the morning, you found out what was the uniform of the day and that's the way you dressed. You didn't have to think about what you're going to wear today. There I was, back in civilian life, and I realized, "I've got to think about what I'm going to wear." I wanted to look presentable and especially up in New Hampshire, with the social life up there, I didn't want to look odd. So, I had brought some civilian clothes with me, some of which still fit, and that was a big concern. I mean, I had nothing else to be concerned about. [laughter] So, I remember that as being a matter of some thought.

NM: Please tell us about getting back into life, and then, going to get your graduate degree, when it comes to that point.

SG: Okay. Well, when I got back, I went to arrange for my old room in the fraternity house. Don't forget now, there were a flock of normal students who were considerably younger than the veterans, so, they were occupying all the rooms in the fraternity house. They said, "No, you can't have your old room back." I said, "But, I have seniority," and that's the way we had always assigned rooms. Seniors had first choice, juniors and down, and they said, "Well, you no longer have seniority. The bylaws have changed, because we're swamped with returning veterans and veterans do not have priority. They're after the undergraduates." That was managed by a fellow whose name I will not mention, who was one of the first returning veterans. He had seen a lot of action in Europe and he was able to get discharged very quickly after the war, after the European War ended. When he got back, he was a very aggressive politician on campus later. He told the undergraduates, "If you fellows want to keep your rooms, you'd better change your bylaws, because all the returning veterans are going to come back and, with their seniority, they're going to claim all the rooms in the fraternity house. You'll be in a dorm." So, they arranged to change the bylaws and all the veterans lost their seniority, but, right next door to the fraternity house, we were 4 Union Street, I guess it was 6 Union Street, was a private home and they rented rooms to students. That was Mr. and Mrs. (Chazen?). So, I arranged for a room there. It was very easy for me to hop out to the next house to eat, go back to my room to study or go to the campus. Union Street is only one block from the campus. Now, small world, there were two daughters in that family. One daughter was already married and living with her husband up further on Union Street. The other daughter was unmarried and one of my returning veteran fraternity brothers was dating her. When we got to Princeton, forty-nine years ago, there she was, married to a veterinarian and living in Princeton. So, we renewed our acquaintance. There were two years then of study to get an undergraduate degree. They were very--oh yes, I had forgotten to mention that when I first came back, I didn't get a room next door to the fraternity house, that was later. I found a fraternity brother who had a room in his grandfather's house. His grandfather was a widower living on Livingston Avenue, the big street there that goes out from the center of New Brunswick. He had a room in his grandfather's house that I would share with him. The reason he was there is because his mother was concerned about her father, who had lost his wife and now was living alone. So, she thought it would be awfully nice if her son lived in the house there with his grandfather, in case--he was an older man--he would be able to take care of any problems that his grandfather had. So, I roomed with him and that was the fellow I shared the ownership of that Old LaSalle, 1929 LaSalle. So, I lived there for, I guess, a year, and it was the following year that I found the room next door to the fraternity house. The two years of undergraduate work in electrical engineering were uneventful, very interesting. Now, I was older. I went to college in '41 at the age of sixteen. So, the girls over in NJC, or Douglass now, some of them were older than I was in the freshman [year]. So, I had to date high school girls in New Brunswick. So, now, I was much older, dating the girls at NJC was easy to do. I was in the Class of 1948. So, I graduated with a mechanical degree in 1944 with the Class of 1945. Now, I graduated with a bachelor's degree in electrical engineering in June of 1948 with the Class of '48. Here, we moved to this location here at Windrows in July of 2011. We found a familiar face. It was my first cousin's sister-in-law; that woman's brother had married my first cousin. Her brother was a Rutgers man, a Phi Epsilon Pi fraternity member, and I knew him from campus. We had maintained some contact over the years. I was very surprised to see her and he was the Class of '48. So, he was my classmate, but he had passed away by the time she moved here. The reason she moved here is because she was a widower and looking for a senior living arrangement, so. [Editor's Note: Windrows is a retirement community in Princeton, New

Jersey.] So, when I graduated in 1948, June, jobs were not easy to get. I had worked in the Engineering Experiment Station as a senior, helping with some simple research. [Editor's Note: The Engineering Experiment Station was founded in 1926 and is commonly referred to today as the Bureau of Engineering Research. The Bureau of Engineering Research provides the engineering faculty with appropriate management of grants and contracts.] I made a friend with Professor (Alfred E. Rice?) and he said, "You're graduating?" He was an Austrian professor with a thick Austrian accent, "What are you going to do?" and I said, "Well, I'm looking for a job and they're not easy to get. I don't know what." He said, "Why don't you stay on campus and get a graduate degree? I will offer you a research associate position and you'll have a stipend and I'll pay your tuition." Whoa, well, that was very attractive and I was already in the social life there at NJC and at Rutgers. So, it was very attractive. I went into electrical engineering graduate school and worked with Dr. (Rice?) in the Engineering Experiment Station. We were doing research on a number of different projects. One was the flow of particulate materials. Sand, for example, if you put sand into a container that has a narrow opening, it will flow, and then, sometimes, clog up. It forms an arch that supports the weight above it and no more material flows through the opening. There isn't much science about that, or wasn't much science about it. So, Dr. (Rice?) was trying to quantify and describe the flow with mathematics, and so forth, and I was running simple experiments with that. It was a lot of fun. Every night, when we quit work at four o'clock or four-thirty, whatever it was, in the spring and summer, I would go with other graduate students to the tennis courts that used to be opposite the Seminary. You know the Seminary's on Seminary Place and there's a picture, William the Silent, his statue was there. There used to be tennis courts at the end of that campus. We would go out to those tennis courts and we would play fierce tennis, doubles. The losing team would have to buy dinner--with a certain monetary limit, I guess, I don't remember how we arranged it--to the winning team. We would change partners, so that it was fair over a period of time. It was a lot of fun and we had dates, go to the movies--it was a very carefree life. The war was over and it was very nice. I would take courses in the Graduate School and that was very, very interesting. Then, when I matriculated--oh, before I matriculated to graduate school, we got a project from Johnson & Johnson to investigate the curing of plaster of Paris. Plaster of Paris is gypsum, which is calcium sulfate, and, when you mix it with water, the calcium sulfate reacts with the water to form plaster of Paris. The water goes into water of hydration in the crystal--so, it goes from free water to bound water in the molecule with the calcium sulfate--and just how that change takes place was not well-known. Johnson & Johnson had a product for orthopedic medicine. It was a role of gauze saturated with gypsum and, when the doctor encountered a patient with a break, he would take a roll, plunge it into a pail of water, for a number of seconds, which was described to him in their instructions for use. Then, he would take the gauze and he'd wrap it. He set the bones, they'd wrap the gauze around the limb, maybe another roll, and that's how he would form the cast, and then, in a little while, the plaster of Paris would set and that would be the cast, but controlling the setting time of the calcium sulfate was kind of an art. If I remember, vinegar in the water made it set more slowly. There were a lot of different tricks to it. Johnson & Johnson was interested in knowing the science of how the water reacted to form the plaster of Paris and they were willing to support a research project, to which I was assigned. I was the lead in this project, because I had made a proposal or I suggested that we watch the state of the water by watching the resonant frequency of the water as it went from free water, where it's relatively easy to rotate in an electric field, to bound water, when it was in the crystal, where it was more restricted and it couldn't react as freely with the field. Johnson & Johnson thought that was a

good idea and they said, "Okay, go ahead." I signed a contract and one of the provisions was that I write a report every month on what the progress was, technical, for that month or the preceding month. Now, I'm matriculating into the Graduate School and one of the choices I had to make was, do I want to enroll in a thesis program or a non-thesis program? With the thesis program, of course, you had six credits less of coursework and those six credits were counted toward your thesis. If you had no thesis, you took two extra courses. In either case, you would get a master's degree. So, I said to myself, "If I'm going to write a report every month to Johnson & Johnson, all I have to do is rewrite it a little bit and I have a thesis." So, I elected for a thesis program. Now, Johnson & Johnson said, "Okay, we like your idea. Design the experiments and what kind of equipment you're going to need and everything else." So, I priced out the equipment, not cheap. You need a source of microwaves and, in those days, radar was brand-new. It had been invented during the latter part of the war. The equipment for measuring all of the parameters of high-frequency radiation, and so forth, was costly. So, it was going to be between one and two hundred thousand dollars, if I remember. When Johnson & Johnson saw that, they said, "Whoa, this is not what we had budgeted for. So, cancel the program." Well, there I was, in a thesis program with no support for the work I wanted to do; so, I went to the Dean and I said, "We've lost support and my thesis subject, which has been approved, is no longer valid, because I don't have any support, unless I can find somebody with one hundred thousand dollars or two hundred thousand dollars to buy the equipment." So, he said, "Well, you'll have to find another thesis subject." In any event, that was no problem, because I had coursework to take before I got to my thesis. So, I continue with my coursework and I took two extra courses to get six extra credits, so [that] I had the right number of credits for my master's. I put in an application. There's a form you have to fill out that says, "I have enough credits for my master's degree. Here are the credits I'm offering and I'm looking for approval from the Dean," or whoever, I guess it was the Dean, "for approval to receive my master's." I put down all of my credits, all the coursework I had taken, and the Dean comes back and says, "You're not in the course curriculum, you're in the thesis curriculum. You don't have a thesis. You can't get a master's degree. You have to write a thesis." I said, "Well, I'd like to switch from the thesis curriculum to the course curriculum." "Uh-uh, when you make your choice, that is it. You can't switch." I said, "Well, I want to get married and I want to go out and get a job, so [that] I can support my wife. I'll not be able to write a thesis here at Princeton." He said, "Well, when you're out in industry, find a subject and we'll get you a thesis committee here and you'll write your thesis." When I got out into industry, I saw quickly that you're not doing basic research. You're doing applied engineering and it's not really suitable for a thesis. So, I put that on the back burner. You want to hear about my job, career, now? Okay, so, I looked for a job in the newspaper, help wanted, and I found an ad for an outfit in Hoboken. Now, the girl I met, I had already been dating from Douglass, she was the Class of 1950 and we were serious and we wanted to get married. She's also from Jersey City, only a block or two away from my parents' home. So, I figured we would live in Jersey City and I would get a job somewhere around Jersey City. So, this job that I saw in the newspaper was with the Jason Corporation in Hoboken, an easy commute from Jersey City, and it wasn't dielectric engineering. It was the kind of work that I had proposed for Johnson & Johnson--a different application, not plaster of Paris--but this company manufactured quilted plastic, which was already on the market, but it was stitched. They would take two layers of plastic with cotton batting between it and they would stitch it in a design and it was puffy and like a quilt. It was very popular in the 1950s. Their product was superior because, instead of stitches, where the needle punctured the two layers of plastic, they

had electrodes that had that same design and, when they came down, they applied radio frequency energy, which softened the plastic, and squeezed it through the cotton and the two layers would glue together through the cotton, only it wasn't cotton batting now; now, it was polyvinyl padding, quilted. It was an instant success. They couldn't make enough of it. So, they hired engineers, including me, to design and build more machines to make this material. Now, a little history about that, if you're interested; an engineer, a professor at Stevens Institute, had the original idea for dielectrically heated quilted plastic. He had made enough experiments to show that he could do it. So, he looked for financial support. He found this corporation, Jason Corporation, seven brothers named Jacobs who had money that they made in the children's wear business, manufacturing children's wear. My father, by coincidence, carried their line in his children's wear store in Jersey City. They supported the engineer from Stevens to build the first of these machines to make the quilted plastic and it worked. They started making and selling the plastic and they wanted to make more machines, so [that] they could get increased quantities of material to sell. Well, when they came to us and hired these engineers, me and several other engineers, the senior engineer on the job was very skilled and very knowledgeable about radio frequency. He was an ex-ham and he had done power radio design. He designed more machines of a different nature than the original one from Stevens, allegedly to improve the production. When the first one was built, it didn't work. So, I was one of the group trying to find out why this machine didn't work and the other machine from Stevens did work. I saw--I'm not going to get too technical--it was a matter of how the press that handled the material was connected to the radio frequency source that gave the power to melt the plastic. That's a transmission line that carries the radio frequency energy from the generating tubes over to the machine that compressed the plastic and put the design into the plastic. I realized the reason was that my friend who had designed the new machine hadn't used the right impedance for the transmission line. I suggested that he use a low impedance transmission line and we'll see what happens. When we tried the low impedance transmission line, [it] worked very, very well. Now, we made more machines, had only had maybe a dozen of them, working twenty-four hours a day, three shifts, making this material as fast as we could, because Sears and Roebuck wanted the material. Detroit, I don't know if--you fellows are too young to remember the Frazer automobile. There were two machines, two automobiles, the Kaiser and the Frazer. Kaiser had made a lot of money during the war, making ships. Now, he wanted to get into the automobile business and Frazer was a partner, or something like that. So, they made two models called the Kaiser and the Frazer; maybe it was one model they called the Kaiser-Frazer. I think it was two models. [Editor's Note: Kaiser-Frazer Automobiles was a successful automobile company after World War II, but quickly declined.] They wanted quilted plastic on their dashboard and inside their doors and everything else. They placed a large order and, boy, we had to keep up with their production and we were making that stuff as fast as we could. Well, one of the ways of improving the speed of production, the original length that they made the material was fifty-four inches wide, but they could only make about six inches at a time. So, they would heat six inches, the press would come up, it would advance six inches, the press would come down, they'd make another six inches and that's the way it worked. They were very careful that each time the press came down, the design picked up from the old one. So, unless you were experienced, when you looked at it, you couldn't see where the joints were between the six-inch material, but, if each time the press came down, you made twelve inches, you'd double production. So, I set about improving the amount you could make in one cycle. The limits were due to certain technical features having to do with the radio frequency energy being equally distributed over the area. I



developed a technique for distributing it over the larger area and, boy, we quickly converted all the machines over to this new arrangement and away it went. Now, Jason Corporation had a patent on this method of making quilted plastic and they kept it as a trade secret. Nobody could get on to our premises without a pass. The security was tight, because they didn't want anybody learning their secrets. One day, the boss was walking through the production area and he saw a familiar face. He realized that that fellow who was working as a laborer, handling material, was a competitor that he had met at one of the tradeshow. He grabbed the guy and threw him out, but the guy already saw what the operation was and how it worked. He started working in the same direction to develop a machine. So, Jason sued him for infringement of their patent and said, "You're developing and you're using the same techniques that we're using and we have a patent to cover it and you're infringing on our patent." So, it came up to court. Jason lost the case, because the new guy showed that before Jason had developed his technique, somebody else had used radio frequency heating to quilt plastic to make gloves. They had put two layers together and made the outline of the fingers, and so forth, using a similar technique. So, the court threw the patent out. Now, it was a question of just keeping it a secret. One guy already knew and, pretty soon, several other competitors came on the market. Well, Sears and Roebuck took a lot of our material, Detroit took a lot of our material, but, after those initial orders, the Kaiser-Frazer automobile crashed. It wasn't a success. We lost their order. Sears and Roebuck orders decreased and business started to drop. So, I started looking for another job. The Korean War had broken out and I got a job with Utility Electronics in East Newark, also an easy commute from Jersey City, and I left the Jason Corporation. While I was working for Utility Electronics, I got a telephone call at home one night and the fellow said, "I am a competitor of the Jason Corporation. I have my own company and I have my own machines, but we don't have the wide electrodes that you developed for Jason. We are still using the narrow electrodes. We would like you to show us how you developed the wide electrodes for Jason." Well, my method was not patented. So, I started work as a consultant for that company. Then, another company within the business said, "Show us how to make the wide electrodes." So, I developed a consulting business where I would work at night, because everybody was working three shifts, even though business was not that good. In the daytime, I'd work for Utility Electronics, and then, a couple of days a week, I would work at night for one of these other companies, developing their techniques. I did that for quite a while. I don't know how long, I don't have my dates handy, but I eventually left Utility. Oh, I didn't mention this--the thing that really hurt the Jason Corporation was that this was radio frequency used for heating and the frequency they used was right in the television band. So, when television came along, all of a sudden, our machines were sending out a signal that everybody picked up on their television machine. So, what they would see would be a picture, and then, the picture would disappear, then, it'd come back, because, every cycle, that's what would happen. So, the FCC, the Federal Communications Commission, came to the plant one day and said, "You are illegally radiating on television frequencies. You've got to change your frequencies or shield your building." Shielding the building was--it was a three-story building--it was too expensive to do that, to keep the radio frequency from emanating out of the building. So, they would have to change the frequency and that was a major change in those machines. That's when I left, because they had a shut down and it was a big change. Well, okay, I went to Utility Electronics and Utility Electronics had contracts [with] the Army to make field radios. I worked on that, developing field radios for that company for a couple of years. The space business came along. What was it

called? The Russian satellite was *Sputnik*. [Editor's Note: The Soviet Union launched *Sputnik I*, the first artificial satellite, into orbit on October 4, 1957.]

JR: *Sputnik*.

SG: *Sputnik* was launched and it was a big excitement for space. I thought I'd like to get into the space business. So, I left Utility Electronics and went to Kearfott in Little Falls. Now, by that time, we had moved to Morristown. Morristown is not far from Little Falls on Route 46, so, it was a relatively easy commute. In Kearfott, I worked on technology for the space business. It was instruments to be used for space travel, and so on, and also aircraft, autopilots and magnetic compasses--not magnetic compasses, radio compasses--and things like that. That was very interesting. Kearfott got a job to design the autopilot for the Minuteman. This was going to be an answer to the Soviet threat. We would have these rockets on ready and, if the Russians launched a first attack on us, we would detect the rocket on its way. We would fire all our rockets and everybody would be blasted away, but it would keep the Russians from feeling that they could attack us with impunity. Really, in politics, nobody really knew--everybody knew they're not going to really destroy us and destroy themselves, but it was a threat. So, when the time came to negotiate, they would always have in the back of their pocket, or in their back pocket, the threat to fire nuclear weapons at us, and the same thing with us. We had to have a threat back to them to neutralize that, so that when the diplomats negotiated, each one was on an equal footing. If one of them had a rocket that could bring a nuclear threat to the other, he could say, "This is what I want and you had better agree." It was implicit that he had this capability to destroy you. Well, the Minuteman was our answer to the Russian threat and it was a thrilling project. I mean, this was going to be the latest hot thing. I wanted very much to get onto that program and they announced the teams--I'm on another project and I'm not on that team. I was PO'd [pissed off]. I was annoyed. [Editor's Note: The Minuteman Missile is an intercontinental ballistic missile that was developed in the early 1960s.] Here, I had looked forward to working with that team. So, I looked for another job and RCA had an ad. They're looking for people to design satellites. So, I went for an interview and I was hired here in Hightstown--it was the Princeton [office], it was the RCA Astro Electronic Division--and I got a job. I went back to Kearfott and said, "I quit and I'm going to go to work for RCA." "Oh," they said, "we're going to put you on Minuteman." I said, "Too late." I said, "If you had told me two weeks ago, or a week ago, I would have been happy," I said, "but you didn't put me on the team and I felt I was being overlooked. So, I have a job now that's [better]." "Well, don't go to RCA, stay here." Well, RCA's job was much better. It had a higher salary, and so forth, and so on. So, I left and came to work for RCA and I commuted from Morristown to Hightstown. Now, 287 runs part of that way. 287 goes down to Somerville, then, you take 206 down to Princeton, but there was no 287 when I was there. You had to take 206, 202, from Morristown down to Princeton. It was three quarters of an hour each way. It was a dreadful commute and my wife was very concerned, because you're in a car with commuters and there could be accidents, and so forth. So, after two years of commuting, she convinced me to move to Princeton and that was forty-nine years ago, almost fifty years ago. At Astro Electronics, I had some very interesting work. I enjoyed my career at RCA very much. My first assignment was to a classified job, which was a military radio, military meteorological satellite, to take pictures of the cloud cover. Nowadays, you can pick it up on your laptop. They have these satellites which they put on the web and you can see, in real-time almost, the cloud cover at any place. In those days, it was a new technique. RCA

had launched TIROS, which was an infrared video satellite that looked down at the cloud cover and that was for civilian work, but the military needed their own satellites, because they were not interested in looking wherever the civilians were looking. They were interested in looking at Korea, at Vietnam, and they were looking at things from a different point of view. So, they wanted their own satellites and they had instruments which were classified that were not on TIROS. [Editor's Note: The Television Infrared Observation Satellite (TIROS) was launched on April 1, 1960.] So, I worked on that and there are stories I could tell about that, but we'd get a long, long story. Not everything was successful. The failures were the most interesting things. As a matter-of-fact, I gave a lecture a few years ago for a retired men's group on failures that I've been associated with. Successes are great and you feel terrific, but some of the best stories are the failures. Okay, after the assignment to the military meteorological satellite, I went to work for relay, which was the first real good communications satellite. We launched six months after Telstar, which gets credit for being the first of the active communication satellites. There had been already a balloon-like satellite, which they blew up with gas up in space, that had an aluminized Mylar outer cover and they could bounce radio waves off of that balloon, but that's what they call a passive relay. [Editor's Note: The first Telstar satellite was launched on July 10, 1962.] It takes a lot of energy going up and hitting that balloon, and then, reflecting a little energy down to a receiver. It's not really very practical, but it paved the way and it gave us some information on what kind of propagation they would get up into space and back down. You have to go through the ionosphere and they were not too sure of what the propagation parameters would be, but that gave them a little information. Now, we had an active communications satellite where you sent up your signal, it was received and amplified, and then, sent back down. So, it was a much more powerful signal and it was much more practical. The RCA satellite, called Relay, which was built for NASA, was much more powerful than the Bell Labs Telstar, more than double the power. That was a lot of fun. [Editor's Note: RCA built three Relay satellites for NASA. *Relay I* was launched on December 13, 1962.] I was in charge of--well, I was called, my title was, oh, I've forgotten what it was, system coordinator or something like that. So, I had my hands in all aspects of it, including the launch. So, my wife and kids--by that time, we had three children--we went down to Florida for the launch. When I came back, I was put in charge of a group responsible for assembling satellites, testing them, and then, launching them. So, we were down to Florida, to Cape Canaveral, several times, to California several times, and it was great for the kids. They knew more about the space business than any of their friends. They had seen all these launches, and so forth, and it was a very thrilling career in the space business. In the space business, after a while, there were retrenchments, budgets were cut, and so forth. During one of those, I transferred from the Astro Electronics Division to the Semiconductor Division of RCA in Somerville. Integrated circuits were becoming the biggest progress now and we were in it, doing integrated circuit work in Somerville. I was very pleased to transfer there and I developed a knowledge and a reputation in the semiconductor assembly area, which then led to the rest of my career. From the Semiconductor Division, during my time in the Semiconductor Division, I had to commute from Princeton to Somerville and that's on 206. Have you fellows traveled on 206, 202? It's a two-lane road. It's now opened up to four lanes in some places, but, in those days, it was all two-lane and commuting was just terrible. So, when I found out that the Plasma Physics Labs here in Princeton were working on nuclear fusion, I applied for a job here and I could roll out of bed. It's right down Harrison, make a left turn up to Forrestal Campus and, in five minutes, I was in my office instead of commuting out to Somerville. [Editor's Note: The James Forrestal Campus is a campus of Princeton that is three

miles away from the main campus.] So, I got this job in the Plasma Physics Lab and I left RCA. At the Plasma Physics Lab, that's a laboratory that's run by Princeton University for the Department of Energy. There are ten laboratories in the country. They're run by different, mostly universities, and they're all doing different work, a lot of it classified. Livermore is one, Fermi Lab up there in Chicago is another. This is one of the ten laboratories and their work is to promote and develop nuclear fusion. The atom bomb and the fission power plants all work on taking uranium and splitting it into two other molecules or atoms. When you do that, you find that the sum of the masses of the two smaller atoms is less than the mass of the original uranium. That difference in mass is converted to energy. If every atom has that little bit of energy--atoms are very small and there are lots and lots of atoms--you get a lot of power out of a small mass of material. So, fission is splitting the uranium atom and you can split plutonium and a lot of other different materials of big mass; you can split and get energy out of it and uranium is what's used mostly for power, for electricity, but the atom bomb uses some of these other materials, which are even more powerful. Fusion is where you take two light materials, two light atoms, and, when you put them together, they fuse to make one atom, but that one atom is less in weight and mass than the sum of the two atoms that you've put together. That difference in mass is what's converted to energy. So, the two light atoms you put together are kinds of hydrogen. There's deuterium and tritium, there's normal hydrogen, deuterium and tritium, they're all isotopes. They're identical. They all are lighter than air and, when you run, if you look at it normal, just casually, they look like hydrogen, but deuterium, instead of having no neutrons, has one neutron, I guess it's deuterium is two neutrons in the nucleus and tritium has three neutrons in the nucleus. Deuterium and tritium, you can put together and make them fuse with the least trouble. Other combinations, you've got to work very, very hard to make them fuse, but deuterium and tritium, you still have to work very hard and we still can't do it well, but they're the easiest to do. That's what we were working with. When I went to work there in the '70s, early '70s, it was thrilling, because we were going to make electricity so cheap that the world's standard of living was going to go up. It's going to be so cheap, it wouldn't pay to put a meter in your house. You'd get free electricity. So, everybody was very keen and morale was very high and we went to work. We engineers went to work with the physicists to prove that this could be done. We built this big machine called Tokamac. The project was called TFTR, Tokamac Fusion Test Reactor, and my job was engineering coordinator. [Editor's Note: The Tokamac is a magnetic confinement system.] For the project office run by physicists, I watched over the engineers and made sure that they were doing things the way the physicists wanted. They're the boss at the Plasma Physics Lab. The physicists run the show. We engineers, after a few years, saw how things were going and, between us, we said, "If engineers ran this program, we would have it solved in no time," [laughter] but the physicists run the program. That's the way it's been ever since. It was twenty years to break even when I went there in the '70s--we predicted that we'd have as much energy out of the machine as we put in in twenty years. Today, it's fifty years and it's forty years since then. So, it's a very tough problem and what they're doing here is trying to confine the plasma in a magnetic field--the plasma being a mixture of deuterium and tritium--and trying to make the reaction take place continuously, as you would if you had a flame and you feed it fuel. You keep the flame going and that boils water and the water steam runs turbines and the turbines run a generator, the generator makes electricity. Well, this would be, deuterium and tritium reacting, you keep putting deuterium and tritium into the machine and it keeps reacting and you generate electricity from steam again, but we can't keep that reaction going. You can have it run for a few seconds and it blows itself out. It doesn't explode, it just disappears and

why that happens, they're still trying to find out. It's very, very tough and the physicists, generations of them now, because the older guys have retired and new physicists come in, they're still trying to figure out how to confine this material and have a continuous reaction. We engineers see that that's not really the problem. If they were able to confine the plasma and to have a continuous reaction, you still wouldn't have electricity on the grid from a reactor, because the deuterium and tritium reaction produces a high energy neutron which flies in all directions out of the machine. The plasma is at a low pressure. So, you need a container to keep the atmosphere out and the deuterium and tritium in. The neutrons hitting the wall of that container destroy it. In five years, the stainless steel has no strength. It's like dust, because the neutrons break up the structure of the metal and there is no material that will stand up to these thirteen million electron volt neutrons for thirty-five years, which is what it takes to get your money back after you make a reactor like that. It has to perform for thirty-five years to pay off, because it costs so much money. That first wall, nobody knows how to solve that problem. They're still working on trying to confine the plasma and ignite it, because, ultimately, one day, the first wall problem will be solved, but we don't know when and how. So, I worked for the Plasma Physics Lab until I retired in 1989. Now, when I was working in the Semiconductor Division of RCA, a man from Sarnoff Laboratories came to see me. He said, "I have these integrated circuits and I'd like you to assemble them in a certain way." He told me how he wanted it done. He said, "If you have some [time], no rush, but, if you have some time, see what you can do to make this assembly for me." So, one day, I had some time and I got a technician and worked with the technician. We assembled them to his specifications and finished the assembly and delivered it to him. He was nice enough to call me back and say thank you very much, it worked fine just the way I had hoped and thank you, which was very nice, because, many times, you do jobs like that for people and you never hear from them again. Well, now, I was working for the Plasma Physics Laboratory and my appointment there had the rank of professor. I was senior professional technical staff, but it meant I had tenure and I had other rights and privileges of a professor. One night, not long after I went to work there, I got a telephone call at home and the man said, "Do you remember me? I am from the Sarnoff Laboratories and you made this assembly for me." I said, "Oh, yes, yes." He said, "Well, I'm now the vice president of iTech in Lexington, Massachusetts, and we're going to get into this kind of business. We'd like you to talk to us about how you did the assembly work and see if we can't do more elaborate assemblies of this nature." So, I said, "I'll be happy to." So, I went up to Lexington and I designed a lecture on how this would be done, a proposal, sort of, and they liked it and said, "Okay, we'll sign a consulting contract and you'll come up here for a certain period every month. You'll have engineers who work here and you'll supervise them to develop this technique." So, I would take my vacation time and my holiday time and all that and I would go up to Lexington, Massachusetts, and do this work. One day, I said to my boss at Princeton, he said, "Where were you the other day?" I said, "Well, I was consulting up in Lexington, Massachusetts." I said, "I take my vacation and my sick leave or whatever else, days I could get, and I use them for my consulting." He said, "Why don't you take your consulting time as consulting time?" I said, "What do you mean?" He said, "At your rank, you're allowed to have two days a month consulting. You're paid for your two days as if you worked here and you could also make your money as a consultant wherever you go." I said, "Well, how do you figure that?" "Well, we figure that you'll come back with more information than you went up with and we want to have our professors have contact with industry, to be aware of the latest techniques and latest technology. Instead of being here on campus talking to each other, we want you to talk to

industry." It was very nice. So, that gave me twenty-four days more a year that I could consult and I consulted for iTech for about seven years. The device we were making was an imager. It's like the silicon detector that's in your video camera or your new digital camera, but we couldn't make big silicon pieces in those days. The biggest we could make was small and the military wants big. It's like having a big piece of film. So, my technique was to put these together so exactly that when you look at the image, it looks like one piece of silicon. I designed special equipment for I-Tech that would do this assembly work and we started out small. We put two together and four together and made it bigger and bigger and, finally, we made the biggest hybrid CCD imager that was then in existence. I-Tech built a system around that piece of silicon, or pieces of silicon, and it flew on the U-2. You know what the U-2 is, the spy plane? It flew on the U-2 for twenty years. [Editor's Note: The Lockheed U-2 spy plane came into service in 1957 and remains in service today.] They made those systems for twenty years before new products came on that were better. I wrote technical papers that were published about this work. As a result, I got telephone calls from other companies, "Can you do that for us? We read what you did for RCA. We have little different techniques that we'd like you to develop." So, I went to work for Fairchild in California, for a number of different companies, and then, RCA called me and said, in Camden, "We're in this business and we read what you did for I-Tech. Come on back and work for us again." So, as a consultant, I worked for RCA. After I retired, I worked full-time for RCA. First in Camden, the group moved from Camden to Moorestown, down in South Jersey, and, from Moorestown, they moved up here to the RCA Laboratories, now Sarnoff Labs, and now SRI [Stanford Research Institute]. So, I was able to roll out of bed and go to my office here. I worked with them on some very interesting projects, mostly government work. Finally, we got a job as a subcontract from a big national defense company to make their imager for them, their whole assembly. That imager, we made several of them. One of them was mounted into a satellite and was launched in October of 2011. It's performing very well in orbit now, but, with the budget cuts, this project is one of the things that were cut. So, the government said to us, to our prime contractor, who we subcontracted it from, said, "Stop that work. It's cut off, no more funds." They told us, "Stop that work, cut off, no more funds." Meanwhile, I keep in touch with them and, now, they've just released funds for another satellite, the same kind. We've got to make another one. I hope--I have a meeting set up with them for next month--that I'll go back to working full-time making another one of these units for another satellite. That brings us down to the present day. So, right now, I'm on hiatus, but I'm looking forward to going to work again with Sarnoff, which is now called SRI, because they were the owners of Sarnoff in recent years. They finally brought SRI into their company and they don't use the name Sarnoff anymore. It's all SRI. Anything more I can tell you? I have lots of stories.

NM: Just for the record, I wanted to get some of the dates of these transitions in your career. Approximately when did you start working with satellites?

SG: Okay, let me think about where the first [one was], because you work on little pieces of satellites for certain companies. The first complete satellite that I worked with was with RCA Astro Electronics, which was in the early 1960s.

NM: Okay. You also mentioned that you started doing engineering work on semiconductors.

SG: Yes, I would say that was in the 1970s.

NM: Okay.

SG: Yes, it was.

NM: Okay. The 1950s was when you were working with the plastic techniques.

SG: That's right. I got married in 1950.

NM: Okay.

SG: That's when I got my first job.

NM: At what point did you transition to your work with the fusion reactor in Princeton?

SG: In the early 1970s.

NM: Okay.

SG: I think; no, let me tell you, thirteen years, yes, maybe 1976, somewhere in there.

NM: Okay. When did you retire from that project?

SG: I retired from the Plasma Physics Lab in 1989.

NM: Okay. Then, afterwards, you continued consulting.

SG: I consulted for RCA.

NM: Okay.

SG: And Sarnoff.

NM: It sounds like these companies were doing a lot of work for the military.

SG: From Kearfott on, there's a lot of military, except for the Plasma Physics Lab, which was for the Department of Energy.

NM: Okay. Was the military the primary customer of many of these companies or did they have consumer buyers?

SG: Yes, I would say; Kearfott, well, first of all, Utility Electronics, strictly military radios.

NM: Okay.

SG: And directed to the Korean War. Kearfott was military equipment for the Navy, for all the Armed Forces. It was bought up later by General Precision and it also supplied the aircraft industry, both commercial and military. Then, RCA Astro Electronics was all government, but not all military.

NM: Okay.

SG: The classified programs were military. There were a lot of programs which were not classified. One of them I didn't mention was the Navy navigation satellite, which was classified as to details, but the fact that there was a project was not classified. This was the beginning of the GPS, the global positioning system. As the Cold War continued, it became obvious that a land-based missile poised to attack another country was vulnerable in itself. The first guy to fire could direct his missile at where the other guy's retaliatory missile was. So, what are you going to do? Well, the Minuteman, to solve that problem, they were going to put it on a trailer truck and the trailer trucks were going to continuously go around the country's highway system, the federal highway system. So, if there was an alarm, they'd pull off the road somewhere, set up and be ready to fire and the Russians couldn't home in on them because they were moving before that. They wouldn't have time to locate where they were, but a fixed missile, they would have years to locate where that missile is and target it. So, the Minuteman had that solution. Then, someone else came up with a better idea. You put the missiles on a submarine and the submarine is hidden down under the water--it never comes up, a nuclear submarine--and they can fire from anywhere they are and that's the answer. When they let leak to the Russians that we've got missiles on our nuclear submarines and they're all around you, they could negotiate pretty well with the Russians, but, then, the Russians came up with their own submarines that had missiles on them as well. Well, the system, in order to hit a target in another part of the world, you have to program your missile--they didn't have GPS in those days--you have to program your missile to go from Point A to Point B. Now, you know where the Point B is, because you've seen it from a satellite or from U-2 pictures of where your target is. So, you knew Point B, but you have to know where Point A is. If you're in a moving vehicle, how do you know where Point A is? You have to stop and you have to calculate where you are. So, with a submarine, they have inertial navigation equipment. These are sensitive accelerometers that measure every little motion of the submarine. So, when you leave port, you take your sightings and you know where you are. Then, you submerge and the inertial navigation system keeps track of where you're going and continually knows where you are, continually updates the autopilot on the missile. So, if it has to fire, it will always go to Point B, because it knows where it is at Point A. However, inertial navigation equipment has an error, can't be perfect, and the error increases with time. So, it's classified how the error builds up with time, but let's take an assumption. I don't know. So, I can--I'm free to conjecture--it might be good for four, five days before the error becomes such that your missile will not hit Point B. What do you do? You have to find out where you are. So, what they do is, at night, they surface and they use a sextant with stars to find out where they are, but that breaks one of their rules. They want to be under the water all the time, so [that] they can never be detected. When they come up and they stick up a periscope or whatever they do to sight the stars, they're breaking cover, but, if they had a global positioning system in the submarine, all they'd have to stick up is a little, tiny--well, a GPS in your pocket, in your iPhone--and you don't even know it's there. It's an app. You can see how small they are. Well, if you had that on a submarine, you'd never have to surface. You put up a



little, tiny antenna and it would be able to detect from GPS where you are. In those days, there was no GPS. So, the Navy said, "We want GPS." Do you want to hear the story of GPS, of how it was started?

NM: Your involvement in it?

SG: Not my involvement, but how it started, the guy who had the first idea.

NM: Sure, briefly, if you want to.

SG: Well, it's hard to do briefly. So, maybe we'll leave it for another day.

NM: Okay.

SG: All right, so, we had a contract to build satellites for the Navy to provide global positioning. It was invented by and designed by the Applied Physics Laboratory of Johns Hopkins University down in Silver Spring, Maryland. That's where the story is; those professors who came up with that idea, brilliant. They designed a satellite and they started to make satellites and the Navy launched them and they failed. Some of them never turned on, some of them failed after a month. They didn't last at all acceptable times. So, the Navy said to the Applied Physics Lab, "You guys are brilliant and you designed great satellites, but you can't make them reliably and they're failing. So, we're going to get a company that's in the satellite business who has a record of reliability. We'll get them to make the satellites that you've designed," and they chose RCA. I was one of maybe a dozen guys, went down to Silver Spring for six months, from Monday through Friday, working with the Applied Physics Lab people to learn about their design to make improvements, to figure out how we're going to make it so [that] it's reliable and to bring the information back to our plant in Hightstown and to make these satellites. I come home for the weekend--we would come home to our homes, wherever they were in New Jersey here, on weekends--and then, Monday morning, we'd set out back to Silver Spring for another week. We made those satellites and the first one we launched lasted for two years. The record was fantastic. The Navy was very happy. We went out with the satellites to Vandenberg Air Force Base in California to launch them. It was very interesting and the cutting edge of technology, really great.

NM: I know Jared has follow-up questions.

JR: Yes. You mentioned in your previous interview how hard it was for people of Jewish faith to find work at one time. Did you see that continue after your time at Rutgers?

SG: I would say no. In the Navy, I had problems and I had discrimination and name calling and things like that, but I think my generation was just after overt anti-Semitism. At Rutgers, when I was a freshman, it was a Dutch--well, it was already a state, no, it wasn't a state university yet, but it was already a secular university--but it still had the vestiges of a Dutch Reformed seminary. [Editor's Note: Rutgers became the State University of New Jersey in 1945 and 1956.] The Dean was Fraser Metzger, Dean of Men--you've heard his name? There was a requirement that all freshmen attend Sunday morning chapel fifty percent of the Sundays. So, I conformed. I

went to chapel half of the Sunday mornings and the first time I was ever in a church for a service was when I went to Kirkpatrick Chapel on one of those Sunday mornings. "Whoa," I said, "this is just like a Jewish service, except it's in English." Now, there's a part of the service that's Christology, having to do with Jesus. That part is not in the Jewish service, but most of the rest of the service is a direct translation of the Hebrew. So, I felt right at home and Kirkpatrick Chapel is lovely. It was really imposing for a young freshman to see all those faces. Do they still have the pictures up there, yes, staring down at you? Oh, I thought that was great; all these great men. [Editor's Note: Mr. Goldfarb is referring to the painted portraits of Rutgers University's presidents that hang in the chapel.] The lecturers and the sermons that they had, they picked up clergymen from other universities who would come in as guests to lecture and the sermons were great. I enjoyed that very much. Then, I found out that you could get excused. So, I went to see Dean Metzger one day and I said, "Dean, I'm Jewish and Saturday is my Sabbath. I irregularly attend Jewish service on Saturday and, some weekends, I go home and I would like to be excused from chapel, so [that] I can do other things, since it's not my Sabbath." I remember, Dean Metzger said, "It's amazing how you Jews are so," what's the word he used? biased, oh, intolerant. He said, "You Jews are intolerant. You want everybody to be tolerant of you, but you're not tolerant of Christianity." I said, "I certainly am. I mean, anybody can go to Sunday morning church as far as I'm concerned. It's just that I don't want to go to Sunday morning church." He said, "All right, excused," but he gave me a hell of a hard time. I would say, in general, in industry, if there was any discrimination, I never saw it. [Editor's Note: Frazer Metzger was Dean of Men from 1925 to 1945.]

JR: Okay, can you ...

SG: Oh, I have to tell you one more thing, yes. In the summer vacation of my freshman year, I looked for a job and I had taken certain technical courses as a freshman. I took drafting, I took a few simple courses like that and I'm an engineer, I thought. [laughter] I'm going to go and get a job in engineering over the summer. So, I went in Jersey City, because I was living at home for the summer. I looked for technical companies doing technical work, where I could go and impress them with my technical education and get a job that would educate me. So, among the companies I went to was Ryerson. Now, Ryerson is still in existence. They are steel jobbers. If you want to buy a piece of steel for your house, a beam that's twenty feet long, you can't call up US Steel and say, "I want a twenty-foot beam of this size." They roll steel by the mile and they're not going to make a twenty-foot piece for you and deliver it to you. So, Ryerson buys a mile of steel from US Steel and they put it in their warehouse in Jersey City and, when you phone for a twenty-foot piece, they say, "It'll cost you this much and it'll cost you this much more for delivery and where do you want it delivered?" They cut it to length, they put it on their truck and they deliver it to you wherever your house is being built. So, I walk in cold and I said, "I'm looking for a summer job. I'm an engineering student. I'm looking for a summer job." "Well, here's an application, fill it out and we'll let you know." So, I sit down and I print--engineers print a certain way. In Rutgers and all other engineering schools, they teach you drafting and part of drafting is to print your letters in a certain [way]. Even the strokes are all prescribed. The reason is, if you're going to make a blueprint or a plan for something and you scrawl on it your instructions, the person who is using your print can't understand what it is you do. He says, "Oh, I think that means fourteen. No, maybe it's nineteen." You've got to be able to be legible. Otherwise, what you get out is not going to be what you think you wanted. So, I printed neatly,

in the application, all the information. It asks religion and I put Jewish. In those days, you could ask. I finish and I put it in and I get a phone call the next day to come in for an interview. Mr. (Luellen?), who's the boss of the Jersey City plant, interviews me. He says, "You're an engineering student. Why do you want to come to work for Ryerson?" I said, "Well, you handle all kinds of steel and, for something that's highly stressed, even in an airplane, they make it out of a steel alloy." Today, there are other alloys which are lightweight, but, in those days, they used steel. The very highly stressed portions of an airplane were made out of steel. I said, "I'd like to learn what the properties are of these steel alloys. If I work here, I'll be able to learn about all the different alloys of steel and how they're used." He said, "Okay, you're hired." So, I went to work for Ryerson and my jobs varied. What I did was take the place of the people who are on vacation. If Joe Blow from the shipping department went on vacation, I took Joe Blow's place in the shipping department and I did whatever Joe Blow did, under supervision, and this happened all the time. One day, a girl came over to me. I was in the inventory department, I think. She said, "Sam, are you Jewish?" I said, "Yes." She said, "Do they know you're Jewish?" I said, "Yes." She said, "I'm the only Jew in this whole company and they don't know I'm Jewish. I put that I was Christian. What did you put down on your [application]?" I said, "I put Jewish." She said, "You're the only person that they know is Jewish." So, there, again, I wasn't discriminated against.

JR: Did it at all occur to you how fast military technology was advancing, right in front of your hands? You were working with Morse code and, the next year, you were working with satellites.

SG: Absolutely. When I was in the Navy, we used Morse code. Now, the Army already had equipment that was voice, the same, well, more advanced equipment than the Navy had, for transmitting pictures, but the Navy, you transmit a picture, and then, you had to get the caption for the picture. The caption came over the lines Morse code. I was educated by the Navy in electronics. The guy who was supposed to take the message was a radioman. He had a different education in the Navy than I did. He learned Morse code and practiced Morse code and lived Morse code for, I don't know, months before he was finished with his course. I never learned Morse code in school. I learned how the electrons performed in a wire and things like that. So, when I get into this radio photo facsimile--did I describe that? I described that in the previous one, didn't I? yes. When I got into that radio photo business and it was sent to Hawaii, to Pearl Harbor, there were four of us. We had to be ready for duty at any time. So, we had watches. We had shifts. We had two radiomen and two radio technicians. I was an electronic technician. It went from radio technician to electronic technician while I was in the Navy. They changed the name of the rating. So, they said, "You're going to have to stand watch with Morse code, because there are only two of us and we can't man the radios twelve hours a day. We're on eight-hour shifts. You'll have to learn Morse code and we'll teach you Morse code." Well, getting taught by a radioman is not like getting taught in school. You don't have the time that you have, that the radiomen have, for Morse code. I learned Morse code, but I can only receive slowly. So, when my turn came to stand watch, I would hear my call letters coming in on the radio, calling my station, and then, I would have to respond. I would respond slowly with the key, and then, right after that, I would send a cue signal directing them to send at low speed. Now, regular radiomen sometimes asked to have stuff sent at low speed because there's static and there's problems in the transmission and, by getting a slow signal, it's easier to understand a dot from a dash. My reason is not because of a transmission problem--my reason is because I can't

take it that fast. I can't write it down that fast. So, I would send the cue signal for, "Send slow." Typically, what would happen is, let's see, I think our call letters were NPM3, [Mr. Goldfarb recites the call letters in Morse code]. You learned a rhythm with Morse code. Most radiomen were very good musicians, so, they already had rhythm and they picked up the rhythm of the Morse code quickly. I had played an instrument, but I was not a very good musician. So, it was very difficult for me to learn Morse code. So, when I would send out my signal back to the transmitting station and ask for QRS2, whatever it was, which is to send two words a minute, very slow, the guy would send back, [slowly], "Dit-dah-dit," which means he received it, but he would exaggerate it, [laughter] because he'd know that I was on watch, that an electronic technician was on watch. There was always a little tension between the electronic technicians and the radiomen, because the radiomen didn't know what the hell was going on inside the radio. They'd know how to receive the signal and they were a little envious of the electronic technicians who knew more about the radio than they did. So, that was a lot of fun, a lot of interesting things; any more questions?

NM: Throughout your long career, the technology was changing rapidly.

SG: Oh, yes, sure. So, single sideband was already in existence when I was in the Navy and that was a big step and we learned radar, sonar, all these different technologies, as electronic technicians, because, if we were aboard a ship, anything electronic, if it failed or had to have some maintenance work done, we had to be familiar with it. We saw how fast things were moving. Before electronic technicians, ships never had anybody like us. When they started getting radar and sonar and everything aboard, who could they look to to fix it? In the Army, [if] the radio didn't work, you threw it back to a rear echelon where there were some people who would repair it. In the Navy, you can't give it to somebody else. There's just a ship, you're out on the high seas somewhere. You can't call the radio repairman and say, "Come on and stop in and see us and fix it," or the television technician or whoever it was. There had to be somebody onboard the ship who could respond quickly to fix it and that was our job. So, we saw things moving very rapidly. Even in radar, you'd learn about this radar set and before you finished the course, a new radar set would come in with superior operation. You had to learn all the ins and outs of that set. So, we saw how fast things were moving.

NM: After the war, did your work and schooling in the Navy assist you at all in your career in civilian life?

SG: Oh, yes. The Navy course that was developed by Bill Eddy; excuse me. Can you stop that?

NM: Yes, of course we can.

[TAPE PAUSED]

NM: In life, if that helped.

SG: Oh, yes.

NM: Record.

SG: Yes, it was. Well, it gave me two years of credit toward an electrical engineering bachelor's and it was a very thorough course. I talked about Bill Eddy in the previous interview and it was a thorough, very well done course. Electrical engineering undergraduate work was very simple for me. For the people who were not trained in the Navy, the regular students who were in my class, I was much more familiar with it than they were. They didn't understand things that were obvious from my Navy training.

NM: Jared, do you have any questions that you want to follow up with?

JR: At all in your career, did you work with any ex-military?

SG: When I came back to Rutgers, most, I don't know if I would say most, of my classmates, but many of my classmates, were returning veterans. So, that was true. Here at Windrows, let's see, where am I? two doors down, not the next house, but the house after it, is another fellow who was in the Navy electronics program. So, I had dinner with him a few nights ago, a few weeks ago, a couple of weeks ago, I guess. We talked about that program and we both marveled at how good that program was. I would say that during my career, after the war, I saw many outstanding people who came out of that program, that Navy program, programs like that, plus the benefits, the school benefits that they gave you as a returning veteran. What was it called again? It was called ...

NM: GI Bill?

SG: GI Bill, I think, was responsible for a lot of the progress that our country made. It educated a whole generation of people in many different fields. If we had the same thing again, not from the [war], just the graduates, but if we had as much support for graduating high school kids as we had coming out of the service, it would be a tremendous benefit for the country.

NM: On your pre-interview survey, you mentioned that, in addition to your career, you were involved in some civic and volunteer activities. Can you speak to some of that?

SG: I'm on the Advisory Board for the Institute of Marine and Coastal Science, which is part of the environmental and, oh, I don't know what division of the University it is, at Rutgers. What's it called? the School of Environmental Science ...

NM: And Biological Sciences?

SG: That's it, Environmental and Biological Science. The Institute is part of that and I'm on the Advisory Board. Rich Lutz is the director and the previous director asked me to join the board and I was happy to do it. It's a lot of fun and it's a very interesting thing. Oceanography is very important and it's a very interesting science. So, I meet with them on an irregular basis and we talk about the work the Institute is doing. Let's see, what else? I'm also a trustee of the New Jersey Inventors Hall of Fame. We're having our banquet on the 23rd of this month. We make awards every year to New Jersey inventors who have come up with something that's important to society. It's amazing how many things we take for granted originated here in New Jersey, even

the ice cream cone, that cake-like thing, that some inventor figured that out here. Of course, saltwater taffy comes to mind also, [laughter] but there are a lot of very significant things, because Bell Labs was here and Sarnoff. Television is a New Jersey invention, color television, black and white, right here, down the street. Let's see, what else? Okay, so, before I did that, I was also religious affairs chairman of my synagogue here in Princeton and I had a few other volunteer jobs, which I can't think about, in previous years, but those are the ones that come to mind. [Editor's Note: The New Jersey Inventor's Hall of Fame was established in 1987.]

NM: Okay. We have come to the point where I wanted to ask you if there is anything you would like to add for the record, either about your career in the Navy or in civilian life.

SG: Well, there's something very trite, but I guess I have to say it. I was born at the right time. I lived in a romantic age when people were presumed to be honest and you could depend on it, when you didn't have to lock your door at night, when people were civil to one another and it was just great. My friends, my childhood friends growing up, were all of good character and I don't know if that was because of just where I was in Jersey City, but I think it was like that in most towns. If you judge by television programs, the programs were all fathers--you wouldn't know those television programs, *Father Knows Best* and Henry Morgan was in one about a young teenager--and they were all very moral shows. You didn't need immorality. You didn't need violence. Everybody was attracted by watching the plays that were just normal life. Today, it has to be something that's violent, I think, to attract attention. So, I was happy that I was born when I was, but, more than that, if I was born a few years earlier, I would have gone into the service earlier and, like, several of my friends, I would have wound up killed in the Battle of the Bulge. Those fellows were in school and we, all of us students, were asked to join the service, to volunteer, and then, services made promises, because they all wanted college kids. So, they wanted these kids to enlist and they would promise various things. "We'll do this for you, we'll do that for you," and so on, and, once you were in, the pressures of wartime prevented them from carrying out their promises. One of those things was ASTP, the Army Specialized Training Program. [Editor's Note: The Army Specialized Training Program (ASTP), established in 1942, was an officer training program that serviced over two hundred thousand enlisted men in several specialties, including engineering, medicine and dentistry, psychology and foreign languages, at 227 colleges and universities. The majority of ASTP cadets were reassigned in the Spring of 1944, before completing the program, to meet manpower needs in other units, particularly in infantry, airborne and armored divisions destined for frontline combat.] Many of my non-technical friends who were students--as an engineer, I was deferred to finish and get my degree before I went into the service--but these political science majors and English majors, they would not be deferred. They would be drafted and put into the service. So, by volunteering, at least they would be sent back to school, tuition paid, in uniform, and, hopefully, to finish and many of my friends did that. So, they'd come back to school, whatever school they were in. They'd march between classes instead of walking and they'd live in a dormitory in a military manner and they'd have a chow hall for food, and so on, but at least they were in college still. Toward the end of the war, they saw, the Armed Forces saw, they're not going to need all those officers. So, why did they have all these students there? put them into the infantry. So, all of a sudden, one day, they're told, "Go to Fort Dix," or go here or there, "for basic training," and they'd get a quick basic training, because they didn't really need all the personnel, they thought. Then, all of a sudden, one day, they're on a ship on their way over to Europe. When they get to

Europe, the commanding officers there say, "Well, these are a bunch of college kids," because they're all in the same unit. They were not broken up and put into other units. They were kept in their original unit. "These college kids, they don't have the real training that the troops that we know have. So, we'll put them behind the lines in a safe place and they'll do support work, so that the guys in the front lines can concentrate on the fighting and these guys can get supplies," and do this and do that, and so on, but the Battle of the Bulge, the Germans broke through the front lines in the Ardennes Forest. The *Panzer* divisions just wiped these guys out. They didn't have training on how to fight against tanks. They weren't really trained and several of my friends were killed there. So, if I had been there a little earlier, I would have been in the service, I would have been, maybe, killed. Now, if I was a little later, born a little later, I might have been in Korea. As it was, the service gave me a great education. As a nineteen-year-old, I traveled halfway across the Earth to Hawaii, something I would never do normally. So, I'm very grateful for being born when I was. [Editor's Note: The Battle of the Bulge, also known as the Von Rundstedt Offensive or Ardennes Offensive, was the failed German attempt to break through the Allied lines in the Ardennes Forest in Luxembourg and Belgium launched on December 16, 1944, and which lasted into late January 1945.]

NM: Okay, we are going to conclude the interview for today. Thank you again, Mr. Goldfarb, for having us today.

SG: It was a pleasure.

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Reviewed by Jesse Braddell 8/11/2014

Reviewed by Shaun Illingworth 10/13/14

Reviewed by Prof. Sally Goldfarb 2/22/24