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PAUL A. LACHANCE
INTERVIEWED BY JENNIFER ROSS-NAZZAL
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ROSS-NAZZAL: Today is May 4th, 2006. This telephone oral history with Dr. Paul Lachance is being conducted for the Johnson Space Center Oral History Project in Houston, Texas, and in New Brunswick, New Jersey. Jennifer Ross-Nazzal is the interviewer, and she is assisted by Sandra Johnson.

Thanks again for joining us this afternoon. I wanted to begin by asking you how you found out about the opportunity to work at the Manned Spacecraft Center [MSC].

LACHANCE: I was pursued. What happened was that I was an ROTC [Reserve Officers' Training Corps] graduate, and I got a category C delay in order to [pursue the] Ph.D. I did that in Canada. I had a choice of a couple of different places I could [be assigned]. I had to go into active duty. One was the [United States Air Force] School of Aerospace Medicine in San Antonio [Texas], and the other was Wright Field in Dayton, Ohio. I was able to [obtain assignment to] Wright Field. It was closer to where my wife and I and the children were from, which is Vermont. So we could drive and see them once in a while. So that's the beginning of that.

Then in my duties at the Aerospace Medical Research Laboratory at Wright-Patterson Air Force Base, I became very involved with the fact that NASA had no one to help them develop what they needed [for new sustenance], and the military laboratory at that time was still a viable [program]. In other words, the military were devising a space program of their own, plus the

NASA one, which had been touted as being open and free of secrecy, and the purposes it might be used for for those reasons.

So our laboratory, or the laboratory I was in, provided all the preflight and postflight—well, not so much postflight, because it wasn't an issue—but the preflight feeding of the Mercury astronauts. I got involved in tube feeding for U-2 pilots at the tail end of it. So we were making product, and we were actually even interested in far-out things. We were growing algae and tilapia and all kinds of things, just spanning the immediate feeding, if you will, for military rations, this kind of [need], to going all the way to a Mars mission, which we still talk about today.

As a result of that, I became the representative from the Air Force, from Wright Field, to the National Academy Space Science Board, which was looking at criteria and all the different issues that were involved in spaceflight, not only human but other experiments they might do and whatever. In fact, we had one of those meetings [at the University of] Iowa, and we had, I remember, [James A.] Van Allen of the Van Allen belt hosting a party at his house on July Fourth. So those were the caliber of people that were brought together.

But I found NASA had no representative whatsoever, and there was a Colonel [Rufus R. Hessberg] on loan from the Air Force, an M.D., as Director of Research for Crew Systems Division of NASA-Houston, of the Manned Spacecraft Center. I made a wiseass remark about, you know, "What's the matter with you guys? Don't you have anybody that can do anything down there?"

He just said to me, "Take your foot out of your mouth, Lachance, and come to Houston and do the job," because he knew that I knew more about it than anybody else did, or I was acquainted with it; that I kept answering the questions or trying to answer the questions that were state of the art.

So I did a trade-off. I was due out of the Air Force, and I had lined up a couple of different job opportunities. So I added this one to the list. My wife and I do trade-off and look at the pros and cons. We'd never lived south of the Mason-Dixon Line, so we had all kinds of apprehension. We chose [NASA-Houston] because I saw it as an opportunity to lead something that would be unique, making many contributions both in the field of nutrition as well as in food science, [in] which I had very little training in. I was trained as a nutritionist, primarily.

So when I went to Houston, there was no Spacecraft Center. The land had been bought and all that at Clear Lake, but the main building was just beginning to take foundation. So we, [the scientists], were scattered all the way into twelve or thirteen different rental properties in the city of Houston, the southern part of Houston, mostly. So we commuted back and forth to our temporary locations to make the program continue to operate.

The big pressure then—Mercury was pretty much over—was Gemini and how it would operate. The Apollo [Program] was beginning. It had its own program office; they both did. In fact, NASA operated these completely separate from each other. The Gemini Program Office operated completely independently from the Apollo Program Office. So that led to redundancies and other issues which I had to end up dealing with, because the spacesuits were different and things like that.

When I got to Houston, I was given a desk and a telephone. There were no windows in the room. This is how crowded we were. Within a matter of months they started Building 4, and we were allowed a little laboratory space to be built into that and office space and this sort of thing. We moved a couple more times in a matter of three years. I mean, the buildings kept coming up, mushrooming all over the place. It was a very exciting time to be in Houston.

So what I inherited then was the fact that the Gemini Program had a food system that someone, some engineer, was trying to put together, and the Apollo Program Office had contracted, subcontracted, through the—North American Aviation was the main contractor. They had subcontracted to a consulting company, [Stanford Research Institute], in California to develop or work on the food systems.

So my first role was to take and evaluate the two systems and figure out which one we would retain or whether we would merge them or what we would do. The most important question I asked was, "Has anyone eaten this, and what was the result?" When they told me that they'd had problems with people eating the Apollo food system prototypes that they were using, some sickness—could have been the flu, but could have been food problems; we weren't sure—I just said, "That's enough. I'm going to go with the Gemini system." For one extra man—going from a two-man to a three-man system—it makes a lot of sense to just not have two separate systems, and capitalize on one and improve it as much as we can.

Well, that left me in a need for a technical support for all the different types of foods, different types of packaging, different types of safety standards. In the Air Force I had learned that I could transfer money between government agencies very readily, and so I was able to transfer monies to Natick Laboratory. The U.S. Army Natick Laboratory in Natick, Massachusetts, had just moved there from Chicago [Illinois], where they had been for years and years, [known as] the Quartermaster Food and Container Institute, which provided for military feeding during World War II and before that.

But they had quite a contingency of talent, [for example] people specializing in packaging and in vegetables and fruit and ionizing radiation as a means of preservation. You name it, they had the capability. So I just said, "Here is a couple hundred thousand dollars. When I ask you a question, you're going to help me solve it." And that's what they did. They wrote the specs [specifications], at my request, that we used. They developed products and prototypes.

So that was the beginning of a coherent program of food development, and I started learning my food technology that way, having to become familiar with different processes that were used for different foods and choosing different choices that we had and putting together something that we could fly in Gemini.

Then complicating [all this as] a nutritionist, I was also in charge of the experiments for bone density changes with zero gravity (microgravity) and also the changes that would occur in muscle mass. There were some ongoing experiments that had already been started, bed rest studies, by NASA-Houston, [however].

I had already started one when I was in the Air Force, a bed rest study that was done at Lankenau Hospital in Philadelphia [Pennsylvania], where we had put some Mennonite student volunteers to bed for six weeks in complete bed rest, and then studied the effect of exercise by putting a bicycle ergometer at the foot of the bed upside down so they could move their butt down to the end of the bed for twice a day and pump the bicycle with 600 kpm of work for thirty minutes twice a day. [Exercise] didn't do a thing, [but standing one hour per day did], which was our discovery, but we almost lost one of the subjects in the tilt table test because of how much debilitation took place in six weeks. So, all subsequent studies were done in three weeks, because we could see the change [we were looking for].

Meanwhile NASA had its studies, and so I inherited those, particularly the bone studies, which were coming out of Texas Woman's University [Denton, Texas], pre- and postflight. They were done by X-ray. So you can see I became in need of knowing how much calcium was in the diet, how much protein was in the diet, and other nutrients; how we would measure the excreta. I found that Crew Systems had not done much about that. How did an astronaut go to the bathroom and all of the physiological things that are involved.

So I had some buddies that I had, First Lieutenant associates of mine that I'd left behind at Wright Field that were still there at that time. I knew we had a chamber at Wright Field. I made a deal with them to set up a contractor to work with them to put men in the chamber in spacesuits that I would get from NASA, some volunteer airmen, to live in the suits [two weeks] to see what would happen, because no one had looked at the impact of fourteen days in a spacesuit on skin. No one had looked at moral hygiene. No one had looked at other problems, you know, the actual physiological phenomena that are involved in the bathroom.

So I had my hands full, but I needed—it was helpful, I had one associate with a master's degree in food science, food technology, actually, so he did a lot of the running around. Bob [Robert A.] Nanz was his name. He was not strong scientifically, but he was a very smooth person who could get anything out of anybody. He was good with the secretaries and other people. He was a charming guy, very helpful, because he got things done for me when I needed.

For example, I needed blocks of wood the size of the food we were going to be putting into the Gemini lockers—there were two of them on each side, on the back side of the spacecraft, or aligned with the back of the astronauts—so that we could see how these different shaped foods would fit in and how we'd pack them.

In fact, when we ended up flying Gemini, the packaging of food had its own blueprints with the [meal] sequence they were in, the fact that [each] astronaut would have [colored] Velcro tabs on them. Then in Apollo I went with red, white, and blue for the three different astronauts. They could identify which foods they had selected or had agreed to eat, which was another area I got into, sensory testing to find out the food preferences of astronauts. Some did not want to eat any fish, for example, so we'd have to change the menu to accommodate them with chicken or beef.

Then we had all of the technology problems of the foods themselves, each one separate from each other. So the easiest ones were the powders, [for example] the puddings and things that were pretty easy [to formulate]. You could really take them off the shelf, and then just find a way to add the water and shake them up and make a pudding and then squeeze it out. Of course, at that time, and what the issues were in Mercury—Mercury, we didn't really need food to eat. We needed to test the concept [of swallowing]; it was very important. The medical literature was really half and half, even though the Russians had beat us to the draw. They had the theory that we would aspirate some foods, because it floats around in your mouth as well as anywhere else. So that was the first testing that we did with food in Mercury was to see if they could swallow it, whether they had any problems with it. Of course, they weren't there long enough to worry about whether they would be able to excrete it. But that solved that problem, so we knew we could do—as long as we had either bite-sized foods or dehydrated foods of one type or another, that we could squeeze these [packaged] foods to get them into the mouth directly. So we got into a number of developments that were important in themselves.

Then, of course, the question came up about safety and the fact that most companies—as a matter of fact, all [food] companies—even today, there are many that don't even meet [GMP]

"Good Manufacturing Practices" but are beginning to, are being forced to, just in this time period, which is quite a few years since. So we were buying top-quality stuff for about a hundred ingredients or foods. We had forty-eight that we used to make our menus with—forty-eight to fifty-two—but about forty-eight, where we could [assure] a variety and different meals and this sort of thing.

As [we] bought ingredients, we checked the microbiological, which was the key or the most important issue in terms of safety, would be whether they would get sick. I mean, [could] there be a [food poisoning] problem? We found that some categories, such as spices, were heavily contaminated [microbiologically], and we had to find a way to make sure that we processed them before they would be used so that they would have no pathogens. They were loaded with pathogens. In fact [would preserving assure safety]?

Then, of course, you have the problem [indicators] that are known. Salmonella is associated with chicken and eggs, milk products, so we needed to screen that. Staphylococcus usually comes from contamination, usually a human contamination of one type or another. We didn't have salads, but somebody mixing something who has a pustule on their finger or something. That was a complete no-no. But we had to make sure all of this would be covered.

So I went back to Natick again and said to Natick, "Well, what can we measure that we can [use] as biomarkers, that are true pathogens and yet we can use them as biomarkers, and also maintain the one that's usually used by the industry?" which is just the total coliform count like they do for a swimming pool. We have to test like that in order to know that the coliforms were very low. We allowed a level of coliforms, but no staph or pathogen was allowed in a product, so that if product ended up being made, and tested as an end item [and found] to be positive for staph or salmonella or vibrio, they were out. The whole batch had to be [discarded] and we had to start over.

But that brought up the whole issue of the sequence of things you do and how you get contamination and the idea of critical control points. We started implementing something like that on our own for Project Gemini, but when we dealt with the Apollo Program Office, they had a regulation which was part of the package of the Program Office, on reliability. In fact, that document probably could be found. It's a reliability document, and it was part of the boilerplate—I guess you understand that—of all contracts that were let, and this goes back to July 1963. It was "Reliability Program Provisions for Safe Systems Contractors." In it, it covers all kinds of dimensions, some of which are much too much for a food system. They talk about criticality and other ways of measuring. They don't use the words "critical control points" exactly, but they do make you blueprint your whole process, how you make the spaghetti bar, or how you make the chicken or the small shrimp that we had, or the pudding, or how we started with the standards that were used to purchase the products, the standards that were used to receive the products, the standards that were used to process the products.

In fact, the story that tells how that worked and how critical it became was the Swift Company, which was a very important food company in meats in Chicago for many, many years. I don't know who it was bought by, Armour, I think. I mean, you could trace that kind of history; it can be traced very easily. But they were still in the stockyards, and the stockyards were filthy.

So they created a ["clean"] room with polyethylene, where they manufactured all the meat products, and then had a positive-pressure—or a negative-pressure situation such that we would be free—essentially, pretty sure that—well, we would run the tests, actually. But that's what made it possible to take their foods, because before we did that, the meats would end up being contaminated with a little bit, and we weren't allowing any.

We have to realize that this was the first time in the history of the American—or of the food industry in the world, in fact—but for the United States, that zero pathogens in foods [was required]. They were required in life islands, for example, and sterilized foods were being experimented with by the medical community, but they cooked the hell out of it, and it wasn't too damn palatable stuff. And, of course, they could use regular dishes and pass-throughs and very fancy equipment to do that.

So there was a precedent in the medical community, in a way. We didn't draw it from there. We just drew it from what we knew about the organisms that would be of interest to us and that we needed to pay attention to. And that's how that were chosen, and even the amount of food that would be tested. In other words, you can look for one cell of staphylococcus in a tenth of a gram or half a gram or five grams, and because it becomes more and more possible that you're going to find it if you get a bigger sample. So, all of these things had to be worked out.

The Army, the U.S. Army, had already dabbled in this field, and they, as a matter of fact, had developed a document, which I don't know the name of, but they had a document for a procedure for trying to minimize military feeding contamination. So the microbiologists who, at the time—the senior microbiologists at Natick—wrote out a spec that we used. We reviewed it and looked it over, and all of us, the technical people, we got together—there was no one else at NASA to look at it, but all the outside people and government people—to see if that would do the job. Even though we've said from the beginning, and you can say it today, there's not 100 percent assurance, but we've never had a problem.

The other reason that drove the, as I tell the story of, the need to have foods that would not get astronauts sick, is I did not want a telephone call at two o'clock in the morning from Chuck [Charles A.] Berry, who was the Chief Medical Officer of NASA, telling me that his astronaut or astronauts were sick and had stomach problems and were having a hard time holding things down. So I've always said that I was concerned about that to the point where I was CYAS. Do you know what that means?

ROSS-NAZZAL: Yes.

LACHANCE: Okay. So I said, "We're going to do this for scientific reasons, and we're going to do this because we just don't want this kind of turmoil, nor do we want astronauts getting sick, period." Of course, I had a working relationship with all of them, one way or another, either as experiments that were being conducted or food selection or their opinion about things.

So we were concerned, and we got involved with all the other aspects of Crew Systems Division which related to food. You know, how do you wipe your mouth? How do you get rid of the storage containers? How do you disinfect them? Then you get into picking them up, you know, taking them out of the spacecraft at the carrier level and reserving those for analysis.

It's a long story, but as these blueprints basically come together, you find you get the critical control point that you need. I mean, HACCP [Hazard Analysis and Critical Control Point] is a systematic way of advancing safety. It involves identification, evaluation, and control of the hazard, and we thought we [accomplished] that. It has evolved a lot since then.

So that's the general story, the overriding story, I guess. I just did not continue—I had collected a number of things I was going to write as kind of a story, but I didn't, because I was very busy doing international work and one thing and another after I came to Rutgers [University, New Brunswick, New Jersey].

What motivated me to do that, you may ask the question, is that the Apollo fire is what threw me off. I had everything ready for Apollo. I had worked on Skylab. In fact, I have photographs of some of the initial foods for Skylab. Those did not change very dramatically from what I had started with and set up. But I did have the in-flight experiments, which I had written all the protocols for, the bone loss experiments, the muscle loss experiments. So I predicted it would be about five years before we'd ever get a chance to fly those, that the engineering feat itself would take precedence.

Then, of course, after the first landing on the Moon, Americans are fickle. When we did it, you don't have to watch the rest of them, and as you know, they didn't even have TV coverage for some of the flights, like 13, until they were in trouble, and everybody worried about whether they were going to live or die. So it plays a role, though, in terms of how we do things. That's it, I think.

ROSS-NAZZAL: Let me go back and ask you some questions. How far along was the Gemini food system when you arrived at MSC? You said you had to choose between the Gemini food system and the Apollo system.

LACHANCE: That's a good question. What NASA had done is they had made an arrangement with Natick Lab to provide food and to do the work, but they had no idea of the systems requirements. They had no NASA angle. They had nothing to do with that. So it was very primitive. My chief, who had started that at the time, was a lung physiologist, so he really didn't know much about it.

So I made a decision immediately that one did not ask a government agency to put out a product. It's not our capability. Maybe somebody can contradict my views about that, but my experience, both in the Air Force and in NASA, was that you don't try to make them an end item producer. They set the specs. They monitor it. They pay the budgets and the whole bit, but don't—so that was a second reason, in addition to the sickness that had occurred with the Apollo system. And the fact that I had experience with Natick Lab, because I became a USAF [United States Air Force] Coordinator of the Quartermaster Food and Container Institute before it moved to Natick, so I knew some of the people, and it made some sense that we would gel our talents.

The Navy had its own system here in Bayonne, New Jersey, but at the time Secretary [Robert S.] McNamara took care of that. He consolidated a lot of things, not only belt buckles, but food laboratories. So I was in an Air Force laboratory, basically, fooling around making food and looking at things. Each service had their own facilities and their own people and their own different-sized laboratories, and that was all standardized by [designating] the U.S. Army Natick Laboratory [for all branches of the military]. So that's how that came about. They were really the first con[tractor]—well, I had used the word *contractor*, I guess, for Gemini foods, but they had just made the prototypes. There was no meal system. There was no packaging done. It was just the beginning. No specs had been written.

ROSS-NAZZAL: Who were some of the key people working on the food system at the Natick Laboratories?

LACHANCE: Well, I had two people that I worked through. The chief of the lab, Herbert [A.] Hollender, is dead, but Herbert Hollender was a food technologist, very competent man, and he was the Director. He knew his people, and he knew who would do what when. And he had an associate who, last time I knew, was still alive, a few years ago, Mary [V.] Klicka. Mary was, she really was my right hand. Herb would come to the meetings and one thing and another when we met. We met at all kinds of places, scientific meetings and NASA-Houston and other meetings, and I would to go Natick, and it was a lot of traveling around. Then when we finally decided on the Gemini feeding contractors, we met in Benton Harbor, Michigan, and places like that.

So they were the two people who [we] would draw on whatever the issue was. If it was vegetables, they'd go to a certain [Natick Lab] food technologist. If it was packaging, they went to a different food technologist. Then they would prepare samples, and then we'd meet, and I'd make a decision. Or I'd say, "Well, let's try this, or let's—you know, try it."

They, [Natick], could do [sensory] panel work, too. They had a sensory panel that could do not only sensory of food, they could even check out a package [design too]. I mean, you know, they would do it blinded and otherwise in control, so you have a pretty good assurance of what's going on, although the packaging part came to grips when the contractor, the integrator for Gemini foods, was hired.

That was the Whirlpool Corporation in Benton Harbor, Michigan. The man in charge was a microbiologist, scientist, by the name of Norm [Norman G.] Roth. He had a few associates. He was called the integrator because he didn't produce any food to speak of, although he did take over the puddings eventually and the easy things, just adding so much Tang® to a packet or something like that. We didn't need a separate contractor for that.

We had two other contractors, subcontractors. One was Pillsbury. Pillsbury did all the baked goods, all the bite-sized brownies and the bacon bars and all these kinds of things. There weren't that many, but I have a list somewhere—probably in my chapter—[if you want to] look at it. All of these kinds of foods. So they were given specs and guidelines and criteria by me through the integrator, although we had worked directly many times. I met at Pillsbury for meetings several times in Minneapolis [Minnesota].

Pillsbury had a—the Director of Research, which was Howard [E.] Bauman, was a microbiologist by training, Ph.D., and so he really knew his microbiology. So he was an ideal person, in some ways, to develop a laboratory where microbiology had to be paid attention to. But he had to do that initially for Gemini, and so he really had a feeling for how to do it for Apollo, because he inherited [the contract for] all of Apollo food systems.

Not initially; the initial contract was won by Melpar, as the integrator, and they were in Maryland somewhere; anyway, near the green belt. But they got so involved in the paperwork that they were not doing very much technically, and the other [subcontractor] company, which was Swift, which we mentioned that made all the meat products.

So [for Gemini] all that was brought together in Benton Harbor, and then the packaging, either the initial packaging or the additional packaging that was needed, was done there, and some tests were done, again, on eating in zero gravity; not using an airplane, but standing on your head and swallowing. We just tried all kinds of things.

We also did that in Wright Field with the zero parabola, the parabola of flight. It was so many seconds of weightlessness. You've seen photos of that, I'm sure. NASA used to use that facility out at Wright Field quite a bit. They used to fly from one corner, the southwest corner, of Ohio to the northwest, and make about three different—as it went down [in altitude], it would take off on another parabola. [For] a few more [minutes], then it would be weightless. So you could try different things.

One of the most difficult experiments we had to do for that was trying to see what would happen with defecation. Timing that was—you can imagine. You've got so many seconds, and you're asking somebody to hang on till they had to—to test the devices that we had proposed to handle that waste. So that shows you the extent. I worried about things from the beginning to the end.

ROSS-NAZZAL: Literally. I think it would be a good idea if you did a comparison for us of the Mercury foods and the Gemini food system that was eventually put into place.

LACHANCE: Well, the Mercury foods were things that we got out of Natick or that we put together at Wright Field. Usually we had Natick finish them off.

We had made cube-sized foods. We called them sugar cubes—well, they weren't sugar; they were cereal cubes. What we did is they chopped up corn flakes and put in freeze-dried strawberries, for example, and then compress it with tremendous pressure, and you can make a cube that sticks together, stays together, and gives you about fifty calories, and it has a nice strawberry taste; that kind of thing. Then we could always put a shellac on them, a food-grade shellac to hold the things from sticking to your fingers and [issues] like that.

There weren't too many items. I'd have to look it up. There are probably a half dozen things. The U-2 foods were used. The ones I had used for the U-2 pilots, because they stayed in their spacesuits at a very high altitude, because, as you know, they went from Turkey to the North Sea. So they would go up to 80[000], 90,000 feet and then turn off the engine and glide.

Of course, they had their suit on all the time. If they would depressurize or anything, they were very dependent on—they had to have some way to eat. We first started with junior baby food in a toothpaste tube, and that's what we basically used. We got some empty toothpaste tubes of different sizes.

Water was not a big issue. You could put water in a tube, and you could squeeze it in. We developed a gun for Gemini and Apollo, where you could drink from it or you could rehydrate your food from it by using the gun. The gun was calibrated so we could tell how much water you had taken if you recorded the information.

The Gemini foods allowed for a two-week varied diet, forty-eight, forty-nine—you know, we had a couple of spare items, things we never flew, like freeze-dried ice cream, which people felt that—we never flew that. Then, you know, adjusted to the preferences of the astronaut, adjusted for an estimate of a couple of thousand calories a day. No one had any idea what caloric needs were, whether they'd be up or down.

The theory was they would be down, because you're weightless, and you don't exert much, and you're sitting all the time. I mean, you don't have any room for exercise to speak of. In the Gemini capsules—I'm sure you've looked at them there at the Center. They're very constraining in space. So foods had to be convenient.

We assembled them by meal, and white and black were the tabs, the Velcro tabs put on the containers. The inside of the spacecraft had a lot of hooks to hook Velcro, so you could paste things to the ceiling or to the sides, wherever there was and hang onto them. They didn't really do that. They used to let things float all the time. They got in very bad habits of letting things float. They would come home, and then they'd be shaving, and they'd let the razor go, and it would drop to the floor and bang, crash, because they forgot they weren't weightless anymore. Stories.

So we provided an entrée, basically chicken or beef. I think that's in the chapter that I sent to you. If it isn't, we can always come up with it, I suppose. And there was a vegetable, but these were minimized, because we wanted a low-residue diet. There would be only one or two foods that were high residue, green beans or peas or things like that, because they didn't want to go to the bathroom while they were up there.

They were put on a low-residue diet before takeoff for four days, preflight feeding. Then they had the in-flight food, so they would go about four diets before they really had to—if the mission was that long, like in many. Gemini IV, there were just there four days. All those durations are in the chapter, too, and I'm sure you have access to all of that. So that decided certain parameters.

Then we had bite-sized foods, and we had puddings. In the container containers, we had the entrée, which came invariably spaghetti or the shrimp or the beef or the chicken for the entrée. Then there'd be a side dish of one type or another, a vegetable, only one serving. Then there would be puddings of one type, which were pretty loaded with calories, vanilla, you know, different flavors, whatever they liked. Well, we only carried two or three, but they were the most popular ones.

We had quite a few bite-sized foods. The bite-sized foods were liked a lot. They were very compact. There were six to a package, fifty calories apiece, so you got three hundred calories right away. But we had these coatings, edible coatings, on there, and those melted at above room temperature, which was one of the problems we had and solved for.

[Walter M.] Schirra, he wanted to fly with all bite-sized food, and I said, "No, I don't believe you should do that, but I'll tell you what I'll do. A couple of you get together and decide you're going to—we'll provide you with all bite-sized foods, and you survive on that for a few days and see what you think." And they all gave it up, because it was coating the throat; some of the coating would stay in the throat, and they got tired of biting these hard chips and getting—you know, they just decided on their own. It was their decision, then, not to do that again, and it was never brought up again.

ROSS-NAZZAL: Let me ask you a couple more clarifying questions. You mentioned that the requirement that you had for the Gemini food system was the first to be imposed on the food industry, and you said that—

LACHANCE: For pathogens.

ROSS-NAZZAL: For pathogens, I'm sorry. And you said that the date on that was July of '63?

LACHANCE: The date on the Apollo document is '63. The date on the Gemini specs was '63. So they do coincide. July of '63.

ROSS-NAZZAL: Could you tell me how this—

LACHANCE: No, wait. I take that back. The critical control point of the reliability document was July '63. The NASA documents on foods, the one I wrote for Gemini, which was used for

Apollo, was 1964, 14th of August. It was the one that carried—there were several of them with different dates. I don't know how they archived it, if they archived it at all, but the code on it was CSD, meaning Crew Systems Division, dash G, meaning Gemini, dash 079 was the major food descriptions. There were several documents, ten of them, I think, dealing with different aspects of the whole delivery system. Those were used with Gemini, and then they were used as the foundation document for the Apollo contract, the Request for Proposal, the RFP.

ROSS-NAZZAL: I wonder if you could tell me how this quality control program differed from those that were used by industry prior to this time.

LACHANCE: Well, there was a substantial—I mean, it was a breakthrough, in the sense that actual pathogens were being measured and not tolerated. I mean, they never even bothered to measure them unless they got into a problem. In other words, somebody gets sick in a beef joint in the West Coast, and all of a sudden somebody's trying to figure out, "Is any of it left that we can analyze it for and find out what it was?" That whole reverse etiological approach has been used over and over and over again, the food poisoning issue.

It doesn't mean that the industry doesn't care, but a couple of examples, here in New Jersey in the fall season some of the men operating—not for NASA, but just operating a retort, a still retort, for the canning of vichyssoise, or cold potato soup, whatever term you want to describe it by, shut off the retorts a few minutes early in order to go out and get enough light to do deer hunting during the season. Well, that product was sold, and several people came down with *Clostridium botulinum*. I think a couple died. Anyway, it was the end of the company.

But here was a situation where the pathogen was not killed. All the data that was needed to know how much—I mean, the actual timing and the temperature and the pressure that's used, is a known entity, followed by all the canning industry. In fact, we at Rutgers, one of our former professors [C. Olin Ball] was very much involved in the establishment of that, before computers, a handbook that was used by the canning industry to prevent [spoilage and viable pathogens (but not measured)]. So that's an example number one.

Example number two is the juice, the Odwalla situation, where again you have a situation where there's some contamination that remains in it, because it wasn't checked for, nor did anybody—and juices are not—you give them a hot treatment, and then you [sell] them cold. You may even cold fill them, but usually you hot fill them. You have to reach a certain temperature, and then you close it. Well, they almost went out of business. They survived, but that was the extent of the technology, and that was the routine that was used. It was dated by quite a bit.

So NASA comes along and says, "Thou shalt." NASA-Natick, because it involved the input of Natick, that "Thou shalt measure these in a certain quantity," and you ask for it from the beginning. I mean, from the specs that you asked for purchase, which are checked at the incoming docks, set aside and then checked before they're allowed to go any further into the laboratory, into the manufacturing facility.

So this was like a major step. I mean, today other organisms might be mentioned or used, depending on who you're talking to. I mean, the whole system has evolved. I mean, we learned by doing, by Pillsbury doing and Swift doing the actual foods, by trial and error. Then we documented the stages we were going through, and then we identified the critical steps that would make the difference between something being safe or not safe. In other words, the temperature, the pressure, whatever that criteria was, whatever that critical control point was.

ROSS-NAZZAL: I wonder if you could walk us through a food item that you'd like to choose, that you recall, and sort of walk us through what some of the critical control points would be for one of those food items, and how you determined what those critical control points would be.

LACHANCE: Well, it's difficult to pick something. Maybe a meat would be it, because of the staph sometimes if you don't keep—well, the chicken would have salmonella possibilities, which it could contaminate. That's a case where the situation would be important, because you can't buy a chicken that's not contaminated or egg—not the interior of the egg, but the outside of the egg—that does not have—it'd be rare to not find salmonella in the tissue or on the tissue.

So your spec would say that you want a minimal amount of that or that you want it—in this case, we would be going through a shredding process, a cooking process, a pressure-canning process, the actual—then these items were freeze-dried when they were done, so you add another step. The processing step included cooking it so that it's ready to eat. Then you check your end item. It's a critical control point to see whether all the pathogens are gone, whether you meet the microbiological steps, whether you meet the other hazard steps, which would be the shape, you know; not hazard, but you would check other things at the same time. If the bar has broken, you're not going to use it. I mean, everything has to fit just right to meet the needs of the end item.

So you start out with chicken that you know—it invariably has salmonella. You process it like you ordinarily would in a supermarket; take the skin off, this kind of thing, debone it. You have all these different steps that you would have involved. The pieces had to be very small to freeze-dry. You couldn't have chunks bigger than—oh, even smaller than the tip of your little finger. That would be the size, the best you could do rheologically and still get it through the mouthpiece and still have palatability. So you would cook it. Once it's cooked, obviously it's sterile at that time.

But then how you move it from the cooker to the former to the freeze-dryer, and from the freeze-dryer, you check it again, make sure the end item is—so just the person handling it makes a difference. A person could have—well, as they do in hospitals, your hands are the worst contaminants of patients and instruments that we have. So we're playing with that even in a hospital system. So how these were handled, put into these plastic containers, the actual food container—each individual food container—which had to be clean and had to be checked, its surfaces, also. Generally speaking, the way plastic is made—when we had different laminates, there's a whole packaging thing. It's a whole story in itself in terms of checks.

At any rate, once you've done that, you pull a vacuum on it, on the container, so that it won't expand once it gets into zero gravity, and you have to spot check that once in a while. But anyway, one of the biggest problems we had was putting a chicken stew, for example, or whatever you want to call it, into a pouch, is that it's put in there hot, and the pouch has to be sealed. You do that by heat, but if there's any food that got onto the seam, it will either let go then or it will let go later. You don't want that. It's one of the biggest areas where we had to redo them. You could save the food inside. You could put it back through the system.

One of the things we had an awful hard time solving was how to load that without—we had about a 10 to 15 percent reject rate right there, because once it, [a closure seam], was contaminated, it could go bad in itself, or it could be contaminated from the outside in. It's like a dented can. It would be a no-no. So all of these things become critical control points.

Then after that, you have a batch, and so you do a representative sampling after an accelerated shelf-life test, which, again, is not done by the industry very often. They do take samples. I mean, they're moving at a different rate than we were. I had two to three people and the backup crew to feed. [When] they feed [you and I], the [processing] line is a thousand a minute. So it's a different kind of ballgame, and yet it's doable. It's been shown to be doable. So if you determine your points, and there's seven steps that have to be involved, and once you've done that—and these steps actually evolved out of the Pillsbury and Natick experience, and with NASA and Natick watching, or the Pillsbury and Swift experience, for Gemini.

That was our testing ground. I mean, we really figured out a lot of things. In fact, only recently did we devise a way of filling half-steam-table trays for the military—for the Department of Defense here at Rutgers. We do that work here at Rutgers. We're the only academic unit that does work like that for the military—to have a decrease in the failure rate at the seams. So it's been a problem for years. It was a big problem for the space program. So it would be a major, major critical control point in terms of how it's done. It would become a major, major critical control point at the end, when you do end item testing of a batch to make sure that it has zero pathogens and a minimal amount of *E.* [*Escherichia*] *coli*. That was tolerated, but very low level.

ROSS-NAZZAL: Were you referring to this concept at this point as "critical control points," or were you referring to it as another concept?

LACHANCE: Critical control points, you know, that's a tough question. Pillsbury probably was the first to put the acronyms together. We had a hazard thing, and we had a requirement, you know, a plan document, reliability document, and we imposed that. So the CCP really came from NASA. NASA created that terminology. It's not in the document I have.

But I'm very adamant about the fact that everything, every component of the Apollo spacecraft, required reliability that we did not have on Gemini, as sophisticated. And critical control points, I remember seeing drawings, blueprints everywhere, and these being identified as to a point where you would have to [do a] check of one type or another, the size, the dimension, the weight, whatever, something. So the critical control points [related to] every part of the spacecraft. No matter what it was, [it] had these drawings, which identified what they called critical control points.

I don't know. There should be a way. I don't know if searching your system at the archives—it's probably not that well tabulated, [whether] you could find it or not, because I'm convinced the CCP came from there.

What happened with Pillsbury is that they saw this. They saw the use of the CCP and the hazard analysis [requirement] we had imposed before, and Howard Bauman just gave a paper at a microbiology meeting where he called it "HACCP," and the HACCP stuck. Then it took of from there. But everything was in place, just the acronym was not. We didn't start with the acronym. We ended up with the acronym.

I remember a Vice President of Pillsbury telling me that the whole [HACCP] program had advanced the company five years, [and] had given them a five-year advantage over other suppliers in food systems, [and] in their regular baking [products and] in their regular cookie blends, and everything else they make, doughs and everything else, which I thought was a tremendous compliment to the system, because once they had worked it out—see, they did it in individual rooms at first and brought things together kind of like the integrator did, or Swift did when they did their meat work. But—I lost my train of thought.

ROSS-NAZZAL: We were talking about the critical control points, and you were talking about Pillsbury.

LACHANCE: Yes. Once they solved it, they applied it to the rest of their food lines. That was what the VP was telling me about, which saved them a lot of money and gave them an advantage, because they knew what to check right away. They could [apply it to] their own product lines. I've never heard that repeated anywhere else nor written anywhere, but I can swear on a stack of bibles that that's [true].

ROSS-NAZZAL: Tell me a little bit about the hazard analysis portion of this discussion. We've talked a bit about the critical control points, but can you talk about the other aspect?

LACHANCE: Well, there are three different kinds of hazards, microbiological, chemical, and physical. You could have a physical hazard, let's say, for example, that some piece of food crystallized and became hard physically. You can do that with Tang®. You can make a candy out of it if you heat it enough. If you didn't know it was there, and you crunched on it, and you broke a tooth, and you're an astronaut, you know, you don't have a dentist with you. So it's a physical hazard.

But more importantly, if it's on the surface of the block [of food], on the corners, the edges, or whatever, [the crystal can] perforate the package. And though it might hold initially, initially it would not probably be—well, it would hold the vacuum, but with the rubbing or with it being packaged together with an overwrap into the meal component—these were not all singular; [each meal] was organized by astronaut [preference]. They pulled out their overwrap, and then they had food [servings] in the inside. They could pick and choose what they wanted to do. For example, they never returned Tang®. It was always empty. It was the only liquid they had to drink, other than water.

Now, in Apollo and later on, they were allowed tea and coffee, but they weren't allowed in Gemini. That was not my decision. That was the Chief Medical Officer's decision. They didn't want them, [astronauts], to be taking any stimulants of any sort, whatever that meant. I guess for the sleep testing we were doing, that made sense, and the depth [and] the amount of sleep they were getting. The depth of the sleep was a part of it, the EEG [Electroencephalogram] experiment that was done on astronauts, who hated to see [some of] these [medical experiments] come.

But anyway, that would be a physical thing, so you can see that. So you have a physical thing from the inside that you get once you chew it, or ingest it, or it destroys the integrity of the package system. Because remember, these are not cans. They're flexible cans, I call them, but they're not cans.

Then the chemical area is not as difficult, and that is we know how much nutrients. We had all of these analyzed for their nutrient content [and] for other residues. So the reject would be at the beginning. For example, if there were pesticide residues or something that we felt was not ideal, the batch—the whole order would be rejected. Or with microbiological contamination [or] contamination of spices; a lot of spices are irradiated.

The public doesn't know that, but that's the way they kill the pathogens, because they're really—spices, if you think about where they're picked and by whom, you already know how dirty they are and how much of an issue it can be. So that was a concern, but it was a microbiological concern more than anything else. The chemical concern was probably the least of the concerns, other than the fact that we wanted to know the [nutrient intake] so that we could plan out—we could see what they ate and therefore how much nutrition they'd [consumed].

ROSS-NAZZAL: What sort of challenges, if any, do you think you faced while you were working on designing the hazard analysis and then coupling it with the critical control points?

LACHANCE: Challenges. Well, there was a lot of give and take, I mean, of testing. We were dealing small amounts of [components], and we had a chance to look at [variables]. But, of course, the ultimate challenge was to have a food delivery system that would be eaten and that would satisfy and would be healthy and would not compromise the astronaut at all. So the challenges were trying to make sure that it all would work.

For example, something we did not discuss at all, but once the blueprints were made of how the food container in the spacecraft was going to be packed, that was down at Kennedy [Space Center, Florida]—or [Cape] Canaveral, in those days. So it was already fixed, but somebody had to go and load them.

Well, we actually would fit these together in a foam shaped box, a box that was actually shaped to the shape of the Gemini "box," so that each item would fall into place exactly where it belonged. Then these were all taped together. They not only had nylon tape connecting one meal with another so they could pull them out, because you [would not] be able to pull them out of this container without [a lanyard]. Well, you just wouldn't have the room in the Gemini [cabin] to turn around and fish the box.

Then there was a recorder put in [the shipping box]. One of my challenges was—which is real—was that none of this food should see any substantial temperature change, so the foam box was an insulated box. As it shipped from Benton Harbor to the Cape by air, [an internal temperature] recorder was kept, and the instructions to the receiving officer, which was a separate NASA, independent person, would open that. There was going to be a refrigerator it was all going to be put into, but would open that case and check the clock to see that the temperature had not been exceeded.

If the temperature had been exceeded, for example, if it had gone to a hundred degrees, the whole thing would be rejected. Anything that would accelerate microbial growth. So we tried to keep it pretty much within normal temperature, seventy to eighty [degrees Fahrenheit], something like that. I can't remember. There's a document that probably tells this. … I know it could not exceed body temperature, which would be about a hundred, ninety-eight-point-six, whatever.

Then that was returned to us. The box would be returned to us; not to us, but to Benton Harbor, to the integrator, for the next flight. So you go [Gemini] IV, V, VI, VII, VIII, you know. [Gemini] VII was a fourteen-day flight, so it took a lot of ingenuity to get everything packed.

So these were all separate challenges. I mean, you've got to realize that for me the challenge was integrating not only food, but the food going in with the food coming out, the experiments that were being conducted at the same time. They weren't done on all flights, but there were different component parts that did make a difference. I mean, I collected sweat off [Gemini VII] astronauts.

ROSS-NAZZAL: How did you do that?

LACHANCE: Well, that was on the carrier, after they got the suit off from them. They had a long john, and the long john was one that we had prepared, had especially prepared free of any minerals, any residues. Then we had a basin they would stand in, and then we had an allocated amount of water to get as much out of their hair and their face, and then we just had a sponge, and we worked the body all the way down, taking the [long john] suit off with everybody there.

ROSS-NAZZAL: Oh, my gosh.

LACHANCE: Asking questions about how this went. Nobody was worried about anything. But I remember [Frank] Borman saying, “It’s wonderful. I hope you got more of that [water] somewhere.” He was anxious to get into a shower. Because we obviously couldn’t get everything off from them. We got as much as we could, and then, of course, the suit and the water and all that was shipped off to Cornell [University, Ithaca, New York]; they were the contractor at the time for doing the analyses. As a matter of fact, the co-investigator, he was an M.D.-Ph.D., Leo Lutwak, well known in the field of calcium metabolism. They did all of the analyses, checked that out.

I’m trying to show the challenges [of] putting all these pieces of a puzzle together and making them work. I think part of it was being the one person—I mean, there was a team already for each part, but like I had a team on the carrier. I had an X-ray person [George P. Vose], one of these co-investigators, because they wouldn't let the PI [Principle Investigator, Dr. Pauline Berry Mack] on because she was a woman. That was against the Navy rules in those days. She could visit [the carrier], you know. We went to Boston [Massachusetts] to visit the ship. But she could not go with the trip. Anyway, that's neither here nor there. It's just some of these incidences.

So it's kind of a wheel and a spoke. You know, I'm the hub, and all these pieces come together and then make possible the whole thing—our share of the job done so that we could claim some things. We did get bone loss. We did get muscle loss. Still problems today. No longer cited—the original papers are not cited any more. Everybody cites the most recent paper. But that's the penalty of science.

ROSS-NAZZAL: Let me ask you a question. You said something that I thought was interesting. You mentioned that the Pillsbury and Swift experience was expanded upon and that steps evolved out of their experience. I was wondering if you could tell me more about that.

LACHANCE: Well, their experience, the biggest was not so much making the food. I mean, some of them, they even made some experimental foods for me for the LEM, the Lunar Excursion Module, that was really a takeoff from the U-2 900-calorie diet in a tube, that kind of thing. So there was independent little investigations going on around us, anticipating what we would do or how we would meet a problem, with alternate prototypes. That's getting away from your question. What was your question again?

ROSS-NAZZAL: Well, you had mentioned that the experience from Swift and Pillsbury, and you had learned from those experiences.

LACHANCE: Well, I mean, we discovered other things. That was, I guess, what I just left with you. We discovered other feeding approaches we needed to consider in the future, so that was ongoing in terms of Lunar Excursion Module feeding, even a feeding on the Moon if you wanted to, although that did not happen that I know of.

The challenges otherwise were learning, were how to spec the food in the first place, the ingredients that you were going to put together. I mean, you know, you could spec a beef stew, for example, and use a certain spice, and that one spice could ruin the whole thing if it wasn't sterile or close to it, or free of the two pathogens, biomarkers we were using, which were pretty strong pathogens.

So the sanitation that had to be maintained of the equipment, the sanitation that had to be maintained of the processing room, the processing that took place, especially the packaging stuff as we went from a freeze-dried bar that was free of pathogen into a food container, into a individual, self-serve container.

We had to deal with the weight of the container, too. We didn't talk about that at all. But it was an issue, because if your waste gets putrefied, and you have that going off in your spacecraft, it probably wouldn't overwhelm the air control system, but it might have caused problems. So we came up with a sulfur-based disinfectant used in the milk industry that would be torn off [from] the outside of the [individual] package and then put into the package [after] they were finished with it—to take care of the residue. Then they would roll it up and [discard] it [into the former food cabinet].

But I never found, when I was unloading a spacecraft, I never found any of these exploding or—in other words, the disinfectant worked. It worked very well. But we needed to know how much was left in the container. We would very meticulously keep track of every gram, every few grams. A teaspoon is five grams, so that gives you an idea.

ROSS-NAZZAL: Let's talk about the Apollo food system. When did you begin working on that food system?

LACHANCE: I was working on both at the same time, as I [indicated], earlier in our conversation. The Gemini was going to fly and had its schedules and the dates were set. Apollo was pretty well set, but North American was the prime contractor, and they had everything. They had chosen a different contractor for the spacesuit, a different contractor for food, and so they were moving. So there had to be some compromises made or some—well, compromises, that's not the right word—some unification, some debate, some standardization, and I'll give you one.

The Gemini and the Apollo spacesuits are different. The Apollo spacesuit is heavier; it's made for walking on the Moon, for more radiation protection than the Gemini suit is, although Gemini did have several extravehicular operations, EVAs.

I'm having a moment. I'm thinking of [Edward H.] White [II]. I feel for those guys. He died in the Apollo fire.

At any rate—

ROSS-NAZZAL: Would you like to take a moment?

LACHANCE: No, I'll be all right. At any rate, I had to get the Gemini suit people and the Apollo suit people to talk to each other. We had already, in Gemini, had talked about a [water] gun. It looks like a gun. It has a handle, and it has a port for a certain size to be put in either the faceplate or the area in the throat, just underneath the faceplate in the metal that's there, and that it would be tight. We don't want a leak, either. It's got to be very, very close engineering. So they would aim towards the mouth, and you could drink. You would turn your head to the right, and you could, if the thing was all the way in, then you would depress the bar on the outside and take a drink.

Other ideas which we toyed with [for] Apollo, later in Apollo, little packets on the inside of the helmet that could be taken, and different things were tried. But the gun was an important thing, because it was going to be used—we had to have something in common that would be used for the [biomedical] experiments, that we could count the amount of water being consumed by putting a meter on it, on the gun. So it took me six months to get all the drawings and everybody in agreement that that gun would fly on Apollo as well as on Gemini.

Their [Apollo] food containers were different. They were going to go definitely for fourteen days several times, or several days. I mean a max fourteen days, which we only tested once with Gemini VII.

So—I'm having these spots here. It took a while to get things coordinated, but the food boxes were a different shape and different—you know, it's a different spacecraft. They were against the wall, but there were five of them. So those had to be much more elaborate. A blueprint had to be made for each one of the cabinets. Of course, the cabinet doors were not heavy-duty. They didn't have to be sealed, because the food was already sealed, and each day was already packaged in an overwrap, the flexible can, as I called it; a flexible overwrap. It had aluminum foil in it, which makes a barrier like a can, if you don't scratch it or hurt it, but we had nylon on the outside, which is pretty strong, and polyethylene on the inside, which is food-grade.

The food had to fit into those containers, and again, the experience of how we did it in Gemini was carried over into Apollo. But after the Apollo fire—food has to be flammable. I mean, it just has to be flammable, or you can't exist, right? You've got to have something that will digest. You [eat] it, and you absorb it and burn it, and make ATPs [adenosine triphosphates] out of it, and that's how you get energy. So it's got to be burnable. So he came to me and said, "We've got to do something about the food." That was Frank Borman. He was head of the astronaut investigators.

I said, "You give me stainless steel astronauts, and I'll give you stainless steel food." He understood right away that there was no way; that the only thing we could do, we could reinforce the doors, make them a little tighter, airtight. We could do that. But it would be foolish to think that we were going to be able to stop a fire in the food compartment, if it ever would happen. There was nothing there to do that. I mean, there's absolutely nothing, no spontaneous anything. But it was just the idea. But Frank, he understood.

See, what he was doing, which makes a lot of sense, he was thinking of every conceivable component, and one of the components that came out was the Velcro. They had put Velcro all over the floor, and we didn't have that in Gemini. We used tabs. We had Velcro in a lot of places, but not as extensive; we didn't wallpaper it. That stuff burns like a fuse. I'm sure that's not what created the pressure where they could not open the doors.

That was a major, major mistake of NASA, was the Apollo doors opened inward. The hatch opened inwardly. The Gemini doors opened outwardly. A major change in the Apollo spacecraft thereafter was the Apollo door opens outward. Because once you increase the pressure on the inside, you cannot open the door. You've wedged it in place, and you're just increasing your wedge. So that there's no way you can save anybody, unless you blew it up or had a gun, or I don't know what you would have had, but [we] didn't have it. That would have made a difference, a relief valve of some sort. I don't know. But anyway, it was a sad story.

ROSS-NAZZAL: You mentioned a couple of the astronauts, like Wally Schirra and Frank Borman. How much contact did you have with the astronauts?

LACHANCE: Well, in Building 4 we were in the same building. I mean, I'd run into them in the hallway and different places and different things. I wasn't the type that pestered anybody. I mean, if I needed to know something, I would ask.

It was easier to solve problems then, because you didn't have the complexity that automatically comes with any new agency. I mean, when I was with NASA, I had my own travel vouchers. I could go anywhere in the world on my signature. Find a civil service who can do that today. You won't find very many. They have to go through the travel office to get their tickets or their e-ticket or whatever it is.

People misused it, misused the privileges, and because we wanted to roll, the average age was thirty-five. We came from everywhere, every agency you can think of. We were assigned rent-a-cars. When we got into airports, we had a Hertz or whatever car. Sometimes, once in a while, we had government cars. Didn't make any difference. But somebody goes parading around with them after hours, it's against the rules. So the rules start getting written, and I'm sure there's a manual over there that's thicker than can be that tells you what you can't do.

ROSS-NAZZAL: We need to take a break for just a second to change our tape.

LACHANCE: Oh, sure.

ROSS-NAZZAL: Then I just had a couple more questions for you. You have such an interesting career. I wish that we had more time to talk with you about your other experiments and so many of these other items that you were working on.

[Tape change]

ROSS-NAZZAL: Let's see. You were assigned to the Biomedical Research Office at MSC, according to your biosheet.

LACHANCE: Not originally. Originally I don't think it was called that. I was just part of Crew Systems Division.

ROSS-NAZZAL: Okay. How did that office change from the time you arrived at MSC until the time you left?

LACHANCE: It changed every few months.

ROSS-NAZZAL: How so?

LACHANCE: Well, I mean, you added—I got an office that was real. It wasn't a desk in the hallway with a phone. Everybody else did, too. So it was clean. We had a little laboratory space. I had a refrigerator. I could store some of the samples. I didn't have anything very fancy, just enough to show and tell, mostly for visiting firemen, is what I call all these congressmen and everybody else that comes floating through.

So, I mean, every few months—it seemed that way, anyway—there'd be another building that came up. Then we stayed in [Building] 4 for quite a while, and then we were moved down. I can't remember which building we went to, which is strange, why I'm doing that, but—or maybe it's the astronauts that moved. Maybe that was it. That was it, because there were new groups of astronauts. In other words, you start with the original seven, and then you have the next seven or eight or whatever it was, the John [W.] Youngs and those people, Ed White. Then they had to have more space. Each one had had his own office, and they shared secretaries and this kind of stuff. So that's probably where that went.

The big building that was being built at the time was the Moon rock building; was a major issue, again, for contamination of the Earth by some foreign, you know, some bug that nobody knew anything about that would come back with—I don't know how old you are, but you may or may not remember their landing on the aircraft carrier and they were put into a trailer, and they talked to the President of the United States by looking through the back window, which was [Richard M.] Nixon at the time, and talking over a telephone, but he could see their faces there. They had to be transported all the way to Houston through various chambers, interlocks, to make sure everything was—nothing would be contaminated from the outside or the inside out. Thank God, it never was—never found anything. I think we've contaminated the Moon; I'm sure of that now. But not the other way around.

ROSS-NAZZAL: Who were some of the key people you worked with in the office? You mentioned one of the people you worked with was Bob Nanz, but who were some of the other key people you worked with at the Manned Spacecraft Center?

LACHANCE: Oh, boy. You know, I would have to go back into my stuff—some of these names. We're talking about forty years here. There was a few engineering people [like William J. Huffstetler]. I mean, we were a small group. I mean, I worked with—the Colonel obviously lasted quite a while, Rufus Hessberg.

Dick Johnston, Richard [S.] Johnston, was the Chief of Crew Systems Division. Well, I didn't have a Chief for a while. Well, I did have. I first reported to this lung physiologist, and then I was put under a guy, a physician, who knew more about total body issues and things like that, the name was [Walter W.] Kemmerer, Bill. So from the technical side of the experiments and the health of the astronauts, and therefore the feeding, that compromised a good share of the group.

There was another man who was a Branch Chief, who I don't remember his name. He was a British fellow. He had a lot to do with the physiological aspects, and I didn't have anything to do with it, other than being a guinea pig myself. But that was in my Air Force days on the centrifuge and things like that. But I would have to go fishing my memorabilia, which I have in boxes. I mean, it would be a terrible [strain] for me to do.

ROSS-NAZZAL: Oh, sure. Did you have a chance to work with Rita [M.] Rapp?

LACHANCE: Yes, that's a good point. Rita had a master's degree, and she worked with a physiologist, mostly. After I left, there was kind of a hiatus, and Malcolm [C.] Smith [Jr.], who was an Air Force veterinary officer on loan to NASA, to my area, kind of handled the food part. Rita kind of took over the experiment part until they hired a guy who I had tried to get, who is not an American citizen. I want to say Paul [C. Rambaut], but that's not it. It's close to that, though. Anyway, he—I'll look at some reprints, see if it comes out—his Ph.D. and a few other things had priority over her master's degree. Rita was a hard worker and a good person, and she knew a lot of things. She was a real expediter.

Do you have other names like that sitting there?

ROSS-NAZZAL: Not in front of me. She's just one person that popped into my head.

LACHANCE: Have you interviewed her?

ROSS-NAZZAL: No. Unfortunately, she passed away.

LACHANCE: She did.

ROSS-NAZZAL: Yes.

LACHANCE: Well, there's a couple of other people that passed away. Come to think of it, I was told that some years ago, and I'd forgotten.

ROSS-NAZZAL: Yes, and we also tried to interview Malcolm Smith and learned that he passed away last summer.

LACHANCE: He did?

ROSS-NAZZAL: He did.

LACHANCE: Oh, my. Because he went off and became an independent consultant. I don't know if he came back to NASA or not. Malcolm was very interesting. I mean, he was more a veterinarian. He got a master's degree. He was a veterinarian who had chosen to get a master's degree in food technology, because veterinarians are in charge of all the military sanitation of all its agencies. So he was trained from that point of view, so he was helpful. But he knew more about foods than he knew anything about experiments and nutrition or anything like that. Even though you'd think a veterinarian would, but he didn't.

ROSS-NAZZAL: Well, I just had a couple more questions for you. Earlier you had talked about botulism and some cases that had occurred in the 1970s. As a result of this breakout of botulism in the early 1970s, the FDA [Food and Drug Administration] actually began to use HACCP in low-acid canning food regulations. I was wondering, were you ever contacted by the FDA to talk about your own experience at NASA with these concepts?

LACHANCE: No. The answer is no. I mean, we talked about it. I taught things like that in my classes, or mentioned it. But the FDA never officially, or even unofficially—I mean, I've had some dealings with the FDA, but not too many. I've written some petitions, like I have a pending one, on calcium restoration to flour, since 1943. Not me, but four of us together, and we're trying to do the same thing with vitamin D. Because of the osteoporosis story, we'd like breads to automatically carry more calcium and D than they do now. Well, D, they don't at all, but calcium they do.

But anyway, that's neither here nor there, as far as something that goes back to 1979—1974. The National Academy's Food and Nutrition Board made a recommendation, and it didn't fly, which applies to the space program. I might tell you that I was not allowed to add any vitamins or minerals or anything. They used no supplements in that program initially. Again, the Chief Medical Officer, Charles Berry, had his own views. He thought things were adequate enough, and besides which, his view was for short flights, it doesn't matter. In some ways he's right, and in some ways he's not. On Gemini IV we had a person take a sample of blood before and after for vitamin E, and it went down 50 percent in four days. I think that's serious, but—neither here nor there. We didn't win that battle, either.

ROSS-NAZZAL: Just a couple more questions for you. HACCP has been touted as probably NASA's best spin-off. Would you agree with that statement?

LACHANCE: I saw that at the end of your letter. It's news to me. I don't feel it's been touted anywhere near, because it's been touted all mixed up. Pillsbury gets the credit. Natick gets some credit. Sometimes NASA gets credit. Very few people know what I contributed or "honchoed" or whatever the word is. So it just sits there as kind of a confused thing. There are people who do know. [O.] Peter Snyder of Minnesota, professor who introduced it into the retail area, credits me, and a couple of other people have. And somebody from England does.

In fact, there's a document, a WHO [World Health Organization] document—I don't know if you saw it or not—"Hazard Analysis Critical Control Point: Concepts and Applications," from 1995, 2931 May 1995. It's a beautiful report; it's well done. But they completely avoid getting into the issue of history. But they do cover—and I think it's a driving document for including people from other countries on the committee, and I think that had a lot to do with spreading the whole concept of HACCP to other countries in their food processing industry and what they were doing. I think it plays that role.

But if you ask me, I would say people take for granted the color video cameras that were really invented or made for the first time for NASA by RCA [Radio Corporation of America] here in Hightstown, New Jersey. And I think that had a lot to do with the development of cameras, video cameras for all these news stories and everything that we use today, more compact than ever. But if they really look at history, I don't think there was much to—there certainly wasn't a color version available at the time that I know of. Now, I'm not in my field, but it's something I point to as being important.

So I don't know. There may be other—there is a commercial impact I just talked to you about, and what's happening now is I've integrated it into—in *Toxicology Letters*. I've integrated HACCP as a component of antiterrorism safety assurance. So then I published a paper before that, which was the American Chemical Society book, which wasn't [referenced]. But this one gets picked up. It's not very long, but I talk about HACCP and its coupling, the bar coding, using three different technologies that could be brought together to make possible—[reads] "Global positioning, bar coding, and HACCP offer safety and protection in products and the foods." Nutraceutical, pharmaceutical. I've not gotten much mileage out of it, but I did put it out, so it adds to the commercial area the things that are being done already and moving from there.

The economic one, I mentioned to you about Pillsbury's comments to me. I feel it was there. It's costly to do, to set up, but in this day and age, as we have more and more food poisoning incidences, there's got to be a better way, and I think some of the HACCP concepts would help that out.

We ought to remember HACCP didn't measure [*E. coli*] HO157, which was what has gotten quite a few food joints in trouble. But I'm not sure that the coliform indicator we were using would not have picked it up. I find it incredible that the markers that we used have been so powerful, even though we have to say to people that they do not assure 100 percent. There's no question about that. They will not guarantee that all foods will be safe. I mean, it's not—but it's not applied across the board, so you can't—that covers that.

The regulatory agencies are Johnny-come-latelies, as far as I'm concerned. The FDA had to have a crisis to do that. And your question, if you think about it—and part of that is because—I do support them from the budget point of view. I don't think they're adequately funded or manned, and I've given testimony to that effect.

But on the other hand, they forever—well, one of the problems of being a civil servant, I think you get dead after ten years. I used to tell my wife, "Don't let me stay in this environment more than ten years. I'll lose my ambition or challenge or whatever." And I don't want to insult you by making that statement, but it was my experience, anyway. I mean, it bothered me. Not so much the military, because the military are moved around from base to base, and they have to readjust. But the civil servants are not, and some of them are very nice people, but they're behind the times.

ROSS-NAZZAL: I wonder if you could tell us, looking back over your short career with NASA, what do you think was your most significant accomplishment while working for MSC?

LACHANCE: Well, you know, it's interesting. I was able to do a lot, because there was money available. The year I left is the year the budget went down for the first time, the total on NASA projects, NASA Program Office, or whatever you want to call it; NASA administration. And I really have seven years into it, because the years I spent in the Air Force all contributed to that, and we contributed to it in things that were done and things that were not done that we're still dreaming about.

We had a multimillion-dollar project from NASA here two years ago, for five years, looking at food systems for Mars and sanitation issues. So Purdue [University, West Lafayette, Indiana] has had it, and we've had it, and I think Cornell's got it now. I mean, they kind of move it around. But we're still—you know, it's there. The mountain is there to be [climbed]. You know, why you want to do it, that kind of thing.

But I was fortunate, I think, in being able to expedite, to move, without anybody giving me a hard time. In the Air Force it took five initials before the Commander of the laboratory could stamp a letter to go out. In NASA you didn't have anybody signing anything. I mean, I did more closure with a contracting officer over the phone—over the phone—before a flight, where I had to change something. The change order would be issued after the flight was over. Completely unheard of, in my opinion, in a federal agency.

But it was driven. [John F.] Kennedy had given a mandate. The dates were set, and we just used the dates as a reason, and we moved. In a way, we moved too fast. I look back and wonder, you know, are there things we did do that we could have—we didn't write them up. A lot of reports are sitting in an archive. People don't know how to retrieve them. I'm sure you know more about that than I do, but I think there's a lot of information that would be still valuable, in terms of other applications, other medical applications or other kinds of applications.

ROSS-NAZZAL: If you had to look back over your career with NASA, what do you think was your biggest challenge?

LACHANCE: Getting something that was flyable, that was standardized. I mean, making sure that—I wasn't afraid of the challenge. It was just working with people to get it done, keep solving. I mean, there wasn't a day went by we weren't on the horn for some reason or other, trying to fix something or getting something better.

I'll give you an example. The outer-wrap packaging—I've called it flexible packaging, flexible cans—three layers. It has an aluminum layer in the middle, which is your can layer. You don't want any pinholes in it. You have an outer layer of nylon, and you have an inner layer of polyethylene. Those have to be glued together, so the material that's used to put them together is an issue in itself. So when we had to buy a quantity of this overwrap to do this packaging into the spacecraft—into the meals and then into the spacecraft. Everything had to be overwrapped.

There were two companies that gave us samples. We asked for samples of this kind of a spec. One was DuPont, a major, major corporation, and another was—oh, man. It was a company in Milwaukee [Milprint Co.], and it was a small company, a very small company, but it made that kind of material. It processed plastics. So I went to a meeting in Benton Harbor, and the Natick people were there, too, and they said, "Well, how are we going to tell which one [to select]?" We tested different things.

I said, "Give me some boiling water and a beaker. Let's boil it up. Let's make strips of this overwrap, and let's just put them into A's and B's, and check it out." Sure enough, the small contractor won. The DuPont stuff started peeling. We couldn't have that, just couldn't have it. So whatever they did, they didn't do—so, again, it's a laboratory bench, simple test, that you make a decision that was major as far as subsequent use of that kind of material for the spacecraft, and for Skylab and for whatever, and even for the public today. I mean, that's available in backpack food, all these kinds of things, the laminates.

That's one of the major areas we contributed to, incidentally, when you brought it up. Backpack food became very improved with space foods, with our developments, because those specs became available, and companies like Oregon Freeze-Dry—now it's not called that anymore; it got bought out by somebody else—made all those freeze-dried bars. But, you know, it went into the business. They weren't making money doing things for NASA. They were making money doing things for backpacking, for camping. That material worked very well. They made it a little cheaper, but it still worked. I mean, you can lengthen the shelf life with it, one way or another. But it depends on whether it hits cold or heat or, you know, this kind of thing.

Right now, in our military rations, we've extended the military ration shelf life from three years to five years, although we'[ve dumped] them out of airplanes in Bosnia and places like that. So you see, I'm talking about things that are today that I learned then, quite a few years ago.

ROSS-NAZZAL: It's amazing. Now, I'm looking at the clock, and we have about ten minutes. Is there anything else that you would like to talk about? I know you have that meeting you mentioned to me.

LACHANCE: Yes, I have to drive to Princeton [University, Princeton, New Jersey].

ROSS-NAZZAL: Is there anything you think that we haven't touched on that I should know about?

LACHANCE: We've covered a lot of things.

ROSS-NAZZAL: Yes, we have.

LACHANCE: I didn't think it would last this long. Of course, I've had a lot of asides.

[End of interview]