NASA HEADQUARTERS NACA ORAL HISTORY PROJECT
ORAL HISTORY TRANSCRIPT

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INTERVIEWED BY REBECCA WRIGHT
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WRIGHT: Today is April 30th, 2008. This oral history session is being conducted with Israel Taback in Newport News, Virginia for the NASA Headquarters History Office NACA [National Advisory Committee for Aeronautics] Oral History Project. Interviewer is Rebecca Wright, assisted by Sandra Johnson. We certainly thank you again for letting us come into your home and visit with you this morning about your career and your experiences. We'd like to start today with you telling us how you became part of NACA.

TABACK: I originally came here from New York City. I graduated from Cooper Union Art and Engineering School in New York, and I took an exam up there and came down to the old NACA because I was very much interested in airplanes at the time. In fact I worked for many years on airplanes, as you could tell by looking at my condensed resume. From 1942 all the way up to about 1957 when the Russians launched their Sputnik [satellite], it was primarily airplanes.

In 1957 I was in charge of the local instrumentation for the X-15 airplane, which was being designed at the time, and because we had to get space into the action somehow, it became the first spaceplane that NASA or the United States ever built. It did go out to the edge of space. It went up to about 100-some-odd thousand feet and flew at Mach 6. I have a model here, if you would like to look at it. Still looks like an airplane; it doesn't look like the modern airplanes that look like everything and the kitchen sink is on the outside of them.

Subsequent to that, JPL [Jet Propulsion Laboratory, Pasadena, California] got very busy doing a lot of work for NASA, and we were asked here at [NASA] Langley [Research Center, Hampton, Virginia] to pick up the Lunar Orbiter, and that was about in 1960 or thereabouts. 1963 to '67 according to this resume. I was Spacecraft Manager on Lunar Orbiter, and we put five spacecraft around the Moon, all of them successful. We photographed all the Apollo sites. We photographed the full Moon. In fact I went to Prague [formerly Czechoslovakia, now Czech Republic] with a map of the Moon sometime in the late 60s, and people were really excited about having all that detailed information about our next-door neighbor, and it was an interesting time. I enjoyed that enormously.

Subsequent to that, I think mostly because NASA didn't know what to do with us, we started investigating going to Mars. That was the start essentially of the Viking Program. For a short period we did purely studies here, and then when Viking started as a program, which was in the very late 60s or early 70s, I became the Spacecraft Manager and Deputy Program Manager for Viking. We landed on Mars in—it was supposed to have been July 3rd, 1976, but it turned out to be July 10th. We couldn't find a safe-looking landing spot. We probably couldn't anyhow, but it was better than the one we started with. We got two spacecraft down to the surface of Mars, and they lasted very well. I think one of them lasted as much as eight years. The other one a little less than that, about five or six I believe it was.

Everything we flew was successful. We determined that life did not exist easily on the surface, although our life experiments, of which there were three, were all positive returns in terms of the normally accepted means of looking at experiments. They were all positive. But the local scientists were smart enough to determine that the positive reactions were entirely due to surface reactivity and not life.

Since then of course now we have something like four or five different programs at Mars. Orbiters, Landers, things that trawl along the surface and so forth. They're really the only game in town in terms of laymen in any case. I believe that they're now of the opinion that we've found water up near the poles. Of course as the first people that went to Mars, we took a really long chance and we started with life experiments, instead of looking for water first, which we knew about. But we did look for life instead. There are descriptions of the experiments, experimenters and so forth in some of the literature I have here. You're welcome to borrow that and look at that at your leisure.

Subsequent to that I stayed with NASA till we landed on Mars, which was '76. We took off of course in '75. It was about a year-and-a-half mission to Mars, year-and-a-half-long-time trip to Mars. In '75 I quit NASA and went to work for a little company called Bionetics [Corporation] right outside the gate, and immediately went back to work with NASA at JPL and helped a little bit, very little, with the landings on Mars. Subsequent to that I've been concerned mostly with consulting with NASA primarily. For the last year or so I've been essentially entirely committed to doing nothing, doing it very hard.

WRIGHT: Does that take a lot of practice to do nothing?

TABACK: No, it's real easy.

WRIGHT: Is it easy?

TABACK: Actually I preferred working, because most of the people I worked with were interesting, pretty smart, and very exhilarating to work with the scientists and outstanding engineers that they put on the programs. I miss that.

WRIGHT: Let's go back and talk about those first days when you came from New York to Hampton.

TABACK: When I first started here at NACA, I started working in the field of aircraft instrumentation. I became head of the local instrument calibration lab right after I came, which was in 1942. I headed the instrument calibration lab. Then in '49 I became head of a flight instrument design group, which essentially started to design instruments rather than just calibrate them. Then 1959 to '63 I headed the navigation and communication sections in instrument research division. Then in '63 to '67 I became Spacecraft Manager for Lunar Orbiter.

WRIGHT: Mr. Taback, let me ask you, when you came here what kind of experience did you bring? Were you right out of college, or did you have experience in your field before you got to NACA?

TABACK: I had no experience in the field that I was interested in.

WRIGHT: When you mention you became head of those areas, how many people were working for you at that time?

TABACK: Well, in the calibration lab about 20 or 30. In the instrument design group, similar numbers, small group of people. Of course in the Lunar Orbiter Program, when I headed the spacecraft team, there was probably closer to about 100 people, including a lot of the lab that helped out, although they were not part of the project office.

WRIGHT: Was that a big change or risk for you to move from the aeronautics side over?

TABACK: It wasn't a strain. I enjoyed it. It was fascinating. Luckily we got a lot of good people. They were good engineers and very bright. The lab really had a problem with them, because they didn't know what to do with them when the program ended. That was true on Lunar Orbiter and also true on Viking, which ended so recently that people are still working out at the lab, but in a miscellany of jobs. In Viking I guess we had about 100 to 150 people in the office that were engaged in spacecraft design, communication, control, etc. I enjoyed that too. Real good people.

In fact I enjoyed putting the spacecraft together, although I was never interested in operations, which started after we landed on the surface of course. There we are almost like today. I spent a few years after leaving NASA with Bionetics Corporation as their Chief Engineer and worked on two programs. One was the NASA balloons which were flying out of Wallops Island [Virginia]. The other was with determining whether or not we could use composites on airplanes, because they had a bit of a problem in that they supported fire if an airplane crashed, and the composites were broken up then during the crash. There was the problem that the little fibers that made up the composites would then fly around and were liable to hurt the electronic instrumentation. So I spent a few years proving that that wasn't too bad a

problem. So that's now a pretty well confirmed method of building airplanes. In fact most airplanes nowadays consist largely of composites rather than metal.

Subsequent to that, I guess I did most of my work for NACA at Langley going through SAIC as a consultant. That work was concerned primarily with looking at proposed programs that went to the planets or circled Earth and was entirely a determination of whether the engineering was sound or so far advanced that they shouldn't be touching it. I enjoyed that very much.

WRIGHT: How did you determine that?

TABACK: Well, normally with lots of meetings, which involved SAIC people, Langley research people, engineers, consultants and so forth. We went over all the proposals in detail, the timing, the costs, technical capability and whether or not things could be done, and made a determination as to whether or not it was a practical program or not. Many times it was. Most of the proposers were pretty outstanding people, and the proposals were generally put in by people like JPL, Martin Marietta, General Dynamics, and others. So we had very good people, including some people, most people that are still in the business. I'm not, they are.

WRIGHT: How were things done differently during those last years when you were consulting compared to when you were first starting with NACA?

TABACK: I can give you one or two illustrations. When we flew Lunar Orbiter, we had no computers. The spacecraft was commanded by a sequencer. In other words, it went through a

prefixed program and did all the things it was supposed to. When we did Viking we had a computer on board, and we were very proud of the fact that it had 25,000 words. That's not kilobits. That's 1,000 words. We used essentially wire recording. All the words were strung out on wires that had been plated and were magnetic. That worked, and the computers operated nicely. But we had a hard time getting them. Of course the capacity was very small compared to what we can do today.

Today we fly kilobits of computers mostly on spacecraft, many kilobits, sometimes terabits in capacity of memory. So it made an enormous change in capacity of what you can attempt to do. The same is true in all the other fields like communication, control, structures, and so forth. Made enormous advances in almost every field. So one can get pretty obsolete in 30 years.

WRIGHT: What about the processes? Are the processes pretty much the same that were in place when you were at NACA?

TABACK: Manufacturing processes?

WRIGHT: No, evaluation for making decisions, decision-making processes, did they change a lot from when you were at NACA, because Langley had been so much an in-house research facility.

TABACK: Well, they are changing. When we did Viking, most of the actual work was accomplished by Martin Marietta in Denver, and we were in a supervisory role, and that had gotten even harder I think. NASA is primarily a contracting agency, with most of the work

being done by commercial firms with some intent of overseeing the work by the Langley engineers and technicians. To a large degree most of that work is now accomplished by contractors, including the work out in the field itself, with Langley being a supervisory group. So there's a lot more administrative work and a lot less technical competence than there used to be.

WRIGHT: Was that an adjustment for you?

TABACK: Well, I didn't mind it, because I could do either and they were both interesting. Although I enjoyed the technical challenge a lot more than most people, I think. But it did change, but I didn't mind it at all.

WRIGHT: It's interesting to me that you came from New York to Hampton to Langley to work on airplanes, and then within 20 years you began working on spacecraft, and then not too long after that you were working on spacecraft that was going to go to Mars.

TABACK: Actually things caught up with me, not the other way around. The airplane didn't become obsolete, but the research on airplanes became obsolete, especially when the Russians showed that they could put a Sputnik around Earth and everybody got real excited about what NASA could do.

WRIGHT: What were your thoughts on that, when you heard that Sputnik had launched?

TABACK: Well, we went through the standard program. We took a lot of courses locally, math and orbital mechanics and things like that. That was fairly interesting. I didn't use most of it, but it was interesting. In the process of doing that, of course, we lost all the competence we may have had at one time with aerodynamics and instrumentation and so forth. Probably not lost, it's probably up to par but not used as much.

WRIGHT: Did you ever go back and do any more research and work on the aeronautics side?

TABACK: No, actually I should have, but I didn't. Mostly a matter of opportunity. As I said, I worked somewhat on balloons with the Wallops people, and I went back to work for NASA on composites for a number of years and ran a large group under the Bionetics Corporation that looked into composites. Eventually began consulting with NASA on new programs. One thing just worked into another in just the passage of time. Airplanes became obsolete. I was lucky enough to have gotten into airplanes when we were just coming out of the subsonic range. We built all the D airplanes, the experimental airplanes. The last one I did, which was the X-15, finally got to be supersonic. In fact it went up to Mach 6, which was unusual at the time. Since then everybody flies supersonically.

WRIGHT: Did you get to see the X-15 fly?

TABACK: Yes, I've seen it fly. It flew mostly out of Wallops Air Force Base where NASA has an installation. I helped a little bit with the determination of the ground range, which had to be enlarged because of the X-15 range. That's installed and working now properly. Radars are

better. Communication is better. Communication with the pilot is better. Everything has gotten better just with the passage of time and because people are smarter I think, get better educations. We have better things to learn with, computers, and we learn how to do things a lot easier than we used to.

WRIGHT: I guess that is a difference. Some of the methods to come up with answers, took you a little bit longer.

TABACK: The methods are a little bit different. But the one thing that strikes me in all the consulting that I've done is how technically competent the people are, and yet they lack experience. The new people on the block can answer a lot of technical questions but haven't got enough sense to do the right things at the right time, which is interesting. Which you can only learn by having done some things yourself. There are very few, handful of people that have done a lot of things. Luckily I was lucky enough to get the right experiences, I think.

WRIGHT: Do you have a favorite project you worked on?

TABACK: I like Viking. I like Lunar Orbiter first because it was a first for Langley. It was the first space program that Langley did after airplanes. So we were pioneering in many instances in spacecraft, spacecraft design, orbital mechanics, how to use spacecraft, and mission design. When I did Viking then subsequently it was also interesting, but different.

WRIGHT: Can you share with us some of those discussions of how you were able to work through those designs? It fascinates me about what research is available. I was reading before I came here about the different theories of what, for instance, the lunar surface was going to be, because you really didn't know. So if you could share some of those experiences.

TABACK: That's true. It turns out we didn't really know after we went either. We weren't very smart in that respect. We were restricted pretty well to landing fairly close to the equator, plus or minus something like 20 degrees, various reasons, thermal, power, and so forth. We really didn't go prepared to find out much about the surface. We had a GCMS, that's a gas chromatograph [and mass spectrometer]. Three life instruments. All the instruments that we used during entry did mostly work with the atmosphere rather than surface.

So when we got to the surface, we measured the usual things. That is temperature, hardness, composition a little bit with the gas chromatograph. But it wasn't very thorough. We did not have a concentrated means of looking for water. In fact, it would have been a good way to have started the missions in Mars, looking for water, but I guess we weren't smart enough. So we just made a big bet and looked for life instead, and we lost the bet. So really we came away from Mars, we knew a little bit more about the surface, but not as much as we know today.

WRIGHT: Have you been following JPL's steps on Mars?

TABACK: Yes. JPL has been mostly active in going to Mars. Europeans are going to Mars, and JPL of course has got two Rovers on the surface now that apparently lived through the latest no-

power problems and are still operating, which is good. I'm amazed at what they've been able to accomplish. They did a lovely job on it.

WRIGHT: It's pretty amazing what you guys were able to put in place in the early 70s.

TABACK: Yeah, we really had a design that was guaranteed for 90 days. But it lived for eight years, which is a bad design, of course. We were very much afraid of the sandstorms on Mars, so we used RTGs, radioactive thermal generators, no solar panels. Most of the latest spacecraft that land on Mars use solar panels, and it turns out that dust isn't the big problem that we thought it was. But that's how you learn things, you go and try. So everything seems to be working okay, including the solar panels on the Orbiters and the Landers.

WRIGHT: How much did you learn from the Lunar Orbiter Project that you were able to apply when you got ready to do Viking?

TABACK: Well, first of all it was the first space program that Langley did, and we learned how a space program operates. It did help quite a bit. We got a lot of experience in running a major technical contract and overlooking all his work, and making sure that he went off in the right direction and didn't spend too much money on any one thing. So that experience was very worthwhile. That is largely where I think JPL and NASA institutions are headed in general in the future, which will be mostly oversight committees, technical competence to some degree. But most of that is going out into industry rather than to a government center like NASA.

WRIGHT: Well, what were your thoughts when you saw those pictures come back from Lunar Orbiter?

TABACK: Well, first of all we were delighted, of course. We had five successful missions out of five goes at the Moon. That was at that time extremely unusual. You might recall that most missions were failing at the time. So we were very proud of that. I was very interested. In fact I helped put together, and I got out here, you may or may not want to look at it, a Lunar Orbiter collection of photographs [Digital Lunar Orbiter Photographic Atlas of the Moon], which were made into an album and put together by a guy named [David E.] Bowker [and J. Kenrick Hughes], and the program manager, which was Cliff [Clifford H.] Nelson, very smart guy, and I wrote the introduction to the book, which is in there. You'll get a chance to read it.

WRIGHT: Yes, we'll take a look at that in a few minutes. Tell us about that moment. Were you all sitting around, and were you in Langley watching for the photos to come back?

TABACK: No, we were at JPL watching for the photos to come back. We had a spacecraft operations area at JPL. Most of the local Langley technical people, the program office went out for the lunar encounters. At that time we had no switch to switch them off, so they all landed on the back of the Moon. We got rid of them somehow. The Australians were very cute about that. After we thought we had put them all in on the back, they played a couple of tapes that indicated that they came out from behind the Moon. They had us fooled for a while. But it was obvious they were tapes after a little bit. It was exciting. We had some beautiful pictures, lots of

magnification. I enjoyed every bit of that, including the data return that we got back. We'll look at that in a little while.

WRIGHT: How did the data that you collected from the Lunar Orbiter Program impact the Apollo Program?

TABACK: I think that they used the landing site information. They claimed they didn't need it of course, but I believe we had the first valid surface pictures of the Moon, and I believe they used them to some extent to get intelligent landings on the surface. I believe they went to one of the sites that we examined beforehand. Subsequent to that, I don't know, they went various places. But they too were restricted to almost equatorial landings as we were. That was fairly interesting. But I think we got more of a return by going to the Moon and photographing the entire Moon than we did out of the Apollo site selection. In fact, from a scientific point of view, that return was a lot more interesting and probably will be used for another 100 years or so before anything new is found out.

WRIGHT: Might be used as part of the new program that NASA's doing right now.

TABACK: Absolutely. Although I think it's a mistake to go back. It's a waste of money.

WRIGHT: Where do you think they should go?

TABACK: Well, the Moon is okay, but this idea of making a research program, how to live on the surface, doesn't sound enticing enough to warrant a lot of money. That's about all we're going to do that's different, keeping people alive and making sure they have a place to live. Other than that, the scientific return has already been gotten from the Moon I think. So we'll have longer stays and we'll learn a lot more about how to keep people alive, but that's about it. We're going to learn that anyhow on the [International] Space Station, so I'm not too excited about it.

But I am excited about going back to Mars with people. That should be more interesting. I do like the rest of the NASA program, which is primarily scientific and going to the planets. One thing is really fascinating, and that's the latest thing, which I believe NASA is doing, which is looking for planets. I consulted on a couple of schemes for planetary surveys that were fascinating. One of them looks for the decrement in light as the planet goes on the front surface of things. The other one looks for planetary lensing, it looks for images of things that come past gravitational disturbances. That seems to work pretty well. What's interesting is that the ground-based telescopes have gotten almost as good. They now know how to take care of the atmosphere by shining a laser through it and then correcting for the atmospheric disturbances. So you'd think you were out in space.

WRIGHT: Have you had an opportunity to see through those telescopes yourself?

TABACK: I haven't looked through a telescope, but we have found about 200 planets. Mostly big ones about the size of Jupiter, but we're still continuing to look, and we're looking forward to finding something similar to Earth, or anyhow a planet that would support life. We haven't found any yet.

WRIGHT: We're back to where you started with Viking, looking for life on other planets, aren't we?

TABACK: I guess we will for a long time, won't we, yes. Do you suppose there's intelligent life on Earth?

WRIGHT: We need to look here first, huh.

TABACK: Yeah we're going to continue to look, right.

WRIGHT: When you were finished with the Lunar Orbiter Project, how soon afterward did you start on Viking?

TABACK: Viking didn't start till the early 70s, and Lunar Orbiter finished in '67, so we had about two or three years studying Mars before we actually hooked up with a contractor to get the job done.

WRIGHT: So you went right into that program.

TABACK: Yes, we did locally. We went from Lunar Orbiter into the Mars Viking Program, essentially. It wasn't called Viking at the time, it was just a study of Mars.

WRIGHT: Where did you get your information to study Mars? Was it published papers?

TABACK: Books, papers, technical treatises, students' theses that were graduating from college. Very hard to find information at the time.

WRIGHT: I would think so.

TABACK: Yes, except we knew that Mars was one of the few planets that could have supported life at one time or might have supported life at one time. That's probably still true. Everything else looks desolate, too hot, too cold, too barren, too something. So that's us and Mars.

WRIGHT: Was there any other NASA Centers other than Langley and JPL that were looking at the Mars adventure?

TABACK: Any other people looking at Mars? Yeah, all over Earth. People in universities, scientists. The Earth by and large was very conscious of Mars as being a good bet for having supported life at one time. For all I know about it, it's still a good bet.

WRIGHT: Still a good bet.

TABACK: Yeah, I hope.

WRIGHT: When you first started, like you said, you mentioned you came in with the instrument calibration lab.

TABACK: I was moved into the instrument design laboratory, partially because we were already in instruments. Then in the instrument research division I got moved into a navigation and communication section and took charge of that, mostly because the field was widening at the time, a lot of stuff going on.

WRIGHT: Had you planned to go so quickly into a leadership position when you arrived?

TABACK: Never. Catch as catch can. Better salaries.

WRIGHT: So that was just a good move for you then.

TABACK: Yes. In fact salaries were interesting, because I think when I came down here the yearly salary was something like $1,700 a year, and when I quit NASA it was closer to $70,000 a year, which is about what I'm making as a retiree out of Langley. So that's gotten an awful lot better. I remember when the salary went up to something like $2,600. That was enormous. It was fantastic. But that's all useless now. Money doesn't mean anything. Decimal points have shifted.

WRIGHT: Yes, they have. What kind of hours did you have? Did your hours that you spent at the Center change after the aeronautics shifted over?

TABACK: I never really counted hours. When we had things to do, we did them. When we finished, we quit. I had a nominal eight-hour day of course. No Saturdays, no Sundays, 40-hour week. But I used to take stuff home and read correspondence all the time. Reports, correspondence, contractor documents, and so forth. Drawings. In fact I used to come here on the couch and get rid of piles of correspondence at a time. All interesting, to me anyhow.

WRIGHT: I bet the drawings were very interesting as well.

TABACK: Yes they were. We had some of the best engineers working in the fields of communications and radar and control of aircraft, control of spacecraft. All very interesting. I didn't realize at the time how big a pioneering effort we had undertaken, because almost everything we did was new. That was true both on Lunar Orbiter and Viking. Lunar Orbiter was new to me. A little bit old hat for spacecraft. Now in Viking we actually had new computers and new communications and so forth, new instruments. So Viking was a fairly brand-new experiment.

In fact, I thought you might be interested, this is one of the original Martin models that was later changed. They moved a lot of things around and saved weight and made it smaller. But they were minor changes. It pretty well flew just like that, just the way they proposed, almost the way they proposed. I had a nice model which I gave to my son-in-law who's taking it up to Connecticut. He took it up and put it in an aquarium. Gave me a lot more publicity than I ever gave it.

WRIGHT: Pretty interesting.

TABACK: I was going to show you the X-15 model, which I still have I think someplace up here. It still looked like an airplane.

WRIGHT: Yes, it does.

TABACK: They don't anymore. They look like flying I don't know what. Look like something that cat drug in. See, this was still an airplane. It was streamlined. Tiny wings. But had to go up to something like 7,000 degrees, the thermal problem more than anything else. The aerodynamics were pretty well known, except that they knew or they thought that there was a large control reversal problem at the time when you went supersonic. That wasn't solved. Well, it turned out not to be true to begin with. Controls didn't reverse.

But now we fly at Mach 2 and 3. All the fighters out at Langley are supersonic airplanes. How about that? That's nice, that's a good surprise. But the X-15 was still a streamlined thing, no tires. They put an alpha-beta attack and yaw things right in the nose of it, in the hottest spot you could get, and that worked fine too. Do you remember that nut that piloted this thing at first? He got into the first flight. He had a broken rib. He didn't tell anybody. He had hurt himself somehow. He was a really strange guy. He's still around. He retired.

WRIGHT: You worked on the instrumentation for the X-15?

TABACK: Yes, it had a lot of new telemetry stuff, which I was not too familiar with. But I installed most of the flight instrumentation. Accelerometers, pressure devices, thermocouples, and things like that. I was in charge of a group that designed the instruments. We sent them out to Edwards Air Force Base [California] after they were built, and they did the installation and checkout. Although, that was done at North American [Aviation, Incorporated], not at Edwards, in Los Angeles [California]. They're still in business?

WRIGHT: Well, North American turned into Rockwell.

TABACK: Okay, they became Rockwell, didn't they.

WRIGHT: They're part of the business called United Space Alliance.

TABACK: Good group of people too. In fact, in the United States—maybe it's true all over the world—there's a lot of smart people around that do all kinds of things. Amazingly smart.

WRIGHT: They have pilots that are crazy and get into airplanes, right, test pilots.

TABACK: Yes, I'm going to go back to airplanes someday. Next life.

WRIGHT: I think that's a good idea. You can redesign them where they'll look like airplanes, won't they.

TABACK: What I don't like is what they're doing nowadays with things like airplanes that they claim are reentry vehicles. What they're doing is they go up to high altitudes and they come back in. But they're not thermal. They don't take the reentry velocities that you need when you go to orbital speeds. But they're going to sell to passengers at about $20,000 a kick or more. $1,000,000 a flight. Tell them that they've been in a reentry. Well, they'll have been in a reentry, but it's a low speed. Not too exciting.

WRIGHT: So you're not planning on buying a ticket then, huh.

TABACK: I don't even expect to be here.

WRIGHT: Well, you never know.

TABACK: No, I'm not going to buy a ticket. I would buy a ticket, if I could go as fast as the X-15 went or the Apollo during reentry. I think I could get interested. But at the speeds they're talking about, it doesn't sound at all exciting. In fact they'll be in an aircraft and they'll experience zero-G [gravity] I think for a short period of time. But other than that, yuck. Yuck.

I'm going to have to clean house one of these days.

WRIGHT: On a rainy day.

TABACK: I'm amazed. Mary Ellen died. She was three years older than I was. She was 90 and she died in November, end of November. I'm amazed at all the work there is to do around the

house, between cooking and cleaning and vacuuming and all kinds of things. I don't know. She taught school for—let's see. She quit school when I quit. So she quit in '75. She started teaching about '50. So she taught for 25 years, and she kept house too. Amazing.

WRIGHT: It is. Did you meet her after you got to Hampton? After you arrived for NACA?

TABACK: Well, I got married down here, yeah. She was an NACA employee, and she was working on strain gauges at the time. You know what a strain gauge is? It's a metal grid, and you put them on structures and you read the resistance of the grid, and from that you determine how much strain the structure is under. They've got a lot of problems. They're temperature-sensitive and all kinds of sensitive to other things. But she worked on those for a number of years. She was doing research on strain gauges at Langley when we met. I was in her car rider combination of course going to Langley. There are no public transportation schemes down here. You got in a car with other people or you stayed home.

WRIGHT: Sounds like you had a good system that worked well.

TABACK: It worked fine, yes, if you had friends it worked fine. That wasn't too bad.

WRIGHT: Did you work with other women during NACA?

TABACK: Yes, there were a number of women, but very few and far between. At the time we had what they called computers at NASA, and they really did computing. They had datasheets

that were full of wind tunnel data and aerodynamic data, and they actually took all the numbers and converted them to coefficients and things like that. They were called computers until we built some real computers. Then they had to retire or go look for other things to do. So the only women really working at Langley—there was one woman engineer, a woman named Joyner, Betty Joyner. The rest were generally computers, and there weren't too many of them.

They used Fridens and hand calculators, things like that. They became obsolete. They were replaced slowly. We had relay computers. If you walked by where these were located, you could hear the relays clacking. Extremely slow. Very small memories. They were eventually replaced with electronic computers, which is what we have today. They were interesting times. You never realize how interesting they are because you're going through them and there's a lot of new things happening. You're very lucky to be at the forefront of the happenings, but you never realize it.

WRIGHT: Did people adapt well to the new technology as it came through?

TABACK: Yes, I think so. In fact, I'm amazed at the way the kids nowadays have adapted, the computers, enormous memories, the Internet. They seem to be born with a sixth sense as to how to use this new equipment. A lot of it has me stumped. I don't understand it at all.

WRIGHT: Just takes you a little bit longer I think, because there's so much and it changes so quickly. I think that's part.

TABACK: It changes awfully fast. That's one reason I enjoyed consulting with NASA, because you could stay abreast of what was going on a little bit, and you were still familiar with the new people. That helped a lot.

WRIGHT: What seems to be a prevailing lesson or a prevailing method all these years that you've been able to apply no matter what project you were working with?

TABACK: The only thing that I remember using on every project was to be conservative about everything. Believe everything, but don't believe anything. It never hurt to be conservative. Langley was a conservative Center. So it was no problem at all to be conservative in the amount of data you were collecting, in the method of getting to the planet. So although we were pioneering in many fields, conservatism was still a good idea. Still is.

WRIGHT: How important was testing?

TABACK: Well, we did an awful lot of testing. Everything we built was tested many times before we flew it.

WRIGHT: Were you part of testing procedures and watched the tests?

TABACK: Not especially so. In fact I was in a part of a design group, and so testing was a little bit not our field. Although the calibration lab did a lot of testing on instruments. The aero people did a lot of testing. In fact they built a lot of new facilities at Langley, landing facilities

and wind tunnels and things like that. But testing has always been a Langley fetish, and I hope still is down at Houston [Texas] too, at least used to be. I haven't been there in years.

WRIGHT: Did you do a lot of traveling?

TABACK: Oh, you did a lot of traveling on Viking. In fact I visited all the subcontractors, all the instruments and the life support stuff. The gas chromatograph. They were all built in different sections of the country. So it was life aboard an airplane a lot of times, most of the time. A lot of motel living. If you don't learn how to live in motels, you don't live.

WRIGHT: Communication was a little different then too. People didn't have cell phones and email.

TABACK: We didn't have cell phones, we had telephones. Cell phones didn't come in till I quit. Everybody's got one now, though. Everybody walks around with one ear at a telephone. I don't even know what they're talking about, but they're talking.

WRIGHT: Maybe they don't either.

TABACK: Maybe they don't care.

WRIGHT: They're just talking.

TABACK: Yes, they're talking and listening.

WRIGHT: It must have been an interesting time to travel for each of those contractors for each of the pieces and the aspects of that project and then coming back to Langley with that information.

TABACK: Well, I was pretty lucky I think in having a job that oversaw all the areas of the spacecraft. We didn't go to one manufacturer and get into communications or other restricted field and stay with that. That was luck.

WRIGHT: It does sound good. I'm going to let you put your X-15 model back.

TABACK: I got it cleaned. I got two years' worth of cleaning on it. I didn't realize how dirty it is up there. I'll put it back. It's still flying. We built two of them, and two of them are still in existence. Never lost any. That was all Langley-forseen, built by North American, except for the instruments. We did the instruments.

WRIGHT: Did you want to get another?

TABACK: Oh, I wanted to show you—let's see, that might be the Lunar Orbiter book. *The Moon as Viewed by [Lunar Orbiter]*. This is the second one. This has a lot more than just pictures. This describes the photo system and so forth. These are typical pictures. All the pictures were made on 35-millimeter film. Then those strips were put together. So each of these 35-millimeter

pieces is what you see about an inch across. Then a whole lot of 35-millimeter stuff became one photograph.

WRIGHT: Oh, that's interesting. Because this is about an 8½-by-11 photo.

TABACK: Yes, but each of these were about an inch to begin, 35 millimeters, about an inch, little over an inch.

WRIGHT: I guess that they labeled them this way by going, the numbers coming through to label the lines of the 35-millimeter film. Is that what they did?

TABACK: Search me. Looks about right, doesn't it? Yes, that must be right.

WRIGHT: They have a scale. Yes, one that goes across the top with letters, and one that goes across the side with numbers.

TABACK: So you could find anything by letter and number. I've got a picture like that on the wall. I thought that was magnificent. That's on the west side of the Moon.

WRIGHT: It says it's the bull's-eye at the center.

TABACK: Bull's-eye, right. The other one, this is the one that was put together. This was an official publication. Let me get the other one, which is the one I'm more familiar with.

Photographic Atlas of the Moon, Bowker and Hughes, that's the one I'm familiar with. I think that's the one, yes. Clifford Nelson and me.

WRIGHT: That looks like you.

TABACK: I wanted to show you a picture of me about 40 years ago, but you won't believe it. You see this is a little more organized somehow. Smaller, isn't it? Okay, let me show you a good picture. I think I'm the last one on the book. These were taken by the son of the guy that did the GCMS. How about that for removing 40 years?

WRIGHT: Look at you, [referring to a photo of Taback] look at that, they saved you a place right there in the corner.

TABACK: Yes, I made it.

WRIGHT: They saved the best for the last right there.

TABACK: This is an interesting book. You can't get it in any library. He made a few copies.

WRIGHT: Called *The Vikings of '76* [Hans-Peter Biemann].

TABACK: That's the guy's son. [Klaus] Biemann was the scientist. That's Jim [James S.] Martin. He was the program manager, bright guy, he's dead.

WRIGHT: How'd that work together in one room, engineers, scientists, managers, accountants? How did you all come to agreement?

TABACK: Somehow it seemed to work. I don't know why. Well, they were pretty bright people in general. I don't remember any particular problems.

WRIGHT: It's good you can converse and make decisions.

TABACK: Yeah, it worked. Well, there's a girl. You asked about how many women. She was at either JPL or Martin. She wasn't Langley. Let's see who else is interesting. He was the head of NASA at the time. Oh man, those were good old days. You remember Sagan, Carl Sagan? That's him over there.

WRIGHT: Very young Carl Sagan.

TABACK: The other scientists didn't like him for some reason, he was too popular. I don't know whether they were jealous or what. But he was too popular. Okay, the other stuff I brought down, there's some good descriptions of the Viking Lander if you need any of that.

WRIGHT: Let me take a look at it.

TABACK: This one is pretty good. I don't know whose property it is, it's mine now. Maurice Parker. This is good because it's got all the scientists and the instruments, and I think it's got a description of the mission to Mars and how we landed and what the instruments looked like and what the spacecraft looked like. It's got a fantastic amount of information. You'll never use it, but if you want a reference, that'll give you some idea of what it looked like.

WRIGHT: Did you publish a lot of papers during your time with NACA and NASA?

TABACK: No, a number, but not very many, half a dozen maybe. They're on the net [Internet] if you look for my name. They have a bunch of links of various papers and things like that. I didn't know that till my daughter told me I was on the net someplace. Yes, this isn't bad, because this is a good description of everything that was done. So you could borrow that. This one isn't bad either. I think this is a description of the thing when it was first built.

WRIGHT: About the Viking Lander itself.

TABACK: It's got more stuff than you can absorb.

WRIGHT: You'd have to explain most of it to me.

TABACK: No way. I don't remember. I don't remember. Yes, that's pretty good. So if you want a technical background to the Landers, JPL did the Orbiters and we did the Landers, and they really carried us to the planet and got into orbit at the planet, and then we left the Orbiter at the

time and we were responsible for the entry and the landing. But they took us there. They did a good job too. In fact, I like JPL. Very competent bunch of people. Okay, shall I see what else we got?

WRIGHT: Sure. You have more?

TABACK: All right. I'll make a pile here. Then you can take whatever you want out of that. Now you say you've got this one, right?

WRIGHT: I do have *The Engineer-in-Charge* [by James R. Hansen].

TABACK: You remember NOVA? NOVA has a little bit, more or less. It's got a pretty good description. But also has the context of a lot of other things happening at the same time. This is a repeat of the broadcast. That's the Lander.

WRIGHT: It was interesting, because you had worked on the Lunar Orbiter Project, and when that was over you started working on the Mars, but yet the rest of the country was looking to go to the Moon. So were you keeping up with what was going on during the Apollo?

TABACK: Well, we landed on the Moon in '69. An old friend of mine landed on the Moon, [Neil A.] Armstrong, he's a good guy, he was a bright guy. Yes, you're right. I think the rest of the country was lunar-oriented rather than Mars-oriented. But I thought Mars fascinating. Mars was a good science thing.

WRIGHT: So did you work much with Neil Armstrong when he was a pilot?

TABACK: Not a lot. I knew him but I didn't know him very well. He's a very down-to-earth, extremely serious-minded guy. I think he's taken his mission to the Moon very seriously. He's not going to do anything that's going to destroy his reputation.

WRIGHT: From things I've read, he takes his life as an engineer and a pilot very seriously too.

TABACK: Yes. Okay, so if you want to borrow that. Let's see what else I got. I don't know. Let me go see. Okay. You can always say no.

WRIGHT: I like looking at it.

TABACK: I don't know what else I got here. My files are obsolete.

WRIGHT: Are these old Langley newsletters? Is that what they are?

TABACK: Yes. In one of them there was a write-up of me.

WRIGHT: Did the Center grow a lot after you got here?

TABACK: Well, I came here in '42, and it became NASA in '57 or '58 after the Russian Sputnik. So that was 12, 13 years.

WRIGHT: Did you see a big increase in employees then?

TABACK: No, not really. There was a big increase in the local attention given to space in the way of local programs, math and science and things like that, because everybody got excited about how good the Soviets were, which turns out to be not all that interesting. Let's see. That's interesting. That's Jim Martin. [Referring to photo of himself and Jim Martin.] We're eating again. Son of a gun.

WRIGHT: It's good to know you ate while you were there.

TABACK: Did you know [Edgar M.] Cortright?

WRIGHT: Yes, I know the name.

TABACK: He just moved up to Maine.

WRIGHT: Was he Director here for a while? [1968-1975]

TABACK: Yes. He came out of [NASA] Headquarters [Washington, D.C.].

[Referring to another photo] Everybody's got a tie, must be a workday.

WRIGHT: Must be. Are you in that picture?

TABACK: Yes.

WRIGHT: It looks like you're getting an award.

TABACK: It is an award. Yes, this is Cliff Nelson. So it's probably an award for the Lunar Orbiter. Yes, I think it is.

WRIGHT: This must be your team. Does look like the Lunar Orbiter award. Spacecraft and Operations Team.

TABACK: This was sent to me by a guy named Price who was in the Public Affairs Office at Langley. I think it's a staff photo so it's got a number on it. Don't know what it is.

WRIGHT: From 1968. It must have been when you were finished.

TABACK: Probably Lunar Orbiter. I looked at these and there's too many words. These are write-ups for raises and changes in status and things like that.

WRIGHT: Did you go through a lot of reorganizations and changes there?

TABACK: No, we were lucky. Very little. Actually Nelson was head of one of the other sections in the Instrument Research Division, and when he got to be appointed manager on Lunar Orbiter he came and got me, for reasons I don't understand. But he did that. So it was a quick change from one job to another. Same boss.

WRIGHT: That's good. Especially if you liked working for him. Sounds like you did.

TABACK: Yes, he was a good guy. Okay, let's see what else we got. Oh, this is just more descriptions of the Lander.

WRIGHT: What was the most difficult part about designing the Lander?

TABACK: Nobody knew anything about the entry, that was all supposition, nobody knew much about the surface, nobody knew how soft it was or how hard it was, or whether you'd bounce or disappear in a cloud of dust. The entry was interesting, because we had to come in from orbit at very high speed and take care of the heat pulse. It's worse than reentry on Earth. You're going faster. Well, that had to be dispensed with with an aeroshell, and we did. In fact we had a lifting aeroshell, which was unusual at the time. So we came in at Mars and lifted the thing as though it were a flying airplane. But actually the doing was relatively simple compared to the immense amount of ignorance before we got there. So it was a lot of good guessing and things like that, good guessing.

Let's see what else we got here. *Mars: The Viking Discoveries* [by Bevan M. French]. Oh, these are the reunions. It's hard to believe it's been close to 40 years.

WRIGHT: It has been 40.

TABACK: That's it, that's all the gifts I've got.

WRIGHT: All right. You've got lots of goodies.

TABACK: Okay. What would you like to take with you?

WRIGHT: I think when we stop for a second I might go back in and get some of the names of the books and things. Let me take a break and we'll do that.

[pause]

TABACK: So I didn't have much to do with the high-speed research at the time, although we were doing what they called cleanup work, cutting the drag and getting more stability and things like that. It was an interesting time.

WRIGHT: You mentioned you had a son-in-law in Connecticut.

TABACK: Yes, I had one daughter and one son. The daughter is married. My son is not. He lives over in Virginia Beach [Virginia]. Smart boy. All by himself. But my daughter is married, and she's got a daughter, so I do have one grandchild.

WRIGHT: Are they in the engineering field like you?

TABACK: No, but she's doing things I can't even pronounce. She used to work for Howard Hughes Medical Center in Oregon, and she's working on what happens in people's brains, how you think and what chemicals are involved and things like that. Don't ask me what, but fascinating. But anyhow she was here up to about a week ago, and she took my van, and she's going to Florida, and then she's going to travel west, going to look for another job. She was going to Baltimore for her PhD and she didn't like it, too tough. Town was too tough.

WRIGHT: Where were you in New York? You said you started in New York. Were you in New York City when you started?

TABACK: Yes, I was born in the lower part of Manhattan, and when I moved down here I was from the Bronx, about 179th Street. My folks lived up there for a long time.

WRIGHT: So it's quite a difference for you to move from a city to—

TABACK: Oh boy, what a difference.

WRIGHT: —an old southern town as you referred to it.

TABACK: I never liked New York, but this wasn't too bad.

WRIGHT: It was quiet here, wasn't it?

TABACK: It's quiet. A lot more outdoors. I never could get used to the segregation though. Pretty violent.

WRIGHT: Your wife was a native of Hampton?

TABACK: No, she's a native of Washington, DC.

WRIGHT: Okay, then she moved here. Both of you came from cities, remarkable cities, to a small town. Did she come to work at NACA?

TABACK: Yes, she came to work for NACA, right. Her dad was a superintendent of platemaking at the Government Printing Office in Washington, DC. Nice guy too. Unfortunately he retired and decided to call it a day. Isn't that terrible? Could have been smart like me and lived.

WRIGHT: Have all the time that you have right now. So it'll be interesting.

TABACK: Would have been better. He was an interesting guy.

WRIGHT: What does your son do in Virginia Beach other than live by himself?

TABACK: He lives by himself in a condominium.

WRIGHT: He didn't go into the engineering or science field?

TABACK: Yes, he went to the University of Virginia and became a city planner over at the city called Chesapeake, part of Norfolk I think now. He did that for about 15 or 20 years, decided he had enough, and he just quit, just plain quit, just stopped.

WRIGHT: That's interesting.

TABACK: Yes, I'm amazed. He's been able to live off the money he earned from the time he quit, which was a long time ago. Still making out all right.

WRIGHT: You mentioned earlier that you really missed talking with people and engineering part. So are there other parts of working at NACA or NASA that you look back on and remember fondly?

TABACK: I enjoyed all the time I spent with NACA, mostly because NACA was largely a research center then. Didn't hire people. They were bright guys at the laboratory, and many of them. I thought that was a fascinating period of time. Very serious people, very smart, very good researchers. They disappeared.

WRIGHT: What was the reaction like with your coworkers when NACA was going to be absorbed.

TABACK: Not really very much. The people that worked in wind tunnels just continued in wind tunnels. In fact other than the fact that we did Lunar Orbiter and Viking, the lab didn't change much at all. It just went into high-speed airplanes more and more. Oh, and it did a little work on landing, spacesuits, composites. But by and large it just continued to do what it was doing before. Of course, all of space started here, including the Manned Spacecraft Center [Houston, Texas], which all the guys lived here, worked here, then they moved down to Houston when [Lyndon B.] Johnson decided he needed an industry down there.

WRIGHT: That's true. Now did you have any desire to become part of the STG [Space Task Group]?

TABACK: No. No, I was doing pretty interesting work. I didn't want to move.

WRIGHT: Climate is better here.

TABACK: I don't know. There's much to be said for either of them. It can get hot down there. I've been down there when it was warm.

WRIGHT: We have two seasons in summer, it's hot and hotter.

TABACK: Hot and wetter.

WRIGHT: And wetter sometimes. So yes, sounds like you made a good decision.

TABACK: It's a pretty lab though.

WRIGHT: Yes, it's very nice how it's laid out.

TABACK: I didn't mind visiting. I visited them quite a bit when we were doing Viking and quite a bit when we were doing the composites job too. They also did a lot of work on spacesuits that I fiddled around with a little bit from time to time.

WRIGHT: That was interesting.

TABACK: Yes, that's interesting.

WRIGHT: Was there much difference in working with the different Centers when you had to go there?

TABACK: Were the people different? No. No, pretty much the same all over. I was always struck by how good the people were in terms of intelligence and reaction to things, technically and otherwise. I miss that. I miss the interactions.

WRIGHT: They're always busy doing something. That's true.

TABACK: Always something going on, right.

WRIGHT: Well, are there other thoughts that you can think of that you want to share with us this morning?

TABACK: No, I just wish you a lot of luck. Have a good time. Enjoy it.

WRIGHT: All right. Well, I guess we'll stop for now. All right, sir.

[End of interview]